

# XCubeSAN SANOS 4.0 Software Manual

Applicable Models: XS5224D, XS5216D, XS5212D, XS5212S, XS5226D, XS5226S XS3224D, XS3224S, XS3216D, XS3216S, XS3212D, XS3212S XS3226D, XS3226S, XS1224D, XS1224S, XS1216D, XS1216S XS1212D, XS1212S, XS1226D, XS1226S



QSAN Technology, Inc. www.QSAN.com



#### Copyright

© Copyright 2020 QSAN Technology, Inc. All rights reserved. No part of this document may be reproduced or transmitted without written permission from QSAN Technology, Inc.

#### July 2020

This edition applies to QSAN XCubeSAN SANOS (SAN Operating System) 4.0. QSAN believes the information in this publication is accurate as of its publication date. The information is subject to change without notice.

#### Trademarks

QSAN, the QSAN logo, XCubeSAN, and QSAN.com are trademarks or registered trademarks of QSAN Technology, Inc.

Microsoft, Windows, Windows Server, and Hyper-V are trademarks or registered trademarks of Microsoft Corporation in the United States and/or other countries.

Linux is a trademark of Linus Torvalds in the United States and/or other countries.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Mac and OS X are trademarks of Apple Inc., registered in the U.S. and other countries.

Java and all Java-based trademarks and logos are trademarks or registered trademarks of Oracle and/or its affiliates.

VMware, ESXi, and vSphere are registered trademarks or trademarks of VMware, Inc. in the United States and/or other countries.

Citrix and Xen are registered trademarks or trademarks of Citrix Systems, Inc. in the United States and/or other countries.

Other trademarks and trade names used in this document to refer to either the entities claiming the marks and names or their products are the property of their respective owners.



### **Table of Contents**

Preface         About This Manual         Related Documents         Technical Support         Information, Tip and Caution         Conventions         1.         SANOS Overview         1.1.         Introduction to SANOS         1.1.1.         SANOS System Architecture         1.1.2.         SANOS Storage Pool Architecture         1.1.3.         SANOS 4.0 Functionality List         1.2.         Terminology         2.         Prepare for Installation         2.1.1.         Configuration Planning         2.1.2.         Management IP Configuration Planning         2.1.3.         Notification Configuration Planning         2.1.4.         SCSI Configuration Planning         2.1.5.         Fibre Channel Configuration Planning         2.1.6.         Storage Configuration Planning         2.1.7.         Backup Configuration Planning         2.1.7.         Backup Configuration Planning         2.1.7.         Backup Configuration Planning         2.1.7.         Backup Configuration Planning	xx xx xx xx xxi 1 1 1 1 1 1 
About This Manual         Related Documents.         Technical Support         Information, Tip and Caution.         Conventions.         1.         SANOS Overview.         1.1.         Introduction to SANOS         1.1.1.         SANOS Overview.         1.1.1.         SANOS System Architecture         1.1.2.         SANOS Storage Pool Architecture         1.1.3.         SANOS 4.0 Functionality List         1.2.         Terminology         2.         Prepare for Installation         2.1.1.         Configuration Planning         2.1.2.         Management IP Configuration Planning         2.1.3.         Notification Configuration Planning         2.1.4.         SCSI Configuration Planning         2.1.5.         Fibre Channel Configuration Planning         2.1.6.         Storage Configuration Planning         2.1.7.         Backup Configuration Planning         2.1.7.         Backup Configuration Planning         2.1.7.         Backup Configuration Planning         2.1.7.	xx xx xxi 1 1 1 1 1 
<ol> <li>SANOS Overview.         <ol> <li>Introduction to SANOS</li> <li>SANOS System Architecture</li> <li>SANOS Storage Pool Architecture</li> <li>SANOS Storage Pool Architecture</li> <li>SANOS 4.0 Functionality List</li> <li>Terminology</li> </ol> </li> <li>Prepare for Installation</li> <li>Prepare for Configuration Planning.</li> <li>Configuration Planning for Initial Setup</li> <li>Management IP Configuration Planning</li> <ol> <li>Notification Configuration Planning</li> <li>SCSI Configuration Planning</li> <li>Fibre Channel Configuration Planning</li> <li>Fibre Channel Configuration Planning</li> <li>Storage Configuration Planning</li> <li>Storage Configuration Planning</li> <li>Configuration Planning</li> </ol> <li>Storage Configuration Planning</li> <li>System Parameters</li> <li>Configuration Example</li> <li>Bower on the Storage System</li> </ol>	1 1 1 
<ul> <li>1.1. Introduction to SANOS</li></ul>	1 1 
<ol> <li>Prepare for Installation</li> <li>2.1. Prepare for Configuration Planning for Initial Setup</li> <li>2.1.1. Configuration Planning for Initial Setup</li> <li>2.1.2. Management IP Configuration Planning</li> <li>2.1.3. Notification Configuration Planning</li> <li>2.1.4. iSCSI Configuration Planning</li> <li>2.1.5. Fibre Channel Configuration Planning</li> <li>2.1.6. Storage Configuration Planning</li> <li>2.1.7. Backup Configuration Planning</li> <li>2.2. System Parameters</li> <li>2.3. Configuration Example</li> <li>3. Getting Started</li> <li>3.1 Power on the Storage System</li> </ol>	9
<ul> <li>2.1. Prepare for Configuration Planning</li></ul>	9
3. Getting Started.	16 16 17 17 20 22 23 26
3.1. Power on the Storage System	33
<ul> <li>3.2. Discover the SAN Storage System</li></ul>	33 33 33 35
4. SANOS User Interface	40
<ul> <li>4.1. Accessing the Management Web UI</li> <li>4.2. SANOS 4.0 Desktop Panel</li> <li>4.3. Function Menus</li></ul>	40 41

		4.3.2.	System Settings Menu	
		4.3.3.	Host Configuration Menu	45
		4.3.4.	Storage Management Menu	45
		4.3.5.	Data Backup Menu	
		4.3.6.	Virtualization Menu	47
		4.3.7.	Monitoring Menu	47
	4.4.	Access	ing the Management USB LCM	
5.	Dash	board		52
	5.1.	Dashbo	pard	
	5.2.	Hardwa	are Monitoring	
6.	Svste	em Settir	nas	
	6.1.	Genera	System Settings	
	6.2.	Manage	ement Port Settings	
	6.3.	Power S	Settings	
		6.3.1.	Boot Management Settings	
		6.3.2.	Cache to Flash Status	70
		6.3.3.	UPS Settings and Status	71
	6.4.	Notifica	ation Settings	74
		6.4.1.	Email Settings	74
		6.4.2.	Alert Settings	76
		6.4.3.	SNMP Settings	77
	6.5.	Mainter	nance	79
		6.5.1.	System Information	
		6.5.2.	Firmware Update	
		6.5.3.	Firmware Synchronization	
		6.5.4.	System Identification	
		6.5.5.	Reset to Factory Defaults	
		6.5.6.	Configuration Backup	
		6.5.7.	Reboot and Shutdown	90
	6.6.	Disk En	cryption	91
7.	Host	Configu	ration	
	7.1.	Host Pr	rotocol Technology	
		7.1.1.	iSCSI Technology	
		7.1.2.	Fibre Channel Technology	
	7.2.	Host Co	onnectivity Overview	94
	7.3.	Configu	ure iSCSI Connectivity	
		7.3.1.	Configure iSCSI Ports	
		7.3.2.	Configure iSCSI Settings	
		7.3.3.	Configure iSCSI Targets	

		7.3.4.	Configure iSCSI CHAP Accounts	106
		7.3.5.	Active Sessions	109
	7.4.	Config	ure Fibre Channel Connectivity	110
		7.4.1.	Configure Fibre Channel Link Speed	111
		7.4.2.	Configure Fibre Channel Topology	111
		7.4.3.	Configure Fibre Channel Targets	112
		7.4.4.	Clear Fibre Channel Counters	113
8.	Stora	ige Man	agement	114
	8.1.	RAID T	echnology	
		8.1.1.	Traditional RAID Overview	114
		8.1.2.	RAID EE Overview	120
		8.1.3.	Theory of RAID EE Operation	121
	8.2.	SANOS	S Storage Architecture	125
		8.2.1.	Pool Technology	126
		8.2.2.	Migrate vs. Add Disk Group	
		8.2.3.	Volume Technology	128
		8.2.4.	LUN Technology	129
		8.2.5.	Hot Spares	130
	8.3.	Workin	ng with Disk Drives	131
		8.3.1.	List Disks	133
		8.3.2.	Operations on Disks	136
		8.3.3.	S.M.A.R.T.	139
	8.4.	Config	ure Thick Provisioning Pools	142
		8.4.1.	Create a Thick Provisioning Pool	142
		8.4.2.	List Thick Provisioning Pools	148
		8.4.3.	Operations on Thick Provisioning Pools	150
		8.4.4.	Migrate a Disk Group in a Thick Provisioning Pool	153
		8.4.5.	Add a Disk Group in a Thick Provisioning Pool	156
	8.5.	Config	uring Volumes	159
		8.5.1.	Create a Volume	160
		8.5.2.	List Volumes	163
		8.5.3.	Operations on Volumes	165
		8.5.4.	Extend Volume Capacity	169
		8.5.5.	Fast RAID Rebuild	170
	8.6.	Config	ure LUN Mappings	172
		8.6.1.	Map a LUN of iSCSI Connectivity	172
		8.6.2.	Map a LUN of Fibre Channel Connectivity	173
		8.6.3.	List LUN Mappings	174
		8.6.4.	Operations on LUN Mappings	175
	8.7.	Conneo	ct by Host Initiator	175

	8.8.	Disk Roaming	176
9.	Thin	Provisioning	177
	9.1.	Overview	
		9.1.1. Thick Provisioning vs. Thin Provisioning	
	9.2.	Theory of Operation	
		9.2.1. Thin Provisioning Architecture	179
		9.2.2. Space Reclamation	
		9.2.3. Thin Provisioning Policies	
	9.3.	Configure Thin Provisioning Pools	
		9.3.1. Create a Thin Provisioning Pool	
		9.3.2. List Thin Provisioning Pools	
		9.3.3. Operations on Thin Provisioning Pools	190
		9.3.4. Add a Disk Group in a Thin Provisioning Pool	193
	9.4.	Configure Volumes	196
		9.4.1. Create a Volume in a Thin Provisioning Pool	196
		9.4.2. List Volumes and Operations on Volumes	
	9.5.	Configure LUN Mappings and Connect by Host Initiator	
10.	SSD (	Cache	
	10.1.	Overview	
	10.2.	Theory of Operation	
		10.2.1. System Memory and SSD Cache Capacity	
		10.2.2. SSD Cache Pool Architecture	
		10.2.3. RAID Level of SSD Cache Pool	
		10.2.4. Read/Write Cache Cases	
		10.2.5. Populating the Cache	213
		10.2.6. SSD Cache Tuning	214
	10.3.	Configure SSD Cache	216
		10.3.1. Enable SSD Cache License	216
		10.3.2. Create an SSD Cache Pool	217
		10.3.3. List SSD Cache Pools	
		10.3.4. Operations on SSD Cache Pools	
	10.4.	Monitor SSD Cache Statistics	
	10.5.	SSD Cache Notices	
11.	Auto	Tiering	
	11.1.	Overview	
		11.1.1. Tier Categories	
		11.1.2. Flexible RAID and Disk Configurations	
	11.2.	Theory of Operation	
		11.2.1. Auto Tiering Architecture	

		11.2.2.	Intelligent Auto Tiering Mechanism	
		11.2.3.	Tiering Policies	
	11.3.	Configu	re Auto Tiering Pools	
		11.3.1.	Enable Auto Tiering License	
		11.3.2.	Create an Auto Tiering Pool	
		11.3.3.	List Auto Tiering Pools	245
		11.3.4.	Operations on Auto Tiering Pools	249
		11.3.5.	Add a Tier (Disk Group) in an Auto Tiering Pool	251
		11.3.6.	Hot Spares in an Auto Tiering Pool	254
	11.4.	Configu	ire Volumes	254
		11.4.1.	Create a Volume in an Auto Tiering Pool	254
		11.4.2.	List Volumes and Operations on Volumes	258
	11.5.	Configu	re LUN Mappings and Connect by Host Initiator	259
	11.6.	Transfe	r to Auto Tiering Pool	259
		11.6.1.	Transfer from Thick Provisioning Pool to Auto Tiering	
		11.6.2.	Transfer from Thin Provisioning Pool to Auto Tiering	
	11.7.	SSD Ca	che vs. Auto Tiering	
12.	Data I	Backup.		
	12.1.	Managi	ng Snapshots	
		12.1.1.	Theory of Operation	
		12.1.2.	Configure Snapshot	
		12.1.3.	Configure Rollback Snapshot	
		12.1.4.	Configure Schedule Snapshots	
		12.1.5.	Snapshot Notices	
	12.2.	Managi	ng Local Clones	
		12.2.1.	Theory of Operation	
		12.2.2.	Configure Local Clone	
		12.2.3.	Configure Schedule Local Clone Tasks	
		12.2.4.	Local Cloning Options	
		12.2.5.	Local Clone Notices	
	12.3.	Managi	ng Remote Replications	
		12.3.1.	Remote Replication Topologies	
		12.3.2.	Theory of Operation	
		12.3.3.	Configure Remote Replication	
		12.3.4.	Configure Traffic Shaping	
		12.3.5.	Configure Schedule Remote Replication Tasks	
		12.3.6.	Replication Options	
		12.3.7.	Configure MPIO in Remote Replication Task	
		12.3.8.	Configure MC/S in Remote Replication Task Path	310
		12.3.9.	Local Clone Transfers to Remote Replication	

# **OSAN**

13.	Monit	toring	
	13.1.	Log Center	
		13.1.1. Operations on Event Logs	
	13.2.	Monitoring Enclosures	321
		13.2.1. Hardware Monitoring	321
		13.2.2. Configuring SES	
	13.3.	Performance Monitoring	325
		13.3.1. Disk Performance Monitoring	325
		13.3.2. Volume Performance Monitoring	
		13.3.3. iSCSI Port Performance Monitoring	
		13.3.4. Fibre Channel Port Monitoring	
14.	SED a	and ISE Support	
	14.1.	Overview	
	14.2.	Theory of Operation	
		14.2.1. SED Operation Process	
		14.2.2. ISE Technology	
	14.3.	Configure Authentication Key	335
		14.3.1. Operations on Authentication Key	
	14.4.	Configure SEDs	340
		14.4.1. List SEDs	341
		14.4.2. Operations on SEDs	343
	14.5.	Configure SED Pools	347
		14.5.1. Create an SED Pool	
		14.5.2. List SED Pools	353
		14.5.3. Operations on SED Pools	356
		14.5.4. Rebuild on SED Pools	356
		14.5.5. Create an SSD Cache Pool on SED Pools	356
		14.5.6. Data Backup on Encrypted Volumes	356
	14.6.	Configure ISE Drives	357
		14.6.1. List ISE Drives	357
		14.6.2. Operations on ISE Drives	
15.	QoS (	Quality of Service)	
	15.1.	Overview	
		15.1.1. QoS in Storage System	
		15.1.2. Benefit of QoS	
		15.1.3. QoS Use Cases	
	15.2.	Theory of Operation	
		15.2.1. Priority and Target Response Time	
		15.2.2. Maximum IOPS and Maximum Throughput	

	15.3.	Configure QoS Settings	
		15.3.1. Operations on QoS Settings	
	15.4.	Configure QoS Volumes	
		15.4.1. List QoS Volumes	
		15.4.2. Operations on QoS Volumes	
16.	Troub	leshooting	374
	16.1.	Fault Isolation Methodology	
		16.1.1. Basic Steps	
		16.1.2. Stopping I/O	
		16.1.3. Diagnostic Steps	
	16.2.	Rebuild	
	16.3.	Volume Restoration	
		16.3.1. Configure Volume Restoration	
17.	Suppo	ort and Other Resources	379
	17.1.	Getting Technical Support	
	17.2.	Online Customer Support	
	17.3.	Accessing Product Updates	
	17.4.	Documentation Feedback	
Арр	endix		387
	Glossa	ary and Acronym List	
	End-Us	ser License Agreement (EULA)	

# **OSAN**

# Figures

Figure 1-1	SANOS System Architecture	1
Figure 1-2	SANOS System Architecture with Single Controller Configuration	2
Figure 1-3	SANOS Storage Pool Architecture	3
Figure 1-4	SANOS 4.0 Desktop Panel	4
Figure 2-1	Dual-controller Topology	18
Figure 3-1	QFinder Utility	34
Figure 3-2	Login Page of web UI	35
Figure 3-3	Initial Configuration Step 1	36
Figure 3-4	Initial Configuration Step 2	37
Figure 3-5	Initial Configuration Step 3	39
Figure 4-1	Login Page of web UI	40
Figure 4-2	SANOS 4.0 Desktop Panel	41
Figure 4-3	Portable USB LCM	48
Figure 4-4	USB LCM Screen	48
Figure 5-1	Dashboard Function Submenu	52
Figure 5-2	Dashboard	52
Figure 5-3	System Information Block in the Dashboard	53
Figure 5-4	System Information Popup Window	54
Figure 5-5	System View Block in the Dashboard	55
Figure 5-6	Pool Information Popup Window	56
Figure 5-7	Performance Block in the Dashboard	59
Figure 5-8	Event Logs in the Dashboard	59
Figure 5-9	Hardware Monitoring Function Submenu	60
Figure 5-10	Hardware Monitoring	61
Figure 5-11	Head Unit Popup Window	62
Figure 6-1	General Function Submenu	63
Figure 6-2	General Settings	64
Figure 6-3	Management Port Function Submenu	65
Figure 6-4	Management Port settings	66
Figure 6-5	Power Settings Function Submenu	68
Figure 6-6	Boot Management Settings	68
Figure 6-7	Cache to Flash	70
Figure 6-8	UPS Status and Settings	72
Figure 6-9	Notifications Function Submenu	74
Figure 6-10	Email Settings	75
Figure 6-11	Alert Settings	76
Figure 6-12	SNMP Settings	78

Figure 6-13	Maintenance Function Submenu	
Figure 6-14	System Information	
Figure 6-15	Firmware Update	
Figure 6-16	Enable Licenses	
Figure 6-17	Trial License	
Figure 6-18	Both Firmware Versions are Synchronized	
Figure 6-19	Turn on the UID (Unique Identifier) LED	
Figure 6-20	Reset to Defaults	
Figure 6-21	Configuration Backup	
Figure 6-22	Reboot and Shutdown	
Figure 6-23	Reboot Options	
Figure 6-24	Disk Encryption Function Submenu	
Figure 7-1	Overview Function Submenu	
Figure 7-2	Host Port Overview	
Figure 7-3	iSCSI Ports Function Submenu	
Figure 7-4	List iSCSI Ports	
Figure 7-5	iSCSI IP Address Settings	
Figure 7-6	Set Link Aggregation	
Figure 7-7	Set VLAN ID	
Figure 7-8	Set Jumbo Frame	
Figure 7-9	Ping Host	
Figure 7-10	Entity Name and iSNS Settings	
Figure 7-11	iSCSI Targets	
Figure 7-12	Authentication Method	
Figure 7-13	Change Target Name	
Figure 7-14	Change Network Portal	
Figure 7-15	Change Alias	
Figure 7-16	Create a CHAP User	
Figure 7-17	List CHAP Users	
Figure 7-18	Modify a CHAP User	
Figure 7-19	Active Sessions	
Figure 7-20	Fibre Channel Ports Function Submenu	
Figure 7-21	List Fibre Channel Ports	
Figure 7-23	Change Topology	
Figure 7-24	Target Configuration	
Figure 8-1	Data Block Distributed of RAID 5EE	
Figure 8-2	Disk 2 has Failed	
Figure 8-3	Empty Blocks are Rebuilt from the Failed Disk Drive	
Figure 8-4	Data is copied back	
Figure 8-5	Data Block Distributed of RAID 60EE	
Figure 8-6	Storage Architecture of Thick Provisioning Pool	

# **OSAN**

Figure 8-7	Volume in Storage Architecture	
Figure 8-8	LUM Mappings in Storage Architecture	130
Figure 8-9	Hot Spares	131
Figure 8-10	Disks Function Submenu	132
Figure 8-11	List Disks	134
Figure 8-12	Disk Health Check	136
Figure 8-13	Set Dedicated Spare	137
Figure 8-14	Update Disk Firmware	138
Figure 8-15	More Information of Disk Drive	139
Figure 8-16	S.M.A.R.T. Attributes of Disk Drive	140
Figure 8-17	S.M.A.R.T. Attributes of SSD	141
Figure 8-18	Disk Settings	142
Figure 8-19	Pools Function Submenu	142
Figure 8-20	Create a Thick Provision Pool Step 1	143
Figure 8-21	Create a Thick Provision Pool Step 2	144
Figure 8-22	Create a Thick Provision Pool Step 3	145
Figure 8-23	Create a Thick Provision Pool Step 4	146
Figure 8-24	Create a Thick Provision Pool Step 5	147
Figure 8-25	A Thick Provisioning Pool is Created	147
Figure 8-26	List Thick Provisioning Pools	148
Figure 8-27	Change Disk Properties	151
Figure 8-28	Transfer Thick Provisioning Pool to Auto Tiering	152
Figure 8-29	Migrate a Disk Group in a Thick Provisioning Pool	153
Figure 8-30	RAID Migration	154
Figure 8-31	Migrate RAID Level Step 1	155
Figure 8-32	Add a Disk Group in a Thick Provisioning Pool	157
Figure 8-33	Add a Disk Group to a Thick Provisioning Pool	158
Figure 8-34	A Disk Group is Added	159
Figure 8-35	Pools Function Submenu	159
Figure 8-36	Create a Volume in Thick Provisioning Pool Step 1	160
Figure 8-37	Create a Volume in Thick Provisioning Pool Step 2	161
Figure 8-38	Create a Volume in Thick Provisioning Pool Step 3	162
Figure 8-39	A Volume in Thick Provisioning Pool is Created and Initializing	
Figure 8-40	List Volumes	
Figure 8-41	Local Cloning Options	165
Figure 8-42	Map a LUN of iSCSI Connectivity	
Figure 8-43	Unmap LUNs	
Figure 8-44	Set Snapshot Space	167
Figure 8-45	Create Local Clone	167
Figure 8-46	Change Volume Properties	168
Figure 8-47	Verify Parity	169

Figure 8-48	Extend Volume Capacity	170
Figure 8-49	Enable Fast RAID Rebuild When Creating a Volume	
Figure 8-50	Pools Function Submenu	172
Figure 8-51	Map a LUN of iSCSI Connectivity	173
Figure 8-52	Map a LUN of FC Connectivity	174
Figure 8-53	List LUN Mappings	174
Figure 9-1	Traditional Thick Provisioning	
Figure 9-2	Thin Provisioning	
Figure 9-3	Benefits of Thin Provisioning	
Figure 9-4	Storage Architecture of Thin Provisioning Pool	179
Figure 9-5	Pools Function Submenu	
Figure 9-6	Create a Thin Provisioning Pool Step 1	
Figure 9-7	Create a Thin Provisioning Pool Step 2	
Figure 9-8	Create a Thin Provisioning Pool Step 3	
Figure 9-9	Create a Thin Provisioning Pool Step 4	
Figure 9-10	Create a Thin Provisioning Pool Step 5	
Figure 9-11	A Thin Provisioning Pool is Created	
Figure 9-12	List Thin Provisioning Pools	
Figure 9-13	Change Thin Provisioning Policy	191
Figure 9-14	Transfer Thin Provisioning Pool to Auto Tiering	192
Figure 9-15	Move Disk Group	193
Figure 9-16	Add a Disk Group in a Thin Provisioning Pool	194
Figure 9-17	Add a Disk Group to a Thin Provisioning Pool	195
Figure 9-18	A Disk Group is Added	196
Figure 9-19	Create a Volume in Thin Provisioning Pool Step 1	197
Figure 9-20	Create a Volume in Thin Provisioning Pool Step 2	198
Figure 9-21	Create a Volume in Thin Provisioning Pool Step 3	199
Figure 9-22	A Volume in Thin Provisioning Pool is Created	199
Figure 9-23	Change Volume Properties	201
Figure 10-1	SSD Read and Write Cache	203
Figure 10-2	Storage Architecture of SSD Cache Pool	205
Figure 10-3	The Relationship between SSD Cache Pool and Storage Pool	207
Figure 10-4	SSD Read Cache with NRAID+	
Figure 10-5	SSD Read-write Cache with NRAID 1+	209
Figure 10-6	Read Data with Cache Miss	210
Figure 10-7	Read Data with Cache Hit	211
Figure 10-8	Write Data in SSD Read Cache	212
Figure 10-9	Write Data in SSD Read-write Cache	212
Figure 10-10	SSD Cache Function Submenu	216
Figure 10-11	Enable SSD Cache License	217
Figure 10-12	Create an SSD Cache Pool Step 1	217

# **OSAN**

Figure 10-13	Create an SSD Cache Pool Step 2	218
Figure 10-14	Create an SSD Cache Pool Step 3	219
Figure 10-15	An SSD Cache Pool is Created	219
Figure 10-16	Another SSD Cache Pool is Created	220
Figure 10-17	List SSD Cache Pools	221
Figure 10-18	Add / Remove SSDs from the SSD Cache Pool	224
Figure 10-19	Add SSDs into the SSD Cache Pool	225
Figure 10-20	SSD Cache Function Submenu	226
Figure 10-21	SSD Cache Statistics	227
Figure 11-1	Auto Tiering Pool	230
Figure 11-2	3 Levels of Tiered Storage	231
Figure 11-3	Flexible RAID and Disk Configurations	232
Figure 11-4	Storage Architecture of Auto Tiering Pool	233
Figure 11-5	Auto Tiering Relocation	236
Figure 11-6	Pools Function Submenu	239
Figure 11-7	Enable Auto Tiering License	239
Figure 11-8	Create an Auto Tiering Pool Step 1	240
Figure 11-9	Create an Auto Tiering Pool Step 2	241
Figure 11-10	Create an Auto Tiering Pool Step 3	242
Figure 11-11	Create an Auto Tiering Pool Step 4	243
Figure 11-12	Create an Auto Tiering Pool Wizard Step 5	244
Figure 11-13	An Auto Tiering Pool is Created	245
Figure 11-14	List Auto Tiering Pools	246
Figure 11-15	Auto Tiering Pools and Status	249
Figure 11-16	Relocation Schedule	250
Figure 11-17	Relocate Now	251
Figure 11-18	Add a Disk Group in an Auto Tiering Pool	252
Figure 11-19	Add Disk Group	253
Figure 11-20	Hot Spares in Auto Tiering Pool	254
Figure 11-21	Create a Volume of Auto Tiering Pool Step 1	255
Figure 11-22	Create a Volume of Auto Tiering Pool Step 2	256
Figure 11-23	Create a Volume of Auto Tiering Pool Step 3	257
Figure 11-24	A Volume in Auto Tiering Pool is Created	258
Figure 11-25	Change Volume Properties	259
Figure 11-26	Block Map of Thick Provisioning Pool Transferring to Auto Tiering	260
Figure 11-27	Block Map of Thin Provisioning Pool Transferring to Auto Tiering	260
Figure 11-28	Transfer Thick Provisioning Pool to Auto Tiering Step 1	261
Figure 11-29	Transfer Thick Provisioning Pool to Auto Tiering Step 2	262
Figure 11-30	Transfer Thick Provisioning Pool to Auto Tiering Step 3	263
Figure 11-31	Transfer Thin Provisioning Pool to Auto Tiering Step 1	264
Figure 11-32	Transfer Thin Provisioning Pool to Auto Tiering Step 2	265

Figure 11-33	Transfer Thin Provisioning Pool to Auto Tiering Step 3	
Figure 11-34	SSD Cache vs. Auto Tiering	
Figure 12-1	Copy-on-Write Technology	269
Figure 12-2	Volume Shadow Copy Services Workflow	270
Figure 12-3	Snapshot Function Submenu	271
Figure 12-4	Set Snapshot Space	271
Figure 12-5	Take Snapshot	272
Figure 12-6	List Snapshots	272
Figure 12-7	List Snapshots	273
Figure 12-8	Set Writable Snapshot Capacity to Expose Snapshot	274
Figure 12-9	Schedule Snapshots	276
Figure 12-10	Host data I/O Route	278
Figure 12-11	Local Clone Diagram	
Figure 12-12	Local Clone Steps	281
Figure 12-13	Rollback Local Clone	
Figure 12-14	Create Target Volume	284
Figure 12-15	List Source and Target Volumes for Local Clone	284
Figure 12-16	Create Local Clone	
Figure 12-17	List Source and Target Volumes	285
Figure 12-18	Schedule Local Clone	
Figure 12-19	Local Cloning Options	287
Figure 12-20	Remote Replication Diagram	
Figure 12-21	Local Clone Transfers to Remote Replication	
Figure 12-22	One-Directional Remote Replication	290
Figure 12-23	Bi-Directional Remote Replication	290
Figure 12-24	One-to-Many Remote Replication	291
Figure 12-25	Many-to One Remote Replication	291
Figure 12-26	Many-to Many Remote Replication	292
Figure 12-27	Remote Replication Steps	293
Figure 12-28	Snapshot Function Submenu	293
Figure 12-29	Example of Creating a Remote Replication Task	294
Figure 12-30	Create Target Volume in Site B	295
Figure 12-31	List Target Volume in Site B	295
Figure 12-32	Create a Remote Replication Task Step 1	296
Figure 12-33	Create a Remote Replication Task Step 2	297
Figure 12-34	Create a Remote Replication Task Step 3	298
Figure 12-35	Create a Remote Replication Task Step 4	299
Figure 12-36	Remote Replication Task is Created	299
Figure 12-37	Shaping Setting Configuration	
Figure 12-38	Set Traffic Shaping	
Figure 12-39	Schedule Remote Replication	

# **OSAN**

Replication Options	
Remote Replication MPIO Diagram	
Remote Replication Source Controller Fail Diagram	
Remote Replication Target Controller Fail Diagram	
Add Multipath in Remote Replication Step 1	
Add Multipath in Remote Replication Step 2	
Add Multipath in Remote Replication Step 3	
List Multipath in Remote Replication Task	
Add Path Connection	
List Multiple Connections in Remote Replication Task Path	
Delete Path Connection	
Local Clone Transfers to Remote Replication Diagram	
List Source and Target Volumes for Local Clone	
Rebuild Clone Relationship Step 1	
Rebuild Clone Relationship Step 2	
Rebuild Clone Relationship Step 3	
Rebuild Clone Relationship Step 4	
Remote Replication Task is Created	
Log Center Function Submenu	
Event Logs	
Download Event Logs	
Clear Event Logs	
Enclosure Function Submenu	
Hardware Monitoring	
Enable SES	
SES Status	
Performance Function Submenu	
Disk Performance Monitoring	
Select Volumes to Monitor	
Volume Performance Monitoring	
iSCSI Performance Monitoring	
SED Operation Process	
ISE Technology	
Disk Encryption Function Submenu	
Authentication Key is Disabled	
Enable Authentication Key	
Authentication Key is Enabled	
Export Authentication Key	
Change Authentication Key	
Disable Authentication Key	
Disk Encryption Function Submenu	
	Replication Options Remote Replication MPIO Diagram. Remote Replication Source Controller Fail Diagram Add Multipath in Remote Replication Step 1 Add Multipath in Remote Replication Step 2 Add Multipath in Remote Replication Step 3 List Multipath in Remote Replication Task. Add Path Connection List Multiple Connections in Remote Replication Task Path Delete Path Connection Local Clone Transfers to Remote Replication Diagram List Source and Target Volumes for Local Clone Rebuild Clone Relationship Step 1 Rebuild Clone Relationship Step 2 Rebuild Clone Relationship Step 2 Rebuild Clone Relationship Step 3 Rebuild Clone Relationship Step 3 Rebuild Clone Relationship Step 4 Remote Replication Task is Created Log Center Function Submenu Event Logs. Download Event Logs. Clear Event Logs. Clear Event Logs. Enclosure Function Submenu Hardware Monitoring Enable SES SES Status. Performance Monitoring Select Volumes to Monitor Volume Performance Monitoring SED Operation Process ISE Techonology. Disk Encryption Function Submenu Authentication Key . Change Authentication Key . Cisable Authentication Key . Disable Authentication Key . Disable Authentication Key . Disable Authentication Key . Disable Authentication Key . Disk Encryption Function Submenu Disk Performance Monitoring . Set Set Status. Deret Sen Stabled. Enable Authentication Key . Disable Authentication Key . Disk Encryption Function Submenu .

Figure 14-11	List SEDs	341
Figure 14-12	Initiate SEDs	343
Figure 14-13	Initiate SED Results	344
Figure 14-14	List SEDs	344
Figure 14-15	Unlock SEDs	345
Figure 14-16	Erase SEDs	346
Figure 14-17	Erase SED by PSID	347
Figure 14-18	Pools Function Submenu	347
Figure 14-19	Create an SED Pool Step 1	348
Figure 14-20	Create an SED Pool Step 2	349
Figure 14-21	Create an SED Pool Step 3	350
Figure 14-22	Create an SED Pool Step 4	351
Figure 14-23	Create an SED Pool Step 5	352
Figure 14-24	An SED Pool is Created	352
Figure 14-25	List SED Pools	353
Figure 14-26	Disks Function Submenu	357
Figure 14-27	List SEDs and ISE Drives	358
Figure 14-28	Instant Erase ISE drives	360
Figure 14-29	Instant Erase Results	360
Figure 15-1	Without and With QoS	365
Figure 15-2	QoS Settings Function Tab	367
Figure 15-3	QoS Setting is Disabled	367
Figure 15-4	QoS Setting with Priority and Target Response	368
Figure 15-5	QoS Setting with Maximum IOPS and Maximum Throughput	368
Figure 15-6	QoS Volumes Function Tab	
Figure 15-7	List QoS Volumes with Priority and Target Response	369
Figure 15-8	List QoS Volumes with Maximum IOPS and Maximum Throughput	
Figure 15-9	Set Priority	
Figure 15-10	Priority and Target Response Time are Set	
Figure 15-11	Set Maximum IOPS and Maximum Throughput	373
Figure 15-12	Maximum IOPS and Maximum Throughput are set	
Figure 16-1	Volume Restoration	
Figure 17-1	Download Service Package in the SANOS UI	
Figure 17-2	Appearance of a Console Cable	
Figure 17-3	Connect the Console Cable	
Figure 17-4	The Procedures of Setup Serial Console by HyperTerminal	
Figure 17-5	The Procedures of Setup Serial Console by PuTTY	

# **OSAN**

### Tables

Table 2-1	Configuration Worksheet	9
Table 2-2	System Parameters	23
Table 2-3	Configuration Worksheet Example	
Table 4-1	SANOS 4.0 Function Menus	
Table 4-2	USB LCM Function List	
Table 4-3	USB LCM Menu Hierarchy	50
Table 5-1	System Information Block Descriptions	53
Table 5-2	Storage View Block Descriptions	55
Table 5-3	Volume Column Descriptions	
Table 5-4	Disk Group Column Descriptions	57
Table 5-5	Disk Column Descriptions	57
Table 6-1	Power Module Column Descriptions	70
Table 6-2	Flash Module Column Descriptions	71
Table 6-3	UPS Column Descriptions	72
Table 6-4	Status in System Information Column Descriptions	
Table 7-1	iSCSI Parameters	93
Table 7-2	Fibre Channel Parameters	94
Table 7-3	Active Sessions Column Descriptions	
Table 8-1	RAID Level Summary - 1	118
Table 8-2	RAID Level Summary - 2	119
Table 8-3	RAID EE Level Summary	
Table 8-4	Thick Provisioning Pool Parameters	
Table 8-5	Volumes Parameters	
Table 8-6	LUN Parameters	
Table 8-7	Enclosure and Disk Parameters	
Table 8-8	Disk Column Descriptions	134
Table 8-9	Pool Column Descriptions	148
Table 8-10	Disk Group Column Descriptions	149
Table 8-11	Disk Column Descriptions	150
Table 8-12	Volume Column Descriptions	
Table 8-13	LUN Mapping Column Descriptions	175
Table 9-1	Thin Provisioning Pool Parameters	
Table 9-2	Thin Provisioning Policies and Available Values	
Table 9-3	Pool Column Descriptions	
Table 9-4	Disk Group Column Descriptions	
Table 9-5	Disk Column Descriptions	
Table 9-6	Thin Provisioning Policy Column Descriptions	

Table 10-1	The Relationship between System Memory and SSD Cache Capacity	
Table 10-2	SSD Cache Parameters	
Table 10-3	I/O Type Table for SSD Read Cache	215
Table 10-4	I/O Type Table for SSD Read-write Cache	216
Table 10-5	SSD Cache Pool Column Descriptions	
Table 10-6	SSDs Column Descriptions	
Table 10-7	Enabled Volume Column Descriptions	
Table 10-8	SSD Cache Statistics Descriptions	
Table 11-1	Auto Tiering Pool Parameters	
Table 11-2	Summary of Tiering Policies	
Table 11-3	Pool Column Descriptions	
Table 11-4	Disk Group Column Descriptions	247
Table 11-5	Disk Column Descriptions	248
Table 11-6	Pool Tiering Status Column Descriptions	249
Table 11-7	SSD Cache vs. Auto Tiering	
Table 12-1	Snapshot Parameters	271
Table 12-2	Snapshot Column Descriptions	
Table 12-3	Local Clone Parameters	
Table 12-4	Remote Replication Parameters	
Table 14-1	Disk Column Descriptions	341
Table 14-2	Pool Column Descriptions	
Table 14-3	Disk Group Column Descriptions	354
Table 14-4	Disk Column Descriptions	
Table 14-5	Disk Column Descriptions	358
Table 15-1	QoS Volume Descriptions	
Table 15-2	QoS Volume Descriptions with Priority and Target Response Time	
Table 15-3	QoS Volume Descriptions with Maximum IOPS and Maximum Throughput	
Table 16-1	RAID Rebuild	
Table 16-2	Volume Restoration Column Descriptions	



### **Notices**

This XCubeSAN SANOS 4.0 user's manual is applicable to the following XCubeSAN models:

Model Name	Controller Type	Form Factor, Bay Count, and Rack Unit
XS5224D	Dual Controller	LFF 24-disk 4U Chassis
XS3224D	Dual Controller	LFF 24-disk 4U Chassis
XS3224S	Single Controller	LFF 24-disk 4U Chassis
XS1224D	Dual Controller	LFF 24-disk 4U Chassis
XS1224S	Single Controller	LFF 24-disk 4U Chassis

#### XCubeSAN Storage System 4U 19" Rack Mount Models

#### XCubeSAN Storage System 3U 19" Rack Mount Models

Model Name	Controller Type	Form Factor, Bay Count, and Rack Unit
XS5216D	Dual Controller	LFF 16-disk 3U Chassis
XS3216D	Dual Controller	LFF 16-disk 3U Chassis
XS3216S	Single Controller	LFF 16-disk 3U Chassis
XS1216D	Dual Controller	LFF 16-disk 3U Chassis
XS1216S	Single Controller	LFF 16-disk 3U Chassis

#### XCubeSAN Storage System 2U 19" Rack Mount Models

Model Name	Controller Type	Form Factor, Bay Count, and Rack Unit
XS5212D	Dual Controller	LFF 12-disk 2U Chassis
XS5212S	Single Controller	LFF 12-disk 2U Chassis
XS3212D	Dual Controller	LFF 12-disk 2U Chassis
XS3212S	Single Controller	LFF 12-disk 2U Chassis
XS1212D	Dual Controller	LFF 12-disk 2U Chassis
XS1212S	Single Controller	LFF 12-disk 2U Chassis
XS5226D	Dual Controller	SFF 26-disk 2U Chassis
XS5226S	Single Controller	SFF 26-disk 2U Chassis
XS3226D	Dual Controller	SFF 26-disk 2U Chassis
XS3226S	Single Controller	SFF 26-disk 2U Chassis
XS1226D	Dual Controller	SFF 26-disk 2U Chassis



XS1226S	Single Controller	SFF 26-disk 2U Chassis

Information contained in this manual has been reviewed for accuracy. But it could include typographical errors or technical inaccuracies. Changes are made to the document periodically. These changes will be incorporated in new editions of the publication. QSAN may make improvements or changes in the products. All features, functionality, and product specifications are subject to change without prior notice or obligation. All statements, information, and recommendations in this document do not constitute a warranty of any kind, express or implied.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products.

All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.



### Preface

#### **About This Manual**

This manual provides technical guidance for designing and implementing QSAN XCubeSAN series SAN system, and it is intended for use by system administrators, SAN designers, storage consultants, or anyone who has purchased these products and is familiar with servers and computer networks, network administration, storage system installation and configuration, storage area network management, and relevant protocols.

#### **Related Documents**

There are related documents which can be downloaded from the website.

- XCubeSAN QIG (Quick Installation Guide)
- XCubeSAN Hardware Manual
- <u>XCubeSAN Configuration Worksheet</u>
- <u>XCubeSAN SANOS 4.0 Software Manual</u>
- <u>Compatibility Matrix</u>
- White Papers
- <u>Application Notes</u>

#### **Technical Support**

Do you have any questions or need help trouble-shooting a problem? Please contact QSAN Support, we will reply to you as soon as possible.

- Via the Web: https://www.gsan.com/technical\_support
- Via Telephone: +886-2-77206355 (Service hours: 09:30 - 18:00, Monday - Friday, UTC+8)
- Via Skype Chat, Skype ID: qsan.support (Service hours: 09:30 - 02:00, Monday - Friday, UTC+8, Summer time: 09:30 - 01:00)
- Via Email: <u>support@qsan.com</u>



#### **Information, Tip and Caution**

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



#### **INFORMATION:**

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



TIP:

TIP provides helpful suggestions for performing tasks more effectively.



#### CAUTION:

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

#### 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 the <b>OK</b> button.	
<italic></italic>	Indicates a variable, which is a placeholder for actual text provided	
	by the user or system.	
	Example: copy <source-file> <target-file>.</target-file></source-file>	
[] square	Indicates optional values.	
brackets	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: [ <u>a</u>   b ]



### 1. SANOS Overview

SANOS (SAN Operating System) is QSAN's proprietary SAN operating system and allows you to manage, monitor, and analyze the configuration and performance of your XCubeSAN series SAN storage system. This chapter provides an overview of the SANOS functionality and includes a brief explanation of storage terminology for you to be more familiar with the storage technologies used by the XCubeSAN system.

#### 1.1. Introduction to SANOS

SANOS is equipped with a refreshingly simple to use web-based GUI and easily is deployable into any infrastructure. Based on the Linux kernel, the 64-bit in-house developed SANOS delivers comprehensive storage functionality and is suitable for primary or secondary storage for SMB to entry-level enterprise businesses. The following sections will introduce the SANOS system and storage pool architecture with enterprise-grade storage features.

#### 1.1.1. SANOS System Architecture

SANOS supports Dual Active (Active/Active) controller system architecture with high availability. Figure 1-1 shows the SANOS system architecture with dual controller.



Figure 1-1 SANOS System Architecture



Figure 1-2 shows the SANOS system architecture with a single controller configuration. The data path is back and forth between the host interfaces and disk drives via the backplane. The LVM (Logical Volume Management) is the core to handle this data flow between them. It provides a method of allocating space on mass-storage devices that is more flexible than conventional partitioning schemes. In particular, a volume manager can concatenate, stripe together or otherwise combine partitions into larger virtual ones that administrators can resize or move, potentially without interrupting system use. Of course, it may rely on the system resources manager to arrange the processor time slot and scheduled tasks.



Figure 1-2 SANOS System Architecture with Single Controller Configuration

Base on LVM technology, it develops the features of auto tiering, thin provisioning, SSD cache and also data backup functions of snapshot, local clone, and remote replication. Upon LVM, QSOE (QSAN Storage Optimization Engine) which we are proud to develop, increases IOPS performance and overall system throughput. SANOS also supports several critical data services such as MPIO (Multi-Path I/O), MC/S (Multiple Connections per



Session), Microsoft VSS (Volume Shadow Copy Service), Microsoft ODX (Offloaded Data Transfer), and VMware VAAI (VMware vSphere Storage APIs for Array Integration). In the periphery, there are management service daemon to provide user interface operations, C2F (Cache to Flash) mechanism includes BBM (Battery Backup Module) / SCM (SuperCap Module) and M.2 flash module to protect cache data from power shortage. These key enterprise storage features are all together in a single box.

Under the operation of dual controllers, HAC (High Availability Control) module has a heartbeat mechanism to detect whether the other controller is alive. Cache mirror synchronizes the memory data of both controllers including the status and storage configuration. When one controller fails, the other controller can seamlessly take over all the tasks of the failed controller thanks to this cache sync. In addition, zero system downtime for the dual controller system takes place during firmware upgrading period.

#### 1.1.2. SANOS Storage Pool Architecture

QSAN storage pool supports a variety of 3.5"/2.5" SAS/NL-SAS HDD and 2.5" SAS/SATA SSD flash drives. Figure 1-3 shows the storage pool architecture. Several disk drives are combined together to form a "disk group" with RAID protection. Then several disk groups can be combined to form a storage pool. A volume (virtual disk) is then created out of the storage pool and served to application servers over either iSCSI or Fibre Channel connections.



Figure 1-3 SANOS Storage Pool Architecture



If the local disk drives are not enough, QSAN expansion enclosures including disk drives can be added to increase storage capacity. There are host spares for standby if any disk drives in pools fail. Base on snapshot technology, the data backup features such as local clone and remote replications are also provided.

#### 1.1.3. SANOS 4.0 Functionality List

SANOS 4.0 provides the following functionality for administrator management.



Figure 1-4 SANOS 4.0 Desktop Panel

#### System Management

- Change system name, date and time.
- Change admin's password, user's password, and configure login options.
- Configure management IP address, DNS, and service ports.
- Support boot management including auto shutdown, wake-on-LAN, and wake-on-SAS.
- Support network UPS via SNMP.
- Monitor cache to flash memory protection status. BBM (Battery Backup Module), SCM (Super Capacitor Module), and flash module are optional add-ons.
- Configure alert notifications through email, syslog server, or SNMP traps.
- Obtain system information and download service package.
- Update firmware of head unit or enclosure unit(s).



- Change operation mode of single or dual controller.
- Blink UID (Unique Identifier) LEDs for locating the storage arrays.
- System reset to default, configuration backup, and volume restoration for maintenance usage.
- System reboot or shutdown.

#### **Host Connectivity**

- Obtain host connectivity information.
- Configure iSCSI connectivity with IP address, link aggregation, VLAN (Virtual LAN) ID and jumbo frame.
- Setup entity name and iSNS (Internet Storage Name Service).
- Configure iSCSI target with CHAP (Challenge-Handshake Authentication Protocol) and mutual CHAP authentication.
- List and disconnect iSCSI sessions.
- Configure fibre channel connectivity with link speed and topology.

#### **Storage Management**

- Support RAID pool with RAID level 0, 1, 3, 5, 6, 0+1, 10, 30, 50, 60, and N-way mirror.
- Support thick provisioning pool and online migrate RAID pool.
- Support thin provisioning pool with space reclamation.
- Support 3-tier auto tiering with scheduled relocation. (auto tiering function is optional)
- Support SSD read cache or read-write cache to improve performance. (SSD cache function is optional)
- Support online storage pool capacity expansion and volume capacity extension.
- Configure disk properties with disk write cache, disk read-ahead, command queuing, and disk standby.
- Configure volume properties with background I/O priority, volume write-back cache, and video editing mode for enhanced performance.
- Support access control for LUN mapping.
- Support global, local, and dedicated hot spares for pool.
- Support fast RAID rebuild.
- Support disk drive health check and S.M.A.R.T attributes.
- Support hard drive firmware batch update.
- Support pool parity check and media scan for disk scrubbing.
- Support pool activated and deactivated for disk roaming.



#### **Data Backup**

- Support writable snapshot with manual or schedule tasks.
- Support volume cloning for local replication.
- Support remote replication with traffic shaping for dynamic bandwidth controller.

#### Virtualization Integration

 Seamless integrated with popular hypervisor including VMware vSphere, Microsoft Hyper-V, and Citrix XenServer.

#### Monitoring

- View event logs with different levels of event and download event logs.
- Monitor enclosure status of head and enclosure units.
- Monitor storage array performance.

#### 1.2. Terminology

In this section, we introduce the terms that are used for the storage system throughout this manual.

#### RAID

RAID is the abbreviation of Redundant Array of Independent Disks. There are different RAID levels with different degrees of data protection, data availability, and performance to the host environment.

#### Pools

A storage pool is a collection of disk drives. One pool consists of a set of volumes and owns one RAID level attribute.

#### Volumes

Each pool can be divided into several volumes. The volumes from one pool have the same RAID level, but may have different volume capacity.

#### Fast RAID Rebuild

When executing rebuild, the Fast RAID Rebuild feature skips any partition of the volume where no write changes have occurred, it will focus only on the parts that have changed.



#### LUN

A LUN (Logical Unit Number) is a unique identifier for designating an individual or collection of physical or virtual storage devices that execute I/O commands with a host computer, as defined by the SCSI (Small Computer System Interface) standard.

#### iscsi

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.

#### **Fibre Channel**

Fibre channel is an extremely fast system interface. It was initially developed for use primarily in the supercomputing field, but has become the standard connection type for storage area networks (SAN) in enterprise storage.

#### SAS

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 connections.

#### **Thick Provisioning**

Thick provisioning is allocated upon creation the physical disk drive space and is equal to the user capacity seen by the host server. It also called fat provisioning.

#### **Thin Provisioning**

Thin provisioning is allocated on-demand and can be less than the user capacity seen by the host server. It involves using virtualization technology to give the appearance of having more physical resources than are actually available.

#### **Auto Tiering**

Auto Tiering is the automated progression or demotion of data across different tiers (types) of storage devices and media. The movement of data takes place in an automated way with the help of software and is assigned to the related media according to performance and capacity requirements. It also includes the ability to define rules and policies that dictate if and when data can be moved between the tiers, and in many cases provides the ability to pin data to tiers permanently or for specific periods of time.



#### SSD Cache

Smart Response Technology (also known as SSD cache) allows an SSD to function as cache for a HDD volume. It is a secondary cache that improves performance by keeping frequently accessed data on SSDs where they are read/write far more quickly than from the HDD volume.

#### Snapshot

A volume snapshot is the state of a system at a particular point in time.

#### Local Clone

Local clone function has another physical data copy as the original volume.

#### **Remote Replication**

Remote replication function prevents primary site failure by replicating data to the remote sites.

### 2. Prepare for Installation

Preparation for installation is an important task, it will help you to plan your system configuration and install your system smoothly. This chapter provides a description of the configuration planning steps and a configuration worksheet example for reference.

#### 2.1. Prepare for Configuration Planning

Before installing your SAN storage system, it is highly recommended you to do installation preparation using the worksheet. Sticking to the worksheet will help you to setup and initialize the storage system. Please refer to the Table 2-1 for the content of worksheet. You can download this worksheet here: <u>XCubeSAN Configuration Worksheet</u>.

1. Initial Configuration		
Item	Value	
System Name:		
The maximum length of the system name is 32 characters.		
Valid characters are [ $A \sim Z   a \sim z   0 \sim 9  ]$ .		
Admin Password:		
The maximum length of the password is 12 characters.		
Valid characters are [ A~Z   a~z   0~9   ~!@#\$%^&*		
+=` \(){}[]:;'''<>,.?/].		
NTP Server:		
FQDN (Fully Qualified Domain Name)or IP address of NTP		
(Network Time Protocol) server.		
Time Zone:		
Depending on your location.		
2. Management Port Setting		
Item	Value	
Management Port IP Address on Controller 1:	IP:	
IP address, subnet mask, and gateway of the management	SM:	
port on controller 1.	GW:	
DNS Server Address:		
IP address of DNS (Domain Name System) server.		

#### Table 2-1 Configuration Worksheet

Management Port IP Address on Controller 2: (optional)			IP:		
IP address, subnet mask, and gateway of the management			SM:		
port on controller 2.			GW:		
3. Notification Se	etting				
Item		Value			
Email-from Addr	ess:				
Email-from addre	ess to send event notification.				
Email-to Address	ses:	Email-to Address 1:			
Email-to address	es to receive event notification				
			Email-to Address 2:		
			Email-to Address 3:		
SMTP Server:					
Network name or	· IP address of SMTP (Simple Mail				
Transfer Protocol) server.					
Syslog Server: (c					
FQDN or IP addre	ess of syslog server.				
SNMP Trap Addr	resses: (optional)	SNMP Trap Address 1:			
FQDNs or IP add	resses of SNMP (Simple Network				
Management Pro	otocol) trap.		SNMP Trap Address 2:		
			CNIMD Them Address 2		
			SNMP Trap Address 3:		
A isosl Port Cor	figuration				
4. ISCSI POIL CO	ingulation		Value		
			value		
Unboard ISCSI Port IP Addresses:					
Opboard 2 x 10CBASE-T iSCSI (P 145) ports					
Controller 1 Onboard LAN1 Onboard		Onhoa	ard LAN2		
	Onboard LANT	UIIDUa			
Subnot Mook					
Gateway					
Galeway	Ophoard I AN1	Onhoo			
		UIDOa			
Subpot Mook					
Gateway					



Slot 1 iSCSI Port	IP Addresses: (o	ptional)				
IP address, subnet mask, and gateway of the iSCSI ports.						
2-port 25GbE iSCSI Host Card (SFP28)						
4-port 10GbE iSCSI Host Card (SFP+)						
2-port 1GBAS	SE-T iSCSI Host C	ard (RJ45)				
4-port 1GBASE-T iSCSI Host Card (RJ45)						
Controller 1	Slot 1 LAN1	Slot 1 LAN2	Slot 1	LAN3	Slot 1 LAN4	
IP Address						
Subnet Mask						
Gateway						
Controller 2	Slot 1 LAN1	Slot 1 LAN2	Slot 1	LAN3	Slot 1 LAN4	
IP Address						
Subnet Mask						
Gateway						
Slot 2 iSCSI Port	IP Addresses: (o	ptional)	•			
IP address, subn	et mask, and gate	eway of the iSCSI p	oorts.			
2-port 25GbE iSCSI Host Card (SFP28)						
• 4-port 10GbE	iSCSI Host Card	(SFP+)				
2-port 10GBASE-T iSCSI Host Card (RJ45)						
4-port 1GBAS	SE-T iSCSI Host C	ard (RJ45)				
4-port 1GBAS Controller 1	SE-T iSCSI Host C Slot 2 LAN1	ard (RJ45) Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4	
4-port 1GBAS Controller 1 IP Address	SE-T iSCSI Host C Slot 2 LAN1	ard (RJ45) Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4	
4-port 1GBAS     Controller 1     IP Address     Subnet Mask	E-T iSCSI Host C Slot 2 LAN1	ard (RJ45) Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4	
4-port 1GBAS     Controller 1     IP Address     Subnet Mask     Gateway	E-T iSCSI Host C Slot 2 LAN1	ard (RJ45) Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4	
4-port 1GBAS     Controller 1     IP Address     Subnet Mask     Gateway     Controller 2	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4	
4-port 1GBAS     Controller 1     IP Address     Subnet Mask     Gateway     Controller 2     IP Address	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> </ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> </ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Gateway</li> <li>Entity Name:</li> </ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2	Slot 2 Slot 2 Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Entity Name: The entity name</li> </ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1 Slot 2 LAN1	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2 Gateway that is	Slot 2 Slot 2 Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Entity Name:</li> <li>The entity name</li> <li>accessible from 5</li> </ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1 is for a device or the network. The	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2 gateway that is maximum length o	Slot 2 Slot 2 Slot 2 Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Entity Name:</li> <li>The entity name is accessible from a continue is 200</li> </ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1 Slot 2 LAN1 is for a device or the network. The 00 characters. Val	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2 gateway that is maximum length c id characters are [	Slot 2 Slot 2 Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Entity Name:</li> <li>The entity name is 20</li> <li>0~9  : ].</li> </ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1 is for a device or of the network. The 00 characters. Val	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2 gateway that is maximum length o id characters are [	Slot 2 Slot 2 Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Entity Name:</li> <li>The entity name accessible from accessible fr</li></ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1 is for a device or of the network. The 0 characters. Val : (optional)	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2 gateway that is maximum length o id characters are [	Slot 2 Slot 2 Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Entity Name:</li> <li>The entity name is accessible from accessible</li></ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1 is for a device or the network. The 00 characters. Val : (optional) IS (Internet Stora	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2 gateway that is maximum length c id characters are [ ge Name Server) s	Slot 2 Slot 2 Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	
<ul> <li>4-port 1GBAS</li> <li>Controller 1</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Controller 2</li> <li>IP Address</li> <li>Subnet Mask</li> <li>Gateway</li> <li>Entity Name:</li> <li>The entity name accessible from accessible fr</li></ul>	SE-T iSCSI Host C Slot 2 LAN1 Slot 2 LAN1 is for a device or of the network. The 00 characters. Val : (optional) IS (Internet Storage	ard (RJ45) Slot 2 LAN2 Slot 2 LAN2 Slot 2 LAN2 gateway that is maximum length o id characters are [ ge Name Server) s	Slot 2 Slot 2 Slot 2	LAN3	Slot 2 LAN4 Slot 2 LAN4	

CHAP Username: (optional)								
CHAP (Challenge	CHAP (Challenge-Handshake Authentication Protocol)							
username. The maximum length of the username is 223								
characters. Valid characters are [ A~Z   a~z   0~9								
~!@#%^&*+= (){{[]:;<>.?/ ].								
CHAP Password: (optional)								
CHAP password.	CHAP password. The length of the password is between12							
to 16 characters. Valid characters are [ A~Z   a~z   0~9								
~!@#\$%^&*+=` \(){}[]:;"'<>,.?/].								
Mutual CHAP Username: (optional)								
Mutual CHAP username. The maximum length of the								
username is 223 characters. Valid characters are [ A~Z								
a~z 0~9 ~!@#%^&*+= (){}[]:;<>.?/].								
Mutual CHAP Password: (optional)								
Mutual CHAP password. The length of the password is								
between12 to 16 characters. Valid characters are [ A~Z								
a~z 0~9 ~!@#\$%^&*+=` \(){{]]:;"'<>,.?/].								
5. Fibre Channel Port Configuration								
Item				Value				
Slot 1 Fibre Char	nel: (optional)							
Link speed and to	opology of the fibre							
Topology suppor	t: FC-AL, point-to-p	oint (16Gb and 32Gb	Fibre					
Channel only support	Channel only support Point-to-Point topology)							
• 2-port 32Gb F	ibre Channel Host	Card (SFP28)						
• 4-port 16Gb F	ibre Channel Host							
2-port 16Gb Fibre Channel Host Card (SFP+)								
Controller 1	Slot 1 FC1	Slot 1 FC2	Slot 1	FC3	Slot 1 FC4			
			0.001					
Link Speed								
Link Speed Topology								
Link Speed Topology Controller 2	Slot 1 FC1	Slot 1 FC2	Slot 1	FC3	Slot 1 FC4			
Link Speed Topology Controller 2 Link Speed	Slot 1 FC1	Slot 1 FC2	Slot 1	FC3	Slot 1 FC4			
Link Speed Topology Controller 2 Link Speed Topology	Slot 1 FC1	Slot 1 FC2	Slot 1	FC3	Slot 1 FC4			
Link Speed Topology Controller 2 Link Speed Topology 6. Pool Configura	Slot 1 FC1	Slot 1 FC2	Slot 1	FC3	Slot 1 FC4			
Link Speed Topology Controller 2 Link Speed Topology 6. Pool Configura Item	Slot 1 FC1	Slot 1 FC2	Slot 1	FC3 Value	Slot 1 FC4			
Link Speed Topology Controller 2 Link Speed Topology 6. Pool Configura Item Pool Type:	Slot 1 FC1	Slot 1 FC2	Slot 1	FC3 Value	Slot 1 FC4			
Link Speed Topology Controller 2 Link Speed Topology 6. Pool Configura Item Pool Type: Thick Provisionin	Slot 1 FC1 ation	Slot 1 FC2	Slot 1	FC3 Value	Slot 1 FC4			
Link Speed Topology Controller 2 Link Speed Topology 6. Pool Configura Item Pool Type: Thick Provisioning Ena	Slot 1 FC1 ation ag, Thin Provisionin bled).	Slot 1 FC2	(Thin	FC3 Value	Slot 1 FC4			


Pool Name:	
The maximum length of the pool name is 16 characters.	
Valid characters are [ $A \sim Z$   $a \sim z$   $0 \sim 9$  <> ].	
Disks:	SSD:
Disk type, disk quantity, and the capacity.	SAS:
	NL-SAS:
RAID Level:	
RAID level 0, 1, 3, 5, 6, 0+1, 10, 30, 50, 60, and N-way mirror	
RAID EE level 5EE, 6EE, 50EE, and 60EE	
Raw Capacity:	
Sum of disk capacity.	
Estimate Capacity:	
Estimate capacity according to the RAID level.	
7. Volume Configuration	
Item	Value
Volume Name:	
The maximum length of the volume name is 32 characters.	
Valid characters are [ $A \sim Z \mid a \sim z \mid 0 \sim 9 \mid - <>$ ].	
Capacity:	
Required capacity of the volume.	
Volume Type:	
RAID Volume or Backup Volume	
8. LUN Mapping Configuration	
Item	Value
Protocol:	
iSCSI or FCP.	
Volume Name:	
Select one of created volumes.	
Allowed Hosts:	
iSCSI IQN or Fibre Channel WWNN for access control.	
Wildcard (*) for access by all hosts.	
Target:	
iSCSI Target or Fibre Channel Target	
LUN:	
Support LUN (Logical Unit Number) from 0 to 255.	
Permission:	
Read-only or Read-write.	



9. SSD Cache Configuration	
Item	Value
SSD Cache Pool Name:	
The maximum length of the pool name is 16 characters.	
Valid characters are [ A~Z   a~z   0~9  <> ].	
Cache Type:	
Read Cache (NRAID+) or Read-write Cache (RAID 1 or	
NRAID 1+).	
I/О Туре:	
Database, File System, or Web Service.	
SSDs:	SSD:
SSD quantity and the capacity.	
Raw Capacity:	
Sum of disk capacity.	
10. Snapshot Configuration	
Item	Value
Volume Name:	
Select one of created volumes.	
Snapshot Space:	
Reserved snapshot space for the volume.	
Snapshot Name:	
The maximum length of the snapshot name is 32	
characters. Valid characters are [ A~Z   a~z   0~9  <> ].	
Schedule Snapshots: (optional)	
Define the cycle of snapshots.	
11. Local Clone Configuration	
Item	Value
Source Volume Name:	
Select one of created volume for source.	
Source Volume Capacity:	
Check the capacity of source volume.	
Target Volume Name:	
Select one of created volume for target.	
Target Volume Capacity:	
Check the capacity of target volume.	
Schedule Local Clones: (optional)	
Define the cycle of local clones.	



12. Remote Repl	lication Configuration		
Item			Value
Source Volume	Name:		
Select one of cre	eated volumes for source.		
Source Volume	Capacity:		
Check the capac	eity of source volume.		
Source iSCSI Po	rt:		
iSCSI port of sou	irce unit. It can be auto or dedicated	iSCSI	
port.			
Target iSCSI Por	rt IP Addresses:		
iSCSI port IP add	dresses of target unit.		
Target	Controller 1	Control	ler 2 (optional)
IP Address			
Target CHAP Us	ername: (optional)		
CHAP username	e. The maximum length of the userna	ame is	
223 characters.	Valid characters are [ A~Z   a~z   0~	,9	
~!@#%^&*+= ()	){{[]:;<>.?/ ].		
Target CHAP Pa	ssword: (optional)		
CHAP password	. The length of the password is betw	veen 12	
to 16 characters	. Valid characters are [ A~Z   a~z   0	~9	
~!@#\$%^&*+=`	` \(){}[]:;'''<>,.?/ ].		
Target Volume N	Name:		
Select one of cre	eated volume for target.		
Target Volume C	Capacity:		
Check the capac	ity of target volume.		
Schedule Remot	te Replications: (optional)		
Define the cycle of remote replications.			
Traffic Shaping	for Peak Hour: (optional)		
Limit the transfe	r rate at peak hour.		
Traffic Shaping	for Off-peak Hour: (optional)		
Limit the transfe	r rate at off-peak hour.		
Off-peak Hour: (	optional)		
Define the off-pe	eak hours.		

Now please follow the steps and fill the worksheet out for initial system configuration.



## 2.1.1. Configuration Planning for Initial Setup

In Table 2-1, the items on part 1, initial configuration, are listed for the initial setup. The information in the following checklist is helpful before the initial configuration is performed.

- System name allows maximum 32 characters. Valid characters are [ A~Z | a~z | 0~9 | -\_<> ].
- Administrator password allows maximum 12 characters. Valid characters are [A~Z | a~z | 0~9 | ~!@#\$%^&\*\_-+=`|\(){[]:;"<>,.?/].
- The date and time can be manually entered, but to keep the clock synchronized, recommend using a NTP (Network Time Protocol) service.
- Enter the time zone based on your geographical location.

## 2.1.2. Management IP Configuration Planning

With your network administrator, determine the IP addresses and network parameters you plan to use with the storage system, and record the information on part 2, management port setting in Table 2-1. You can manage the storage system through a dedicated management port at least on controller 1. This port must share a same subnet with the host you use to initialize the system. After initialization, any host on the same network and with a supported browser can manage the system through the management port.

- It is recommended using a static IP address for the management port. Please prepare a list of the static IP addresses, the subnet mask, and the default gateway.
- DNS (Domain Name Service) server address provides a means to translate FQDN (Fully Qualified Domain Name) to IP address. Some notification services need DNS setting.
- For dual controller configurations, the management port IP address on controller 2 is optional. If enabling the dual management ports setting, both management ports of controller 1 and 2 have their own IP addresses, and both are active. Otherwise, only the management port of master controller is active, the other one is standby. The management port fails over to the slave controller when the master controller goes offline even planned or unplanned.

## 2.1.3. Notification Configuration Planning

On part 3, notification setting in Table 2-1, prepare to configure the notification. It's helpful for monitoring the system health.



- SMTP server and email address to direct notification alerts the IT administrator and any alternate or back-up personnel.
- Syslog server address to log monitored events.
- SNMP (Simple Network Management Protocol) trap to send system event logs to SNMP trap agent.

## 2.1.4. iSCSI Configuration Planning

Although SAN is a private network environment, IP addresses of iSCSI data ports should be planned, too. Optionally, CHAP security information, including CHAP username and password should be prepared.

For an iSCSI dual-controller system, recommend to install an iSNS server on the same storage area network. For better usage of failover, the host must logon the target twice (both controller 1 and controller 2), and then the MPIO should setup automatically. More advanced, all the connections among hosts (with clustering), switches, and the dual-controller are recommended as redundant as shown below.



Figure 2-1 Dual-controller Topology

If you are using onboard iSCSI LAN ports, please fill in part 4, onboard iSCSI port IP addresses of iSCSI port configuration. Optionally, if you have iSCSI host card at slot 1 and slot 2, please fill in iSCSI port IP address.



#### **INFORMATION:**

iSCSI Host Cards at Slot 1 (PCIe Gen3 x 8)

- RHCE25P2, 2 x 25GbE iSCSI (SFP28) ports
- HQ-10G4S2, 4 x 10GbE iSCSI (SFP+) ports
- HQ-10G2T, 2 x 10GbE iSCSI (RJ45) ports
- HQ-01G4T, 4 x 1GbE iSCSI (RJ45) ports

iSCSI Host Cards at Slot 2 (PCIe Gen2 x 4)

- RHCE25P2, 2 x 25GbE iSCSI (SFP28) ports (Slot 2 provides 20Gb bandwidth)
- HQ-10G4S2, 4 x 10GbE iSCSI (SFP+) ports (Slot 2 provides 20Gb bandwidth)
- HQ-10G2T, 2 x 10GbE iSCSI (RJ45) ports
- HQ-01G4T, 4 x 1GbE iSCSI (RJ45) ports
- The entity name is for a device or gateway that is accessible from the network.
- An iSNS (Internet Storage Name Service) server uses the iSNS protocol to maintain information about active iSCSI devices on the network, including their IP addresses, iSCSI node names, and iSCSI targets. The iSNS protocol enables automated discovery and management of iSCSI devices on an IP storage network. An iSCSI initiator can query the iSNS server to discover iSCSI target devices.
- CHAP (Challenge-Handshake Authentication Protocol) is a one-way authentication which the initiator will be authenticated by the iSCSI target. CHAP requires that both the client and server know the plaintext of the password/secret, although it is never sent over the network. In addition, mutual CHAP is a two-way authentication between the iSCSI target and the initiator. For CHAP username, the maximum length of name is 223 characters and for CHAP password, the length range is from 12 to 16 alphanumeric characters.

## 2.1.5. Fibre Channel Configuration Planning

Optionally, if you have fibre channel host card, please fill at slot 1 fibre channel on part 5, fibre channel port configuration in Table 2-1. You have to be familiar the fibre channel protocol. Please consider the fibre channel typology, either direct-attach to HBA or connection with fibre channel switch.

# **C**SAN



#### **INFORMATION:**

Fibre Channel Host Card at Slot 1 (PCIe Gen3 x 8)

- RHCF32P2, 2 x 32Gb FC (SFP28) ports
- HQ-16F4S2, 4 x 16Gb FC (SFP+) ports
- HQ-16F2S2, 2 x 16Gb FC (SFP+) ports

Fibre Channel Host Cards at Slot 2 (PCIe Gen2 x 4)

- RHCF32P2, 2 x 32Gb FC (SFP28) ports (Slot 2 provides 20Gb bandwidth)
- HQ-16F4S2, 4 x 16Gb FC (SFP+) ports (Slot 2 provides 20Gb bandwidth)
- HQ-16F2S2, 2 x 16Gb FC (SFP+) ports (Slot 2 provides 20Gb bandwidth)
- Set the link speed as the same as the HBA or fibre channel switch, or set it to auto if you are not sure the link speed.
- Set the topology as the same as the HBA or fibre channel switch. Topology supports FC-AL, point-to-point (16Gb and 32Gb fibre channel only support Point-to-Point topology).

## 2.1.6. Storage Configuration Planning

This is the most important part to use the SAN storage system effectively. Depending on your application, estimated volume capacity, and disk failure risk, you should have a well-thought out storage plan. Complete all storage configuration planning jobs on part 6, pool configuration, part 7, volume configuration, part 8, LUN mapping configuration, and part 9, SSD cache configuration.

#### **Planning the Disks**

To plan the disk drives, determine:

- The cost/performance ratio of the disk drive type.
- Estimate the total required capacity of the system.
- Whether the disk drives are SSDs.
- Quantity of spare disks. Recommend for hot spare to active drive ratios, 1 in 30 for SAS drives and 1 in 15 for NL-SAS.

#### **Planning the Pools**

Necessary activities are in the following, please fill in part 6, pool configuration, in Table 2-1.

• The pool name, the maximum length of name is 16 characters.



- According to the pool and disk drive characteristics, such as total capacity, budget, performance, and reliability, determine a pool type (thick, thin provisioning, or auto tiering) and a RAID level of storage systems to use. For example, create a pool which is grouped by RAID 10 for performance and RAID 5 in another storage pool to achieve desired results.
- Plan to extend the capacity of the storage pool in the future.

#### Planning the Volumes

A volume is a member of the pool. Determine the following items and fill in part 7, volume configuration, in Table 2-1.

- The volume name, the maximum length of name is 32 characters.
- The volume capacity.
- Plan the volume capacity for local clone or remote replication. Set it as RAID volume for normal RAID volume usage, or set it as backup volume for the backup target of local clone or remote replication.

#### **Planning the LUNs**

LUN is a unique identifier which volume maps it to differentiate among separate devices. At the same time, there are some access controls by allowed hosts, target, LUN (logic unit number), and read/write permission. Please fill in part 8, LUN mapping configuration, in Table 2-1.

- Prepare an allowed host list for access control. They are (iSCSI Qualified Name) or Fibre Channel WWNN (World Wide Node Name). Set it as wildcard (\*) for access by all hosts.
- Select an iSCSI target for iSCSI network portal. Or a FC target.
- Support LUN from 0 to 255.
- Usually, set the volume as read-write permission. For read only purpose, set it as readonly.

#### Planning the SSD Cache

Optionally, preparing for some SSDs will enhance the system performance. Please fill in part 9, SSD cache configuration, in Table 2-1.

• For SSD cache planning, the capacity of read cache is the sum of SSDs. But the capacity of read-write cache is half of all SSDs because it needs RAID protection for write buffer.



## 2.1.7. Backup Configuration Planning

Backup plan is also an important job for disaster recovery. Complete the backup configuration planning jobs on part 10, snapshot configuration, part 11, local clone configuration, and part 12, remote replication configuration.

#### **Planning the Snapshots**

To plan the snapshots, you have to reserve some snapshot spaces from the pool. Normally, we suggest reserving **20%** of the volume capacity as a minimum.

- Select a volume and reserve its snapshot space.
- Plan the schedule of snapshots, determine the cycle of taken snapshots. It can be hourly, daily, or weekly.

#### **Planning the Local Clones**

To plan the local clones, you have to select a source volume and prepare a target volume which the source clones to.

- Select a source volume and check its capacity.
- Prepare a target volume and set it as backup volume. The capacity of target volume should be larger than the source one.
- Plan the schedule local clones, determine the cycle of executing clone tasks. It can be hourly, daily, or weekly.

#### **Planning the Remote Replications**

To plan the remote replications, except to select a source volume in source unit and prepare a target volume which the source replicates to in target unit, you have to prepare the information of iSCSI port IP addresses to transfer the data. In addition, according to the network bandwidth, determine the transfer rate at peak and off-peak hours.

- Select a source volume and check its capacity in source unit.
- Select a source iSCSI port to send the replication data.
- Prepare the information of iSCSI port IP addresses in target unit to receive the replication data. Also prepare CHAP username and password if the target unit is enabled CHAP authentication.
- Prepare a target volume and set it as backup volume in target unit. The capacity of target volume should be larger than the source one.
- Plan the schedule remote replications, determine the cycle of executing replication tasks. It can be hourly, daily, or weekly.



• Define the off-peak hours and plan the transfer rate at peak and off-peak hours.

## 2.2. System Parameters

In this section, we list all of system parameters which will help you to understand and plan the system configuration. The following table shows the maximum number of each item you can use.

iSCSI Parameters			
Item	Value		
Maximum iSCSI target quantity per system	256		
Maximum initiator address quantity per system	256		
Maximum host quantity for single controller system	512		
Maximum host quantity for dual controller system	1,024		
Maximum iSCSI session quantity for single controller	1,024		
Maximum iSCSI session quantity for dual controller	2,048		
Maximum iSCSI connection quantity for single controller	4,096		
Maximum iSCSI connection quantity for dual controller	8,192		
Maximum CHAP accounts per system	64		
Fibre Channel Parameters			
Item	Value		
Maximum host quantity for single controller	256		
Maximum host quantity for dual controller	512		
Expansion Unit and Disk Parameters			
Item	Value		
Maximum expansion unit quantity in a system	10		
Maximum disk quantity in a system	286		
Pool Parameters (Thick Provisioning / Thin Provisioning / Auto Tiering)			
Item	Value		
Maximum disk group quantity in a pool	32		
Maximum disk drive quantity in a disk group	64		
(include dedicated spares)			
Maximum disk drive quantity in a pool	256		
(include dedicated spares)			
Maximum pool quantity per system	64		

Table 2-2System Parameters

## **OSAN**

Maximum dedicated spare quantity in a pool	8
Thick Provisioning Pool Parameters	
Item	Value
Maximum addressable capacity of a disk group	640TB
	(calculated by 10TB HDD)
Maximum addressable capacity of a thick provisioning pool	2,560TB
Maximum addressable supacity of a tillox provisioning poor	(calculated by 10TB HDD)
Maximum addressable capacity of total thick provisioning	Unlimited
pools	
Thin Provisioning Pool Parameters	
Item	Value
Maximum addressable capacity of a disk group	64TB
Maximum addressable capacity of a thin provisioning pool	256TB
Maximum addressable capacity of total thin provisioning	1,024TB
pools	
(include auto tiering pools)	
Provisioning granularity	1GB
Auto Tiering Pool Parameters	
Item	Value
Maximum tiers	3
(include SSD, SAS HDD, NL-SAS HDD)	
Maximum addressable capacity of a tier (disk group)	64TB
Maximum addressable capacity of an auto tiering pool	256TB
Maximum addressable capacity of total auto tiering pools	1,024TB
(include thin provisioning pools)	
Provisioning granularity	1GB
Volumes Parameters	
Item	Value
Maximum volume quantity in a pool	96
Maximum volume quantity per system	4,096
(include snapshot volumes)	
Maximum host number per volume	16
Maximum addressable volume capacity of a thick	2,560TB
provisioning pool	(calculated by 10TB HDD)
Maximum addressable volume capacity of a thin	256TB
provisioning pool	



Maximum addressable volume capacity of an auto tiering	256TB	
pool		
LUN Parameters		
Item	Value	
Maximum LUN quantity per system	4,096	
SSD Cache Parameters		
Item	Value	
Maximum SSD cache pool quantity per system	4	
(either dual controller or single controller)		
Maximum SSD quantity in an SSD cache pool	8	
Maximum addressable capacity of an SSD cache pool	32TB	
Maximum quantity of volume shared in an SSD cache pool	32	
Maximum dedicated spare SSD quantity in an SSD cache	4	
pool		
Snapshot Parameters		
Item	Value	
Maximum snapshot quantity per volume	64	
Maximum volume quantity for snapshot	64	
Maximum snapshot quantity per system	4,096 (= 64 x 64)	
Local Clone Parameters		
Item	Value	
Maximum clone task quantity per volume	1	
(Maximum clone pairs per source volume)		
Maximum clone task quantity per system	64	
Remote Replication Parameters		
Item	Value	
Maximum remote replication task quantity per volume	1	
(Maximum remote replication pairs per source volume)		
Maximum remote replication task quantity per system	32	
Maximum traffic shaping quantity per system	8	
Maximum iSCSI multi-path quantity in a remote replication	2	
task		
Maximum iSCSI multiple connection quantity per remote	4	
replication task path		



#### 2.3. **Configuration Example**

The following is an example of finished configuration worksheet just for reference.

Table 2-3 Configuration Worksheet Example			
1. Initial Configuration			
Item	Value		
System Name:	XCubeSAN		
The maximum length of the system name is 32 characters.			
Valid characters are [ $A \sim Z \mid a \sim z \mid 0 \sim 9 \mid$ ].			
Admin Password:	1234		
The maximum length of the password is 12 characters.			
Valid characters are [ A~Z   a~z   0~9   ~!@#\$%^&*			
+=` \(){}[]:;'''<>,.?/ ].			
NTP Server:	pool.ntp.org		
FQDN (Fully Qualified Domain Name)or IP address of NTP			
(Network Time Protocol) server.			
Time Zone:	(GM +08:00) Taipei		
Depending on your location.			
2. Management Port Setting			
Item	Value		
Management Port IP Address on Controller 1:	<b>IP:</b> 192.168.1.234		
IP address, subnet mask, and gateway of the management	<b>SM:</b> 255.255.255.0		
port on controller 1.	<b>GW:</b> 192.168.1.254		
DNS Server Address:	8.8.8.8		
IP address of DNS (Domain Name System) server.			
Management Port IP Address on Controller 2: (optional)	IP: 192.168.1.235		
IP address, subnet mask, and gateway of the management	<b>SM:</b> 255.255.255.0		
port on controller 2.	<b>GW:</b> 192.168.1.254		
3. Notification Setting			
Item	Value		
Email-from Address:	admin@company.com		
Email-from address to send event notification.			

Table 2.2 *c*. .. n Warkah nl ~



Email-to Address	ses:		Email-to Address 1:	
Email-to address	es to receive event notification		user1@company.com	
			Email-to Address 2:	
			user2@company.com	
			Email-to Address 3:	
			user3@company.com	
SMTP Server:			smtp.company.com	
Network name of	r IP address of SMTP (Simple Mail			
Transfer Protoco	l) server.			
Syslog Server: (c	optional)		syslog.company.com	
FQDN or IP addre	ess of syslog server.			
SNMP Trap Add	resses: (optional)		SNMP Trap Address 1:	
FQDNs or IP add	resses of SNMP (Simple Network		snmp1.company.com	
Management Pro	otocol) trap.		SNMP Trap Address 2:	
			snmp2.company.com	
			SNMP Trap Address 3:	
			snmp3.company.com	
4. iSCSI Port Cor	nfiguration			
Item			Value	
Onboard iSCSI P	ort IP Addresses:			
IP address, subn	et mask, and gateway of the iSCSI po	orts.		
• Onboard 2 x	10GBASE-T iSCSI (RJ45) ports			
Controller 1	Onboard LAN1	Onboard LAN2		
IP Address	10.10.1.1	10.10.	2.1	
Subnet Mask	255.255.255.0	255.25	55.255.0	
Gateway	10.10.1.254	10.10.	2.254	
Controller 2	Onboard LAN1	Onboard LAN2		
IP Address	10.10.3.1	10.10.	4.1	
Subnet Mask	255.255.255.0	255.255.255.0		
Gateway	10.10.3.254	10.10.4.254		
Slot 1 iSCSI Port	IP Addresses: (optional)			
IP address, subn	et mask, and gateway of the iSCSI po	orts.		
• 2-port 25GbE	iSCSI Host Card (SFP28)			
• 4-port 10GbE	iSCSI Host Card (SFP+)			
• 2-port 1GBAS	SE-T iSCSI Host Card (RJ45)			
• 4-port 1GBAS	SE-T iSCSI Host Card (RJ45)			
1				

## **OSAN**

Controller 1	Slot 1 LAN1	Slot 1 LAN2	Slot 1	LAN3	Slot 1 LAN4
IP Address	10.10.11.1				
Subnet Mask	255.255.255.0				
Gateway	10.10.11.254				
Controller 2	Slot 1 LAN1	Slot 1 LAN2	Slot 1	LAN3	Slot 1 LAN4
IP Address	10.10.21.1				
Subnet Mask	255.255.255.0				
Gateway	10.10.21.254				
Slot 2 iSCSI Port	IP Addresses: (op	tional)			
IP address, subne	et mask, and gatev	vay of the iSCSI po	orts.		
2-port 25GbE	iSCSI Host Card (S	SFP28)			
4-port 10GbE	iSCSI Host Card (S	SFP+)			
2-port 1GBAS	E-T iSCSI Host Ca	rd (RJ45)			
4-port 1GBAS	E-T iSCSI Host Ca	rd (RJ45)			
Controller 1	Slot 2 LAN1	Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4
IP Address	10.10.31.1				
Subnet Mask	255.255.255.0				
Gateway	10.10.31.254				
Controller 2	Slot 2 LAN1	Slot 2 LAN2	Slot 2	LAN3	Slot 2 LAN4
IP Address	10.10.41.1				
Subnet Mask	255.255.255.0				
Gateway	10.10.41.254				
Entity Name:				lqn.2004-	08.com.qsan
The entity name i	s for a device or g	ateway that is			
accessible from t	the network. The m	naximum length of	the		
entity name is 20	0 characters. Valio	d characters are [ a	a∼z∣		
0~9  : ].					
iSNS IP Address: (optional)			10.1.1.1		
IP address of iSN	IS (Internet Storage	e Name Server) se	rver.		
CHAP Username: (optional)		chap1			
CHAP (Challenge	-Handshake Authe	entication Protocol	)		
username. The m	naximum length of	the username is 2	23		
characters. Valid	characters are [ A	~Z a~z 0~9			
~!@#%^&*+= ()	{}[]:;<>.?/ ].				



CHAP Password	: (optional)			1234567	89012	
CHAP password. The length of the password is between12						
to 16 characters. Valid characters are [ $A \sim Z$   $a \sim z$   $0 \sim 9$						
~!@#\$%^&*+=` \(){{[]:;"'<>,.?/ ].						
Mutual CHAP Us	ername: (optional)	)		mutualchap1		
CHAP (Challenge	e-Handshake Authe	entication Protocol	l)			
username. The n	naximum length of	the username is 2	223			
characters. Valid	characters are [ A	~Z a~z 0~9				
~!@#%^&*+= ()	{}[]:;<>.?/ ].					
Mutual CHAP Pa	ssword: (optional)			1234567	123456789012	
CHAP password	. The length of the	password is betwe	een12			
to 16 characters.	. Valid characters a	are [ A~Z   a~z   0~	.9			
~!@#\$%^&*+=`	\(){}[]:;""<>,.?/].					
5. Fibre Channel	Port Configuration	1				
Item				Value		
Slot 1 Fibre Char	nnel: (optional)					
Link speed and to	opology of the fibro	e channel ports.				
Topology suppor	t: FC-AL, point-to-p	oint (16Gb and 32Gb	Fibre			
Channel only suppor	t Point-to-Point topolog	gy)				
<ul> <li>2-port 32Gb I</li> </ul>	Fibre Channel Host	Card (SFP28)				
• 4-port 16Gb I	Fibre Channel Host	Card (SFP+)				
• 2-port 16Gb I	Fibre Channel Host	Card (SFP+)				
Controller 1	Slot 1 FC1	Slot 1 FC2	Slot 1	FC3	Slot 1 FC4	
Link Speed	Auto					
Topology	Point-to-Point					
Controller 2	Slot 1 FC1	Slot 1 FC2	Slot 1	FC3	Slot 1 FC4	
Link Speed	Auto					
Topology	Point-to-Point					
6. Pool Configura	ation					
Item				Value		
Pool Type:				Auto Tier	ing	
Thick Provisionir	ng, Thin Provisionir	ig, or Auto Tiering	(Thin			
Provisioning Ena	bled).					
Pool Name:				PL1		
The maximum le	ngth of the pool na	ame is 16 characte	ers.			
Valid characters	are [ A~Z   a~z   0 <sup>,</sup>	~9  <> ].				

## **OSAN**

Disks:	<b>SSD:</b> 4x 100GB
Disk type, disk quantity, and the capacity.	<b>SAS:</b> 4x 600GB
	NL-SAS: 4x 4TB
RAID Level:	RAID 5
RAID level 0, 1, 3, 5, 6, 0+1, 10, 30, 50, 60, and N-way mirror	
RAID EE level 5EE, 6EE, 50EE, and 60EE	
Raw Capacity:	18.8TB (= 100GB x 4 +
Sum of disk capacity.	600GB x 4 + 4TB x 4)
Estimate Capacity:	14.1TB (= 100GB x 3 +
Estimate capacity according to the RAID level.	600GB x 3 + 4TB x 3)
7. Volume Configuration	
Item	Value
Volume Name:	V1-PL1
The maximum length of the volume name is 32 characters.	
Valid characters are [ A~Z   a~z   0~9  <> ].	
Capacity:	8TB
Required capacity of the volume.	
Volume Type:	RAID Volume
RAID Volume or Backup Volume	
TAID Volume of Dackup Volume	
8. LUN Mapping Configuration	
8. LUN Mapping Configuration Item	Value
8. LUN Mapping Configuration Item Protocol:	Value iSCSI
8. LUN Mapping Configuration Item Protocol: iSCSI or FCP.	Value iSCSI
8. LUN Mapping Configuration Item Protocol: iSCSI or FCP. Volume Name:	Value iSCSI V1-PL1
8. LUN Mapping Configuration Item Protocol: iSCSI or FCP. Volume Name: Select one of created volumes.	Value iSCSI V1-PL1
8. LUN Mapping Configuration Item Protocol: iSCSI or FCP. Volume Name: Select one of created volumes. Allowed Hosts:	Value iSCSI V1-PL1 *
8. LUN Mapping Configuration     Item     Protocol:     iSCSI or FCP.     Volume Name:     Select one of created volumes.     Allowed Hosts:     iSCSI IQN or Fibre Channel WWNN for access control.	Value iSCSI V1-PL1 *
8. LUN Mapping Configuration         Item         Protocol:         iSCSI or FCP.         Volume Name:         Select one of created volumes.         Allowed Hosts:         iSCSI IQN or Fibre Channel WWNN for access control.         Wildcard (*) for access by all hosts.	Value iSCSI V1-PL1 *
8. LUN Mapping Configuration         Item         Protocol:         iSCSI or FCP.         Volume Name:         Select one of created volumes.         Allowed Hosts:         iSCSI IQN or Fibre Channel WWNN for access control.         Wildcard (*) for access by all hosts.         Target:	Value iSCSI V1-PL1 *
8. LUN Mapping Configuration         Item         Protocol:         iSCSI or FCP.         Volume Name:         Select one of created volumes.         Allowed Hosts:         iSCSI IQN or Fibre Channel WWNN for access control.         Wildcard (*) for access by all hosts.         Target:         iSCSI Target or Fibre Channel Target	Value iSCSI V1-PL1 *
8. LUN Mapping Configuration         Item         Protocol:         iSCSI or FCP.         Volume Name:         Select one of created volumes.         Allowed Hosts:         iSCSI IQN or Fibre Channel WWNN for access control.         Wildcard (*) for access by all hosts.         Target:         iSCSI Target or Fibre Channel Target         LUN:	Value iSCSI V1-PL1 * 0 LUN 0
8. LUN Mapping Configuration         Item         Protocol:         iSCSI or FCP.         Volume Name:         Select one of created volumes.         Allowed Hosts:         iSCSI IQN or Fibre Channel WWNN for access control.         Wildcard (*) for access by all hosts.         Target:         iSCSI Target or Fibre Channel Target         LUN:         Support LUN (Logical Unit Number) from 0 to 255.	Value iSCSI V1-PL1 * 0 LUN 0
8. LUN Mapping Configuration         Item         Protocol:         iSCSI or FCP.         Volume Name:         Select one of created volumes.         Allowed Hosts:         iSCSI IQN or Fibre Channel WWNN for access control.         Wildcard (*) for access by all hosts.         Target:         iSCSI Target or Fibre Channel Target         LUN:         Support LUN (Logical Unit Number) from 0 to 255.         Permission:	Value iSCSI V1-PL1 * 0 LUN 0 Read-write
8. LUN Mapping Configuration         Item         Protocol:         iSCSI or FCP.         Volume Name:         Select one of created volumes.         Allowed Hosts:         iSCSI IQN or Fibre Channel WWNN for access control.         Wildcard (*) for access by all hosts.         Target:         iSCSI Target or Fibre Channel Target         LUN:         Support LUN (Logical Unit Number) from 0 to 255.         Permission:         Read-only or Read-write.	Value iSCSI V1-PL1 * 0 LUN 0 Read-write
8. LUN Mapping Configuration         Item         Protocol:         iSCSI or FCP.         Volume Name:         Select one of created volumes.         Allowed Hosts:         iSCSI IQN or Fibre Channel WWNN for access control.         Wildcard (*) for access by all hosts.         Target:         iSCSI Target or Fibre Channel Target         LUN:         Support LUN (Logical Unit Number) from 0 to 255.         Permission:         Read-only or Read-write.	Value         iSCSI         V1-PL1         *         0         LUN 0         Read-write
8. LUN Mapping Configuration         Item         Protocol:         iSCSI or FCP.         Volume Name:         Select one of created volumes.         Allowed Hosts:         iSCSI IQN or Fibre Channel WWNN for access control.         Wildcard (*) for access by all hosts.         Target:         iSCSI Target or Fibre Channel Target         LUN:         Support LUN (Logical Unit Number) from 0 to 255.         Permission:         Read-only or Read-write.	Value         iSCSI         V1-PL1         *         0         LUN 0         Read-write



9. SSD Cache Configuration		
Item	Value	
SSD Cache Pool Name:	SCPL1	
The maximum length of the pool name is 16 characters.		
Valid characters are [ $A \sim Z   a \sim z   0 \sim 9   - <>$ ].		
Cache Type:	Read Cache	
Read Cache (NRAID+) or Read-write Cache (RAID 1 or		
NRAID 1+).		
І/О Туре:	Database	
Database, File System, or Web Service.		
SSDs:	<b>SSD:</b> 2x 400GB	
SSD quantity and the capacity.		
Raw Capacity:	800GB	
Sum of disk capacity.		
10. Snapshot Configuration		
Item	Value	
Volume Name:	V1-PL1	
Select one of created volumes.		
Snapshot Space:	1.6TB	
Reserved snapshot space for the volume.		
Snapshot Name:	Snap-V1-PL1	
The maximum length of the snapshot name is 32		
characters. Valid characters are [ A~Z   a~z   0~9  <> ].		
Schedule Snapshots: (optional)	Daily 00:00	
Define the cycle of snapshots.		
11. Local Clone Configuration		
Item	Value	
Source Volume Name:	V1-PL1	
Select one of created volume for source.		
Source Volume Capacity:	8TB	
Check the capacity of source volume.		
Target Volume Name:	T1-PL1	
Select one of created volume for target.		
Target Volume Capacity:	8TB	
Check the capacity of target volume.		
Schedule Local Clones: (optional)	Daily 01:00	
Define the cycle of local clones.		



12. Remote Replication Configuration				
Item			Value	
Source Volume	Name:		V1-PL1	
Select one of cre	eated volume for source.			
Source Volume	Capacity:		8TB	
Check the capac	ity of source volume.			
Source iSCSI Po	rt:		Auto	
iSCSI port of sou	rce unit. It can be auto or dedicated	iSCSI		
port.				
Target iSCSI Por	rt IP Addresses:			
iSCSI port IP add	lresses of target unit.			
Target	Controller 1	Control	ller 2 (optional)	
IP Address	10.10.100.1	10.10.1	01.1	
Target CHAP Us	ername: (optional)		chap2	
CHAP username	. The maximum length of the userna	ame is		
223 characters.	Valid characters are [ A~Z   a~z   0~	9		
~!@#%^&*+= ()	o{}[]:;<>.?/ ].			
Target CHAP Pa	ssword: (optional)		123456789012	
CHAP password	. The length of the password is betw	/een 12		
to 16 characters. Valid characters are [ A~Z   a~z   0~9				
~!@#\$%^&*+=`	\(){}[]:;"'<>,.?/].			
Target Volume Name:			RT1-PL1	
Select one of cre	eated volume for target.			
Target Volume Capacity:			8TB	
Check the capacity of target volume.				
Schedule Remote Replications: (optional)			Daily 02:00	
Define the cycle of remote replications.				
Traffic Shaping for Peak Hour: (optional)			100MB	
Limit the transfer rate at peak hour.				
Traffic Shaping for Off-peak Hour: (optional)			200MB	
Limit the transfer rate at off-peak hour.				
Off-peak Hour: (optional)			Mon. ~ Fri. PM10:00 ~	
Define the off-peak hours.			AM06:59	
			Sat. ~ Sun. AM00:00 ~	
			PM23:59	

## **C**SAN

## 3. Getting Started

After completing the configuration planning, it's time to power on the system, find your system and log into SANOS (SAN operating system). This chapter explains how to discover the SAN storage system and how to sign into SANOS.

## 3.1. Power on the Storage System

Before you power on the system, we assume that you have followed the following hardware installation document to finish the hardware installation.

- XCubeSAN QIG (Quick Installation Guide)
- XCubeSAN Hardware Manual



#### TIP:

Please double check all the cables (including power cords, Ethernet, fibre channel, and SAS cables) are connected properly, especially network cable connects to the management port. If everything is ready, now you can power on the system.

## 3.2. Discover the SAN Storage System

The default setting for the management IP address is DHCP. For users who are going to install at the first time, we provide the QFinder Java utility to search for QSAN products on the network and aid quick access to the login page of the SANOS web interface.

### 3.2.1. QFinder Utility

QFinder utility provides to search QSAN products on LAN. You can discover the management IP addresses of the storage systems via this utility. Please download QFinder utility from the following website.

https://qsan.com/QFinder



In addition, QFinder is a java based program. It is also a highly portable utility. To execute this program, JRE (Java Runtime Environment) is required. You can visit the following websites to download and install JRE.

http://www.java.com/en/download/

After JRE is installed, run the **QFinder.jar** program. The SAN storage system in your network will be detected and listed in the table.

Func	ction Icons	Information Area	
OFinder			
C (i) (Rescan About	(E) Exit		<b>C</b> SAN
IP Address	NIC System Name	Model Name Firmward	e Ver. 🛛 MAC Address 🔺
192.168.30.234 I	Mgmt XS5216-D40000	XS5216 1.0.0	00:13:78:D4:00:00
1 system found		2016/-	10/14 15:42:04

Figure 3-1 QFinder Utility

Take an example in Figure 3-1, the default setting of the management port IP address is gotten from the DHCP server, e.g., 192.168.30.234. The default system name is the model name plus the last 6 digits of serial number, e.g., XS5216-D40000. Double clicking the selected entry will automatically bring up the browser and display the login page.





#### **INFORMATION:**

QFinder utility works in the following network environments:

- Both the management port of the SAN storage system and the management computer are both on the same subnet domain of the LAN.
- The LAN works with or without DHCP server.
- If the LAN doesn't have a DHCP server, it still can work on zeroconfiguration networking. The management port will be assigned a fix IP address: 169.254.1.234/16. So you can configure the IP address of your management computer to the same subnet domain of the storage system, e.g.: 169.254.1.1/16. Then open a browser and enter <u>http://169.254.1.234</u> to go into the login page. For more information about zero configuration, please refer to: <u>https://en.wikipedia.org/wiki/Zero-configuration\_networking</u>

## 3.3. Initial Setup

The Initial configuration wizard will guide the first time user to initialize and setup the system quickly. After discovering the storage system, please follow the steps to complete the initial configuration.

	De	fault System Name
Welco	ome to <b>(</b> \$5216-D	40000
Username:	admin	
Password:	••••	
English	Y	Login

Figure 3-2 Login Page of web UI

1. To access the SANOS web interface, you have to enter a username and password. The initial defaults for administrator login are:



- Username: admin
- Password: 1234



#### TIP:

For existing users who are experienced, the Initial configuration wizard will not be shown again when you login next time, unless the system is **Reset to Defaults**. You may skip this section to start the operations of web UI in next chapter.

You can execute **Reset to Defaults** function in **SYSTEM SETTINGS** -> **Maintenance** -> **Reset to Defaults**. Please refer to the chapter 6.5.5, <u>Reset to Factory Default</u> section for more details.

Initial Configuration			
System Setup	System Name		
Network Setup	System Name :	XCubeSAN_SANOS	0
Summary	Admin Password		
	New Password :		0
	Confirm New Password :		
	Date and Time		
	Keep Current Time :	2017/3/28 15:49:37	
	Manual Setting :		
	Synchronize with a NTP (N	letwork Protocol Time) server automatically :	
	NTP Server :	0.pool.ntp.org	
	Time Zone		
	Time Zone :	(GMT+08:00) Taipei	*
			Next

Figure 3-3 Initial Configuration Step 1

Enter a System Name, for security reason, it's highly recommended to change system name. The maximum length of the system name is 32 characters. Valid characters are [A~Z | a~z | 0~9 | -\_].



- 3. Change **Admin Password**, The maximum length of the password is 12 characters. Valid characters are [ A~Z | a~z | 0~9 | ~!@#\$%^&\*\_-+=`|\(){[]:;"'<>,.?/].
- 4. Set the local **Date and Time**. Date and time can be set by manually or synchronized with a NTP (Network Time Protocol) server.
- 5. Select a **Time Zone** depending on your location.
- 6. Click the **Next** button to proceed.

Initial Configuration	
System Setup	Management Port IP Address on Controller 1
Network Setup	O DHCP
Summary	O BOOTP
,	Static IP Address
	IP Address : 192.168.1.234
	Subnet Mask : 255.255.255.0
	Gateway : 192.168.1.254
	DNS Server Address
	notification services need DNS setting.
	Obtain DNS server address automatically
	• User the following DNS server addresses
	Preferred DNS Server : 8.8.8.8
	Back Next

Figure 3-4 Initial Configuration Step 2

7. Assign an IP address for the management port by **DHCP**, **BOOTP**, or **Static IP Address**.

# **C**SAN



#### **INFORMATION:**

**DHCP:** The Dynamic Host Configuration Protocol is a standardized network protocol used on IP (Internet Protocol) networks for dynamically distributing network configuration parameters, such as IP addresses for interfaces and services. With DHCP, computers request IP addresses and networking parameters automatically from a DHCP server, reducing the need for a network administrator or a user to configure these settings manually.

**BOOTP:** Similar to DHCP, the Bootstrap Protocol is also a computer networking protocol used in Internet Protocol networks to automatically assign an IP address to network devices from a configuration server. While some parts of BOOTP have been effectively superseded by the DHCP, which adds the feature of leases, parts of BOOTP are used to provide service to the DHCP protocol. DHCP servers also provide legacy BOOTP functionality.

- Assign a DNS Server Address. DNS (Domain Name System) provides a means to translate FQDN (Fully Qualified Domain Name) to IP address. Some notification services require DNS settings.
- 9. Click **Next** button to proceed.



Initial Configuration		
System Setup	System Setup	
Network Setup	System Name	XCubeSAN_SANOS
Summary	Date and Time	Synchronize with a NTP
	Time Zone	(GMT+08:00) Taipei
	Network Setup	
	Management Port Type	Static
	IP Address	192.168.1.234
	Subnet Mask	255.255.255.0
	Gateway	192.168.1.254
	DNS Server Address	
	DNS Server	8.8.8.8
	Please click Finish button to ta	ke effect, and then login as new IP address of management port and new admin password.
		Back Finish

Figure 3-5 Initial Configuration Step 3

10. Verify all items, and then click the **Finish** button to complete the initial configuration. You have to login with the new IP address of the management port and new admin password next time.



## 4. SANOS User Interface

This chapter illustrates the web user interface of SANOS and provides a brief introduction to the SANOS 4.0 desktop function menus.

## 4.1. Accessing the Management Web UI

To access the management web user interface, open a supported web browser and enter the management IP address or Hostname of the system. The login panel is displayed, as shown in Figure 4-1.

Welcome to XCubeSAN_SANOS		
Username:	admin	
Password:	•••••	
English	Y	Login

Figure 4-1 Login Page of web UI

To access the web user interface, you have to enter a username and password.

- Username: admin
- Password: <Your Password>



#### **INFORMATION:**

Supported web browsers:

- Google Chrome 45 or later.
- Mozilla Firefox 45 or later.
- Microsoft Internet Explorer 10 or later.
- Apple Safari 8 or later.



## 4.2. SANOS 4.0 Desktop Panel

When the password has been verified, the home page is displayed. As shown in Figure 4-2, the SANOS 4.0 desktop panel has three main sections:

- Function Menus and Submenus
- Function Tabs
- Main Working Area

	Functio	on Tabs			Main Worl	king Area	
	/				1		
SAN SANOS 4.0							
DASHBOARD Dashboard Hardware Monitoring	Dashboard System Information			Performance	+		
SYSTEM SETTINGS General Settings Management Port Power Settings Notifications Maintenance Disk Enryption HOST CONNECTIVITY Overview ISCSI Ports Fibre Channel Ports	X85216	Item System Name Model Name Backglane ID System Serial Number Firmware Version System Controller Status System Health	Information XSS216-640000 XSS216 QVX36 QVX3601600021001 1.2.0 Daal Controller, Active-Active Good	More	System Throughput 2 5	20 20 20 20 20 20 20 20 20 20	
STORAGE MANAGEMENT Disks Pools Volumes	Storage View	UBb Secolute Local Class	n Durate Decimitary	Event Logs	Tee	Control	
LUN Mappings SSD Cache	16 2 2	1 0 0	0	Information	Sun, 18 Sep 2016 11:09:30 Sun, 18 Sep 2016 11:09:30	[CTR1] Virtual disk Vol-1' has started initialization. [CTR1] Virtual disk Vol-1' finished arrains process	
DATA BACKUP Snapshots	Click a pool name to show m	ore information.		Information	Sun, 18 Sep 2016 11:09:30 Sun, 18 Sep 2016 11:09:30	[CTR1] Virtual disk Vol-1 Instando examp process. [CTR1] Virtual disk Vol-1' started erasing process. [CTR1] Virtual disk Vol-1' has been created	
Remote Replications VIRTUALIZATION VMware Microsoft Citrix	Pool Name Health Pool-1 Good Pool-2 Good	Total         Percentag           3.64 TB         10.92 TB	pe Used	Information	Sun, 18 Sep 2016 11:09:07	[CTR1] RAID group 'Pool-1' has been created.	
MONITORING							Mor

#### Figure 4-2 SANOS 4.0 Desktop Panel

All function menus are listed at the left side of the window. They are grouping by function icon and uppercase letter such as **DASHBOARD**, **SYSTEM SETTINGS** ...etc. The following is the second level function submenus such as **General Settings**, **Management Port** ...etc. This provides an efficient and quick mechanism for navigation.

Click a second level function submenu will appear the related user interface in main working area. Some function submenus have their sub functions and display at the top of function tabs. You may see all functions in Table 4-1.

The top-right corner displays a **Logout** button.





TIP:

For security reasons, always logout when you finish working in SANOS.

## 4.3. Function Menus

The following table shows all function menus and their function tabs for reference.

Table 4-	1 SANOS 4.0 Function Menu	IS
	Function Menus	Function Tabs
aid)	DASHBOARD	
	Dashboard	Dashboard
	Hardware Monitoring	Hardware Monitoring
()	SYSTEM SETTING	
	General Settings	General Settings
	Management Port	Management Port
	Power Settings	Boot Management   Cache to Flash   UPS
	Notifications	Email   Alert   SNMP
	Maintenance	System Information   Update   Firmware
		Synchronization   System Identification   Reset
		to Defaults   Configuration Backup   Volume
		Restoration   Reboot and Shutdown
	Disk Encryption	Authentication Key   SEDs
۲	HOST CONNECTIVITY	
	Overview	Overview
	iSCSI Ports	iSCSI Ports   iSCSI Settings   iSCSI Targets
		CHAP Accounts   Active Sessions
	Fibre Channel Ports	Fibre Channel Ports
8	STORAGE MANAGEMENT	
	Disks	Disks   Disk Settings
	Pools	Pools   Auto Tiering



	volumes	Volumes   QoS Settings   QoS Volumes
	LUN Mappings	LUN Mappings
	SSD Cache	SSD Cache Pools   SSD Cache Statistics
0	DATA BACKUP	
	Snapshots	Snapshots
	Remote Replications	Remote Replications
	VIRTUALIZATION	
	VMware	VMware
	Microsoft	Hyper-V
	Citrix	Citrix
4~	MONITORING	
	Log Center	Event Logs
	Enclosures	Hardware Monitoring   SES
	Performance	Disk   Volume   iSCSI   Fibre Channel

The following describes a brief introduction of desktop function menus.

### 4.3.1. Dashboard Menu

The **DASHBOARD** menu provides access to function menus of Dashboard and Hardware Monitoring.

#### Dashboard

Select **Dashboard** function menu provides summary of the overall system. For more information, please refer to the chapter 5.1, <u>Dashboard</u> section in the Dashboard chapter.

#### Hardware Monitoring

Select **Hardware Monitoring** function menu provides summary enclosure information. For more information, please refer to the chapter 5.2, <u>Hardware Monitoring</u> section in the Dashboard chapter.



### 4.3.2. System Settings Menu

The **SYSTEM SETTINGS** menu provides access to function menus of General, Management Port, Power, Notification, and Maintenance.

#### **General Settings**

Select **General Settings** function menu to setup general system settings. For more information, please refer to the chapter 6.1, <u>General System Settings</u> section in the System Settings chapter.

#### **Management Port**

Select **Management Port** function menu to setup IP address and DNS settings of management port. For more information, please refer to the chapter 6.2, <u>Management Port</u> <u>Settings</u> section in the System Settings chapter.

#### **Power Settings**

Select **Power Settings** function menu to setup boot management which includes auto shutdown, wake on LAN, and wake on SAS ...etc., view the status of cache to flash, and setup UPS for power outage. For more information, please refer to the chapter 6.3, <u>Power</u> <u>Settings</u> section in the System Settings chapter.

#### Notifications

Select **Notifications** function menu to setup notification settings of email, syslog, popup alert, LCM alert, and SNMP trap. For more information, please refer to the chapter 6.4, <u>Notification Settings</u> section in the System Settings chapter.

#### Maintenance

Select **Maintenance** function menu to view system information, update system firmware and check firmware synchronization, system identification, reset to system defaults, import and export configuration files, restore volumes if an accidental delete occurs, reboot and shutdown. For more information, please refer to the chapter 6.5, <u>Maintenance</u> section in the System Settings chapter.

#### **Disk Encryption**

Select **Disk Encryption** function menu to setup the authentication key and configure SEDs. For more information, please refer to the chapter 14, <u>SED and ISE Support</u> chapter.



### 4.3.3. Host Configuration Menu

The **HOST CONFIGURATION** menu provides access to function menus of Overview, iSCSI Port, and Fibre Channel Ports which is visible when fibre channel host cards are installed.

#### Overview

Select **Overview** function menu to view all host connectivity which includes status and settings of all host cards. For more information, please refer to the chapter 7.2, <u>Host</u> <u>Connectivity Overview</u> section in the Host Configuration chapter.

#### **iSCSI** Ports

Select **iSCSI Ports** function menu to setup iSCSI port settings, including iSCSI port IP address, link aggregation, VLAN ID, jumbo frame, iSNS server, iSCSI targets, CHAP accounts, and view iSCSI active sessions. For more information, please refer to the chapter 7.3, <u>Configure for iSCSI Connectivity</u> section in the Host Configuration chapter.

#### **Fibre Channel Ports**

Select **Fibre Channel** function menu to setup fibre channel port settings, including link speed, topology, target configuration, and clear counters of fibre channel statistics. For more information, please refer to the chapter 7.4, <u>Configure for Fibre Channel Connectivity</u> section in the Host Configuration chapter.

### 4.3.4. Storage Management Menu

The **STORAGE MANAGEMENT** menu provides access to function menus of Disks, Pools, Volumes, and Mappings.

#### Disks

Select **Disks** function menu to view status of disk drives and S.M.A.R.T. (Self-Monitoring Analysis and Reporting Technology) information. For more information, please refer to the chapter 8.3, <u>Working with Disk Drives</u> section in the Storage Management chapter.

#### Pools

Select **Pools** function menu to configure storage pools. For more information, please refer to the chapter 8.4, <u>Configuring Thick Provisioning Pools</u> section in the Storage Management

## **OSAN**

chapter, chapter 9.3, <u>Configuring Thin Provisioning Pools</u> section in the Thin Provisioning chapter, chapter 11.3, <u>Configuring Auto Tiering Pools</u> section in the Auto Tiering chapter.

#### Volumes

Select **Volumes** function menu to configure volumes, manage clone tasks, and configure QoS (Quality of Service). For more information, please refer to the chapter 8.5, <u>Configuring</u> <u>Volumes</u> section in the Storage Management chapter, the chapter 12.2, <u>Managing Local</u> <u>Clones</u> section in the Data Backup chapter, and the chapter 15, <u>QoS (Quality of Service)</u> chapter.

#### **LUN Mappings**

Select **LUN Mappings** function menu to configure LUN mappings. For more information, please refer to the chapter 8.6, <u>Configuring LUN Mappings</u> section in the Storage Management chapter.

#### SSD Cache

Select **SSD Cache** function menu to configure SSD cache pools. For more information, please refer to the chapter 10.3, <u>Configuring SSD Cache</u> section in SSD Cache chapter.

### 4.3.5. Data Backup Menu

The **DATA BACKUP** menu provides access to function menus of Snapshots and Replications.

#### Snapshots

Select **Snapshots** function menu to manage snapshots, including setting up snapshot space, taking snapshots, rollback to a snapshot, and scheduling snapshots. For more information, please refer to the chapter 12.1, <u>Managing Snapshots</u> section in the Data Backup chapter.

#### Replications

Select **Replications** function menu to manage remote replications, including setup replication tasks, schedule replication tasks, configure shaping settings. For more information, please refer to the chapter 12.3, <u>Managing Remote Replications</u> section in the Data Backup chapter.



### 4.3.6. Virtualization Menu

The **VIRTUALIZATION** menu provides access to function menus of VMware, Microsoft, and Citrix.

#### VMware

Provide information of supported VMware integration of storage, such as VAAI (VMware vSphere Storage APIs for Array Integration).

#### Microsoft

Provide information of supported Microsoft Windows feature of storage, such as ODX (Offloaded Data Transfer).

#### Citrix

Provide information of Citrix XenServer platform and its compatible version.

### 4.3.7. Monitoring Menu

The **MONITORING** menu provides access to function menus of Log Center, Enclosure, and Performance.

#### Log Center

Select **Log Center** function menu to view event logs, download event logs, or clear event logs. Also mute buzzer if system happens alerts. For more information, please refer to the chapter 13.1, <u>Log Center</u> section in the Monitoring chapter.

#### Enclosures

Select **Enclosures** function menu to view hardware monitor status and enable SES (SCSI Enclosure Services). For more information, please refer to the chapter 13.2, <u>Hardware Monitor</u> section in the Monitoring chapter.

#### Performance

Select **Performance** function menu to view system performance. For more information, please refer to the chapter 13.3, <u>Performance Monitor</u> section in the Monitoring chapter.

## **OSAN**

## 4.4. Accessing the Management USB LCM

Optionally, we provide a portable USB LCM (LCD Control Module) for simple management. To access the management USB LCM, plug it into the USB port of the right ear in the front panel.



Figure 4-3 Portable USB LCM



#### INFORMATION:

For the USB port in front panel, please refer to the chapter 2, System Components Overview in the <u>XCubeSAN Hardware Manual</u>.

After plugging the USB LCM into the system, the LCD screen shows the management port IP address and the system model name.

```
192.168.1.234
QSAN XS5216D ←
```

Figure 4-4 USB LCM Screen

To access the LCM options, use the **ENT** (Enter) button, **ESC** (Escape) button,  $\blacktriangle$  (up) and  $\checkmark$  (down) to scroll through the functions. **MUTE** button to mute the buzzer when the system alarms. If there are event logs occurred, events will be displayed on the first line of the LCM.



**TIP:** The event alert settings can be chan

The event alert settings can be changed, please refer to the chapter 6.4.2, <u>Allert Settings</u> section in the System Settings chapter.

This table describes the function of each item.


Table 4-2 USB	LCM Function List
Function	Description
System Info.	Display system information including firmware version and memory
	size.
Reset/Shutdown	Reset or shutdown the system.
View IP Setting	Display current IP address, subnet mask, and gateway.
Change IP	Set IP address, subnet mask, and gateway. There are three options of
Config	DHCP, BOOTP, or static IP address.
Enc.	Show the enclosure data of disk drive temperature, fan status, and
Management	power supply status.
Reset to Default	Reset the system to default settings. The default settings are:
	Reset Management Port IP address to DHCP, and then fix IP
	address: 169.254.1.234/16.
	Reset admin's <b>Password</b> to 1234.
	• Reset <b>System Name</b> to model name plus the last 6 digits of serial
	number. For example: XS5216-123456.
	<ul> <li>Reset IP addresses of all iSCSI Ports to 192.168.1.1,</li> </ul>
	192.168.2.1, etc.
	<ul> <li>Reset link speed of all Fibre Channel Ports to Automatic.</li> </ul>
	Clear all access control settings of the host connectivity.



### **INFORMATION:**

**DHCP:** The Dynamic Host Configuration Protocol is a standardized network protocol used on IP (Internet Protocol) networks for dynamically distributing network configuration parameters, such as IP addresses for interfaces and services. With DHCP, computers request IP addresses and networking parameters automatically from a DHCP server, reducing the need for a network administrator or a user to configure these settings manually.

**BOOTP:** Similar to DHCP, the Bootstrap Protocol is also a computer networking protocol used in Internet Protocol networks to automatically assign an IP address to network devices from a configuration server. While some parts of BOOTP have been effectively superseded by the DHCP, which adds the feature of leases, parts of BOOTP are used to provide service to the DHCP protocol. DHCP servers also provide legacy BOOTP functionality.



This table displays the LCM menu hierarchy for your reference when you operate USB LCM.

Menu	L1	L2	L3	L4
<ip addr=""></ip>	System Info.	Firmware Version		
QSAN <model></model>		<n.n.n></n.n.n>		
▲ ▼		RAM Size <nnnn></nnnn>		
		MB		
		▲Yes No▼		
	Reset /	Reset	▲Yes No▼	
	Shutdown	Shutdown	▲Yes No▼	
	View IP Setting	IP Config		
		<static <="" ip="" td=""><td></td><td></td></static>		
		DHCP / BOOTP>		
		IP Address		
		<192.168.001.234>		
		IP Subnet Mask		
		<255.255.255.0>		
		IP Gateway		
		<xxx.xxx.xxx.< td=""><td></td><td></td></xxx.xxx.xxx.<>		
	Change IP	DHCP		
	Config	BOOTP		
		Static IP	IP Address	Adjust IP
				address
			IP Subnet	Adjust
			Mask	Submask IP
			IP Gateway	Adjust
				Gateway IP
			Apply IP	▲Yes No▼
			Setting	
	Enc.	Phy. Disk Temp.	Local	
	Management		Slot <n>: <nn></nn></n>	
			(C)	
		Cooling	Local	
			FAN <n>:</n>	
			<nnnnn> RPM</nnnnn>	
		Power Supply	Local	

Table 4-3USB LCM Menu Hierarchy



		PSU <n>:</n>	
		<status></status>	
Reset to	≜Yes No▼		
Default			



## 5. Dashboard

The **DASHBOARD** function menu provides submenus of **Dashboard** and **Hardware Monitoring**. These pages may help user to quickly view the basic information and system health.

## 5.1. Dashboard

Select the **Dashboard** function submenu to show summary of overall system. It's divided into four blocks in the main working area. There are system information, storage view, performance, and event logs.

		Dashboard	
άŭ.	DASHBOAR	D	
-	Dashboard		
	Hardware N	lonitoring	
Figu	re 5-1	Dashboard Fun	ction Submenu

System Information Performance Information Item System Throughput System IOPS System Name XS5216-D40000 Model Name XS5216 Backplane ID OW316 System Serial Numbe QW3160160I0021001 Firmware Version 1.2.0 XS5216 Dual Controller, Active-Active System Controller Status System Health Good Storage View Event Logs Type Information Information Disks Pools Volumes LUNs Snapshots Local Clones Remote Replications Time Content 16 18 Sep 2016 11:09:3 [CTR1] Virtual disk Vol-1' has started initialization. [CTR1] Virtual disk Vol-1' finished erasing process. Sun. 18 Sep 2016 11:09:30 Information Sun, 18 Sep 2016 11:09:30 [CTR1] Virtual disk 'Vol-1' started erasing process Click a pool name to show more information [CTR1] Virtual disk Vol-1' has been created. Information Sun, 18 Sep 2016 11:09:30

Sun, 18 Sep 2016 11:09:07

Informatio

[CTR1] RAID group 'Pool-1' has been creat



Total

3.64 TB

10.92 TB

Pool Name

Pool-1

Pool-2

Health

Good

Good

52 © Copyright 2020 QSAN Technology, Inc. All Right Reserved.

tage Us



## **System Information**

The system information block displays the basic information of the system. In addition, clicking More... will pop up a window for more details.

System Information			
	Item	Information	
	System Name	XS5216-D40000	
	Model Name	XS5216	
The base is a second with the second with t	Backplane ID	QW316	
ا بسطها به به به به به به ا	System Serial Number	QW316016010021001	
¥05240	Firmware Version	1.2.0	
XS5216	System Controller Status	Dual Controller, Active-Active	
	System Health	Good	
			More

Figure 5-3 System Information Block in the Dashboard

This table shows the column descriptions.

Column Name	Description
System	The status of system availability:
Availability	Dual Controller, Active/Active: Dual controllers and expansion
Status	units are in normal stage.
	Dual Controller, Degraded: In dual controller mode, one controller
	or one of expansion unit fails or they have been plugged out.
	Please replace or insert a good controller.
	Dual Controller, Lockdown: In dual controller mode, the
	configurations of two controllers are different, including the
	memory capacity, host cards, and controller firmware version.
	Please check the hardware configurations of two controllers or
	execute firmware synchronization.
	Single Controller: Single controller mode.
System Health	The status of system health:
	Good: The system is good.
	• Fan Fault: A fan module has failed or is no longer connected.
	• <b>PSU Fault</b> : A power supply has failed or is no longer connected.

 Table 5-1
 System Information Block Descriptions



٠	Temperature Fault: Temperature is abnormal.
•	Voltage Fault: Voltage values are out of range.
•	UPS Fault: UPS connection has failed.

Clicking More... will pop up a window of system information details.

ystem Information	
System	
ltem	Information
System Name	SANOSecc
Model Name	XS5216
System Serial Number	QW316016010021001
System Controller Status	Dual Controller, Active-Active
Master Controller	Controller 1
Controller 1	·
Item	Information
Controller Serial Number	50013780080A0440
CPU	Intel(R) Xeon(R) Processor D-1500 4 Cores
Memory	8 GB
Host Card Slot 1	Empty
Host Card Slot 2	Empty
Firmware Version	1.0.0
SAS IOC Firmware Version	15.00.00.00
SAS Expander Firmware Version	1000
Controller 2	
ltem	Information
Controller Serial Number	50013780080A0380
CPU	Intel(R) Xeon(R) Processor D-1500 8 Cores
	8 GB
Memory	0.00
Memory Host Card Slot 1	Empty

Figure 5-4 System Information Popup Window

Click the **Close** button to exit the window.



## **Storage View**

The storage view block displays the basic information of storage. In addition, clicking pool column will pop up a window for more details.

torage V	/iew					
Disks	Pools	Volumes	LUNs	Snapshots	Local Clones	Remote Replications
16	2	2	1	0	0	0
Click a Pool Na	i pool nam ame	e to show m Health	nore infor	mation.	Percentage U	lsed
Pool-1		Good	3.6	4 TB		
Pool-2		Good	10.	92 TB		

Figure 5-5 System View Block in the Dashboard

The top table displays sum of disks, pools, volumes, LUN mappings, snapshots, clones, and remote replications in system. The following table displays all created pools and its basic information.

Table 5-2 Stora	age View Block Descriptions
Column Name	Description
Name	Pool name.
Health	The health of the pool:
	• Good: The pool is good.
	• Failed: The pool has failed.
	• Degraded: The pool is not healthy and not completed. The reason
	could be lack of disk(s) or have failed disk.
Total	Total capacity of the pool.
Percentage Used	Mouse over the Blue block will display the percentage of used. And
	the Gray block will display the percentage of available.

able 5-2	Storage View Block Descriptions
	otorage them brook becomptione

Click any one of the pool names such as Pool-1 in Figure 5-4 will pop up the detailed pool information.

Pool Name: Pool-2         Volumes         Name       Health       Capacity       Snapshot Space       Snapshots         Vol-2       Optimal       100.00 GB       0 MB / 0 MB       0         Disk Groups         No.       Status       Health       Total       Free       Tier Level       Disk Used       Location (Enclosure ID:Slot)         1       Online       Good       10.92 TB       10.92 TB       NL-SAS       3       0:13, 0:14, 0:15         Disks       Enclosure ID       Slot       Status       Health       Capacity       Disk Type       Manufacturer       Model         0       13       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034         0       14       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034		maton								
Name       Health       Capacity       Snapshot Space       Snapshots         Vol-2       Optimal       100.00 GB       0 MB / 0 MB       0         Disk Groups       Disk Groups       Free       Tier Level       Disk Used       Location (Enclosure ID:Slot)         1       Online       Good       10.92 TB       10.92 TB       NL-SAS       3       0:13, 0:14, 0:15         Disks       Enclosure ID       Slot       Status       Health       Capacity       Disk Type       Manufacturer       Model         0       13       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034         0       14       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034	Pool Nar	me: Pool	-2							
Name       Health       Capacity       Snapshot Space       Snapshots         Vol-2       Optimal       100.00 GB       0 MB / 0 MB       0         Disk Groups       Oline       Good       10.92 TB       Tier Level       Disk Used       Location (Enclosure ID:Slot)         1       Online       Good       10.92 TB       10.92 TB       NL-SAS       3       0:13, 0:14, 0:15         Disks       Enclosure ID       Slot       Status       Health       Capacity       Disk Type       Manufacturer       Model         0       13       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034         0       14       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034	Volume	es								
Vol-2       Optimal       100.00 GB       0 MB / 0 MB       0         Disk Groups       Disk Groups       Disk Used       Location (Enclosure ID:Slot)         No.       Status       Health       Total       Free       Tier Level       Disk Used       Location (Enclosure ID:Slot)         1       Online       Good       10.92 TB       10.92 TB       NL-SAS       3       0:13, 0:14, 0:15         Disks       Enclosure ID       Slot       Status       Health       Capacity       Disk Type       Manufacturer       Model         0       13       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034         0       14       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034	Name	Healt	h Ca	apacity	Snaps	hot Space	Snapshots			
Disk Groups         No.       Status       Health       Total       Free       Tier Level       Disk Used       Location (Enclosure ID:Slot)         1       Online       Good       10.92 TB       10.92 TB       NL-SAS       3       0:13, 0:14, 0:15         Disks         Enclosure ID       Slot       Status       Health       Capacity       Disk Type       Manufacturer       Model         0       13       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034         0       14       Online       Good       5.46 TB       NL-SAS HDD 12.0Gb/s       SEAGATE       ST6000NM0034	Vol-2	Optim	nal 10	0.00 GB	0 MB	/ 0 MB	0			
No.     Status     Health     Total     Free     Tier Level     Disk Used     Location (Enclosure ID:Slot)       1     Online     Good     10.92 TB     10.92 TB     NL-SAS     3     0:13, 0:14, 0:15       Disks     Enclosure ID     Slot     Status     Health     Capacity     Disk Type     Manufacturer     Model       0     13     Online     Good     5.46 TB     NL-SAS HDD 12.0Gb/s     SEAGATE     ST6000NM0034       0     14     Online     Good     5.46 TB     NL-SAS HDD 12.0Gb/s     SEAGATE     ST6000NM0034	Disk G	roups								
No.     Status     Health     Total     Pree     Ther Level     Disk Osed     Location (Enclosure ID.Stot)       1     Online     Good     10.92 TB     10.92 TB     NL-SAS     3     0:13, 0:14, 0:15       Disks     Enclosure ID     Slot     Status     Health     Capacity     Disk Type     Manufacturer     Model       0     13     Online     Good     5.46 TB     NL-SAS HDD 12.0Gb/s     SEAGATE     ST6000NM0034       0     14     Online     Good     5.46 TB     NL-SAS HDD 12.0Gb/s     SEAGATE     ST6000NM0034       0     14     Online     Good     5.46 TB     NL-SAS HDD 12.0Gb/s     SEAGATE     ST6000NM0034	NIa	Chatria	L La alti	Tatal		<b>F</b>	Tinglaud	DialeUran	Lesstian (Er	ala aura ID: Clat)
Disks       Enclosure ID     Slot     Status     Health     Capacity     Disk Type     Manufacturer     Model       0     13     Online     Good     5.46 TB     NL-SAS HDD 12.0Gb/s     SEAGATE     ST6000NM0034       0     14     Online     Good     5.46 TB     NL-SAS HDD 12.0Gb/s     SEAGATE     ST6000NM0034       0     14     Online     Good     5.46 TB     NL-SAS HDD 12.0Gb/s     SEAGATE     ST6000NM0034	1 NO.	Oplino	Good	10 10tal	TB	10.02 TB	NI SAS	DISK USED	Location (Enclosure ID:Slot)	
0 14 Online Good 5.46 TB NL-SAS HDD 12.0Gb/s SEAGATE ST6000NM0034	Enclos 0	ure ID	Slot 13	Status Online	Health Good	Capacity 5.46 TB	Disk Type NL-SAS HDD	) 12.0Gb/s	Manufacturer SEAGATE	Model ST6000NM0034
0 15 Optime Cood 5.46 TR NU SAS HDD 12.0Cb/a SEACATE ST6000NM002	0		14	Online	Good	5.46 TB	NL-SAS HDD	) 12.0Gb/s	SEAGATE	ST6000NM0034
U IS Online Good 5.46 TB NE-SAS HDD 12.000/S SEAGATE STOUDUNI0034	0		15	Online	Good	5.46 TB	NL-SAS HDD	0 12.0Gb/s	SEAGATE	ST6000NM0034

Figure 5-6 Pool Information Popup Window

This table shows the column descriptions.

Table 5-3 Volume Column Descriptions				
Column Name	Description			
Name	Volume name.			
Health	<ul> <li>The health of the volume:</li> <li>Optimal: the volume is working well and there is no failed disk in the RG.</li> <li>Failed: the pool disk of the VD has single or multiple failed disks than its RAID level can recover from data loss.</li> <li>Degraded: At least one disk from the RG of the Volume has failed</li> </ul>			



	or plugged out.
	• Non-optimal: the volume has experienced recoverable read errors.
	After passing parity check, the health will become Optimal.
Capacity	Total capacity of the volume.
Used	Used capacity of the volume.
Used %	Used percentage of the volume.
Snapshot space	Used snapshot space / Total snapshot space. The first capacity is current used snapshot space, and the second capacity is reserved total snapshot space.
Snapshots	The quantity of snapshot of the volume.

Table 5-4	Disk Group Column Descriptions

Column Name	Description					
No	The number of disk group.					
Status	The status of the disk group:					
	Online: The disk group is online.					
	Offline: The disk group is offline.					
	Rebuilding: The disk group is being rebuilt.					
	Migrating: The disk group is being migrated.					
	Relocating: The disk group is being relocated.					
	• EE Rebuilding: The disk group is being RAID EE rebuilt.					
Health	The health of the disk group:					
	Good: The disk group is good.					
	Failed: The disk group has failed.					
	• Degraded: The pool is unhealthy and incomplete. The cause may					
	be a disk loss or failure.					
Total	Total capacity of the disk group.					
Free	Free capacity of the disk group.					
Disks Used	The quantity of disk drives in the disk group.					
Location	Disk location represents in Enclosure ID:Slot.					

Table 5-5	Disk Column Descriptions

Column Name	Description
Enclosure ID	The enclosure ID.
Slot	The position of the disk drive.
Status	The status of the disk drive:



	Online: The disk drive is online.
	• Missing: The disk drive is missing in the pool.
	Rebuilding: The disk drive is being rebuilt.
	• Transitioning: The disk drive is being migrated or is replaced by
	another disk when rebuilding occurs.
	• Scrubbing: The disk drive is being scrubbed.
	• Check Done: The disk drive has been checked the disk health.
	Copying Back: The disk drive is being copied back.
Health	The health of the disk drive:
	Good: The disk drive is good.
	• Failed: The disk drive has failed.
	Error Alert: S.M.A.R.T. error alerts.
	Read Errors: The disk drive has unrecoverable read errors.
Capacity	The capacity of the disk drive.
Disk Type	The type of the disk drive:
	• [SAS HDD   NL-SAS HDD   SAS SSD   SATA SSD ]
	• [12.0Gb/s   6.0Gb/s   3.0Gb/s   1.5Gb/s ]
Manufacturer	The manufacturer of the disk drive.
Model	The model name of the disk drive.

Click the **Close** button to exit the window.

## Performance

The performance block displays the system throughput or system IOPS of all front-end ports for reference.





## Figure 5-7 Performance Block in the Dashboard

When selecting System Throughput:

- TX: Green line is transmitting throughput performance data. Unit of measure is MBps (Mega Byte Per Second).
- RX: Amber line is receiving throughput performance data. Unit of measure is MBps (Mega Byte Per Second).

When selecting System IOPS:

• IOPS: Green line is total IOPS (Input/Output Per Second). Unit is the number of times.

### **Event Logs**

The event log block displays the recent 5 event logs. In addition, clicking More... will link to **Event Logs** function tab of **Log Center** function submenu to view complete event logs.

туре	Time	Content	
Information	Sun, 18 Sep 2016 11:09:30	[CTR1] Virtual disk Vol-1' has started initialization.	
Information	Sun, 18 Sep 2016 11:09:30	[CTR1] Virtual disk 'Vol-1' finished erasing process.	
Information	Sun, 18 Sep 2016 11:09:30	[CTR1] Virtual disk Vol-1' started erasing process.	
nformation	Sun, 18 Sep 2016 11:09:30	[CTR1] Virtual disk Vol-1' has been created.	
Information	Sun, 18 Sep 2016 11:09:07	[CTR1] RAID group 'Pool-1' has been created.	

Figure 5-8 Event Logs in the Dashboard



## TIP:

The displaying types of the event logs are the same as the event level filter in Event Logs, please refer to the chapter 13.3, <u>Log Center</u> section in the Monitoring chapter.



## 5.2. Hardware Monitoring

Select the **Hardware Monitoring** function submenu to show summary status of all enclosures. There are current voltage, temperature, status of fan module, and power supply. In addition, clicking More... will pop up a window for more details.



Figure 5-9 Hardware Monitoring Function Submenu



н	load		lmi	+
	eau	U		L.



System		
Item		Information
Enclosur	re ID	0
System S	Serial Number	QW316016010021001
System	Name	XS5216-D40000
Model Na	ame	XS5216
Backplar	ne ID	QW316
System	Health	Good
Controll	er 1	
Item		Information
Voltage		Good
Temperat	ture	Good
Controll	er 2	
Item		Information
Voltage		Good
Temperat	ture	Good
Backpla	ne	
Item		Information
Voltage		Good
Temperat	ture	Good
System	Components	
Item		Information
Power S	upply	Good
Fan Mod	ule	Good
Cache to	Flash	
Item		Information
Item Power M	odule	Good

Figure 5-10 Hardware Monitoring

There are many voltage and temperature sensors on the controller and backplane. If the statuses of every sensor are Good, the information in this page displays Good. On the other hand, if anyone is not good, it will display Failed. So you may click More... to see details on what component has a fault.

Clicking More... of every enclosure will pop up a window of enclosure status in detail.

# **OSAN**

lead Unit							
Controller 1							
Туре	Item	Value	Low Critical	High Warning	High Warning	High Critical	Status
Voltage	+3.3V	+3.33 V	+3.04 V	+3.14 V	+3.47 V	+3.56 V	Good
Voltage	Standby +3.3V	+3.34 V	+3.04 V	+3.14 V	+3.47 V	+3.56 V	Good
Voltage	CPU 10GbE MAC	+1.06 V	+0.98 V	+1.02 V	+1.07 V	+1.12 V	Good
Voltage	CPU South Complex	+1.00 V	+0.90 V	+0.95 V	+1.05 V	+1.10 V	Good
Voltage	CPU KR/KX PHY	+1.29 V	+1.23 V	+1.24 V	+1.35 V	+1.37 V	Good
Voltage	SAS Expander	+0.90 V	+0.81 V	+0.85 V	+0.95 V	+0.99 V	Good
Voltage	SAS IOC	+0.96 V	+0.87 V	+0.92 V	+1.03 V	+1.08 V	Good
Voltage	Battery	+3.26 V	+2.00 V	+2.30 V	+3.47 V	+3.56 V	Good
Voltage	+1.2V	+1.26 V	+1.08 V	+1.13 V	+1.28 V	+1.32 V	Good
Voltage	+0.82V	+0.82 V	+0.73 V	+0.77 V	+0.86 V	+0.90 V	Good
Voltage	VCore	+1.81 V	+1.40 V	+1.45 V	+1.97 V	+2.00 V	Good
Temperature	CPU	60.0°C / 140.0°F	0.0°C / 32.0°F	5.0°C / 41.0°F	82.0°C / 179.6°F	95.0°C / 203.0°F	Good
Temperature	SAS Expander	73.3°C / 163.9°F	0.0°C / 32.0°F	5.0°C / 41.0°F	90.0°C / 194.0°F	95.0°C / 203.0°F	Good
Controller 2						·	
Туре	Item	Value	Low Critical	High Warning	High Warning	High Critical	Status
Voltage	+3.3V	+3.32 V	+3.04 V	+3.14 V	+3.47 V	+3.56 V	Good
Voltage	Standby +3.3V	+3.33 V	+3.04 V	+3.14 V	+3.47 V	+3.56 V	Good
Voltage	CPU 10GbE MAC	+1.05 V	+0.98 V	+1.02 V	+1.07 V	+1.12 V	Good
Voltage	CPU South Complex	+1.00 V	+0.90 V	+0.95 V	+1.05 V	+1.10 V	Good
Voltage	CPU KR/KX PHY	+1.28 V	+1.23 V	+1.24 V	+1.35 V	+1.37 V	Good
Voltage	SAS Expander	+0.89 V	+0.81 V	+0.85 V	+0.95 V	+0.99 V	Good
Voltage	SAS IOC	+0.96 V	+0.87 V	+0.92 V	+1.03 V	+1.08 V	Good
Voltane	Batten/	+3 16 V	+2 00 \/	+2 30 \/	+3 /17 \/	+3.56 V	Good

Figure 5-11 Head Unit Popup Window

Click the **Close** button to exit the window.

## **C**SAN

## 6. System Settings

This chapter describes the details of system settings. The **SYSTEM SETTINGS** function menu provides submenus of **General Settings**, **Management Port**, **Power Settings**, **Notification**, **Maintenance**, and **Disk Encryption**.

## 6.1. General System Settings

Select the **General Settings** function submenu to show the information of system name, date and time, and login related settings. The system name, administrator's password, user's password, date and time, and the login options can be changed as required.



Figure 6-1 General Function Submenu



**TIP:** Mouse over the icon **(**) can get online help.

# **C**SAN

System Name			
System Name:	XCubeSAN_SANOS		0
Admin Password			
Change Admin Pass	sword		
Current Password	l:	•••••	0
New Password:			
Confirm New Pas	sword:		
committeer rus	, , , , , , , , , , , , , , , , , , ,		
User Password			
Change User Passw	ord		
New Password:			0
Confirm New Pas	sword:		
Data and Time			
Date and Time	imo		
	0047/0/00 40 00 04		
Current Time:	2017/6/22 16:30:24		
Time Zone:	(GMT+08:00) Taipei		*
Setup Date and	Time Manually		
Date:	2017 • / 6 • / 22 •		
Time:	16 V: 29 V: 18 V		
NTP			
NTP Server:	0.pool.ntp.org		
Login Options			
Auto Logout:		Disabled	U
Login Lock:		Disabled	U
Apply			

Figure 6-2 General Settings

## **Options of System Settings**

The options are available in this tab:



- System Name: Change the system name, highlight the old name and type in a new one. Maximum length of the system name is 32 characters. Valid characters are [A~Z | a~z | 0~9 | -\_].
- Change Admin Password: Check it to change administrator password. The maximum length of the password is 12 alphanumeric characters. Valid characters are [A~Z | a~z | 0~9 | ~!@#\$%^&\*\_-+=`|\(){[:;"'<>,.?/].
- Change User Password: Check it to change user password. The maximum length of the password is 12 alphanumeric characters. Valid characters are [ A~Z | a~z | 0~9 | ~!@#\$%^&\*\_-+=`|\(){{]:;"'<>,.?/ ].
- **Date and Time:** Check **Change Date and Time** button and change the current date, time and time zone as required. Date and time can be set by manually or synchronized from a NTP (Network Time Protocol) server.
- **Auto Logout:** When the auto logout option is enabled, you will be logged out of the admin interface after the time specified. There are Disabled (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 Disabled (default) and Enabled options.

When finished, click the **Apply** button to take effect.

## 6.2. Management Port Settings

Select the **Management Port** function submenu to show the information of the management ports. MAC address is displayed for reference and it is used on wake-on-LAN feature. IP address, DNS server, and service ports can be modified according to the management purpose.



Figure 6-3 Management Port Function Submenu

# **OSAN**

🖉 Enable Dual Management Ports 🔋 🚺		
Show Information for: Controller 1  Controller 1 Controller 1 Controller 1		
MAC Address Controller 2		
MAC Address:	00:13:78:D4:00:00	
IP Address		
O DHCP		
BOOTP		
Static IP Address		
IP Address:	192.168.1.234	
Subnet Mask:	255.255.255.0	
Gateway:	192.168.1.254	
DNS Server Address		
Address:	8.8.8.8	
Service Ports		
Enable HTTP Service		
HTTP Port:	80	(Default Port : 80)
Enable HTTPS Service		
HTTPS Port:	443	(Default Port : 443)
Enable SSH Service		
SSH Port:	22	(Default Port : 22)
Apply		

Figure 6-4 Management Port settings

## **Options of Management Port Settings**

The options are available in this tab:

• Enable Dual Management Ports: This is for dual controller models. When the setting is enabled, both management ports of the controllers have their own IP addresses and MAC addresses, and both are active. If the setting is disabled, only the management port of the master controller is active, the other one is on standby. Both controller management ports share the same IP address and MAC address. The management port



fails over to the slave controller when the master controller goes offline, either planned or unplanned.



### **INFORMATION:**

For deployment of management ports, please refer to the chapter 4 Deployment Types and Cabling in the <u>XCubeSAN Hardware Manual</u>.

- **MAC Address:** Display the MAC address of the management port.
- **IP Address:** The option can change IP address for remote administration usage. There are three options for **DHCP**, **BOOTP**, or **Static IP Address**.



## **INFORMATION:**

**DHCP:** The Dynamic Host Configuration Protocol is a standardized network protocol used on IP (Internet Protocol) networks for dynamically distributing network configuration parameters, such as IP addresses for interfaces and services. With DHCP, computers request IP addresses and networking parameters automatically from a DHCP server, reducing the need for a network administrator or a user to configure these settings manually.

**BOOTP:** Similar to DHCP, the Bootstrap Protocol is also a computer networking protocol used in Internet Protocol networks to automatically assign an IP address to network devices from a configuration server. While some parts of BOOTP have been effectively superseded by the DHCP, which adds the feature of leases, parts of BOOTP are used to provide service to the DHCP protocol. DHCP servers also provide legacy BOOTP functionality.

- **DNS Server Address:** DNS (Domain Name System) provides a means to translate FQDN (Fully Qualified Domain Name) to IP address. Some notification services need DNS setting. Enter an IP address of DNS server here.
- Service Ports: Uncheck to disable the service ports of HTTP, HTTPS, and SSH. If the default port numbers of the service ports are not allowed on your network environment, they can be changed here.

When finished, click the **Apply** button to take effect.



## 6.3. Power Settings

The **Power Settings** function submenu provides **Boot Management**, **Cache to Flash**, and **UPS** function tabs to show information and configuration setup.

	Boot Management	Cache to Flash	UPS
SYSTEM SETTINGS General Settings Management Port Power Settings Notifications Maintenance	;		
Disk Encryption			

Figure 6-5 Power Settings Function Submenu

## 6.3.1. Boot Management Settings

Select the **Boot Management** function tab in the **Power Settings** function submenu to enable or disable options about boot.

```
    Enable Auto Shutdown 1
    If auto shutdown is enabled, the system will shutdown automatically when voltage and temperature are over critical levels.
    Enable Wake-on-LAN
    If Wake-on-LAN is enabled, the system will accept a magic packet from management port to power on the system.
    Enable Wake-on-SAS
    If Wake-on-SAS is enabled, and connect the expansion unit(s) with the proprietary Wake-on-SAS expansion cable(s), the expansion cable(s), the expansion cable (s).
```

Apply

Figure 6-6 Boot Management Settings

### **Options of Boot Management Settings**

The options are available in this tab:

• Enable Auto Shutdown: Check to enable the auto shutdown feature. If it is enabled, the system will shut down automatically when the voltage and temperature exceed a critical level.



### TIP:

For better protection and to avoid a single short period of abnormal voltage or temperature, enabling the setting could trigger an automatic shutdown. This is done using several sensors placed on key systems that the system checks every 30 seconds for present voltages or temperatures. The following items are trigger conditions.

- The value of voltage or temperature is lower than **Low Critical** or higher than **High Critical**.
- When one of these sensors reports above the threshold for three contifuous minutes, the system will be shutdown automatically.

For more information about critical values, please refer to the chapter 13.2.1, <u>Hardware Monitoring</u> section in the Monitoring chapter.

• **Enable Wake-on-LAN:** Check to enable the wake-on-LAN feature. If it is enabled, the system will accept a magic packet from the management port to power on the system.



### TIP:

To execute wake-on-LAN function, MAC address of management port is needed. For the information of MAC address, please refer to the chapter 6.2, <u>Management Port Settings</u> page.

• Enable Wake-on-SAS: Check to enable the wake-on-SAS feature. If the wake-on-SAS feature is enabled and the expansion units (XD5300 series) are connected to the proprietary wake-on-SAS cables, the expansion units will power on or shut down together with the head unit.



### **INFORMATION:**

For deployment of the head unit and expansion units, please refer to the chapter 4, Deployment Types and Cabling in the <u>XCubeSAN</u> <u>HardwareManual</u>.





### CAUTION:

Wake-on-SAS feature required QSAN proprietary expansion cables connected between the head unit and expansion units. Please contact local sales for this accessory.

When finished, click the **Apply** button to take effect.

## 6.3.2. Cache to Flash Status

Select the **Cache to Flash** function tab in the **Power** function submenu to show information of power module and flash module for cache to flash protection. Power module indicates BBM (Battery Backup Module) or SCM (Super Capacitor Module).



### **INFORMATION:**

For hardware information about power module and flash module, please refer to the chapter 2.7.2, Features of the Cache-to-Flash Module section in the <u>XCubeSAN Hardware Manual</u>.

**Power Module** 

Item	Information
Status	Good
Туре	BBM
Power Level	100%
Temperature	+32.0(C)

#### Flash Module

Item	Information
Status	Good

Figure 6-7 Cache to Flash

This table shows the column descriptions.

Table 6-1	Power	Module	Column	Descriptions
-----------	-------	--------	--------	--------------

Column Name	Description
Status	The status of power module:



	Good: The power module is good.
	• Failed: The power module is failure.
	Absent: The power module is absent.
	Charging: The power module is charging.
Туре	The type of power module:
	BBM (Battery Backup Module)
	SCM (Super Capacitor Module)
Power Level	The power level of the module.
Temperature	The temperature of the power module

## Table 6-2Flash Module Column Descriptions

Column Name	Description	
Status	The status of flash module:	
	Good: The flash module is good.	
	<ul> <li>Failed: The flash module is failure.</li> </ul>	
	Absent: The flash module is absent.	
	Detecting: The flash module is detecting.	

## 6.3.3. UPS Settings and Status

Select the **UPS** function tab in the **Power** function submenu to enable UPS (Uninterruptible Power Supply) settings and watch the UPS status.



#### **INFORMATION:**

For deployment of UPS, please refer to the chapter 3, Installing the System Hardware in the <u>XCubeSAN Hardware Manual</u>.

# **C**SAN

UPS Status			
UPS Status :	On Line		
UPS Battery Level :	58.00%		
UPS Manufacturer :	CYBERPOWER		
UPS Model :	PR750LCD		
UPS Settings C Enable UPS Support			
Communication Type :	SNMP	٠	
Shutdown Battery Level :	80	٠	%
SNMP IP Address :	192.168.123.123		
SNMP Version :	SNMP v3	٠	
Username :	snmp1		0
Use Authenication			
Authentication Protocol :	MD5	•	
Authentication Password :	•••••		0
🕑 Use Privacy			
Privacy Protocol :	DES		
Privacy Password :	•••••		0
Apply			

Figure 6-8 UPS Status and Settings

This table shows the column descriptions.

Table 6-3	UPS Column Descriptions

Column Name	Description
UPS Status	The status of UPS:
	On Line: The UPS is online.
	On Battery: The UPS is on battery.
	• Low Battery: The voltage of the battery is low.
	High Battery: The voltage of the battery is high.
	Replace Battery: The battery needs to be replaced.
	Charging: The battery is charging.
	Discharging: The battery is discharging.
	• Bypass Mode: The power circuit bypasses the UPS battery, so no
	battery protection is available. It may happen to check if the UPS
	operates properly during a power loss. Or the UPS is offline for



	maintenance.
	• Offline: UPS is offline and is not supplying power to the load.
	Overloaded: UPS is overloaded. You plugged more equipments
	into the UPS than it was designed to handle.
	Forced Shutdown: Forced shutdown the UPS.
UPS Battery	The battery level of the UPS.
Level	
UPS	The manufacturer of the UPS.
Manufacturer	
UPS Model	The model of the UPS.

## **Options of UPS Settings**

The options are available in this tab:

- **Enable UPS Support:** Check to enable UPS supported. Now we support network UPS via SNMP, Serial UPS with COM port, and USB UPS.
- **Communication Type:** Now we support network UPS via SNMP, Serial UPS with COM port, and USB UPS.
- **Shutdown battery Level:** If the power is shortage, the system will execute shutdown process when reaching the UPS battery level.

If Communication Type selects SNMP:

- SNMP IP Address: Enter the IP address of the network UPS via SNMP.
- SNMP Version: Select SNMP supported versions: v1, v2c, or v3. Please enter community
  if select SNMP v1 or v2c. If select SNMP v3, it needs more options for authentication.
  Please enter a username, check to use authentication if necessary, select an
  authentication protocol and enter an authentication password, check to use privacy if
  necessary, the privacy protocol supports DES, and enter a privacy password.

If Communication Type selects Serial:

- UPS Manufacturer: Select the UPS manufacture.
- UPS Model: Select the UPS model.

When finished, click the **Apply** button to take effect.

# **C**SAN



### **INFORMATION:**

Authentication Protocol:

- **MD5:** The MD5 algorithm is a widely used hash function producing a 128-bit hash value. It can still be used as a checksum to verify data integrity, but only against unintentional corruption.
- SHA: SHA (Secure Hash Algorithm) is a cryptographic hash function which is a mathematical operation run on digital data; by comparing the computed "hash" (the output from execution of the algorithm) to a known and expected hash value, a person can determine the data's integrity.

Privacy Protocol:

• **DES:** The DES (Data Encryption Standard) is a symmetric-key algorithm for the encryption of electronic data.

## 6.4. Notification Settings

The **Notifications** function submenu provides **Email**, **Alert** and **SNMP** function tabs to show information and configuration setup.



Figure 6-9 Notifications Function Submenu

## 6.4.1. Email Settings

Select the **Email** function tab in the **Notifications** function submenu to be used to enter up to three email addresses for receiving the event notifications.



SMTP Settings		
SMTP Server:	smtp.company.com	0
SMTP Port:	25	
Email-from Address:	admin@company.com	0
Authentication Required		
User Name:	admin	0
Password:	•••••	0
Secure Connection:	TLS	
Subject Prefix:	[SAN]	0
Email Notification Settings		
Email-to Address 1:	user1@company.com	0
	🗌 Information 🗹 Warning 🖉 Error	
Email-to Address 2:	user2@company.com	0
	🗏 Information 🗹 Warning 🗹 Error	
Email-to Address 3:	user3@company.com	0
	🔲 Information 🗹 Warning 🗹 Error	
Send Test Email & Apply Reset to Default		

Figure 6-10 Email Settings

## **Options of SMTP Settings**

The options are available in this tab:

- **SMTP Server:** Enter the IP address or FQDN (Fully Qualified Domain Name) of SMTP server to deliver the notification mails.
- SMTP Port: Default is port 25. You can change the SMTP port here.
- Email-from Address: Enter the sender email address.
- Authentication Required: Some email servers require authentication for SMTP relay. Check to enable authentication and enter the User Name and Password.
- Secure Connection: Using SSL (Secure Sockets Layer) or TLS (Transport Layer Security) for secure connection.
- **Subject Prefix:** The input string will be appended to the front of the email subject.

## **Options of Email Notification Settings**

The options are available in this tab:

# **C**SAN

• **Email-to-Address:** Enter the email address for receiving the event notifications. 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.



TIP:

Please make sure the IP address of DNS server is well-setup in **Management Port** tab. So the event notification emails can be sent successfully. Please refer to the <u>Management Port Settings</u> section for more details.

When finished, click the **Send Test Email & Apply** button to take effect. Or click the **Reset to Default** button to reset settings.

## 6.4.2. Alert Settings

Select the **Alert** function tab in the **Notifications** function submenu to be used to setup alerts via the **Syslog** protocol, the pop-up alerts and alerts on the front display. The device buzzer is also managed here.

Syslog Server Settings 🧃	
Host Address or Name:	192.168.123.123
UDP Port:	514
Facility:	User •
	🔲 Information 🗹 Warning 🗹 Error
Admin Interface and LCM Alerts 🕕	
Admin Interface Popup Alerts:	🗌 Information 🔲 Warning 🔲 Error
Show Alerts on LCM:	🗏 Information 🕑 Warning 🕑 Error
Device Buzzer 🕕	
Enable Buzzer:	
Apply	

Figure 6-11 Alert Settings



## **Options of Alert Settings**

The options are available in this tab:

- **Syslog 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. Most LINUX/UNIX systems built in syslog daemon.
- Admin Interface and LCM Alerts: You can check or uncheck the alert levels which you would like to have pop-up message in the Web UI and show on LCM.
- **Device Buzzer:** Check it to enable the device buzzer. Uncheck it to disable device buzzer.

When finished, click the **Apply** button to tack effect.



### **INFORMATION:**

The device buzzer features are listed below:

- The buzzer alarms 1 second when system boots up successfully.
- The 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. For example, when a RAID 5 pool is degraded and alarm rings immediately, user replaces one disk drive for rebuild. When the rebuild process is done, the alarm will be muted automatically.

## 6.4.3. SNMP Settings

Select the **SNMP** function tab in the **Notifications** function submenu to be used to setup SNMP (Simple Network Management Protocol) traps for alerting with event logs and also setup SNMP server settings for client monitoring.



#### SNMP Trap

Enable SNMP (Simple Network Management Protocol) trap to send system event logs to SNMP trap agent.

Enable SNMP Trap			
SNMP Trap Port:	162	<u></u>	(Default Port : 162)
	Information	Warning	Error
SNMP Trap Address 1:	192.168.123.1	.23	
SNMP Trap Address 2:			
SNMP Trap Address 3:			
SNMP Server			
SNMP Version:	SNMP v3		
Username:	user1		0
Authentication Protocol:	MD5		
Authentication Password:	•••••	٩	0
Use Privacy			
Privacy Protocol:	DES	•	
Privacy Password:	•••••	( <u>a</u> )	0
Apply			
SNMP MIB Files			
Downlaod SNMP MIB File:	Download		
Download iSCSI MIB File:	Download		

Figure 6-12 SNMP Settings

## **Options of SNMP Trap Settings**

The options are available in this tab:

• Enable SNMP Trap: Check to enable SNMP trap to send system event logs to SNMP trap agent. The default SNMP trap port is 162. You can check or uncheck the alert levels which you would like to receive. And then fill in up to three SNMP trap addresses for receiving the event notifications.

#### **Options of SNMP Server Settings**

The options are available on this tab:

• **SNMP Version:** Select SNMP supported versions: v1/ v2, or v3. If select SNMP v3, it needs more options for authentication. Please enter a username, select an



authentication protocol and enter an authentication password, check to use privacy if necessary, select a privacy protocol, and enter a privacy password.

When finished, click the Apply button to take effect.



### **INFORMATION:**

Authentication Protocol:

- MD5: The MD5 algorithm is a widely used hash function producing a 128-bit hash value. It can still be used as a checksum to verify data integrity, but only against unintentional corruption.
- **SHA:** SHA (Secure Hash Algorithm) is a cryptographic hash function which is a mathematical operation run on digital data; by comparing the computed "hash" (the output from execution of the algorithm) to a known and expected hash value, a person can determine the data's integrity.

**Privacy Protocol:** 

- **DES:** The DES (Data Encryption Standard) is a symmetric-key algorithm for the encryption of electronic data.
- **AES:** The AES (Advanced Encryption Standard) is a specification for the encryption of electronic data. It supersedes the DES.

## **Options of SNMP MIB Files**

The options are available in this tab:

- **Download SNMP MIB File:** Click the **Download** button to save the SNMP MIB file which can be imported to the SNMP client tool to get system information. You can view fan, voltage, and system status via SNMP MIB.
- **Download iSCSI MIB File:** Click the **Download** button to save the iSCSI MIB file which can be imported to the SNMP client tool to get network information. You can view iSCSI traffic via iSCSI MIB.

## 6.5. Maintenance

The **Maintenance** function submenu provides **System Information**, **Upgrade**, **Firmware Synchronization** (This option is only visible when dual controllers is installed.), **System** 



Identification, Reset to Defaults, Configuration Backup, Volume Restoration, and Reboot / Shutdown function tabs. The Volume Restoration function will be described in the Volume Restoration section in the Advanced Volume Administration chapter, the others are described in the following sections.

			System Information	Update	Firmware	Synchronization	Syst	em Identification
			Reset to Defaults	Configuration	on Backup	Volume Restora	tion	Reboot / Shutdown
9 🕲	SYSTEM SETTINGS General Settings							
	Management Port Power Settings Notifications							
Maintenance Disk Encryption								
Figure 6-13 Maintenance Function Submenu								

## 6.5.1. System Information

Select the **System Information** function tab in the **Maintenance** function submenu to display all system information.

Caret	
SVSI	

Item	Information
System Name	XS5216-D40000
Model Name	XS5216
System Serial Number	QW316016010021001
System Controller Status	Dual Controller, Active-Active
Master Controller	Controller 1

#### **Controller 1**

Item	Information
Controller Serial Number	50013780080A0440
CPU	Intel(R) Xeon(R) Processor D-1500 4 Cores
Memory	8 GB
Host Card Slot 1	Empty
Host Card Slot 2	Empty
Firmware Version	1.2.0
SAS IOC Firmware Version	07.00.01.00
SAS Expander Firmware Version	1000



#### Controller 2

Item	Information
Controller Serial Number	50013780080A0380
CPU	Intel(R) Xeon(R) Processor D-1500 4 Cores
Memory	8 GB
Host Card Slot 1	Empty
Host Card Slot 2	Empty
Firmware Version	1.2.0
SAS IOC Firmware Version	07.00.01.00
SAS Expander Firmware Version	1000

#### Backplane

Item	Information	
Backplane Serial Number	001378D40000	
Backplane ID	QW316	
MCU Version	1.2.0	
Licenses		
Item	Information	
SSD Cache	Enabled	
Auto Tiering	Enabled	

Download Service Package

### Figure 6-14 System Information

This table shows the descriptions.

Column Name	Description
System	The status of system availability:
Availability	Dual Controller, Active/Active: Dual controllers and expansion
Status	units are in normal stage.
	• Dual Controller, Degraded: In dual controller mode, one controller
	or one of expansion unit fails or they have been plugged out.
	Please replace or insert a good controller.
	Dual Controller, Lockdown: In dual controller mode, the
	configurations of two controllers are different, including the
	memory capacity, host cards, and controller firmware version.
	Please check the hardware configurations of two controllers or
	execute firmware synchronization.
	Single Controller: Single controller mode.

## Table 6-4 Status in System Information Column Descriptions

# **OSAN**

## **Options of System Information**

The options are available in this tab:

• **Download Service Package:** Click button to download system information for service.



### 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.

## 6.5.2. Firmware Update

Select the **Update** function tab in the **Maintenance** function submenu to be used to update controller firmware, expansion unit firmware, change operation mode, and active licenses.



TIP:

Before upgrading, we recommend you to export your system configurations first in the **Configuration Backup** function tab. Please refer to the <u>Configuration Backup</u> section for more details.



Head Unit Firmware Update		
Model Name:	XS5216	
Firmware Version:	1.2.0	
Select the firmware file for the update:	Choose File QSAN_XSx200_1.2.0.bin	
Apply		
Expansion Unit Firmware Update		
Select an Expansion Unit:		Ŧ
Firmware Version:		
Select the firmware file for the update:	Choose File No file chosen	
Apply		
Change Operation Mode		
Charge Operation Mode	Dual Cashallan	-
Select an Operation Mode:	Dual Controller	•
Apply		

Figure 6-15 Firmware Update

## **Options of Firmware Update**

The options are available in this tab:

 Head Unit Firmware Update: Please prepare new controller firmware file named "xxxx.bin" in local hard drive, click the Choose File button to select the firmware file. Then click the Apply button, it will pop up a warning message, click the 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.

# **C**SAN



## TIP:

Firmware update can be done without downtime if the MPIO configuration is well-configured between the connected host / server and both controllers. A firmware update process will update both controllers at the same time. After finished updating, you have to reboot the system.

A system reboot will reboot the master controller first. At this point, the slave controller will take over all tasks (and becomes a new master controller). After the original master controller finishes the booting process (the original master controller is slave controller at this moment), the new master controller (the original slave controller) will reboot automatically, and so on for the original master controller to take over the tasks, once the original slave controller finishes the booting process, the firmware update procedure is completed.

- **Expansion Unit Firmware Update:** To upgrade expansion unit firmware, first select an expansion unit. Then other steps are the same as the head unit firmware update. After finished upgrading, the expansion unit must reboot manually to make the new firmware take effect.
- Change the Operation Mode: This option can be modified to operate in dual-controller or single-controller mode here. If the system installed only one controller, switch this mode to Single Controller, and then click the Apply button. After changing the operation mode, the system must reboot manually to take effect.

SSD Cache License			
Download Request License file and send to your local	sales to get a License Key.		
Select the license file to enable SSD Cache:	Choose File No file chosen		
Apply Request License			
Auto Tiering License			
Download Request License file and send to your local sales to get a License Key.			
Select the license file to enable Auto Tiering:	Choose File No file chosen		
Apply Request License			

Figure 6-16 Enable Licenses


- **SSD Cache License:** This option enables SSD cache. Download the **Request License** file and send to your local sales to obtain a License Key. After getting the license key, click the **Choose File** button to select it, and then click the **Apply** button to enable. Each license key is unique and dedicated to a specific system. If you have already enabled, this option will be invisible. After enabling the license, the system must reboot manually to take effect.
- **Auto Tiering License:** This option enables auto tiering. The operation is the same as SSD cache.



### CAUTION:

After enabling the licenses, the functions cannot be disabled and these license options will be hidden.

Trial License			
Click the Request License button to download a file and use it to request a trial license key. When you get the trial license key file, put it in to enable the 30-day trial period. You can try the advanced features until it expires. We DO NOT recommend using trial features in official production.			
Select the trial license key file to enable:	Choose File No file chosen		
I have read and agree to the Trial License Agreement.			
Apply Request License			

Figure 6-17 Trial License

Trial License: This option enables trial license. Download the Request License file and register on our website in a few clicks, then you will get a 30-day trial license via email. After getting the license key, click the Choose File button to select it, check that I have read and agree to the Trial License Agreement, and then click the Apply button to enable. Each license key is unique and dedicated to a specific system. After enabling, you can fully experience SANOS with SSD Cache, Auto Tiering, and future advanced features.

# **C**SAN



### CAUTION:

DO NOT recommend using trial features in official production.

After the trial license expires for SSD cache, all SSD cache pools are deleted. Read-write SSD cache pool will be flushed first.

After the trial license expires for auto tiering, all auto tiering pools are deactivated.



### **INFORMATION:**

Trial license feature is available in SANOS firmware 1.4.0.

## 6.5.3. Firmware Synchronization

Select the **Firmware Synchronization** function tab in the **Maintenance** function submenu to be 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 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.

The firmware versions are the same between the two controllers.
Apply

Figure 6-18 Both Firmware Versions are Synchronized

If the firmware versions between two controllers are different, it will display a warning message. Click the **Apply** button to synchronize and force a reboot.



### **INFORMATION:**

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



## 6.5.4. System Identification

Select the **System Identification** function tab in the **Maintenance** function submenu to turn on or turn off the UID (Unique Identifier) LED control mechanism. The system UID LED helps users to easily identify the system location within the rack.

When the UID LEDs are turn off, click the **OK** button to turn on the UID LEDs which are light blue color, located on the right panel of front view and both controllers of rear view.

System Identifi	cation	
Turn o	n the UID (Unique Identifier) LEDs.	ОК
Figure 6-19	Turn on the UID (Unique Iden	tifier) LED

When the UID LEDs are steady on, click the **OK** button to turn off the UID LEDs.



#### **INFORMATION:**

For the front and rear view about the UID LEDs, please refer to chapter 2, System Components Overview in the <u>XCubeSAN Hardware Manual</u>.

## 6.5.5. Reset to Factory Defaults

Select the **Reset to Defaults** function tab in the **Maintenance** function submenu to allow users to reset the system configurations back to the factory default settings and clean all configurations of the expansion enclosure ID.



#### Reset to Factory Default

Click the Reset button to clear all user-entered configurations and reset the system to factory default. If the following item is checked, it will also clear all volume restoration records. It is irreversible, the system won't be able to restore the recorded RAID configuration if it fails while there is no record. Please carefully consider before making this reset.
Clear all volume restoration records
Reset
Clean Expansion Enclosure ID
Click the Clean button to clean all configurations of the expansion enclosure ID.
Clean

Figure 6-20 Reset to Defaults

### **Options of Resets to Factory Defaults**

The options are available in this tab:

- Reset to Defaults: Click the Reset button to progress reset to defaults and force a reboot. The default settings are:
  - Reset Management Port IP address to DHCP, and then fix IP address: 169.254.1.234/16.
  - Reset admin's **Password** to 1234.
  - Reset System Name to model name plus the last 6 digits of serial number. For example: XS5216-123456.
  - Reset IP addresses of all **iSCSI Ports** to 192.168.1.1, 192.168.2.1, ... etc.
  - Reset link speed of all Fibre Channel Ports to Automatic.
  - Clear all access control settings of the host connectivity.
- Clear all volume restoration records: Check to clear all volume restoration records.



#### **CAUTION:**

Process the **Reset to Defaults** function will force a reboot. To clear all volume restoration records is irreversible. The system won't be able to restore the recorded RAID configuration if it fails while there is no record. Please carefully consider before making this reset.



• **Clean Expansion Enclosure ID:** Click the **Clean** button to clean all configurations of expansion enclosure ID. A clean will cause the system shutdown, and then you have to start manually.



### **INFORMATION:**

The XCubeDAS XD5300 series features the seven-segment LED display for users to easily identify a specific XCubeDAS system. The enclosure ID is assigned by head unit (XCubeSAN series) automatically. The seven segment LED display supports up to ten XCubeDAS systems, and the numbering rule will start from 1 to A. For dual controller models, both controllers will display the same enclosure ID. After the XD5300 had been assigned the enclosure ID, head unit will assign the same enclosure ID when the system reboots or goes shutdown. For hardware information enclosure ID, please refer to the chapter 2.7, Seven-segment LED Display section in the <u>XCubeDAS Hardware Manual</u>.



#### CAUTION:

Process the **Clean Expansion Enclosure ID** function will force the system shutdown to clean all configurations of expansion enclosure ID.

## 6.5.6. Configuration Backup

Select the **Configuration Backup** function tab in the **Maintenance** function submenu to be used to either save system configuration (export) or apply a saved configuration (import).



Export		
Export Mode:	System	<b>v</b>
Export File:	CONFIG-XS52	16-D40000-20170627-135559.csv
Apply		
Import		
Import File:	Choose File	No file chosen
Apply		

Figure 6-21 Configuration Backup

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

### **Options of Configuration Backup**

The options are available in this tab:

- **Export:** Select the **Export Mode** for exporting system or volume configurations, then click the **Export** button to save a file.
- Import: Import all system configurations excluding volume configuration.



#### CAUTION:

The Import option will import all system configurations excluding volume configuration. The current system configurations will be replaced.

### 6.5.7. Reboot and Shutdown

Select the **Reboot / Shutdown** tab in the **Maintenance** function submenu to be used to reboot or shutdown the system. Before powering off the system, it is highly recommended to execute **Shutdown** function to flush all data from memory cache into the disk drives. The step is important for data protection.





Figure 6-22 Reboot and Shutdown

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

Reboot	
<ul> <li>Both Controller 1 and Controller 2</li> <li>Controller 1</li> <li>Controller 2</li> </ul>	OK Cancel

Figure 6-23 Reboot Options

# 6.6. Disk Encryption

The **Disk Encryption** function submenu provides **Authentication**, and **SEDs** function tabs. SED (Self-Encrypting Drive) support will be described in the chapter 14, <u>SED and ISE Support</u> chapter.



Figure 6-24 Disk Encryption Function Submenu



# 7. Host Configuration

This chapter describes host protocol concepts and the details of host configuration. The **HOST CONFIGURATION** function menu provides submenus of **Overview, iSCSI Ports**, and **Fibre Channel Ports**.



#### **INFORMATION:**

The **Fibre Channel Ports** function menu will appear only when the system has a fibre channel host card installed.

## 7.1. Host Protocol Technology

This section describes the host protocol technology of iSCSI (Internet SCSI) and fibre channel.

### 7.1.1. iSCSI Technology

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 protocols, such as iSCSI, have "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).



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

Each iSCSI node, that is, an initiator or target, has a unique IQN (iSCSI Qualified Name). The IQN is formed according to the rules that were adopted for Internet nodes. The IQNs can be abbreviated by using a descriptive name, which is known as an alias. An alias can be assigned to an initiator or a target.

Item	Value
Maximum iSCSI target quantity per system	256
Maximum initiator address quantity per system	256
Maximum host quantity for single controller system	512
Maximum host quantity for dual controller system	1,024
Maximum iSCSI session quantity for single controller	1,024
Maximum iSCSI session quantity for dual controller	2,048
Maximum iSCSI connection quantity for single controller	4,096
Maximum iSCSI connection quantity for dual controller	8,192
Maximum CHAP accounts per system	64

Table 7-1 iSCSI Parameters

## 7.1.2. Fibre Channel Technology

Fibre channel is an extremely fast system interface. It was initially developed for use primarily in the supercomputing field, but has become the standard connection type for SAN in enterprise storage.

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.

Fibre Channel is the traditional method used for data center storage connectivity. The XCubeSAN supports fibre channel connectivity at speeds of 4, 8, and 16 Gbps. Fibre Channel Protocol is used to encapsulate SCSI commands over the fibre channel network. Each device on the network has a unique 64 bit WWPN (World Wide Port Name).



Table 7-2 Fibre Channel Parameters	Table 7-2	Fibre Channel Parameters
------------------------------------	-----------	--------------------------

Item	Value
Maximum host quantity for single controller	256
Maximum host quantity for dual controller	512

## 7.2. Host Connectivity Overview

Storage system provides different type of host connectivity according to the system configuration, it could be base system or host cards installed system. The host cards must be installed the same type on both controllers. Currently host card has several types, 1GbE iSCSI (RJ45), 10GbE iSCSI (SFP+), 25GbE iSCSI (SFP28), 16Gb FC (SFP+), and 32Gb FC (SFP28) for selection according to system infrastructure.

Select **Overview** function submenu to display all host connectivity in system. The status and information of all host ports are listed.



The following is an example to show all host connectivity in system.

# **CSAN**

Controller 1					
Location	Name	Status	MAC Address/WWPN		
Onboard	LAN1 (10Gb)	Down	00:13:78:ff:88:02		
Onboard	LAN2 (10Gb)	Down	00:13:78:ff:88:03		
Slot2	LAN1 (1Gb)	1 Gb/s	00:13:78:ff:88:04		
Slot2	LAN2 (1Gb)	1 Gb/s	00:13:78:ff:88:05		
Slot2	LAN3 (1Gb)	1 Gb/s	00:13:78:ff:88:06		
Slot2	LAN4 (1Gb)	1 Gb/s	00:13:78:ff:88:07		
Slot1	FC1 (16Gb)	16Gb/s	2100001378FF8800		
Slot1	FC2 (16Gb)	16Gb/s	2200001378FF8800		
Slot1	FC3 (16Gb)	16Gb/s	2300001378FF8800		
Slot1	FC4 (16Gb)	16Gb/s	2400001378FF8800		

### Controller 2

Location	Name	Status	MAC Address/WWPN
Onboard	LAN1 (10Gb)	Down	00:13:78:ff:88:0c
Onboard	LAN2 (10Gb)	Down	00:13:78:ff:88:0d
Slot2	LAN1 (1Gb)	1 Gb/s	00:13:78:ff:88:0e
Slot2	LAN2 (1Gb)	1 Gb/s	00:13:78:ff:88:0f
Slot2	LAN3 (1Gb)	1 Gb/s	00:13:78:ff:88:10
Slot2	LAN4 (1Gb)	1 Gb/s	00:13:78:ff:88:11
Slot1	FC1 (16Gb)	16Gb/s	2900001378FF8800
Slot1	FC2 (16Gb)	16Gb/s	2A00001378FF8800
Slot1	FC3 (16Gb)	16Gb/s	2B00001378FF8800
Slot1	FC4 (16Gb)	16Gb/s	2C00001378FF8800

### Figure 7-2 Host Port Overview

The columns display information of **Location**, **Name**, **Status**, and **MAC address** for iSCSI or **WWPN** (World Wide Port Name) for fibre channel.

# **C**SAN



### **INFORMATION:**

Fibre Channel / iSCSI Host Card at Slot 1:

- RHCF32P2, 2 x 32Gb FC (SFP28) ports
- HQ-16F4S2: 4 x 16Gb FC (SFP+) ports
- HQ-16F2S2: 2 x 16Gb FC (SFP+) ports
- RHCE25P2, 2 x 25GbE iSCSI (SFP28) ports
- HQ-10G4S2: 4 x 10GbE iSCSI (SFP+) ports
- HQ-10G2T: 2 x 10GBASE-T iSCSI (RJ45) ports
- HQ-01G4T: 4 x 1GBASE-T iSCSI (RJ45) ports

iSCSI Host Card at Slot 2 (20Gb bandwidth):

- RHCF32P2, 2 x 32Gb FC (SFP28) ports
- HQ-16F4S2: 4 x 16Gb FC (SFP+) ports
- HQ-16F2S2: 2 x 16Gb FC (SFP+) ports
- RHCE25P2, 2 x 25GbE iSCSI (SFP28) ports
- HQ-10G4S2, 4 x 10GbE iSCSI (SFP+) ports
- HQ-10G2T: 2 x 10GBASE-T iSCSI (RJ45) ports
- HQ-01G4T, 4 x 1GBASE-T iSCSI (RJ45) ports



### **INFORMATION:**

For hardware information about host cards, please refer to the chapter 3.3, Installing the Optional Host Cards section in the <u>XCubeSAN Hardware</u> <u>Manual</u>.



### CAUTION:

If you change the configuration of the host cards including insert or remove them, it has to execute **Reset to Defaults** function in **SYSTEM SETTINGS** -> **Maintenance** -> **Reset to Defaults**. Before that, you can keep the system configurations by export and import the configuration file in **SYSTEM SETTINGS** -> **Maintenance** -> **Configuration Backup**. Please refer to the chapter 6.5.5, <u>Reset to Factory Default</u> section and the chapter 6.5.5, <u>Configuration Backup</u> section for more details.



# 7.3. Configure iSCSI Connectivity

The **iSCSI Ports** provides **iSCSI Ports**, **iSCSI Settings**, **iSCSI Targets**, **CHAP Accounts**, and **Sessions** function tabs to configure iSCSI ports.

			iSCSI Ports	iSCSI Settings	iSCSI Targets	CHAP Accounts	Sessions
S H	IOST CONN	ECTIVI	ТҮ				
	Overview						
	iSCSI Ports						
	Fibre Chann	el Ports					
Figur	e 7-3	iSCSI	Ports Fund	ction Submen	u		

## 7.3.1. Configure iSCSI Ports

Select the **iSCSI Ports** function submenu to show information of iSCSI ports where they are located (onboard or host cards). The iSCSI port properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific iSCSI port.

Controll	Controller 1								
	Location	Name	Status	LAG	VLAN ID	IP Address	Gateway	Jumbo Frame	MAC Address
▼	Onboard	LAN1 (10Gb)	Down	N/A	N/A	192.168.1.1	192.168.1.254	Disabled	00:13:78:ff:88:02
<b>V</b>	Onboard	LAN2 (10Gb)	Down	N/A	N/A	192.168.2.1	192.168.2.254	Disabled	00:13:78:ff:88:03
▼	Slot2	LAN1 (1Gb)	1 Gb/s	N/A	N/A	192.168.100.11		Disabled	00:13:78:ff:88:04
▼	Slot2	LAN2 (1Gb)	1 Gb/s	N/A	N/A	192.168.100.12		Disabled	00:13:78:ff:88:05
▼	Slot2	LAN3 (1Gb)	1 Gb/s	N/A	N/A	192.168.100.13		Disabled	00:13:78:ff:88:06
	Slot2	LAN4 (1Gb)	1 Gb/s	N/A	N/A	192.168.100.14		Disabled	00:13:78:ff:88:07

Cor	trol	lor.	0
001	100	ier.	~

	Location	Name	Status	LAG	VLAN ID	IP Address	Gateway	Jumbo Frame	MAC Address
▼	Onboard	LAN1 (10Gb)	Down	N/A	N/A	192.168.11.1	192.168.11.254	Disabled	00:13:78:ff:88:0c
▼	Onboard	LAN2 (10Gb)	Down	N/A	N/A	192.168.12.1	192.168.12.254	Disabled	00:13:78:ff:88:0d
▼	Slot2	LAN1 (1Gb)	1 Gb/s	N/A	N/A	192.168.100.21		Disabled	00:13:78:ff:88:0e
▼	Slot2	LAN2 (1Gb)	1 Gb/s	N/A	N/A	192.168.100.22		Disabled	00:13:78:ff:88:0f
▼	Slot2	LAN3 (1Gb)	1 Gb/s	N/A	N/A	192.168.100.23		Disabled	00:13:78:ff:88:10
▼	Slot2	LAN4 (1Gb)	1 Gb/s	N/A	N/A	192.168.100.24		Disabled	00:13:78:ff:88:11



The columns display information of **Location**, **Name**, **Status**, **LAG** (Link Aggregation), **VLAN ID** (Virtual LAN ID), **IP address**, **Gateway** IP address, **Jumbo Frame** status, and **MAC address**.



### Set IP Address

Click ▼ -> Set IP Address which 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.



#### **INFORMATION:**

**DHCP:** The Dynamic Host Configuration Protocol is a standardized network protocol used on IP (Internet Protocol) networks for dynamically distributing network configuration parameters, such as IP addresses for interfaces and services. With DHCP, computers request IP addresses and networking parameters automatically from a DHCP server, reducing the need for a network administrator or a user to configure these settings manually.

Set IP Addre	ess		
You can sel select 'Stati	ect 'DHCP' to acqui c' to specify an IP a	ire an IP address autor address manually.	natically or
$\bigcirc$	DHCP		
۲	Static IP Address	3	
	IP Address:	192.168.1.1	
	Subnet Mask:	255.255.255.0	
	Gateway:	192.168.1.254	
			OK Cancel

Figure 7-5 iSCSI IP Address Settings

### Set Link Aggregation

Click ▼ -> Set Link Aggregation, the default mode of each iSCSI data port is connected without any bonding. Two bonding methods, Trunking and LACP (Link Aggregation Control Protocol), can be selected. At least two iSCSI data ports must be checked for iSCSI link aggregation.



Set Link Aggregation						
Select the network interfac	es that you would like to bond together.					
Bonding Method:						
IP Address:	192.168.1.1					
Subnet Mask:	255.255.255.0					
Gateway:	192.168.1.254					
Network Setup:	<ul> <li>Onboard-LAN1 (10Gb)</li> <li>Onboard-LAN2 (10Gb)</li> </ul>					
	OK					

Figure 7-6 Set Link Aggregation



### **INFORMATION:**

**Trunking:** Sometimes called "Port 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 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. LACP can increase bandwidth usage and automatically perform failover when the link status fails on a port.

### Set VLAN ID

Click ▼ -> Set VLAN ID, VLAN (Virtual LAN) 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 transfer 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. Please 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.



Set VLAN ID		
VLAN ID:	2	VLAN ID range (2~4094)
Priority:	0	Priority range $(0 \sim 7)$
		OK

Figure 7-7 Set VLAN ID



### **INFORMATION:**

**VLAN ID:** VLAN ID is a number ranges from 2 to 4094. Three numbers (0, 1, and 4095) are reserved for special purposes.

**Priority:** The PCP (Priority Code Point) is a number ranges from 0 to 7 and reserved for QoS (Quality of Service). The definition is compliant with IEEE 802.1p protocol and 0 is the default value. In normal cases, you don't need to set this value.

### Set Default Gateway

Click ▼ -> Set Default Gateway to set the gateway of the IP address as default gateway. There can be only one default gateway.

### **Remove Default Gateway**

To remove the default gateway, click ▼ -> **Remove Default Gateway**.

### Set Jumbo Frames

Click ▼ -> Set Jumbo Frames to set the MTU (Maximum Transmission Unit) size. The jumbo frame size could be set as 4000 or 9000 bytes. Jumbo Frame is disabled by default.

Set Jumbo Frame		
Jumbo Frame:	Disabled <b>v</b>	
	9000	
	4000	
-	Disabled	
		OK Cancel

Figure 7-8 Set Jumbo Frame





### CAUTION:

If the VLAN ID or jumbo frames are set, the related switching hub and HBA on host must be set, too. Otherwise, the LAN connection cannot work properly.

### **Ping Host**

Click ▼ -> **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. Click **Stop** button will stop ping activity.

```
Please input the host's IP address:
```



Figure 7-9 Ping Host

### **Reset Port**

Click ▼ -> **Reset Port**, which is generally used to recover from a port malfunction.

## 7.3.2. Configure iSCSI Settings

Select the **iSCSI Settings** function tab in the **iSCSI Ports** function submenu to provide to setup entity name of the system and iSNS (Internet Storage Name Service) server. The entity name is default in IQN (iSCSI Qualified Name) format and could be modified for management purpose. The iSNS IP is used by iSNS protocol for automated discovery, management and configuration of iSCSI devices on a TCP/IP network. To use iSNS, an iSNS server must be added to the SAN. The iSNS server IP address must be added to the storage system for iSCSI initiator service to send queries.



Entity Name		
Entity Name:	iqn.2004-08.com.qsan:xs5216-000d40000	0
The entity name is fo	or a device or gateway that is accessible from the network.	
ISNS IP Address		
ISNO IP AUL		
ISNS IP Address:		
The iSNS protocol a	llows automated discovery, management, and configuration of iSC	SI devices on a network
Apply		

Figure 7-10 Entity Name and iSNS Settings

### **Options of iSCSI Settings**

The options are available in this tab:

- Entity Name: Change the entity name; highlight the old name and type in a new one. The maximum length of entity name is 200 characters. Valid characters are [ a~z | 0~9 | -.: ].
- **iSNS IP Address:** The option can change iSNS IP address for internet storage name service.

When finished, click the **Apply** button to effect changes.



#### **INFORMATION:**

**iSNS:** The iSNS protocol allows automated discovery, management, and configuration of iSCSI devices on a network.

### 7.3.3. Configure iSCSI Targets

Select the **iSCSI Targets** function tab in the **iSCSI Ports** function submenu to show the iSCSI target information for iSCSI initiator. The iSCSI target properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific iSCSI target.



Controller 1		
<< first < prov	1 2 3 4 5 6 7 8 9 10	nevt > last >>

	ID	Auth	Target Name	Portal	Alias
V	0	CHAP	iqn.2004-08.com.qsan:xs5216-000d40000:dev0.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
▼	1	None	iqn.2004-08.com.qsan:xs5216-000d40000:dev1.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
▼	2	None	iqn.2004-08.com.qsan:xs5216-000d40000:dev2.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
▼	3	None	iqn.2004-08.com.qsan:xs5216-000d40000:dev3.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
▼	4	None	iqn.2004-08.com.qsan:xs5216-000d40000:dev4.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
▼	5	None	iqn.2004-08.com.qsan:xs5216-000d40000:dev5.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
▼	6	None	iqn.2004-08.com.qsan:xs5216-000d40000:dev6.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
▼	7	None	iqn.2004-08.com.qsan:xs5216-000d40000:dev7.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
▼	8	None	iqn.2004-08.com.qsan:xs5216-000d40000:dev8.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
▼	9	None	iqn.2004-08.com.qsan:xs5216-000d40000:dev9.ctr1	10.10.1.101:3260, 10.10.1.102:3260	
< first <	<prev< td=""><td>1 2 3</td><td>4 5 6 7 8 9 10 next &gt; last &gt;&gt;</td><td></td><td></td></prev<>	1 2 3	4 5 6 7 8 9 10 next > last >>		

Figure 7-11 iSCSI Targets

### Change Authentication Mode

Click ▼ -> Authentication Method to enable CHAP (Challenge Handshake Authentication Protocol) and mutual CHAP authentication method used in point-to-point for user login. CHAP is a type of authentication in which the authentication server sends the client a key to be used for encrypting the username and password. It enables the username and password to transmit in an encrypted form for protection.

In addition, mutual CHAP is a two-way authentication between the iSCSI target and the initiator. User has to enter another username and password which are set in the initiator side.

# **C**SAN

Change Authentication Method			
Target : iqn.2004-08.com.qsa	n:xs5216-000d	40000:dev0.ctr1	
🗹 Enable CHAP 🚺			
Please select at least one CHA target. It allows multiple selec	AP user to prot ttion.	ect the iSCSI	
CHAP Username :	chap1 chap2	-	
		Ŧ	
🗆 Mutual CHAP 🕕			
Username :		0	
Password :		0	
			OK Cancel

Figure 7-12 Authentication Method

Here is an example of changing the authentication method.

- 1. Check **Enable CHAP** to enable CHAP authentication.
- 2. Select the CHAP usernames that you would like to have access to this target. CHAP users can be more than one, but it must be at least one CHAP to enable on the target.
- 3. If necessary, check Mutual CHAP to enable mutual CHAP authentication.
- 4. Enter **Username** of mutual CHAP user. The maximum length of the username is 223 characters. Valid characters are [ A~Z | a~z | 0~9 | ~!@#%^&\*\_-+=|(){}[];;<>.?/].
- 5. Enter **Password** (mutual CHAP secret). The length of the password is between 12 to 16 characters. Valid characters are [ A~Z | a~z | 0~9 | ~!@#\$%^&\*\_-+=`|\(){}[];,"'<>,.?/].
- 6. Click the **OK** button to change the authentication method.





#### TIP:

A CHAP account must be added before you can use this authentication method. Please refer to the chapter 7.3.4, <u>Configure iSCSI CHAP</u> <u>Accounts</u> section to create an account.

After enabling the CHAP authentication mode, the host initiator should be set with the same CHAP account. Otherwise, the host cannot connect to the volume.

### Change Target Name

Click  $\vee$  -> Change Target Name to change iSCSI target name if necessary. The maximum length of the target name is 223 characters. Valid characters are [  $a \sim z \mid 0 \sim 9 \mid -.:$  ].

Change Target Nam	e	
To change iSCSI Ta	arget Name, enter the name below and click the OK button.	
Target Name:	iqn.2004-08.com.qsan:xs7216-000d40000	:dev0.ctr1 (1
		OK Cancel

Figure 7-13 Change Target Name

### Change Network Portal

Click ▼ -> Change Network Portal, and then select the network ports that you would like to be available for this iSCSI target.

Change Network Portal					
Select the network por	s that you would like to be available for this iSCSI target.				
Available On:					
	✓192.168.2.1 (Onboard LAN2)				
	OK Cance	el			

Figure 7-14 Change Network Portal



### **Change Alias**

Click  $\vee$  -> Change Alias to add or change the alias name. To remove an alias, clear out the current name. The maximum length of the alias name is 223 characters. Valid characters are [  $a \sim z \mid 0 \sim 9 \mid -::$  ].

Change Alias					
To add or cha current name	ange the alias name, enter the name below and press OK. To remove an alias, clear out and press OK.	the			
Alias Name:	alias-0	0			
		OK Cancel			

Figure 7-15 Change Alias

## 7.3.4. Configure iSCSI CHAP Accounts

Select the **CHAP Accounts** function tab in the **iSCSI Ports** function submenu to manage the CHAP accounts on the system.

### Create a CHAP user

Here is an example of creating a CHAP user.

1. Select the **CHAP Account** function tab of the **iSCSI Ports** function submenu, click the **Create CHAP User** button.



	,,	elect maniple talgete.	
Username:	chap1	0	
Password:	•••••	0	
Confirm Password:	•••••		
Targets:	0 ▲ 1 2 3 4 5 6 7 8 9 ▼		

Figure 7-16 Create a CHAP User

- 2. Enter **Username** of CHAP user. The maximum length of the username is 223 characters. Valid characters are [ A~Z | a~z | 0~9 | ~!@#%^&\*\_-+=|(){]:;<>.?/].
- Enter Password (CHAP secret) and Confirm Password. The length of the password is between 12 to 16 characters. Valid characters are [A~Z | a~z | 0~9 | ~!@#\$%^&\*\_-+=`|\(){[];;"'<>,.?/].
- 4. Select the targets using this CHAP user.
- 5. Click the **OK** button to create a CHAP user.

### List CHAP Users

Here is an example of list CHAP users. The CHAP account properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the CHAP account.



	CHAP Username	Access to Targets			
▼	chap1	0			
▼	chap2	1, 2			
· · · · · · · · · · · · · · · · · · ·					
Create CHAP User					

Figure 7-17 List CHAP Users

### **Modify CHAP User**

Click ▼ -> Modify CHAP User to modify the selected CHAP user information. To change the targets that this user has access to, please go to **iSCSI Targets** tab, click on the option menu, and select Change CHAP Users. For more information, please refer to the chapter 7.3.3, Configure for iSCSI Targets section.

Modify CHAP User			
You can change the ( user has access to, p Change CHAP Users	CHAP user's information below. To chan lease go to iSCSI Targets, click on the	nge the targets that this e option menu, and select	_
Username:	chap1	0	
Password:	•••••	0	
Confirm Password:	•••••		
			_
		ОК	Cancel

Figure 7-18 Modify a CHAP User

Here is an example of modifying the CHAP user.

- 6. Enter **Username** of CHAP user. The maximum length of the username is 223 characters. Valid characters are [ A~Z | a~z | 0~9 | ~!@#%^&\*\_-+=|(){[]:;<>.?/].
- Enter Password (CHAP secret) and Confirm Password. The length of the password is between 12 to 16 characters. Valid characters are [ A~Z | a~z | 0~9 | ~!@#\$%^&\*\_-+=`|\(){[]:;""<>,.?/].
- 8. Click the **OK** button to modify the CHAP user.

### **Delete CHAP User**

Click ▼ -> **Delete CHAP User** to delete the selected CHAP user.



# 7.3.5. Active Sessions

Select the **Sessions** function tab in the **iSCSI Ports** function submenu to shows all currently active iSCSI sessions and their connection information.

Controller 1						
	No.	TSIH	Initiator Name	Target Name		
•	0	0x0008	iqn.1991-05.com.microsoft:win-hevb9u50pv9	iqn.2004-08.com.qsan:xs5224-0001246a0:dev7.ctr1		
▼	1	0x0009	iqn.1991-05.com.microsoft:win-hevb9u50pv9	iqn.2004-08.com.qsan:xs5224-0001246a0:dev8.ctr1		
▼	2	0x0006	iqn.1991-05.com.microsoft:win-hevb9u50pv9	iqn.2004-08.com.qsan:xs5224-0001246a0:dev5.ctr1		
V	3	0x0007	iqn.1991-05.com.microsoft:win-hevb9u50pv9	iqn.2004-08.com.qsan:xs5224-0001246a0:dev6.ctr1		

Figure 7-19 Active Sessions

This table shows the column descriptions.

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
	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.
MaxDataBurstLe	MaxDataBurstLen (Maximum Data Burst Length) determines the
n	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

### Table 7-3 Active Sessions Column Descriptions



|--|

### **List Connection Details**

Click ▼ -> Connection Details which will list all connection(s) of the selected session.

### **Disconnect Session**

Click ▼ -> **Disconnect** will disconnect the selected session, click the **OK** button to confirm.

# 7.4. Configure Fibre Channel Connectivity

Select the **Fibre Channel Ports** function submenu to show information of installed fibre channel ports. The fibre channel port properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific fibre channel port.



Figure 7-20 Fibre Channel Ports Function Submenu



	Location	Name	Status	Change Topology	WWNN/WWPN	Loss of Signal	Loss of Sync	Link Failure	Invalid CR0
•	Slot1	FC1 ( 16Gb )	16Gb/s	Point-to-Point	WWNN: 2000001378124770 WWPN: 2100001378124770	0	655	0	0
•	Slot1	FC2 ( 16Gb )	Down	NA	WWNN: 2000001378124770 WWPN: 2200001378124770	0	0	0	0
V	Slot1	FC3 ( 16Gb )	Down	NA	WWNN: 2000001378124770 WWPN: 2300001378124770	0	0	0	0
•	Slot1	FC4 ( 16Gb )	Down	NA	WWNN: 2000001378124770 WWPN: 2400001378124770	0	0	0	0
ntrolle	er 2 Location	Name	Status	Change Topology	WWNN/WWPN	Loss of Signal	Loss of Sync	Link Failure	Invalid CR
ntrolle	er 2 Location Slot1	Name FC1(16Gb)	Status 16Gb/s	Change Topology Point-to-Point	WWNN/WWPN WWNN: 2000001378124770 WWPN: 2900001378124770	Loss of Signal	Loss of Sync	Link Failure	Invalid CR
ntrolle	Er 2 Location Slot1 Slot1	Name FC1 ( 16Gb ) FC2 ( 16Gb )	Status 16Gb/s Down	Change Topology Point-to-Point NA	WWNN/WWPN WWNN: 2000001378124770 WWPN: 2900001378124770 WWNN: 2000001378124770 WWPN: 2A00001378124770	Loss of Signal 0 0	Loss of Sync 561 0	Link Failure 0 0	Invalid CR 0 0
ntrolle	Location Slot1 Slot1 Slot1	Name FC1 (16Gb) FC2 (16Gb) FC3 (16Gb)	Status 16Gb/s Down Down	Change Topology Point-to-Point NA NA	WWNN/WWPN WWNN: 2000001378124770 WWPN: 2900001378124770 WWNN: 2000001378124770 WWPN: 2A00001378124770 WWNN: 2000001378124770 WWPN: 2B00001378124770	Loss of Signal 0 0	Loss of Sync 561 0 0	Link Failure 0 0 0 0 0	Invalid CF 0 0 0

Figure 7-21 List Fibre Channel Ports

The columns display information of **Location**, **Name**, **Status**, **Topology**, **WWNN** (World Wide Node Name), **WWPN** (World Wide Port Name), and some statistical information.

## 7.4.1. Configure Fibre Channel Link Speed

Click ▼ -> Change Link Speed to change the link speed of fibre channel.

### **Options of Change Link Speed**

The option available in this tab:

• Link Speed: Set the link speed of fibre channel. The options are Automatic (default), 4Gb/s to 32Gb/s. Recommend to set it as Automatic to detect the data rate automatically.

## 7.4.2. Configure Fibre Channel Topology

Click ▼ -> **Change Topology** to change the topology of fibre channel.

# **CSAN**

Change Topology		
Change the topology below		
Change Topology :	Point-to-Point 🔻	
	Point-to-Point	
	Loop	OK Cance

Figure 7-22 Change Topology

### **Options of Change Topology**

The option available in this tab:

• **Topology:** Set the topology fibre channel. The option Point-to-Point is for 16Gb/s and 32Gb/s fibre channel, Point-to-Point and Loop modes are for 4Gb/s and 8Gb/s fibre channel. Set it appropriately according to your fibre channel environment.



### **INFORMATION:**

**Point-to-Point (FC-P2P):** Two devices are connected directly by FC interface. This is the simplest topology with limited connectivity and supports 4Gb/s, 8Gb/s, 16Gb/s, and 32Gb/s fibre channel speed.

**Loop (FC-AL, Arbitrated Loop):** All devices are connection in loop or ring, similar to token ring networking. Add or remove any device will affect activities on the loop. The failure of any device will cause ring broken. Fibre Channel hub connects multiple devices together and may bypass the failed ports. A loop may also be made by cabling each port to the next in a ring. Loop mode supports 4Gb/s and 8Gb/s fibre channel speed only.



### CAUTION:

If the link speed and topology are set, the related fibre channel switch and HBA on host must be set, too. Otherwise, the connection cannot work properly.

# 7.4.3. Configure Fibre Channel Targets

Click ▼ -> **Target Configuration** to set multi-target configurations which are accessible by the host.



Target Configuration		
Target List :	All	
	🖉 Target 1 🗹 Target 2 🗹 Target 3 🗹 Target 4	
	🕑 Target 5 🗹 Target 6 🗹 Target 7 🗹 Target 8	
	🗹 Target 9 🗹 Target 10 🗹 Target 11 🗹 Target 12	
	Target 13 Target 14 Target 15 Target 16	
	Target 17 Target 18 Target 19 Target 20	
	Target 21 Target 22 Target 23 Target 24	
	Target 25 Target 26 Target 27 Target 28	
	Target 29 Target 30 Target 31 Target 32	
	✓ Target 33 ✓ Target 34 ✓ Target 35 ✓ Target 36	
	I larget 37 € larget 38 € larget 39 € larget 40	
	Iarget 41 € larget 42 € larget 43 € larget 44	
	■ larget 45 ■ larget 46 ■ larget 47 ■ larget 48	
	✓ Target 49 € Target 50 € Target 51 € Target 52	
	Target 55 Target 54 Target 55 Target 56	
	Target 61 Stranget 62 Target 63 Target 64	
	arger of a larger oz a larger os a larger o4	
		OK Cancel

Figure 7-23 Target Configuration



#### CAUTION:

Point-to-Point connection mode does not support multi-target.

# 7.4.4. Clear Fibre Channel Counters

Click Clear All Counters button to clear all counters of fibre channels.

Click ▼ -> Clear Counters to clear the counters of the selected fibre channel.

# **OSAN**

# 8. Storage Management

This chapter describes storage technologies of RAID, storage pool, volume, and LUN mapping. Also includes the details of storage management operations and examples. The **STORAGE MANAGEMENT** function menu provides submenus of **Disks**, **Pools**, **Volume**, and **LUN Mappings**. In this chapter, we will focus on the fundamental storage architecture called thick provisioning. The advanced storage features and functions will be described in the following.

- Thin Provisioning feature is described in the <u>Thin Provisioning</u> chapter.
- Auto Tiering feature is described in the <u>Auto Tiering</u> chapter.
- SSD Cache feature is described in the <u>SSD Cache</u> chapter.
- SED (Self-Encrypting Drive) and ISE (Instant Secure Erase) drive support is described in the <u>SED and ISE Support</u> chapter.

The data backup functions are described in the following sections.

- Snapshot function is described in the <u>Managing Snapshots</u> section.
- Local Clone function is described in the <u>Manage Local Clones</u> section.
- Remote Replication function is described in the Managing Remote Replications section.

## 8.1. RAID Technology

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. In point view of the host, the operating system in host detects the RAID drive as a single storage device.

### 8.1.1. Traditional RAID Overview

The disk drives in storage are referred to as members of the array. Each array has a RAID level. RAID levels provide different degrees of redundancy and performance. They also have different restrictions regarding the quantity of member disk drives in the array. The following describe the features of RAID levels.



### RAID 0 (Striping, no redundancy)

RAID 0 consists of striping, without mirroring or parity. It has more than two disks in parallel, as a large-capacity disk. The capacity of a RAID 0 volume is the sum of the capacities of the disks. There is no added redundancy for handling disk failures. Thus, failure of one disk causes the loss of the entire RAID 0 volume. Striping distributes the contents roughly equally among all member disks, which makes concurrent read or write operations on the multiple disks and results in performance improvements. The concurrent operations make the throughput of most read and write operations equal to the throughput of one disk multiplied by the quantity of disk drives. Increased throughput is the big benefit of RAID 0, at the cost of increased vulnerability of data due to drive failures.

### RAID 1 (Mirroring between two disks)

RAID 1 consists of data mirroring, without parity or striping. Data is written identically to two drives, thereby producing a mirrored set of drives. Thus, any read request can be serviced by any member drive. Write throughput is always slower because every drive must be updated, and the slowest drive limits the write performance. The array continues to operate as long as at least one drive is functioning.

### N-way Mirror (Mirroring between N disks)

It's an extension of RAID 1. Data is written identically to N drives, thereby producing an Nway mirrored set of drives

# RAID 3 (Striping, can survive one disk drive fault, with parity on a dedicated disk drive)

RAID 3 consists of byte-level striping with dedicated parity. All disk spindle rotation is synchronized and data is striped such that each sequential byte is on a different drive. Parity is calculated across corresponding bytes and stored on a dedicated parity drive. The data disperses on a different hard drive, even if you want to read short information, it may need all the hard drives to work. So this is more suitable for large amounts of read data requests.

# RAID 5 (Striping, can survive one disk drive fault, with interspersed parity over the member disk drives)

RAID 5 consists of block-level striping with distributed parity. It requires at least three disk drives. Upon failure of a single drive, subsequent reads can be calculated from the distributed parity such that no data is lost. RAID 5 is seriously affected by the general trends



regarding array rebuild time and the chance of disk drive failure during rebuild. Rebuilding an array requires reading all data from all disks, opening a chance for a second disk drive failure and the loss of the entire array.

# RAID 6 (Striping, can survive two disk drive faults, with interspersed parity over the member disk drives)

RAID 6 consists of block-level striping with double distributed parity. It requires a minimum of four disks. Double parity provides fault tolerance up to two failed disk drives. This makes larger RAID groups more practical, especially for high-availability systems, as large-capacity drives take longer to restore. As with RAID 5, a single drive failure results in reduced performance of the entire array until the failed drive has been replaced. With a RAID 6 array, using drives from multiple sources and manufacturers, it is possible to mitigate most of the problems associated with RAID 5. The larger the drive capacities and the larger the array size, the more important it becomes to choose RAID 6 instead of RAID 5.

### RAID 0+1 (RAID 1 on top of RAID 0)

RAID 0+1 creates a second striped set to mirror a primary striped set. The array continues to operate with one or more drives failed in the same mirror set, but if drives fail on both sides of the mirror, the data on the RAID system is lost.

### RAID 10 (RAID 0 on top of RAID 1)

RAID 10 creates a striped set from a series of mirrored disk drives. The array can sustain multiple drive losses so long as no mirror loses all its drives.

### RAID 30 (RAID 3 on top of RAID 0)

RAID 30 is the combination of RAID 3 and RAID 0, do RAID 3 first, further RAID 0. It is composed of multiple sets of RAID 3 stripe access to each other. Because RAID 30 is based on RAID 3 which requires at least three disk drives, therefore RAID 30 is constituted a plurality RAID 3, at least six disk drives. RAID 30 can still operate when appearing a damaged disk drive in disk group of RAID 3. But if any one group of RAID 3 appears two or two or more disk drives damaged, the entire RAID 30 will fail.

### RAID 50 (RAID 5 on top of RAID 0)

RAID 50 is the combination of RAID 5 and RAID 0, do RAID 5 first, further RAID 0. The concept is the same as RAID 30. RAID 50 requires at least six disk drives. Since RAID 50



constitutes stripe of multiple disk group of RAID 5, it has higher performance than RAID 5, but capacity utilization is lower than RAID 5.

### RAID 60 (RAID 6 on top of RAID 0)

RAID 60 is the combination of RAID 6 and RAID 0, do RAID 6 first, further RAID 0. In other words, it accesses stripes for more than two groups of RAID 6. RAID 6 needs to have at least four disk drives, so the minimum requirement of RAID 60 is eight disk drives.

RAID 60 can tolerate maximum two damage disk drives in any disk group of RAID 6, while it still maintains the operating, but as long as it damages three drives in any group of RAID 6, the entire RAID 60 will fail. Of course, the probability of this case is quite low.

Compared to a simple RAID 6, RAID 60 binds stripes through multiple of RAID 6. Therefore it has higher performance. However, high threshold usage and the capacity utilization rate are major problems.

### **RAID Level Summary**

The following is the summary of the RAID levels.



Table 8-1 RAI	D Level Summa	ary - 1			
	RAID 0	RAID 1	RAID 3	RAID 6	N-way
			RAID 5		Mirror
Min. # Drives	1	2	3	4	3
Fault Tolerance	No	One drive	One drive	Two drive	N-1 drive
	protection	failure	failure	failures	failures
Read	Very Good	Very Good	Very Good	Very Good	Very Good
Performance					
Write	Excellent	Good	Good	Fair to Good	Fair
Performance					
Capacity	N×M	N/2 x M	(N-1) x M	(N-2) x M	(N/N) x M
(N = drive quantity,	(e.g., 8 drives x	(e.g., 8 drives /	(e.g., (8 drives	(e.g., (8 drives	(e.g., 8 drives /
M = drive capacity,	1TB = 8TB)	2 x 1TB = 4TB)	-1) x 1TB =	-2) x 1TB =	8 x 1TB = 1TB)
G = subgroups)	100%	50%	67% av 96%	50% ~ 02%	1% ~ 22%
Utilization	(e.g. 8/8 =	(e.g. 4/8 =	$(e_{1}, \frac{7}{8}) =$	$(e_{1}, 6/8 =$	4 % ~ 33 %
(Min.~26 drives)	100%)	(c.g., 4/0 = 50%)	88%)	(c.g., 0, 0 = 75%)	13%)
Typical	High end	Operating	Data	Data	Operating
Applications	workstation,	system,	warehouse,	archive,	system,
	Data	Transaction	Web	High	Transaction
	logging,	database	service,	Availability	database
	Real-time		Archive	solution,	
	rendering,			Server with	
	Very			large	
	transitory			capacity	
	data			requirement	



		<i>ary 2</i>			
RAID Level	RAID 0+1	RAID 10	RAID 30	RAID 50	RAID 60
Min. # Drives	4	4	6	6	8
Fault Tolerance	One drive	One drive	One drive	One drive	Two drive
	failure in	failure in	failure in	failure in	failures in
	each sub-	each sub-	each sub-	each sub-	each sub-
	group	group	group	group	group
Read	Excellent	Excellent	Very Good	Very Good	Very Good
Performance					
Write	Very Good	Very Good	Good	Good	Fair to Good
Performance					
Capacity	N/2 x M	G x M	(N-G) x M	(N-G) x M	(N-2xG) x M
(N = drive quantity,	(e.g., 8 drives /	(e.g., (2	(e.g., (8 drives	(e.g., (8 drives	(e.g., (8 drives
M = drive capacity,	2 x 1TB = 4TB)	subgroups) x	- 2 subgroups)	- 2 subgroups)	- 2 x 2
G = subgroups)		11B = 21B)	x 1   B = 6   B)	x 1   B = 6   B)	subgroups) x 1TB = 4TB)
Capacity	50%	8% ~ 50%	67% ~ 92%	67% ~ 92%	50% ~ 85%
Utilization	(e.g., 4/8 =	(e.g., 2/8 =	(e.g., 6/8 =	(e.g., 6/8 =	(e.g., 4/8 =
(Min.~26 drives)	50%)	25%)	75%)	75%)	50%)
Typical	Fast	Fast	Large	Large	Data
Applications	Database,	Database,	database,	database,	archive,
	Application	Application	File server,	File server,	High
	Server	Server	Application	Application	Availability
			server	server	solution,
					Server with
					large
					capacity
					requirement

Table 8-2	RAID Level Summarv - 2
1 4010 0 2	

SANOS supports hot spare drives. When a member disk drive in array fails, the system automatically replaces the failed member with a hot spare drive and rebuilds the array to restore its redundancy. Candidate and spare drives can be manually exchanged with array members. For more information, please refer to the chapter 15.2, <u>Rebuild</u> section in the Troubleshooting chapter.



## 8.1.2. RAID EE Overview

RAID (Redundant Array of Independent Disks) is to combine multiple independent physical disks based on a certain algorithm to form a virtual logical disk that provides a larger capacity, higher performance, or better data error tolerance. RAID has been the basic technology of storage system as a mature and reliable data protection standard. However, with the rapid growth in demand of disk drive for data storage and the advent of high-performance applications in recent years, traditional RAID has gradually revealed its defects.

As hard disk capacity increases, the amount of time required to rebuild RAID data has also dramatically increased. This makes one of the most troubles for enterprise storage management today. In the past days when the hard disk capacity was only 10GB to 100GB, RAID built was a job that could be completed in 10 minutes or even more than 10 minutes, which was not yet a problem without special concern. However, as disk capacity grows to hundreds of GB and even TB, RAID rebuild times have increased to hours or even days, it becomes a major problem in storage management.

For example, a traditional RAID 5 with 8 and 1 parity on 6TB NL-SAS disk drives takes 2.5 days to rebuild data. The rebuild process consumes system resources, reducing the overall performance of the application system. If users restrict the rebuild priority, the rebuild time will be even longer. The important of all, during time-consuming rebuilding, a large number of access operations could cause the failure of other disk drives in the pool, greatly increasing the probability of disk failure and the risk of data loss.

### Limitations of Traditional RAID Architecture

The traditional RAID architecture is composed of a certain number of disk drives which are selected to form a disk group (also known as RAID group). You may also assign some disk drives as idle hot spare disk drives. A storage pool is grouped to provide capacity for volumes, and then finally map the LUN to the host to become the storage space on the host.

There are several limitations in such RAID architecture:

- First of all, when a disk drive of the disk group is damaged and the rebuild is required, only the member disks of the disk group participates in the rebuild job, and the data writing loading at the time is concentrated on the spare disk to form a bottleneck.
- Second, volume data access is limited to the member disks belonging to a disk group; this restricts the performance available to the host because the storage is executing both accessing and rebuilding I/O.


#### Why RAID Rebuild Time-Consuming

As drive capacity grows, RAID rebuild time grows linearly, raising the rebuild time required by traditional RAID architectures to tens of hours when using RAID disks with more than 4TB HDD capacity.

There are several factors that affect the RAID rebuild time:

- **HDD Capacity:** The HDD capacity makes up the disk group, the larger the HDD capacity, the longer the rebuild time is required.
- **Quantity of Disk Drives:** The quantity of disk drives included in a disk group affects the amount of time it takes for the system to read data from the remaining healthy disk drives and write them to the hot spare disk drives. The more disk disks, the longer the rebuild time.
- **Rebuild Job Priority:** During RAID rebuild, the system still has to assume I/O access to the front-end host. The higher the priority assigned to the RAID rebuild job, the faster the rebuild, but the less the front-end host gains I/O performance.
- **Fast Rebuild:** Enabling fast rebuild function only need to rebuild the actual capacity of the volume, unused disk group space has not to rebuild. If only part of the space in a disk group is used by the volume, the rebuild time will be shortened.
- **RAID level:** RAID 1 and RAID 10 with direct block-to-block replication will rebuild faster than RAID 5 and RAID 6 with parity calculations.

Given the potential for failure on each disk drive, the more disk drives contain in a disk group, the more possibility of cumulative failure increase, so there is an upper limit on the quantity of disk drives in a disk group. Compared with the previous factors, the increasing impact of the disk drive capacity on the rebuild speed has become the primary factor. Such a long rebuild time is apparently not acceptable to any user. To solve the problems of traditional RAID, we implement RAID EE technology.

## 8.1.3. Theory of RAID EE Operation

RAID EE adds more spare disks in a disk group, we call them **RAID EE spares** to separate the original global, local, and dedicated spares. Spare areas are preserved in each stripe of the disk group and are distributed in the disk group by means of disk rotation. When disks have failed in the disk group, missing data is rebuilt into the preserved spare areas. Since all disks in the set are destination of rebuilt data, the bottleneck of traditional RAID rebuild is gone, rebuild performance dramatically improved. If new disks are added in, data in spare areas are copied back to new joined disks.

Four new RAID levels are provided for RAID EE, there are:



- RAID 5EE (E stands for Enhanced), requires a minimum of 4 disk drives with one RAID EE spare disk which can tolerate 2 disk drives failure. Adding more RAID EE spares will tolerate more disk drives failure.
- RAID 6EE requires a minimum of 5 disk drives.
- RAID 50EE requires a minimum of 7 drives.
- RAID 60EE requires a minimum of 9 drives.



#### **INFORMATION:**

The RAID EE spare quantity in a disk group is 1 to 8 disk drives.

#### Example of RAID 5EE with 1 RAID EE spare

Now we take an example to describe how it works. The following example is a RAID 5EE with 5 disks. 4 disks are for RAID disks, and additional one disk is for RAID EE spare. After initialization, data block distribution is as follows. P is stands for parity, S is stands for RAID EE spare, and it is empty now.



Figure 8-1 Data Block Distributed of RAID 5EE

Assume that disk 2 has failed. RAID 5EE is under degraded mode.





Figure 8-2 Disk 2 has Failed

The spare areas are rebuilt with data from the failed disk drive. This action is called **EE Rebuild**. After rebuild, data distributed is like RAID 5 and it can tolerate another failed disk drive. As we can imagine, the more RAID EE spare disks, the faster it rebuilds.

D1	D3	D4	D5
1	3	Ρ	2
4	5	6	Ρ
Ρ	7	8	9
10	Р	11	12
13	Ρ	14	15

Figure 8-3 Empty Blocks are Rebuilt from the Failed Disk Drive

When a new disk drive is joined into the RAID EE disk group, the data rebuilt in the spare area will be copied back to the new disk. This action is called **Copyback**.

# **C**SAN



Figure 8-4 Data is copied back

After copied back, it is back to RAID 5EE normal state.

### Example of RAID 60EE with 2 RAID EE spares

Take another example of a RAID 60EE with 10 disks. 8 disks are for RAID disks, and 2 disks are for RAID EE spares. After initialization, data block distribution is as follows.

← Quantity of Disk Group = 10								$\rightarrow$	
< ──	– Subgr	oup 1 –	$\rightarrow$	<	– Subgr	oup 2 -	$\rightarrow$	← Spar	re=2 →
D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
1	2	Ρ	Q	3	4	Р	Q	S	S
S	5	6	Р	Q	7	8	Р	Q	S
S	S	9	10	Ρ	Q	11	12	Р	Q
Q	S	S	13	14	Р	Q	15	16	Р
Ρ	Q	S	S	17	18	Ρ	Q	19	20
24	Р	Q	S	S	21	22	Р	Q	23
27	28	Р	Q	S	S	25	26	Ρ	Q
Q	31	32	Ρ	Q	S	S	29	30	Р
Ρ	Q	35	36	Ρ	Q	S	S	33	34
38	Р	Q	39	40	Р	Q	S	S	37

Figure 8-5 Data Block Distributed of RAID 60EE

Rebuild and copy back of RAID 60EE is similar as the above; it will not be repeated here.

#### **RAID EE Level Summary**

The following is the summary of the RAID EE levels.

	RAID 5EE	RAID 6EE	RAID 50EE	RAID 60EE
Min. # Drives	4	5	7	9
Fault Tolerance	2 ~ 9 drive	3 ~ 10 drive	G+1 ~ G+8	2xG+1 ~
(G = subgroups,	failure	failures	drive failure	2xG+8 drive
S = RAID EE spares = 1	(e.g., 1 (RAID 5) +	(e.g., 2 (RAID 6) +	(e.g., 2 subgroups	failures
~ 8)	S spares)	S spares)	(RAID 50) + S spares)	(e.g., 2x2 (RAID
Dood Doutouroon	Vary Cood	Vary Cood	Van Caad	Vory Cood
Read Performance	very Good	very Good	very Good	very Good
Write Performance	Good	Fair to Good	Good	Fair to Good
Capacity	(N-1-S) x M	(N-2-S) x M	(N-G-S) x M	(N-2xG-S) x M
(N = drive quantity,	(e.g., (10 drives –	(e.g., (10 drives - 2	(e.g., (10 drives - 2	(e.g., (10 drives - 2
M = drive capacity,	1 – 2 spares) x	-2 spares) x 1TB =	subgroups - 2	x 2 subgroups - 2
G = subgroups,	1TB = 7TB)	6TB)	spares) x 1TB =	spares) x 1TB =
S = RAID EE spares)			6TB)	4TB)
Capacity Utilization	18% ~ 92%	17% ~ 88%	29% ~ 88%	25% ~ 80%
(Min.~26 drives)	(e.g., 7/10 = 70%)	(e.g., 6/10 = 60%)	(e.g., 6/10 = 60%)	(e.g., 4/10 = 40%)
Typical	Same as RAID	Same as RAID	Same as RAID	Same as RAID
Applications	5	6	50	60

Table 8-3RAID EE Level Summary



#### **INFORMATION:**

RAID EE technology is available in SANOS firmware 1.3.0.

## 8.2. SANOS Storage Architecture

This section describes the SANOS storage architecture including pool, volume, LUN mapping, and hot spares.



## 8.2.1. Pool Technology

A storage pool is a collection of disk drives. It has three pool types which are listed in the following.

- Thick or fat provisioning pool, we use the term of thick provisioning pool in the following.
- Thin provisioning pool
- Auto tiering pool

We describe thick provisioning pool here, and introduce thin provisioning in the <u>Thin</u> <u>Provisioning</u> chapter and auto tiering in the <u>Auto Tiering</u> chapter.

A thick provisioning pool is a collection of disk groups which contain disk drives and made up a RAID. A storage pool is grouped to provide capacity for volumes. Volumes are then allocated out of the storage pool and are mapped to LUN which can be accessed by a host system. The following is the storage architecture of a thick provisioning pool.



Figure 8-6 Storage Architecture of Thick Provisioning Pool

In thick provisioning pool, there are two methods to increase the capacity of the pool. They are migration or adding disk groups. For migration, disk drives can be added to a disk group at any time, no matter the disk drives are from the head SAN system or from expansion units. Or disk drives can be added to upgrade the RAID level in a thick provisioning pool. For example, you can migrate RAID 5 to RAID 6 by adding disk drives because RAID 6 needs one more disk drive for parity.

The other method is adding other disk groups which contain disk drives to increase the capacity of the pool. A thick provisioning pool can have up to 32 disk groups with each disk



group containing up to 64 disk drives. And the maximum disk drive quantity in a pool is 256. For more information about pool operation, please refer to the chapter 8.4, <u>Configuring</u> <u>Thick Provisioning Pools</u> section.



#### **INFORMATION:**

To support disk group storage architecture in thick provisioning pool starts from SANOS firmware 1.2.0.

#### Table 8-4Thick Provisioning Pool Parameters

Item	Value
Maximum disk group quantity in a pool	32
Maximum disk drive quantity in a disk group	64
(include dedicated spares)	
Maximum RAID EE spare quantity in a disk group	8
Maximum disk drive quantity in a pool	256
(include dedicated spares)	
Maximum pool quantity per system	64
Maximum dedicated spare quantity in a pool	8
Maximum addressable capacity of a disk group	640TB
	(calculated by 10TB HDD)
Maximum addressable capacity of a thick provisioning pool	2,560TB
	(calculated by 10TB HDD)
Maximum addressable capacity of total thick provisioning	Unlimited
pools	

## 8.2.2. Migrate vs. Add Disk Group

In thick provisioning pool, there are two methods to increase the capacity of the pool. Migration takes a long time and risk during migration. But after migration, it is more efficient than adding disk groups. By this way, it can also migrate RAID level to get a better protection.

With adding disk group, it can increase the capacity immediately but cannot change the quantity or RAID level after adding this disk group. User can evaluate the advantages and disadvantages to choose the best way.

# **OSAN**

## 8.2.3. Volume Technology

A volume is a logical disk that is presented to a host system. The capacity is provided by pool. Each pool can be divided into several volumes. The volumes in one pool share the same RAID level, but may have different volume capacity.



Figure 8-7 Volume in Storage Architecture

Volume is a basic unit of data backup. Base on the volume, SANOS provides snapshot, local clone, and remote replication functions. For more information about data backup, please refer to the chapter 12, <u>Data Backup</u> chapter.

A pool contains up to 96 volumes and a system can contain up to 4,096 volumes including snapshot volumes. For more information about volume operation, please refer to the chapter 8.5, <u>Configuring Volumes</u> section.

Item	Value
Maximum volume quantity in a pool	96
Maximum volume quantity per system	4,096
(include snapshot volumes)	
Maximum host number per volume	16
Maximum addressable volume capacity of a thick	2,560TB
provisioning pool	(calculated by 10TB HDD)
Maximum addressable volume capacity of a thin	256TB

Table 8-5 Volumes Parameters



provisioning pool	
Maximum addressable volume capacity of an auto tiering	256TB
pool	

## 8.2.4. LUN Technology

LUN (Logical Unit Number) is a number used to identify a logical unit, which is a device addressed by the SCSI protocol or Storage Area Network protocols which encapsulate SCSI, such as Fibre Channel or iSCSI.

The LUN is not the only way to identify a logical unit. There is also the SCSI device ID, which identifies a logical unit uniquely in the world. Labels or serial numbers stored in a logical unit's storage volume often serve to identify the logical unit. However, the LUN is the only way for an initiator to address a command to a particular logical unit, so initiators often create, via a discovery process, a mapping table of LUN to other identifiers.

There is one LUN which is required to exist in every target: LUN 0. The logical unit with LUN 0 is special in that it must implement a few specific commands, most notably report LUNs, which is how an initiator can find out all the other LUNs in the target. LUN 0 does not provide any other services, such as a storage volume. Many SCSI targets contain only one logical unit (so its LUN is necessarily 0). Others have a small number of logical units that correspond to separate physical devices and have fixed LUNs. A large storage system may have up to thousands of logical units, defined logically, by administrative command, and the administrator may choose the LUN or the system may choose it.





#### Figure 8-8 LUM Mappings in Storage Architecture

Volumes are then allocated out of the storage pool and are mapped to LUN which can be accessed by a host system. In Figure 8-3, a LUN can be accessed by cluster with two or more hosts via iSCSI. Or can be accessed by MPIO to provide HA (High Availability) architecture and increase the access bandwidth. The snapshot volumes can also be mapped to a LUN. The same, the read-only snapshot LUN can be read by the host, and the writable snapshot LUN can be read/write.

A SANOS system can contain up to 4,096 LUNs which includes the total of volume LUN mappings and snapshot volume LUN mappings.

Table 8-6	LUN Parameters	
Item		Value
Maximum L	UN quantity per system	4,096

For more information about LUN mapping operation, please refer to the chapter 8.6, <u>Configure LUN Mappings</u> section.

### 8.2.5. Hot Spares

A hot spare disk is a disk used to automatically or manually replace a failing or failed disk in a RAID configuration. The hot spare disk reduces the MTTR (Mean Time To Recovery) for the RAID redundancy group, thus reducing the probability of a second disk failure and the resultant data loss that would occur in any singly redundant RAID (e.g., RAID 1, RAID 5, or RAID 10). Typically, a hot spare is available to replace some different disks and systems employing a hot spare normally require a redundant group to allow time for the data to be generated onto the spare disk. During this time the system is exposed to data loss due to a subsequent failure, and therefore the automatic switching to a spare disk reduces the time of exposure to that risk compared to manual discovery and implementation.

If one disk drive of the pool fails or has been removed from any singly redundant RAID, the pool status will change to degraded mode. At the moment, the SANOS system will search the spare disk to execute pool/volume/data rebuild into a healthy RAID drive.

There are three types of spare disk drive which can be set in function menu **Disks**:

• Dedicated Spare: Set a spare disk drive to a dedicated pool.



- **Local Spare**: Set a spare disk drive to the pools which located in the same enclosure. The enclosure is either in head unit or in one of expansion units.
- **Global Spare**: Set a spare disk drive to all pools which located whether in head unit and expansion unit.



When a member disk of the pool fails, the system will first search for a dedicated spare disk for the pool, if not present, search for a local spare instead, then eventually global spare disk. For more information about spare disk operation, please refer to the chapter 8.3.2, <u>Operations on Disks</u> section.

## 8.3. Working with Disk Drives

Select the **Disks** function submenu to display the status of the disk drives, set hot spares, check disk health, and update disk firmware. The entire SAN storage system can contain up to 10 expansion enclosures and 286 disk drives.





#### Figure 8-10 Disks Function Submenu





#### **INFORMATION:**

For deployment of the SAN system and expansion enclosures, please refer to the chapter 4, Deployment Types and Cabling in the <u>XCubeSAN</u> <u>Hardware Manual</u>.

Tahle 8-7	Enclosure	and Disk	Parameters
	LIICIOSUIE	and Disk	i arameters

Item	Value
Maximum expansion unit quantity in a system	10
Maximum disk quantity in a system	286

## 8.3.1. List Disks

The drop-down lists at the top enable you to select the enclosure from head unit (SAN system) or expansion units (expansion enclosures). The disk properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific disk drive.



#### **INFORMATION:**

Enclosure format: Enclosure ID ([Head Unit | Expansion Unit]: Model Name). For example: 0 (Head Unit: XS5216), 1 (Expansion Unit: XD5316)

## **OSAN**

#### Enclosure ID: 0 (Head Unit: XS5216) 🔻

	Slot	Status	Health	Encryption	SED / ISE Status	Capacity	Disk Type	Usage	Pool Name	Manufacturer	Model
	1	Online	Good	None	N/A	372.36 GB	SAS SSD 12.0Gb/s	Free		SEAGATE	ST400FM0053
	2	Online	Good	None	N/A	372.36 GB	SAS SSD 12.0Gb/s	Free		SEAGATE	ST400FM005
	3	Online	Good	None	N/A	372.36 GB	SAS SSD 12.0Gb/s	Free		SEAGATE	ST400FM005
	4	Online	Good	None	N/A	372.36 GB	SAS SSD 12.0Gb/s	Free		SEAGATE	ST400FM005
]	5	Online	Good	None	N/A	744.96 GB	SAS SSD 12.0Gb/s	Free		MICRON	S630DC-800
	6	Online	Good	None	N/A	744.96 GB	SAS SSD 12.0Gb/s	Free		MICRON	S630DC-800
	7	Online	Good	None	N/A	744.96 GB	SAS SSD 12.0Gb/s	Free		MICRON	S630DC-800
	8	Online	Good	None	N/A	744.96 GB	SAS SSD 12.0Gb/s	Free		MICRON	S630DC-800
	9	Online	Good	None	N/A	1.09 TB	SAS HDD 12.0Gb/s	Free		SEAGATE	ST1200MM0
	10	Online	Good	None	N/A	1.09 TB	SAS HDD 12.0Gb/s	Free		SEAGATE	ST1200MM0
]	11	Online	Good	None	N/A	1.09 TB	SAS HDD 12.0Gb/s	Free		SEAGATE	ST1200MM0
	12	Online	Good	None	N/A	1.09 TB	SAS HDD 12.0Gb/s	Free		SEAGATE	ST1200MM0
	13	Online	Good	None	N/A	5.46 TB	NL-SAS HDD 12.0Gb/s	Free		SEAGATE	ST6000NM00
	14	Online	Good	None	N/A	5.46 TB	NL-SAS HDD 12.0Gb/s	Free		SEAGATE	ST6000NM00
	15	Online	Good	None	N/A	5.46 TB	NL-SAS HDD 12.0Gb/s	Free		SEAGATE	ST6000NM0
1	16	Online	Good	None	N/A	5.46 TB	NL-SAS HDD 12.0Gb/s	Free		SEAGATE	ST6000NM0

 Disk Health Check
 View Disk Check Report
 Instant Erase

Figure 8-11 List Disks

This table shows the column descriptions.

Column Name	Description
Slot	The position of the disk drive.
Status	The status of the disk drive:
	Online: The disk drive is online.
	Rebuilding: The disk drive is being rebuilt.
	• Transitioning: The disk drive is being migrated or is replaced by
	another disk when rebuilding occurs.
	• Scrubbing: The disk drive is being scrubbed.
	• Check Done: The disk drive has been checked the disk health.
	Copying Back: The disk drive is being copied back.
Health	The health of the disk drive:
	Good: The disk drive is good.
	• Failed: The disk drive has failed.
	Error Alert: S.M.A.R.T. error alerts.
	Read Errors: The disk drive has unrecoverable read errors.
Encryption	The data security mode of the disk drive:

Tahle 8-8	Disk Column	Descriptions



	SED: The disk drive is a Self-Encryping Drive.
	ISE: The disk drive is an Instant Secure Erase drive.
	• None: The disk drive does not have encryption function.
SED / ISE Status	The status of the SED:
	• Enabled: The SED is enabled.
	• Locked: The SED is locked. It must be unlocked by the correct AK
	before it can be used.
	• Disabled: The SED is disabled. It must be initiated before it can be
	used.
	Password Locked: The SED is locked by entering the incorrect
	password too many times.
	Unknown: The SED is unknown.
	Initiating: The SED is being initiated.
	Unlocking: The SED is being unlocked.
	• Erasing: The SED is being erased.
	• Changing Key: The SED is being changed the key.
	The status of the ISE:
	Normal: The ISE is normal.
	• Erasing: The ISE is being erased.
	Unknown: The ISE is unknown.
	The status of the Non SED/ISE:
	• N/A: The field is not applicable.
Capacity	The capacity of the disk drive.
Disk Type	The type of the disk drive:
	• [SAS HDD   NL-SAS HDD   SAS SSD   SATA SSD ]
	• [12.0Gb/s 6.0Gb/s 3.0Gb/s 1.5Gb/s]
Usage	The usage of the disk drive:
	Free: This disk drive is free for use.
	• RAID: This disk drive has been set to a pool.
	• SSD Cache: This SSD has been set to an SSD cache pool.
	Dedicated Spare: This disk drive has been set as dedicated spare     of a need
	UI a puul.
	and opuro
	<ul> <li>Clobal Spare: This dick drive has been act as global opera of</li> </ul>
	whole system
	whole system.



	<ul> <li>SSD Spare: This SSD has been set as dedicated SSD spare of an SSD cache pool.</li> </ul>
Pool Name	Which pool the disk drive belongs to.
Manufacturer	The manufacturer of the disk drive.
Model	The model name of the disk drive.

## 8.3.2. Operations on Disks

The options are available in this tab:

#### **Disk Health Check**

Click the **Disk Health Check** button to check the health of the selected disks. Also select the quantity of bad block to stop disk health check. And then click **OK** button to proceed. It cannot check disks which are currently in use.

Disk Health Check		
Disk Slot: Stop disk health check when the quantity of bad block is greater than:	Select Disks	
	OK Cancel	

Figure 8-12 Disk Health Check

#### **Disk Check Report**

Click the **Disk Check Report** button to download the disk check report. It's available after executing **Disk Health Check**.

#### Set Free Disk

Click ▼ -> Set Free Disk to make the selected disk drive be free for use.

#### Set Spare Disk

Click ▼ -> Set Global Spare to set the selected disk drive to global spare of all pools which located whether in head unit and expansion unit.



Click ▼ -> Set Local Spare to set the selected disk drive to local spare of the pools which located in the same enclosure. The enclosure is either in head unit or in one of expansion units.

Click ▼ -> Set Dedicated Spare to set the disk drive to dedicated spare of the selected pool.

For more information about hot spares, please refer to the chapter 8.2.4, <u>Hot Spares</u> section and the chapter 15.2, <u>Rebuild</u> section in the Troubleshooting chapter. Here is an example how to set a spare disk to a dedicated pool.

1. Select a free disk, and then click  $\mathbf{\nabla}$  -> Set Dedicated Spare.

No. Pool Name Total Free Disks Used Volumes Status Health
Image: 1         Pool-1         2.18 TB         2.18 TB         3         0         Online         Good
2         Pool-2         10.92 TB         10.92 TB         3         0         Online         Good

Figure 8-13 Set Dedicated Spare

2. Select the pool which the disk drive is set to its dedicated spare, and then click **OK** button.

#### **Disk Scrub and Clear Disk Read Error**

Click ▼ -> Disk Scrub to scrub the disk drive. It's not available when the disk drive is in used.

Click ▼ -> Clear Disk Read Error to clean the read error of the disk drive and reset the failed status.

#### **Update Disk Firmware**

Click ▼ -> Update Disk Firmware to upgrade the firmware of the disk drive.



Upda	te Disk Fi	irmware						
Selec	t the firm	nware file:		Choose File No	file chosen			
Selec	t Disks:							
	Slot	Health	Capacity	Disk Type	Usage	Manufacturer	Model	Firmware Version
	1	Good	372.36 GB	SAS SSD 12.0Gb/s	Free	SEAGATE	ST400FM0053	0006
	2	Good	372.36 GB	SAS SSD 12.0Gb/s	Free	SEAGATE	ST400FM0053	0006
	3	Good	372.36 GB	SAS SSD 12.0Gb/s	Free	SEAGATE	ST400FM0053	0006
	4	Good	372.36 GB	SAS SSD 12.0Gb/s	Free	SEAGATE	ST400FM0053	0006
				·		·		,
-								
								OK Cancel

Figure 8-14 Update Disk Firmware



#### CAUTION:

If the disk to be updated firmware is a member of the pool and there are multiple disks of the same model, it is not recommended to update all at the same time. You need to set one disk to idle and then update the disk firmware. After completion, perform pool rebuild and then execute the next disk firmware update. These steps will avoid the risk of data loss.

#### Turn on Disk LED

Click ▼ -> Turn on Disk LED to turn on the indication LED of the disk drive.

#### Turn off Disk LED

Click ▼ -> **Turn off Disk LED** to turn off the indication LED of the disk drive.

#### S.M.A.R.T.

Click  $\vee$  -> S.M.A.R.T. to show the S.M.A.R.T. information of the disk drive. For more information about S.M.A.R.T., please refer to the chapter 8.3.3, <u>S.M.A.R.T.</u> section

#### More Information of the Disk

Click ▼ -> More Information to show the detail information of the disk drive.



lore Information		
Location and Status		
Item	Information	
Enclosure ID	0	
Slot	1	
Status	Online	
Health	Good	
)isk Information		
tem	Information	
Manufacturer	SEAGATE	
Model	ST400FM0053	
Serial Number(s)	Z3F010RT0000Z3F010RT	
Capacity	372.36 GB	
Disk Type	SAS SSD 12.0Gb/s	
Disk Firmware Version	0006	
isk Properties		
tem	Information	
Disk Write Cache	Enabled	
Disk Read-ahead	Enabled	
Disk Command Queuing	Enabled	
Disk Standby	Disabled	
Storage Properties		
ltem	Information	

Figure 8-15 More Information of Disk Drive

## 8.3.3. S.M.A.R.T.

S.M.A.R.T. (Self-Monitoring Analysis and Reporting Technology) is a diagnostic tool for disk 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 disk drives all the time and inspects the properties of disk drives which are close to being out of tolerance. The advanced notice of possible disk drive failure will allow users to back up the data of disk drive or replace the disk drive.



This is much better than a disk drive crash when it is writing data or rebuilding a failed disk drive.

Select a disk drive and click  $\vee$  -> S.M.A.R.T. to show the S.M.A.R.T. information of the disk drive. The number is the current value. Please refer to the product specification of that disk drive for details.

S.M.A.R.T.	
Item	Information
Write Errors Corrected with Possible Delays	0
Total Write Errors	0
Total Write Errors Corrected	0
Total Write Errors Corrected by Algorithm	0
Total Bytes Written	28768743330304
Total Uncorrected Write Errors	0
Read Errors Corrected by ECC Hardware Method	0
Read Errors Corrected with Possible Delays	0
Total Read Errors	0
Total Read Errors Corrected	0
Total Read Errors Corrected by Algorithm	0
Total Bytes Read	49617093781504
Total Uncorrected Read Errors	0
Non Medium Errors	0
Temperature	29°C / 84.2°F
Reference Temperature	60°C / 140°F
Specified Cycle Count Over Device Lifetime	10000
Accumulated Start-stop Cycles	692
Accumulated Load-unload Count Over Device Lifetime	0
Accumulated Load-unload Cycles	0
Blocks Sent to Initiator	2419105780
Blocks Received from Initiator	344659577
Blocks Read from Cache and Sent to Initiator	2504089149
I/O Commands with Size Smaller than Segment Size	1527136133
I/O Commands with Size Larger than Segment Size	3866641966

Figure 8-16 S.M.A.R.T. Attributes of Disk Drive



Item	Information
Read Error(Rate)	100(0)
Reallocated Sector(Count)	100(0)
Erase Fail(Count)	100(0)
Unexpected Power Loss(Count)	100(0)
Uncorrectable Error(Count)	100(0)
Temperature	30°C / 212°F
SSD Endurance	100%

Figure 8-17 S.M.A.R.T. Attributes of SSD

For some SSDs, we provide SSD endurance values to monitor the health of SSDs. The value is a percentage to know how much remaining life of SSD is. The system will notify user if the SSD endurance is under 10%. And also 5%, 3%, 2% by sequence.



#### TIP:

Although it's a useful reference value to know the remaining life of the SSD, we recommend replacing the SSD if the value is under 5%.



#### **INFORMATION:**

SAS/SATA SSD Endurance for monitoring the life remaining is available in SANOS firmware 1.2.0.

#### S.M.A.R.T. Polling

Select the **Disk Settings** function submenu to configure the S.M.A.R.T. polling setting. Uncheck the **Enable S.M.A.R.T. Polling** to disable S.M.A.R.T. polling setting. Disabling S.M.A.R.T. polling will let system not report any problems if there were any S.M.A.R.T. error. There are 2 options when enabling the S.M.A.R.T. polling setting. Selecting the **Inquiry** option will let system report problems of disk when discovering S.M.A.R.T. error and show in event log to inform customers. Selecting the **Inquiry and Action** option will allow system to report problems of disk when discovering S.M.A.R.T. error and show in event log to inform customers, and then the system will remove the problematic disk drive from the pool. The pool will be rebuilt by using a spare disk drive.



Enable S.M.A.R.T. Polling

Disabling S.M.A.R.T. polling will let system not report any problems if there were any S.M.A.R.T. error. Selecting Inquiry will let system report problems of disk when discovering S.M.A.R.T. error and show in event log to inform customers. Selecting Inquiry & Action will allow system to report problems of disk when discovering S.M.A.R.T. error and show in event log to inform customers, and then the system will remove the problematic disk drive from the pool. The pool will be rebuilt by using a spare disk drive.

S.M.A.R.T. Polling:	Inquiry 🔻	7
	Inquiry	
Apply	Inquiry and Action	

Figure 8-18 Disk Settings



#### **INFORMATION:**

S.M.A.R.T. polling setting is available in SANOS firmware 1.3.0.

## 8.4. Configure Thick Provisioning Pools

Select the **Pools** function submenu to create, modify, delete, or view the status of the pools. We will describe thick provisioning pool in the following section; keep thin provisioning technology in the <u>Thin Provisioning</u> chapter and auto tiering in the <u>Auto Tiering</u> chapter.

	Poo	ols
STORAGE M.	ANAGEMEN	T
Disks		
Pools		
Volumes		
LUN Mapping	gs	
SSD Cache		
Figure 8-19	Pools Fu	ncti

## 8.4.1. Create a Thick Provisioning Pool

Here is an example of creating a thick provisioning pool with 4 disks configured in RAID 5. At the first time of creating a thick provisioning pool, it contains a disk group and the maximum quantity of disk in a disk group is 64.



1. Select the **Pools** function submenu, click the **Create Pool** button. It will scan available disks first.



#### TIP:

It may take 20 ~ 30 seconds to scan disks if your system has more than 200 disk drives. Please wait patiently.

Create Pool	
General Disk Selection RAID Configuration Disk Properties Summary	Pool Type         Please select a pool type. <ul> <li>Thick Provisioning</li> <li>Thin Provisioning</li> </ul> Pool Properties           Please enter a pool name and select preferred controller setting.           Pool Name :         Pool-1 <ul> <li>Preferred Controller :</li> <li>Controller 1</li> <li>The I/O resources will be managed by the preferred controller which you specified.</li> </ul> SED Pool <ul> <li>Enable SED Pool</li> <li>Enable SED Pool will use the secure SEDs to create a pool. Intermixing SEDs and non-SEDs are not supported in a pool.</li> </ul>
	Next Cancel

Figure 8-20 Create a Thick Provision Pool Step 1

- 2. Select the **Pool Type** as Thick Provisioning.
- Enter a Pool Name for the pool. Maximum length of the pool name is 16 characters. Valid characters are [ A~Z | a~z | 0~9 | -\_<> ].



- 4. Select a **Preferred Controller** from the drop-down list. The backend I/O resources in this pool will be processed by the preferred controller which you specified. This option is available when dual controllers are installed.
- 5. Check the **Enable SED Pool** checkbox. Enabling SED pool will use the secure SEDs to create a pool. Intermixing SEDs and non-SEDs are not supported in a pool.
- 6. Click the **Next** button to continue.

Jisk Selection	Pleas	e select disks to	add a d	lisk group	in a thick provi	sioning pool. The maximum	quantity of disk in	a disk group is 64.	
RAID Configuration	Enclo	sure ID:	0 (Head	d Unit: XS	5216)				
Disk Properties		Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model	
ummary		0	1	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	2	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	4	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	9	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	10	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	11	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	12	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	13	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
		0	14	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
		0	15	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	

Figure 8-21 Create a Thick Provision Pool Step 2

- 7. Please select disks for pool. The maximum quantity of disk in a disk group is 64. Select an **Enclosure ID** from the drop-down list to select disks from expansion enclosures.
- 8. Click the **Next** button to continue.



eate Pool			
General	RAID Configuration		
Disk Selection	Please select a RAID level.		
RAID Configuration	RAID Level :	RAID 0	
Disk Properties	Quantity of SAS Disks :	RAID 0 RAID 1	
Summary		RAID 3	
		RAID 5EE RAID 6 RAID 0+1 RAID 10	
1			
Back			Next Cancel

Figure 8-22 Create a Thick Provision Pool Step 3

- 9. Select a **RAID Level** from the drop-down list which lists available RAID level only according to the disk selection. And also select a **Quantity of Subgroups** if the combination RAID level is selected.
- 10. Click the **Next** button to continue.



Create Pool	
General	Disk Properties
Disk Selection	Please configure the disk properties.
RAID Configuration	Enable Disk Write Cache Enabling disk write cache will improve write I/O performance but risking data loss when power failure.
Summary	Enable Disk Read-ahead System will preload data to disk buffer based on previously retrieved data. This feature will efficiently improve the performance of sequential data retrieved.
	Enable Disk Command Queuing Send multiple commands to a disk at once to improve performance.
	Enable Disk Standby The disks will spin down for power saving when they are idle for a period of time according to the setting.
	Disk Standby : 30 seconds
	Enable High Latency Disk Warning The system will send event logs if there is a high latency disk in the disk group.
Back	Next Cancel

Figure 8-23 Create a Thick Provision Pool Step 4

11. Disk properties can also be configured optionally in this step:

- **Enable Disk Write Cache**: Check to enable the write cache option of disks. Enabling disk write cache will improve write I/O performance but have a risk of losing data when power failure.
- **Enable Disk Read-ahead**: Check to enable the read-ahead function of disks. System will preload data to disk buffer based on previously retrieved data. This feature will efficiently improve the performance of sequential data retrieved.
- **Enable Disk Command Queuing**: Check to enable the command queue function of disks. Send multiple commands to a disk at once to improve performance.
- **Enable Disk Standby**: Check to enable the auto spin down function of disks. The disks will be spun down for power saving when they are idle for the period of time specified.
- **Enable High Latency Disk Warning**: Check to enable the high latency disk warning function in a disk group. When a disk drive is abnormal with high latency, the system



will send event logs to notify IT administrators in advance to avoid affecting overall performance.

12. Click the **Next** button to continue.

Create Pool			
General	Pool Properties		
General Disk Selection RAID Configuration Disk Properties Summary	Pool Properties Pool Type : Pool Name : Preferred Controller : RAID Configuration RAID Level : Quantity of SAS Disks : Disk Properties Disk Write Cache : Disk Read-ahead : Disk Command Queuing : Disk Standby : High Latency Disk Warning :	Thick Provisioning Pool-1 Controller 1 RAID 5 4 Enabled Enabled Disabled Disabled	
Back			Finish Cancel

Figure 8-24 Create a Thick Provision Pool Step 5

13. After confirmation at summary page, click the **Finish** button to create a pool.

	Pool Name	Status	Health	Total	Free	Available	Thin Provisioning	Encryption	Volumes	Current Controller
▼	Pool-1	Online	Good	3.27 TB	3.27 TB	3.27 TB	Disabled	Disabled	0	Controller 1
Create P	001									

Figure 8-25 A Thick Provisioning Pool is Created



14. A pool has been created. If necessary, click Create Pool button again to create others.

## 8.4.2. List Thick Provisioning Pools

Click a pool; it will display the related disk groups. Similarly, click a disk group; it will display the related disk drives. The pool properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific pool.

	Pool N	ame	Status	Health	Total	Free	Available	Thi	n Provisioning	End	ryption	Volumes	Current Controller		
▼	Pool-1		Online	Good	3.27 TB	3.27 TB	3.27 TB	Dis	Disabled		Disabled		abled		Controller 1
Disk Gr	Disk Groups														
	No.	Status	Health	n Total	Free	RAID	Disks Us	ed	RAID EE Spa	ares					
V		Online	Good	3.27 1	В 3.271	B RAID			N/A						
Disks	re ID	Slot	Status	Health	Canacity	Disk T	vne	M	anufacturer	Model					
0		9	Online	Good	1.09 TB	SASE	HDD 12.0Gb/s	SE	EAGATE	ST120	0000088	-			
0		10	Online	Good	1.09 TB	SAS H	HDD 12.0Gb/s	SE	EAGATE	ST120	0000088				
0		11	Online	Good	1.09 TB	SASH	HDD 12.0Gb/s	SE	EAGATE	ST120	00000088				
0		12	Online	Good	1.09 TB	SASH	IDD 12.0Gb/s	SE	EAGATE	ST120	00MM0088				
Create F	Pool														

Figure 8-26 List Thick Provisioning Pools

This table shows the column descriptions.

Column Name	Description
Pool Name	The pool name.
Status	The status of the pool:
	Online: The pool is online.
	Offline: The pool is offline.
	Rebuilding: The pool is being rebuilt.
	Migrating: The pool is being migrated.
	Relocating: The pool is being relocated.
	• EE Rebuilding: The pool is being RAID EE rebuilt.
Health	The health of the pool:
	Good: The pool is good.

## Table 8-9 Pool Column Descriptions



	Failed: The pool has failed.
	• Degraded: The pool is unhealthy and incomplete. The cause may
	be a disk loss or failure.
Total	Total capacity of the pool.
Free	Free capacity of the pool.
Available	Available capacity of the pool.
Thin	The status of Thin provisioning:
Provisioning	• Disabled.
	Enabled.
Encryption	The Data Secure Mode:
	Disabled: The pool is not encrypted.
	Enabled: The pool is encrypted.
Volumes	The quantity of volumes in the pool.
Current	The current running controller of the pool.
Controller	
(This option is	
only visible when	
dual controllers	
are installed.)	

Table 8-10 Disl	Group	Column	Descriptions
-----------------	-------	--------	--------------

Column Name	Description
No.	The number of the disk group.
Status	The status of the disk group:
	Online: The disk group is online.
	Offline: The disk group is offline.
	Rebuilding: The disk group is being rebuilt.
	Migrating: The disk group is being migrated.
	Relocating: The disk group is being relocated.
	• EE Rebuilding: The disk group is being RAID EE rebuilt.
Health	The health of the disk group:
	Good: The disk group is good.
	Failed: The disk group has failed.
	• Degraded: The disk group is not healthy and not complete. The
	reason could be missing or failed disks.
Total	Total capacity of the disk group.
Free	Free capacity of the disk group.



RAID	The RAID level of the disk group.
Disks Used	The quantity of disk drives in the disk group.
RAID EE Spare	The quantity of RAID EE spare disk drives in the disk group.
	Traditional RAID level is display as N/A.

Table 8-11 Disk Column Descriptions	Table 8-11	Disk Column Descriptions
-------------------------------------	------------	--------------------------

Column Name	Description					
Enclosure ID	The enclosure ID.					
Slot	The position of the disk drive.					
Status	The status of the disk drive:					
	Online: The disk drive is online.					
	• Missing: The disk drive is missing in the pool.					
	Rebuilding: The disk drive is being rebuilt.					
	• Transitioning: The disk drive is being migrated or is replaced by					
	another disk when rebuilding occurs.					
	Scrubbing: The disk drive is being scrubbed.					
	• Check Done: The disk drive has been checked the disk health.					
	Copying Back: The disk drive is being copied back.					
Health	The health of the disk drive:					
	Good: The disk drive is good.					
	Failed: The disk drive has failed.					
	• Error Alert: S.M.A.R.T. error alerts.					
	Read Errors: The disk drive has unrecoverable read errors.					
Capacity	The capacity of the disk drive.					
Disk Type	The type of the disk drive:					
	• [SAS HDD   NL-SAS HDD   SAS SSD   SATA SSD ]					
	• [12.0Gb/s   6.0Gb/s   3.0Gb/s   1.5Gb/s ]					
Manufacturer	The manufacturer of the disk drive.					
Model	The model name of the disk drive.					

## 8.4.3. Operations on Thick Provisioning Pools

The options are available in this tab:

#### Activate or Deactivate the Pool

Click ▼ -> Activate/Deactivate in one of pools, these options are usually used for online disk roaming. Deactivate can be executed when the status is online. Conversely, activate



can be executed when the pool status is offline. For more information, please refer to the chapter 8.8, <u>Disk Roaming</u> section.

#### **Change Disk Properties of the Pool**

Click ▼ -> Change Disk Properties in one of pools to change disk properties of the pool.

Change Disk Properties		
Set the following options for the Pool Pool-1:		
Disk Write Cache:	Enabled	· •
Disk Read-ahead:	Enabled	· •
Disk Command Queuing:	Enabled	· •
Disk Standby:	Disabled	· •
		OK Cancel

Figure 8-27 Change Disk Properties

#### Change Thin Provisioning Policy of the Pool

Click ▼ -> Change Thin Provisioning Policy in one of pools to change policy of the thin provisioning pool. For more information, please refer to the chapter 9, Thin Provisioning.

### **Change Preferred Controller of the Pool**

Click ▼ -> Change Preferred Controller in one of pools to change the pool ownership to the other controller.

### Verify Parity of the Pool

Click ▼ -> Verify Parity in one of pools to regenerate parity for the pool. It supports RAID level 3, 5, 6, 30, 50, 60 and RAID EE level 5EE, 6EE, 50EE, 60EE.

#### Add a Disk Group into the Pool

Click ▼ -> Add Disk Group in one of pools to add another disk group into the pool. For more information, please refer to the chapter 8.4.5, Add a Disk Group in a Thick Provisioning Pool section.

# **CSAN**

If the auto tiering license is enabled, you can click ▼ -> Add Disk Group in one of pools to transfer from the thick provisioning pool to auto tiering pool. For more information, please refer to the chapter 11.7, Transfer to Auto Tiering Pool section.

	Add Disk Group							
Pool	Туре							
Thin Provisioning :		Disabled						
Auto Tioring :		Disable						
Auto Hennig .		Disable	Disabled					
RAID	Level		Enabled	i				
Pleas	e select a RAID I	evel.						
RAID	Level :		RAID 1		¥			
Selec	t Disks							
Pleas	e select disks to	add a dis	k group. The	maximum qua	ntity of disk in a disk group is 6	4.		
Enclo	sure ID :		0 (Head	Unit: XS5216	5) <b>v</b>			
	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model	
	0	1	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
	0	2	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
	0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
	0	4	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
	0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
	0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
	0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
	0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
	0	13	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
	0	14	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
	0	15	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
	0	16	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	

Figure 8-28 Transfer Thick Provisioning Pool to Auto Tiering



#### CAUTION:

The action of transferring from the thick provisioning pool to auto tiering is irreversible. Consider all possible consequences before making this change.



#### Delete a Pool

Click  $\triangledown$  -> **Delete** to delete the pool. The pool cannot be deleted when there are volumes in the pool.

#### More Information of the Pool

Click ▼ -> More Information to show the detail information of the pool.

## 8.4.4. Migrate a Disk Group in a Thick Provisioning Pool

The **Migrate Disk Group** function changes the disk group to a different RAID level or adds the member disks of the disk group to increase the capacity. Each disk group is independent, you can migrate each one of disk groups.



Figure 8-29 Migrate a Disk Group in a Thick Provisioning Pool

Usually, the disk group migrates to higher RAID level for better protection. To perform a migration, the total capacity of the disk group must be larger than or equal to the original one. If the RAID level doesn't change, the migration can also move the member disk drives to completely different disk drives.





Figure 8-30 RAID Migration

Here's an example of migrate a disk group from RAID 5 to RAID 6.

1. Select a disk group, and then click ▼ -> Migrate Disk Group



Please select a RAID level. RAID Level :			RAID 5		Ŧ			
Select Disks		RAID 0						
Please select disks to migrate the		he (RAID 3 RAID 5		tity of disk in a disk gr	tity of disk in a disk group is 64.			
Enclo	sure ID :		RAID 5	EE				
	Enclosure ID	Slot	RAID 6	EE	Туре	Manufacturer	Model	
	0	1	RAID 0 RAID 1	+1 0	SSD 12.0Gb/s	SEAGATE	ST400FM0053	-
	0	2	C RAID 3	0	SSD 12.0Gb/s	SEAGATE	ST400FM0053	
	0	3	RAID 5	0 DEE	SSD 12.0Gb/s	SEAGATE	ST400FM0053	
	0	4	C RAID 6	0	SSD 12.0Gb/s	SEAGATE	ST400FM0053	
	0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
	0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
	0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
	0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
-	0	9	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
1	0	10	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
-	0	11	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
-	0	12	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
	0	13	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
	0	14	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	-

Figure 8-31 Migrate RAID Level Step 1

- 2. Select a **RAID Level** from the drop-down list.
- 3. Please select disks for pool. The maximum quantity of disk in a disk group is 64. Select an **Enclosure ID** from the drop-down list to select disks from expansion enclosures.
- 4. Click the **OK** button to execute migration.
- 5. Migration starts. The status of the **Disks**, **Pools** and **Volumes** are changing. The complete percentage of migration is displayed in the **Status**.
- 6. It's done when the complete percentage reaches 100%.

# **C**SAN

### INFORMATION:

There are some operation limitations when a pool is being migrated.

- The capacity after migration must be larger than the current capacity.
- A traditional RAID level can be migrated to RAID EE level, but RAID EE level can be migrated to RAID EE level only.



#### **INFORMATION:**

There are some operation limitations when a pool is being migrated. The System would reject these operations:

- Add dedicated spare.
- Remove a dedicated spare.
- Create a new volume.
- Delete a volume.
- Extend a volume.
- Scrub a volume.
- Perform another migration operation.
- Scrub entire pool.
- Take a snapshot.
- Delete a snapshot.
- Expose a snapshot.
- Rollback to a snapshot.



#### TIP:

Pool migration cannot be executed during rebuilding or volume extension.

#### TIP:

Thin provisioning pool cannot execute the **Migrate Disk Group** option; it uses the **Add Disk Group** option to enlarge the capacity. For more information, please refer to the chapter 9, <u>Thin Provisioning</u>.

## 8.4.5. Add a Disk Group in a Thick Provisioning Pool

The Add Disk Group function adds a disk group to a pool to increase the capacity.




Figure 8-32 Add a Disk Group in a Thick Provisioning Pool

Here is an example of adding a disk group into a thick provisioning pool with 2 disks configured in RAID 1.

1. Select a pool, click ▼ -> Add Disk Group to add a disk group in a thick provisioning pool.



Figure 8-33 Add a Disk Group to a Thick Provisioning Pool

- 2. Select a **RAID Level** from the drop-down list and also select a **Quantity of Subgroups** if the combination RAID level is selected.
- Select disks to add into a disk group. The maximum quantity of disk in a disk group is 64. Select an Enclosure ID from the drop-down list to select disks from expansion enclosures.
- 4. Click the **OK** button to add a disk group into the pool.



	Pool N	lame	Status	He	ealth	Total		Free	Availab	le	Thin Prov	isioning	Encryptio	n	Volumes	Current Controller
V	Pool-1		Online	G	ood	4.00	тв	4.00 TB	4.00 TE		Disabled		Disabled			Controller 1
Disk Gr	oups															
	No.	Status	e He	alth	Total		Free		RAID	Disk	s Used	RAID E	E Spares			
▼	1	Online	e Go	bd	3.27 1	в	3.27	ТВ	RAID 5	4		N/A				
V	2	Online	e Go	bd	744.0	0 GB	744.(	00 GB	RAID 0	2		N/A				
Disks																
Enclosu	re ID	Slot	Status	H	lealth	Сар	acity	Disk	Туре		Manufac	turer	Model			
0		1	Online	0	Good	372	36 GB	SAS	SSD 12.0	Gb/s	SEAGAT	E	ST400FM00	53		
0		2	Online	0	Good	372	.36 GB	SAS	SSD 12.0	Gb/s	SEAGAT	E	ST400FM00	53		
Create F	Pool															

Figure 8-34 A Disk Group is Added

5. A disk group has been added into the pool.



#### TIP:

If auto tiering license is enabled, the thick provisioning pool without disk group of mixed disk type can be transferred to the auto tiering pool by **Add Disk Group** option. Please refer to the chapter 11.6.1, <u>Transfer from</u> <u>Thick Provisioning Pool to Auto Tiering</u> section.

## 8.5. Configuring Volumes

Select the **Volumes** function submenu to create, modify, delete, or view the status of the volumes. The same as pool, we will describe thick provisioning volume in the following section, and keep thin provisioning in the <u>Thin Provisioning</u> chapter and auto tiering in the <u>Auto Tiering</u> chapter.

				Volu	mes	
<b>[]</b> (	STORAGE	MANA	GE	MEN	т	
	Disks					
	Pools					
	Volumes					
	LUN Mapp	oings				
	SSD Cach	ne				
		-	,	_		<b>•</b> 1

Figure 8-35 Pools Function Submenu



## 8.5.1. Create a Volume

Here is an example of creating a volume in thick provisioning Pool.

1. Select the Volumes function submenu, click the Create Volume button.

Create Volume				
General	Volume General Se	ttings		
Advanced	Please enter a volun	ne name and configure th	ie volun	ne general settings.
Summary	Volume Name :	Vol-1		0
	Pool Name :	Pool-1	•	(Available : 2607 GB)
	Capacity :	100		GB 🔻
	Volume Type :	RAID Volume	•	
	replication.			
				Next Cancel

Figure 8-36 Create a Volume in Thick Provisioning Pool Step 1

- 2. Enter a **Volume Name** for the pool. The maximum length of the volume name is 32 characters. Valid characters are [A~Z | a~z | 0~9 | -\_<>].
- 3. Select a **Pool Name** from the drop-down list. It will also display the available capacity of the pool.
- 4. Enter required **Capacity**. The unit can be selected from the drop-down list.
- 5. Select the **Volume Type**. The options are **RAID Volume** (for general RAID usage) and **Backup Volume** (for the target volume of local clone or remote replication).
- 6. Click the **Next** button to continue.



eate Volume				
General	Volume Advanced Settin	ngs		
Advanced	Please configure the volu	me advanced settir	gs.	
Summary	Stripe Size :	64 KB		
	Block Size :	512 Byte		
	Background I/O Priority :	High		0
	Erase Volume Data :	Fast Erase		
	Enable Cache Mode (Node)	Write-back Cache)	0	
	Enable Video Editing N	Node 🕕		
	Enable Read-ahead	0		
	Enable Fast RAID Reb	build		
Back				Next Cance

Figure 8-37 Create a Volume in Thick Provisioning Pool Step 2

- 7. Volume advanced settings can also be configured optionally in this step:
  - Stripe Size: The options are 64KB to 1,024KB.
  - **Block Size**: The options are 512Bytes to 4,096 Bytes.
  - **Background I/O Priority**: The options are High, Medium, and Low. It will influence volume initialization, rebuild, and migration.
  - Erase Volume Data: This option is available when the pool is thick provisioning. This option will wipe out old data in volume to prevent that OS recognizes the old partition. The options are Do Not Erase, Fast Erase which will erase the first 1GB data of the volume, or Full Disk which will erase entire volume.
  - **Enable Cache Mode (Write-back Cache)**: Check to enable cache mode function of volume. Write back optimizes the system speed but comes with the risk where the data may be inconsistent between cache and disks in one short time interval.
  - **Enable Video Editing Mode**: Check to enable video editing mode function. It is optimized for video editing usage. Please enable it when your application is in video editing environment. This option provides a more stable performance figure without high and low peaks but slower in average.
  - **Enable Read-ahead**: Check to enable the read ahead function of volume. 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 disk's buffer. This feature will improve performance when the data being retrieved is sequential.

 Enable Fast RAID Rebuild: This option is available when the pool is created in protection RAID level (e.g., RAID 1, 3, 5, 6, 0+1, 10, 30, 50, and 60). For more information, please refer to the chapter 8.5.5, <u>Fast RAID Rebuild</u> section.

#### **INFORMATION:**

Stripe sizes from 64KB to 1,024KB support more than 8GB of memory for resource allocation. 4GB memory is only support 64KB stripe size.

8. Click the **Next** button to continue.

ate Volume			
General	Configure Volume General Set	tings	
Advanced	Volume Name :	Vol-1	
Summary	Pool Name :	Pool-1	
	Capacity :	100 GB	
	Volume Type :	RAID Volume	
	Configure Volume Advanced	ettings	
	Stripe Size :	64 KB	
	Block Size :	512 Byte	
	Background I/O Priority :	High	
	Erase Volume Data :	Fast Erase	
	Cache Mode :	Enabled	
	Video Editing Mode :	Disabled	
	Read-ahead :	Disabled	
	Fast RAID Rebuild :	Disabled	
Back			Finish Cancel

Figure 8-38 Create a Volume in Thick Provisioning Pool Step 3

- 9. After confirmation at summary page, click the **Finish** button to create a volume.
- 10. The volume has been created. It will be initialized in protection RAID level (e.g., RAID 1, 3, 5, 6, 0+1, 10, 30, 50, and 60).



<< first <	prev 1 next >	last >>									
	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name
▼	Vol-1	Initializing (8%)	Optimal	100.00 GB	RAID Volume	Disabled	0 MB / 0 MB	0	N/A	WB	Pool-1
<< first <	prev 1 next >	last >> ne Options									

Figure 8-39 A Volume in Thick Provisioning Pool is Created and Initializing

11. A volume has been created. If necessary, click **Create Volume** button to create another.



#### **INFORMATION:**

SANOS supports instant RAID volume availability. The volume can be used immediately when it is initializing or rebuilding.



#### TIP:

If the pool contains some disk drives of 4Kn type, it is not available to set 512, 1024, or 2048 block size. When the case happens, it will pop up a warning message and suggest changing the block size to 4096.

## 8.5.2. List Volumes

Select one of the volumes; it will display the related LUN Mappings if the volume is mapped. The volume properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific volume.

<< first <	prev 1	next >	last >>									
	Volume N	Vame	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name
V	Vol-1		Online	Optimal	100.00 GB	RAID Volume	Disabled	0 MB / 0 MB		N/A		Pool-1
<< first <	prev 1 ppings	next >	last >>									
Allowed	Hosts	Target	LUN	Permission	n Sessior	15						
*		0	0	Read-write	e 0							
Create \	/olume	Local Clo	ne Options	]								

Figure 8-40 List Volumes

This table shows the column descriptions.

# **C**SAN

Column Name	Description
Volume Name	The volume name.
Status	The status of the volume:
	Online: The volume is online.
	Offline: The volume is offline.
	• Erasing: The volume is being erased if the Erase Volume Data
	option is set.
	Initiating: The volume is being initialized.
	Rebuilding: The volume is being rebuilt.
	Migrating: The volume is being migrated.
	Rollback: The volume is being rolled back.
	Parity Checking: The volume is being parity check.
	Relocating: The volume is being relocated.
	• EE Rebuilding: The volume is being RAID EE rebuilt.
Health	The health of the volume:
	Optimal: the volume is working well and there is no failed disk in
	the RG.
	• Failed: the pool disk of the volume has single or multiple failed
	disks than its RAID level can recover from data loss.
	• Degraded: At least one disk from the pool of the volume has
	failed or plugged out.
	• Non-optimal: the volume has experienced recoverable read errors.
	After passing parity check, the health will become Optimal.
Capacity	Total capacity of the volume.
Volume Type	The type of the volume:
	RAID Volume.
	Backup Volume.
SSD Cache	The status of the SSD cache:
	Enabled: The volume is enabled SSD cache.
	Disabled: The volume is disabled SSD cache.
Snapshot space	Used snapshot space / Total snapshot space. The first capacity is
	current used snapshot space, and the second capacity is reserved
	total snapshot space.
Snapshots	The quantity of the snapshot in the volume.
Clone	The target name of the clone volume.
Write	The access right of the volume:

## Table 8-12Volume Column Descriptions



	WT: Write Through.
	• WB: Write Back.
	• RO: Read Only.
Pool Name	Which pool the volume belongs to.

## 8.5.3. Operations on Volumes

The options are available in this tab:

#### **Setup Local Cloning Options**

Click the **Local Cloning Options** button to set the clone options. For more information, please refer to the chapter 12.2.4, <u>Local Cloning Options</u> section in the Data Backup chapter.

Local Clone Options	
Automatic Snapshot Space Allocation Ratio:  🕕	2 💌
Automatic Snapshot Checkpoint Threshold: 1	50% •
Restart the task an hour later if it failed:	Enabled
	OK Cancel

Figure 8-41 Local Cloning Options

#### LUN Mapping Operations

Click ▼ -> Map LUN to map a logical unit number to the volume. For more information about map and unmap LUN, please refer to the chapter 8.6, <u>Configure LUN Mappings</u> section.

viap a LUN (Logica	al Unit Number) to a vol	ume.	
Protocol:	iscsi	*	
Volume Name:	Vol-1(100 GB)	×	
Allowed Hosts:	*	0	Add Host
Target:	0		
LUN:	LUN 0	•	
Permission:	O Read-only   Read-only	ead-write	

Figure 8-42 Map a LUN of iSCSI Connectivity

Click ▼ -> **Unmap LUNs** to unmap logical unit numbers from the volume.

ie Name
OK Cancel

Figure 8-43 Unmap LUNs

OSAN

#### **Snapshot Operations**

Click ▼ -> Set Snapshot Space to set snapshot space for preparing to take snapshots. For more information about snapshot, please refer to the chapter 12.1, <u>Managing Snapshots</u> section in the Data Backup chapter.



Set Snapshot Space			
Volume Name:	Vol-1	¥	
Capacity:	100	GB V Available: 2507GB Minimum: 6GB	
Free Capacity:	2507GB		
			OK Cancel

Figure 8-44 Set Snapshot Space

Click ▼ -> Take Snapshot to take a snapshot of the volume.

Click ▼ -> Schedule Snapshots to set the snapshots by schedule.

Click ▼ -> List Snapshots to list all snapshots of the volume.

Click ▼ -> Cleanup Snapshots to clean all snapshots of the volume and release the snapshot space.

#### **Local Clone Operations**

Click ▼ -> Create Local Clone to set the target volume for clone. For more information about local clone, please refer to the chapter 12.2, <u>Managing Local Clones</u> section in the Data Backup chapter.

Create Local Clone					
<< first < prev <b>1</b> next	t > last >>				
Volume Name	Capacity	Status	Health	Pool Name	
Target-Vol-2	110.00 GB	Online	Optimal	Pool-1	-
<< first < prev <b>1</b> next	t> last>>				

Figure 8-45 Create Local Clone

Click ▼ -> Clear Clone to clear the clone.

- Click ▼ -> Start Clone to start the clone.
- Click ▼ -> **Stop Clone** to stop the clone.



Click ▼ -> Schedule Clone to set the clone function by schedule.

Click ▼ -> Change Replication Options to change the clone to Replication relationship. For more information about remote replication, please refer to the chapter 12.3, <u>Managing</u> <u>Remote Replications</u> section in the Data Backup chapter.

#### **SSD Cache Options**

Click ▼ -> Enable SSD Cache to enable SSD cache for the volume. For more information about SSD cache, please refer to the chapter 10, <u>SSD Cache</u> chapter.

Click ▼ -> **Disable SSD Cache** to disable SSD cache for the volume.

#### **Change Volume Properties**

Click ▼ -> Change Volume Properties to change the volume properties of the volume.

Change Volume Properties			
Volume Name:	Vol-1	0	
Priority:	● High ⊖ Medium	Low	
Background I/O Priority:	High	Ψ.	
Cache Mode:	O Write-through	Cache 🖲 Write-back Cache 🔾 Read-Only	0
Video Editing Mode:	Disabled	· · •	
Read-ahead:	Enabled	· • •	
Volume Type:	RAID Volume	<b>v</b> (i)	
			OK Cancel

Figure 8-46 Change Volume Properties

#### Verify Parity of the Volume

Click ▼ -> Verify Parity to execute parity check for the volume which is created by the pool in parity RAID level (e.g., RAID 3, 5, 6, 30, 50, and 60). This volume can either be verified and repaired or only verified for data inconsistencies. This process usually takes a long time to complete.



Veri	rify Parity	
Ver	rify the parity for volume Volume Vol-1	
This repa	is volume can either be verified and repaired or only verified for data inconsistencies. The verify and pair process will take longer.	
۲	Verify and repair data inconsistencies.	
$\bigcirc$	Only verify for data inconsistencies.	
	Stop verifying when the following number of inconsistencies have been found. 1 $\checkmark$	
	OK	el

Figure 8-47 Verify Parity

#### **Extend Volume Capacity**

Click ▼ -> Extend Volume to extend the volume capacity. For more information, please refer to the chapter 8.5.4, Extend Volume Capacity section.

#### **Delete Volume**

Click ▼ -> **Delete** to delete the volume. The related LUN mappings will also be deleted.

#### More Information of the Volume

Click ▼ -> More Information to show the detail information of the volume.

## 8.5.4. Extend Volume Capacity

**Extend Volume** function extends the capacity of the volume if there is enough free space.

Here's how to extend a volume:

- Select the Volumes function submenu, select a volume, and then click ▼ -> Extend Volume.
- 2. Change the volume capacity. The capacity must be larger than the current, and then click the **OK** button to start extension.

Extend Volume			
Enter a capacity that y current.	you would like to extend. The	capacity must be large	r than the
Capacity:	150	GB 🔻	
Free Space:	2397 GB		
			OK Cancel

Figure 8-48 Extend Volume Capacity

- 3. If the volume needs initialization, it will display the status **Initiating** and the complete percentage of initialization in **Status**.
- 4. It's done when the complete percentage reaches 100%.



#### **INFORMATION:**

The extension capacity must be larger than the current capacity.



**TIP:** Extension cannot be executed during rebuilding or migration.

## 8.5.5. Fast RAID Rebuild

When executing rebuild, the Fast RAID Rebuild feature skips any partition of the volume 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. For more information, please refer to the <u>Fast Rebuild</u> White Paper.

#### **Enable Fast RAID Rebuild**



Here is an example of enabling the Fast RAID Rebuild function when creating a volume.

Create Volume	
General	Volume Advanced Settings
Advanced	Please configure the volume advanced settings.
Summary	Block Size : 512 Byte 🔻
	Priority : High 🔻
	The priority is the comparison with the other volumes.
	Background I/O Priority : High v
	Background I/O priority will influence volume initilization, rebuild, and migration.
	Erase Volume Data : Fast Erase 🔻
	Enable Cache Mode (Write-back Cache) Write back optimizes the system speed but comes with the risk which the data may be inconsistent between the cache and disks in a short time interval.
	Enable Video Editing Mode Please enable it when the application is in the video editing environment. It sacrifices a bit of performance but is stable.
	<ul> <li>Enable Read-ahead</li> <li>The system will identify what is needed next, based on the content just retrieved from the disk, and then preload the data into the disk's buffer. When the data to be transmitted is continuous, this feature will improve performance.</li> <li>Enable Fast RAID Rebuild</li> </ul>
Back	Next Cancel

Figure 8-49 Enable Fast RAID Rebuild When Creating a Volume

### Fast RAID Rebuild Notices

Here are some notices about Fast RAID Rebuild.

- Only a thick provisioning pool supports enabling/disabling this feature, a thin provisioning pool has included this feature and set as enabled by default.
- When a rebuild occurs in a fast rebuild volume, 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 volume 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.

# **C**SAN



#### CAUTION:

Disabling Fast RAID Rebuild function is recommended when the access pattern to the volume is random write.

## 8.6. Configure LUN Mappings

Select the **LUN Mappings** function submenu to map, unmap or view the status of LUN (Logical Unit Number) for each volume.

LUN Mappings	
STORAGE MANAGEMENT	
Disks	
Pools	
Volumes	
LUN Mappings	
SSD Cache	

Figure 8-50 Pools Function Submenu

## 8.6.1. Map a LUN of iSCSI Connectivity

Here's an example of mapping a LUN of iSCSI connectivity.

1. Select the LUN Mappings function submenu, click the Map LUN button.

Map LUN				
Map a LUN (Logical	Unit Number) to a vol	ume.		
Protocol:	iSCSI			
Volume Name:	Vol-1(100 GB)			
Allowed Hosts:	*	0	Add Hos	t
Target:	0			
LUN:	LUN 0			
Provide Land				
Permission:	○ Read-only ● Re	ad-write		
				OK Cancel

## **CSAN**

Figure 8-51 Map a LUN of iSCSI Connectivity

- 2. Select the **Protocol** as iSCSI.
- 3. Select a **Volume** from the drop-down list.
- 4. Enter the **Allowed Hosts** with semicolons (;) or click the **Add Host** button to add one by one. Fill-in wildcard (\*) for access by all hosts.
- 5. Select a **Target** from the drop-down list.
- 6. Select a **LUN** from the drop-down list.
- 7. Select a Permission level, normally set it as Read-write.
- 8. Click the **OK** button to map a LUN.

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 which are set to the same volume:

- 1. Allow Hosts sets \*, LUN is LUN 0
- 2. Allow Hosts sets iqn.host1, LUN is LUN 1

The host *iqn.host2* can login successfully because it matches the rule 1.

Wildcard \* and ? are allowed in this field.

- Wildcard \* can replace any word.
- Wildcard ?: 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.

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

## 8.6.2. Map a LUN of Fibre Channel Connectivity

Here's an example of mapping a LUN of fibre channel connectivity.

1. Select the LUN Mappings function submenu, click the Map LUN button.

Map LON			
Map a LUN (Logical	l Unit Number) to a vol	ume.	
Protocol:	FCP	Ŧ	
Volume Name:	Vol-1(100 GB)	Ŧ	
Allowed Hosts:	*	0	Add Host
Target:	2000001378FF880	00 🔻	
LUN:	LUN 0	<b>v</b>	
Permission:	○ Read-only <sup>●</sup> Re	ead-write	
Link Reset:	🔾 Yes 🖲 No		

Figure 8-52 Map a LUN of FC Connectivity

- 2. Select the **Protocol** as FCP (Fibre Channel Protocol).
- 3. Select a Volume from the drop-down list.
- 4. Enter the **Allowed Hosts** with semicolons (;) or click the **Add Host** button to add one by one. Fill-in wildcard (\*) for access by all hosts.
- 5. Select a Target from the drop-down list.
- 6. Select a LUN from the drop-down list.
- 7. Select a **Permission** level. Normally set it as **Read-write**.
- 8. Set Link Reset to Yes if the fibre channel needs to reset when it is connected.
- 9. Click the **OK** button to map a LUN.

## 8.6.3. List LUN Mappings

OSAN

List all LUN mappings in this page. The LUN properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific LUN.

	Allowed Hosts	Target	LUN	Permission	Sessions	Volume Name
▼	*	0	0	Read-write	0	Vol-1
Map LU	N					

Figure 8-53 List LUN Mappings



This table shows the column descriptions.

Column Name	Description
Allowed Hosts	The target of FC / iSCSI for access control or a wildcard (*) for
	access by all hosts.
Target	The target number.
LUN	The logical unit number which is mapped.
Permission	The permission level:
	Read-write
	Read-only
Sessions	The quantity of the active iSCSI connection linked to the logical unit.
	Show N/A if the protocol is FCP.
Volume Name	The name of the volume assigned to this LUN.

 Table 8-13
 LUN Mapping Column Descriptions

## 8.6.4. Operations on LUN Mappings

The options are available on this tab:

#### **Unmap a LUN**

Click ▼ -> **Unmap LUN** to unmap a logical unit number from the volume.

## 8.7. Connect by Host Initiator

After map a LUN to a volume, the host can connect the volume by initiator program. We provide some documents of host connections for reference. The documents are available at the website:

- How to Configure iSCSI Initiator in Microsoft Windows
- How to Configure iSCSI Initiator in ESXi 6.x
- Implement iSCSI Multipath in RHEL 6.5



## 8.8. Disk Roaming

Disks can be re-sequenced in the same system or move all member disks in the same pool from system-1 to system-2. This is called disk roaming. System can execute disk roaming online. Please follow these steps.

- 1. Select the **Pools** function submenu, selects a pool. And then click ▼ -> **Deactivate**.
- 2. Click the **OK** button to apply. The Status changes to Offline.
- 3. Move all member disks of the pool to another system.
- 4. In the **Pools** function submenu, select the pool. And then click ▼ -> **Activate**.
- 5. Click the **OK** button to apply. The Status changes to Online.

Disk roaming has some constraints as described in the following.

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



#### CAUTION:

XCubeSAN series does NOT support disk roaming fromAegisSAN LX, AegisSAN Q500, and AegisSAN V100.

## **CSAN**

## 9. Thin Provisioning

This chapter describes an overview and operations of thin provisioning.

## 9.1. Overview

Nowadays, thin provisioning is a hot topic people talk about in IT management and storage industry circles. To contrast thin provisioning, it naturally comes to mind with the opposite term – thick or 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 of deciding 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 each logical volume than it needs in the beginning. This is why it's called thick or fat provisioning. Usually it turns out that a lot of free disk space is sitting around idle. This stranded capacity is wasted, which equals to waste of investment in drives, energy usage, and general 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.



Figure 9-1 Traditional Thick Provisioning

Thin provisioning sometimes is known as just-in-time capacity or over allocation. As the term explains itself, it provides storage space dynamically on demand. Thin provisioning presents more storage space to the hosts or servers connecting to the storage system than is actually physically available on the storage system. To 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.



Figure 9-2 Thin Provisioning

## 9.1.1. Thick Provisioning vs. Thin Provisioning

The efficiency of thin or thick provisioning is a function of the use case, not of the technology. Thick provisioning is typically more efficient when the amount of resource used very closely approximates to the amount of resource allocated. Thin provisioning offers more efficiency where the amount of resource used is much smaller than allocated, so that the benefit of providing only the resource needed exceeds the cost of the virtualization technology used.



Figure 9-3

Benefits of Thin Provisioning



## 9.2. Theory of Operation

Thin provisioning, in a shared-storage environment, provides a method for optimizing utilization of available storage. It relies on on-demand allocation of blocks of data versus the traditional method of allocating all the blocks up front. This methodology eliminates almost all whitespace which helps avoid poor utilization rates.

With thin provisioning, storage capacity utilization efficiency can be automatically driven up towards 100% with very little administrative overhead. Organizations can purchase less storage capacity up front, defer storage capacity upgrades in line with actual business growth, and save the operating costs (electricity and floor space) associated with keeping unused disk capacity spinning.

## 9.2.1. Thin Provisioning Architecture

A thin provisioning pool is a collection of disk groups which contain disk drives and made up a RAID. Similarly, a storage pool is grouped to provide capacity for volumes. Volumes are then allocated out of the storage pool and are mapped to LUN which can be accessed by a host system. The following is the storage architecture of a thin provisioning pool.



Figure 9-4 Storage Architecture of Thin Provisioning Pool

Disk groups which contain disk drives can be added to a thin provisioning pool at any time to increase the capacity of the pool. A thin provisioning pool can have up to 32 disk groups with each disk group containing up to 64 disk drives. And the maximum disk drive quantity

# **C**SAN

in a pool is 256. The maximum addressable capacity of each disk group is 64TB. So the maximum capacity in a system is 256TB. For more information about pool operation, please refer to the chapter 9.3, <u>Configuring Thin Provisioning Pools</u> section.

Item	Value
Maximum disk group quantity in a pool	32
Maximum disk drive quantity in a disk group	64
(include dedicated spares)	
Maximum RAID EE spare quantity in a disk group	8
Maximum disk drive quantity in a pool	256
(include dedicated spares)	
Maximum pool quantity per system	64
Maximum dedicated spare quantity in a pool	8
Maximum addressable capacity of a disk group	64TB
Maximum addressable capacity of a thin provisioning pool	256TB
Maximum addressable capacity of total thin provisioning	1,024TB
pools	
(include auto tiering pools)	
Provisioning granularity	1GB

Table 9-1	Thin	Provisionina	Pool	Parameters
		1 TOVISIOIIIII Y	1 001	i aranicici s

## 9.2.2. Space Reclamation

Previously allocated, but currently unused volume space can be reclaimed in disk pools after all data within a granularity have been deleted from volumes by hosts. Data must be permanently deleted to be considered as unused space. The unused space is returned to the pool.

Similar to the manual operation of reclaiming volume space is the auto-reclamation process, which is the continual process of automatically reclaiming spaces that are "not in use" or "zeroed-out" and returning them to the pool without user intervention. The auto-reclamation process has some benefits over running the manual operation. For more information about the operation, refer to the chapter 9.4.1, <u>Create a Volume in a Thin Provisioning Pool</u> section.



## 9.2.3. Thin Provisioning Policies

Because thin provisioning is just-in-time capacity or over allocation, thin provisioning polices have been designed to warn in advance. There are 2 levels of threshold percentage and the available values defined as the following table.

Table 9-2 Thin Provisioning Policies and Available values									
No.	Action	Threshold	Default Threshold						
1	Reclaim Space	85% ~ 89%	85%						
2	Read-only Volume	95% ~ 99%	95%						

 Table 9-2
 Thin Provisioning Policies and Available Values

You can configure a threshold percentage based on pool capacity. Take the default threshold as an example. When the used capacity of the thin provisioning pool reaches 85%, in addition to the system issued an event with warning level, but also began to implement space reclamation. After reaching 95%, the volumes will be set to read-only to avoid data loss.

For more information about the operation, refer to the chapter 9.3.3, <u>Operations on Thin</u> <u>Provisioning Pools</u> section.



#### CAUTION:

Please always watch the system logs of thin provisioning pool. If the used capacity of the thin provisioning pool reaches 95%, the system will force to set all volumes in the pool to be read-only to avoid data loss. So the host cannot write data at this time. You have to expand the pool capacity, and then configure the **Volume Type** back to **RAID Volume** to resolve the issue. For more information about the operation, refer to the chapter 8.5.3, <u>Operations on Volumes</u> section.

## 9.3. Configure Thin Provisioning Pools

This section will describe the operations of configuring thin provisioning pool.





	STORAG	GE MANAGEMENT
	Disks	
	Pools	
	Volume	s
	LUN Ma	appings
	SSD Ca	ache
Figu	ure 9-5	Pools Function Submenu

## 9.3.1. Create a Thin Provisioning Pool

Here is an example of creating a thin provisioning pool with 4 disks configured in RAID 5. At the first time of creating a thin provisioning pool, it contains a disk group and the maximum quantity of disk in a disk group is 64.

1. Select the **Pools** function submenu, click the **Create Pool** button. It will scan available disks first.



#### TIP:

It may take 20 ~ 30 seconds to scan disks if your system has more than 200 disk drives. Please wait patiently.



Create Pool		
General	Pool Type	
Disk Selection	Please select a pool type.	
RAID Configuration	Thick Provisioning	
Disk Properties	Thin Provisioning	
Summary	Pool Properties	
	Plana aster a seal aster a	
	Please enter a pool name ar	d select preferred controller setting.
	Pool Name : Po	iol-2 <b>()</b>
	Preferred Controller : (	ontroller 1
	The I/O resources will be	managed by the preferred controller which you specified.
	SED Pool	
	Enable SED Pool	
	Enabling SED pool will u	e the secure SEDs to create a pool. Intermixing SEDs and non-SEDs are not supported in a pool.
		Next Cancel

Figure 9-6 Create a Thin Provisioning Pool Step 1

- 2. Select the **Pool Type** as Thin Provisioning.
- 3. Enter a **Pool Name** for the pool. The maximum length of the pool name is 16 characters. Valid characters are [ A~Z | a~z | 0~9 | -\_<> ].
- 4. Select a **Preferred Controller** from the drop-down list. The backend I/O resources in this pool will be processed by the preferred controller which you specified. This option is available when dual controllers are installed.
- 5. Check the **Enable SED Pool** checkbox. Enabling SED pool will use the secure SEDs to create a pool. Intermixing SEDs and non-SEDs are not supported in a pool.
- 6. Click the **Next** button to continue.

Disk Selection	Pleas	e select disks to	add a dis	sk group in a	thin provisionin	g pool. The maximum quan	tity of disk in a dis	k group is 64.	
RAID Configuration	Enclo	sure ID:	0 (Head	Unit: XS52:	16)	Ψ.			
Disk Properties		Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model	
Summary		0	1	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	2	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	4	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	9	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	10	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	11	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	12	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	13	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
		0	14	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
		0	15	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0034	

Figure 9-7 Create a Thin Provisioning Pool Step 2

- 7. Please select disks for pool. The maximum quantity of disk in a disk group is 64. Select an **Enclosure ID** from the drop-down list to select disks from expansion enclosures.
- 8. Click the **Next** button to continue.

**CSAN** 



Create Pool			
General	RAID Configuration		
Disk Selection	Please select a RAID level.		
RAID Configuration	RAID Level :	RAID 5	
Disk Properties Summary	Quantity of SAS Disks :	RAID 0 RAID 1 RAID 3 RAID 5 RAID 5EE RAID 6 RAID 0+1 RAID 10	
Back			Next Cancel

Figure 9-8 Create a Thin Provisioning Pool Step 3

- 9. Select a **RAID Level** from the drop-down list which lists available RAID level only according to the disk selection. And also select a **Quantity of Subgroups** if the combination RAID level is selected.
- 10. Click the **Next** button to continue.



Create Pool	
General	Disk Properties
Disk Selection	Please configure the disk properties.
RAID Configuration	✓ Enable Disk Write Cache
Disk Properties	Enabling disk write cache will improve write I/O performance but risking data loss when power failure.
Summary	Enable Disk Read-ahead System will preload data to disk buffer based on previously retrieved data. This feature will efficiently improve the performance of sequential data retrieved.
	Enable Disk Command Queuing Send multiple commands to a disk at once to improve performance.
	Enable Disk Standby The disks will spin down for power saving when they are idle for a period of time according to the setting.
	Disk Standby : 30 seconds 🔻
	Enable High Latency Disk Warning The system will send event logs if there is a high latency disk in the disk group.
Back	Next Cancel

Figure 9-9 Create a Thin Provisioning Pool Step 4

11. Disk properties can also be configured optionally in this step:

- **Enable Disk Write Cache**: Check to enable the write cache option of disks. Enabling disk write cache will improve write I/O performance but have a risk of losing data when power failure.
- **Enable Disk Read-ahead**: Check to enable the read-ahead function of disks. System will preload data to disk buffer based on previously retrieved data. This feature will efficiently improve the performance of sequential data retrieved.
- **Enable Disk Command Queuing**: Check to enable the command queue function of disks. Send multiple commands to a disk at once to improve performance.
- **Enable Disk Standby**: Check to enable the auto spin down function of disks. The disks will be spun down for power saving when they are idle for the period of time specified.
- **Enable High Latency Disk Warning**: Check to enable the high latency disk warning function in a disk group. When a disk drive is abnormal with high latency, the system



will send event logs to notify IT administrators in advance to avoid affecting overall performance.

12. Click the **Next** button to continue.

Create Pool			
General	Pool Properties		
General Disk Selection RAID Configuration Disk Properties Summary	Pool Properties Pool Type : Pool Name : Preferred Controller : RAID Configuration RAID Level : Quantity of SAS Disks : Disk Properties Disk Write Cache : Disk Read-ahead : Disk Command Queuing : Disk Standby : High Latency Disk Warning :	Thin Provisioning Pool-2 Controller 1 RAID 5 4 Enabled Enabled Enabled Disabled Disabled	
Back			Finish Cancel

Figure 9-10 Create a Thin Provisioning Pool Step 5

13. After confirmation of info on the summary page, click the **Finish** button to create a pool.

	Pool Name	Status	Health	Total	Free	Available	Thin Provisioning	Encryption	Volumes	Current Controller
▼	Pool-2	Online	Good	3.27 TB	3.27 TB	3.27 TB	Enabled	Disabled	0	Controller 1
Create F	2001									

Figure 9-11 A Thin Provisioning Pool is Created



14. A pool has been created. If necessary, click the **Create Pool** button again to create others.

## 9.3.2. List Thin Provisioning Pools

Click a pool; it will display the related disk groups. Similarly, click a disk group; it will display the related disk drives. The pool properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific pool.

	Pool N	ame	Status	Health	Total	Free	Available	Thi	n Provisioning	E	ncryption	Volumes	Current Controller
V	Pool-2		Online	Good	3.27 TB	3.27 TB	3.27 TB	Enabled		Disabled			Controller 1
Disk Gro	Disk Groups												
	No.	Status	Health	Total	Free	RAID	Disks Use	ed	RAID EE Spa	ares			
V		Online	Good	3.27 T	В 3.27 Т	B RAID			N/A				
Disks												_	
Enclosu	re ID	Slot	Status	Health	Capacity	Disk T	ype	Ma	anufacturer	Mod	el		
0		9	Online	Good	1.09 TB	SAS H	DD 12.0Gb/s	SE	EAGATE	ST1	200MM0088		
0		10	Online	Good	1.09 TB	SAS H	DD 12.0Gb/s	SE	EAGATE	ST1	200MM0088		
0		11	Online	Good	1.09 TB	SAS H	DD 12.0Gb/s	SE	EAGATE	ST1	200MM0088		
0		12	Online	Good	1.09 TB	SAS H	DD 12.0Gb/s	SE	EAGATE	ST1	200MM0088		
Create F	2001												
- or other													

Figure 9-12 List Thin Provisioning Pools

This table shows the column descriptions.

Column Name	Description
Pool Name	The pool name.
Status	<ul> <li>The status of the pool:</li> <li>Online: The pool is online.</li> <li>Offline: The pool is offline.</li> <li>Rebuilding: The pool is being rebuilt.</li> <li>Migrating: The pool is being migrated.</li> <li>Relocating: The pool is being relocated.</li> </ul>
	• EE Rebuilding: The pool is being RAID EE rebuilt.
Health	The health of the pool:

Table 9-3Pool Column Descriptions



	Good: The pool is good.
	• Failed: The pool has failed.
	• Degraded: The pool is not healthy and not completed. The reason
	could be lack of disk(s) or have failed disk.
Total	Total capacity of the pool.
Free	Free capacity of the pool.
Available	Available capacity of the pool.
Thin	The status of Thin provisioning:
Provisioning	• Disabled.
	• Enabled.
Encryption	The Data Secure Mode:
	Disabled: The pool is not encrypted.
	Enabled: The pool is encrypted.
Volumes	The quantity of volumes in the pool.
Current	The current running controller of the pool.
Controller	
(This option is	
only visible when	
dual controllers	
are installed.)	

Tahla 0_1	Dick Group	Column	Descriptions
		COIUIIII	

Column Name	Description				
No.	The number of the disk group.				
Status	The status of the disk group:				
	Online: The disk group is online.				
	Offline: The disk group is offline.				
	Rebuilding: The disk group is being rebuilt.				
	Migrating: The disk group is being migrated.				
	Relocating: The disk group is being relocated.				
	• EE Rebuilding: The disk group is being RAID EE rebuilt.				
Health	The health of the disk group:				
	Good: The disk group is good.				
	Failed: The disk group has failed.				
	• Degraded: The pool is unhealthy and incomplete. The cause may				
	be a disk loss or failure.				
Total	Total capacity of the disk group.				



Free	Free capacity of the disk group.
RAID	The RAID level of the disk group.
Disks Used	The quantity of disk drives in the disk group.
RAID EE Spare The quantity of RAID EE spare disk drives in the disk group.	
	Traditional RAID level is display as N/A.

Table 9-5 Disk	Column Descriptions
Column Name	Description
Enclosure ID	The enclosure ID.
Slot	The position of the disk drive.
Status	The status of the disk drive:
	Online: The disk drive is online.
	• Missing: The disk drive is missing in the pool.
	Rebuilding: The disk drive is being rebuilt.
	• Transitioning: The disk drive is being migrated or is replaced by
	another disk when rebuilding occurs.
	Scrubbing: The disk drive is being scrubbed.
	• Check Done: The disk drive has been checked the disk health.
	Copying Back: The disk drive is being copied back.
Health	The health of the disk drive:
	Good: The disk drive is good.
	Failed: The disk drive has failed.
	Error Alert: S.M.A.R.T. error alerts.
	Read Errors: The disk drive has unrecoverable read errors.
Capacity	The capacity of the disk drive.
Disk Type	The type of the disk drive:
	• [SAS HDD   NL-SAS HDD   SAS SSD   SATA SSD ]
	• [12.0Gb/s   6.0Gb/s   3.0Gb/s   1.5Gb/s ]
Manufacturer	The manufacturer of the disk drive.
Model	The model name of the disk drive.

## 9.3.3. Operations on Thin Provisioning Pools

Most operations are described in the Configuring Storage Pools section. For more information, please refer to the chapter 8.4.3, <u>Operations on Thick Provisioning Pools</u> section. We describe the operations about thin provisioning in the following.



#### Change Thin Provisioning Policy of the Pool

Click ▼ -> Change Thin Provisioning Policy in pools to change the policies of the thin provisioning pool. There are 2 levels of threshold percentage and the default values defined. The threshold percentage can be changed when the usage of the pool capacity reaches the threshold. For more information, please refer to the chapter 9.2.3, <u>Thin Provisioning Policies</u> section.

No	Action	Threshold		
1	Reclaim Space	85%	•	
2	Read-only Volume	95%		

Figure 9-13 Change Thin Provisioning Policy

Column Name	Description
No.	Number of item.
Action	Action to take on the system when the usage of the pool reaches the
	threshold. The options are:
	Read-only Volume
Threshold	The threshold of the pool.

 Table 9-6
 Thin Provisioning Policy Column Descriptions

### Add a Disk Group into the Pool

Click ▼ -> Add Disk Group in one of pools to add another disk group into the pool. For more information, please refer to the chapter 9.3.4, Add a Disk Group in a Thin Provisioning Pool section.

If the auto tiering license is enabled, you can click ▼ -> Add Disk Group in one of pools to transfer from the thin provisioning pool to auto tiering pool. For more information, please refer to the chapter 11.7, <u>Transfer to Auto Tiering Pool</u> section.

Add Disk Group							
Pool	Гуре						
Thin Provisioning Enabled							
Auto 1	Fiering :		Disable	d 🔻 🔒			
	Lovel		Disabled				
KAID	Enabled Enabled						
Please	e select a RAID I	evel.					
RAID	Level :		RAID 1		Ψ.		
Selec	t Disks						
Please	e select disks to	add a disl	k group. The	e maximum qua	ntity of disk in a disk group i	s 64.	
Enclos	sure ID :		0 (Head	d Unit: XS5216	5) <b>•</b>		
	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model
	0	1	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
	0	2	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
	0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
	0	4	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
	0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800
	0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800
	0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800
	0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800
	0	13	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014
	0	14	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014
	0	15	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014
	0	16	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014
							OK Cancel

Figure 9-14 Transfer Thin Provisioning Pool to Auto Tiering



#### CAUTION:

The action of transferring from the thin provisioning pool to auto tiering is irreversible. Carefully consider the consequences before making this change.

## Move Disk Group Member Disks

Click ▼ -> Move Disk Group in disk group to move the member disks of disk group to other disk drives. Select disks and then click the OK button.


Enclosure IDSlotHealthCapacityDisk TypeManufacturerModel01Good372.36 GBSAS SSD 12.0Gb/sSEAGATEST400FM005302Good372.36 GBSAS SSD 12.0Gb/sSEAGATEST400FM005303Good372.36 GBSAS SSD 12.0Gb/sSEAGATEST400FM005303Good372.36 GBSAS SSD 12.0Gb/sSEAGATEST400FM005304Good372.36 GBSAS SSD 12.0Gb/sSEAGATEST400FM005305Good744.96 GBSAS SSD 12.0Gb/sMICRONS630DC-80006Good744.96 GBSAS SSD 12.0Gb/sMICRONS630DC-80007Good744.96 GBSAS SSD 12.0Gb/sMICRONS630DC-80008Good744.96 GBSAS SSD 12.0Gb/sMICRONS630DC-800013Good5.46 TBNL-SAS HDD 12.0Gb/sSEAGATEST6000NM0014014Good5.46 TBNL-SAS HDD 12.0Gb/sSEAGATEST6000NM0014015Good5.46 TBNL-SAS HDD 12.0Gb/sSEAGATEST6000NM0014016Good5.46 TBNL-SAS HDD 12.0Gb/sSEAGATEST6000NM0014	Please select disks to move the disk group. The maximum quantity of disk in a disk group is 64. Enclosure ID : 0 (Head Unit: XS5216)										
0         1         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         2         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         3         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         3         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         4         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         4         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         5         Good         372.36 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         5         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         13         Good         5.46 TB         NL-SA	)	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model			
0         2         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         3         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         4         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         4         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         4         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         5         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         6         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         8         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         13         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         14         Good         5.46 TB         NL	)	0	1	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053			
0         3         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         4         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         4         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         5         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         6         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         8         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         8         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         13         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         14         Good         5.46 TB         NL-SAS		0	2	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053			
0         4         Good         372.36 GB         SAS SSD 12.0Gb/s         SEAGATE         ST400FM0053           0         5         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         6         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         6         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         8         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         13         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         13         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         14         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         16         Good         5.46 TB         NL-S		0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053			
0         5         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         6         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         8         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         13         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         14         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         15         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         16         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014		0	4	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053			
0         6         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         8         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         8         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         13         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         14         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         15         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         16         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014	)	0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800			
0         7         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         8         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         13         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         14         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         15         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         16         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014		0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800			
0         8         Good         744.96 GB         SAS SSD 12.0Gb/s         MICRON         S630DC-800           0         13         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         14         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         14         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         15         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         16         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014		0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800			
0         13         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         14         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         15         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         15         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         16         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014		0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800			
0         14         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         15         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         16         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014		0	13	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014			
0         15         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014           0         16         Good         5.46 TB         NL-SAS HDD 12.0Gb/s         SEAGATE         ST6000NM0014		0	14	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014			
0 16 Good 5.46 TB NL-SAS HDD 12.0Gb/s SEAGATE ST6000NM0014	)	0	15	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014			
	1	0	16	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014			

Figure 9-15 Move Disk Group



### **INFORMATION:**

The capacity after moving must be larger than the current capacity.

# 9.3.4. Add a Disk Group in a Thin Provisioning Pool

The Add Disk Group function adds a disk group to a pool to increase the capacity.

# **OSAN**



Figure 9-16 Add a Disk Group in a Thin Provisioning Pool

Here is an example of adding a disk group into a thin provisioning pool with 2 disks configured in RAID 1.

1. Select a pool, click ▼ -> Add Disk Group to add a disk group in a thin provisioning pool.



in F	rovicioning :		Enabled				
	rovisioning .		Linableu				
AID	Level						
leas	e select a RAID I	level.					
RAID Level : RAID 1					v		
Select Disks RAID 0							
Please select disks to add a disk g					disk in a disk group	is 64.	
Enclosure ID :			RAID 5	EE			
	Englagura ID	Clat	RAID 6		Tune	Manufacturer	Madal
		5100	RAID 6	+1	sep 12 0Ch/c		ST400EM00E2
	0	1	RAID 1	0	SSD 12.0Gb/s	SEAGATE	ST400FM0053
	0	2	RAID 5	0	SSD 12.0Gb/s	SEAGATE	ST400FM0053
	0	3	RAID 5	0EE 0	SSD 12.0Gb/s	SEAGATE	ST400FM0053
	0	4	RAID 6	OEE	SSD 12.0Gb/s	MICDON	S1400FW0055
	0	6	Good	744.50 GD	SAS SSD 12.000/S	MICRON	S630DC-000
	0	7	Good	744.50 GD	SAS SSD 12.0Gb/s	MICRON	S630DC-800
	0	8	Good	744.50 GD	SAS SSD 12.06b/s	MICRON	S630DC-000
	0	12	Good	5 /6 TB	NIL SAS HDD 12 0Gb/s	SEAGATE	ST6000NIM0014
	0	14	Good	5.40 TB	NL-SAS HDD 12.00b/s	SEAGATE	ST6000NIM0014
	0	15	Good	5.46 TB	NL-SAS HDD 12.000/s	SEAGATE	ST6000NIM0014
0	0	16	Good	5.46 TB	NL-SAS HDD 12.000/S	SEAGATE	ST6000NIM0014

Figure 9-17 Add a Disk Group to a Thin Provisioning Pool

- 2. Select a **RAID Level** from the drop-down list and also select a **Quantity of Subgroups** if the combination RAID level is selected.
- Select disks to add into a disk group. The maximum quantity of disk in a disk group is 64. Select an Enclosure ID from the drop-down list to select disks from expansion enclosures.
- 4. Click the **OK** button to add a disk group into the pool.



Pool	-2	Online	Good 3	.64 TB	3.64 TB	3.64 TE	3	Enabled		Disabled	0	Controller 1
Disk Groups												
No												
INO.	Status	Health	Total	Free		RAID	Disks	s Used	RAID EI	E Spares		
▼ 1	Online	Good	3.27 TB	3.27	ТВ	RAID 5	4		N/A			
▼ 2	Online	Good	371.00 G	B 371.	00 GB	RAID 1	2		N/A			
Disks Enclosure ID	Slot	Status	Health	Capacity	Disk	Туре		Manufac	turer	Model		
0	1	Online	Good	372.36 GE	SAS	SSD 12.0	Gb/s	SEAGAT	E	ST400FM008	53	
0	2	Online	Good	372.36 GE	SAS	SSD 12.0	Gb/s	SEAGAT	E	ST400FM008	53	

Figure 9-18 A Disk Group is Added

5. A disk group has been added into the pool.



### TIP:

If auto tiering license is enabled, the thin provisioning pool without disk group of mixed disk type can be transferred to the auto tiering pool by **Add Disk Group** option. Please refer to the chapter 11.6.2, <u>Transfer from</u> <u>Thin Provisioning Pool to Auto Tiering</u> section.

# 9.4. Configure Volumes

This section will describe the operations of configuring volume in a thin provisioning pool.

# 9.4.1. Create a Volume in a Thin Provisioning Pool

Here is an example of creating a volume of thin provisioning pool.

1. Select the **Volumes** function submenu, click the **Create Volume** button.



Create Volume				
General	Volume General Se	ttings		
Advanced	e general settings.			
Summary	Volume Name :	Vol-2		0
	Pool Name :	Pool-2	•	(Available : 262144 GB)
	Capacity :	100		GB T
	Volume Type :	RAID Volume	•	
	Select RAID Volu replication.	me for general RAID us	age or Ba	ackup Volume for backup usage such as the target volume of local clone or remote
				Next Cancel

Figure 9-19 Create a Volume in Thin Provisioning Pool Step 1

- 2. Enter a **Volume Name** for the pool. The maximum length of the volume name is 32 characters. Valid characters are [A~Z | a~z | 0~9 | -\_<>].
- 3. Select a **Pool Name** from the drop-down list. It will also display the available capacity of the pool.
- 4. Enter required **Capacity**. The unit can be selected from the drop-down list.
- 5. Select **Volume Type**. The options are **RAID Volume** (for general RAID usage) and **Backup Volume** (for the target volume of local clone or remote replication).
- 6. Click the **Next** button to continue.

General Advanced Summary	Volume Advanced Settin Please configure the volum	n <mark>gs</mark> me advanced settin			
Advanced Summary	Please configure the volu	me advanced settin			
Summary	Stripe Size :		gs.		
		64 KB			
	Block Size :	512 Byte			
	Background I/O Priority :	High		0	
	Enable Cache Mode (V)	Vrite-back Cache)	0		
	Enable Video Editing N	1ode 🕕			
	Enable Read-ahead	0			
	Enable Space Reclam	ation			
	I				
Back					Next

Figure 9-20 Create a Volume in Thin Provisioning Pool Step 2

OSAr

- 7. Volume advanced settings can also be configured optionally in this step:
  - Stripe Size: The options are 64KB to 1,024KB.
  - **Block Size**: The options are 512Bytes to 4,096Bytes.
  - **Background I/O Priority**: The options are High, Medium, and Low. It will influence volume initialization, rebuild, and migration.
  - **Enable Cache Mode (Write-back Cache)**: Check to enable cache mode function of volume. Write back optimizes the system speed but comes with the risk where the data may be inconsistent between cache and disks in one short time interval.
  - **Enable Video Editing Mode**: Check to enable video editing mode function. It is optimized for video editing usage. Please enable it when your application is in video editing environment. This option provides a more stable performance figure without high and low peaks but slower in average.
  - Enable Read-ahead: Check to enable the read ahead function of volume. 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 disk's buffer. This feature will improve performance when the data being retrieved is sequential.
  - **Enable Space Reclamation**: Check to enable the space reclamation function of the volume when the pool is thin provisioning. For more information about space reclamation, please refer to the chapter 9.2.2, <u>Space Reclamation</u> section.





### **INFORMATION:**

Stripe sizes from 64KB to 1,024KB support more than 8GB of memory for resource allocation. 4GB memory is only support 64KB stripe size.

8. Click the **Next** button to continue.

ate Volume			
General	Configure Volume General Set	tings	
Advanced	Volume Name :	Vol-2	
Summary	Pool Name :	Pool-2	
	Capacity :	100 GB	
	Volume Type :	RAID Volume	
	Configure Volume Advanced	iettings	
	Stripe Size :	64 KB	
	Block Size :	512 Byte	
	Background I/O Priority :	High	
	Cache Mode :	Enabled	
	Video Editing Mode :	Disabled	
	Read-ahead :	Disabled	
	Space Reclamation :	Enabled	
Back			Finish Cancel

Figure 9-21 Create a Volume in Thin Provisioning Pool Step 3

- 9. After confirmation at summary page, click the **Finish** button to create a volume.
- 10. The volume has been created. It will be initialized in protection RAID level (e.g., RAID 1, 3, 5, 6, 0+1, 10, 30, 50, and 60).

<< first < prev 1 next > last >>											
	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name
▼	Vol-2	Online	Optimal	100.00 GB	RAID Volume	Disabled	0 MB / 0 MB	0	N/A	WB	Pool-2
< <fre>&lt;first &lt; prev 1 next &gt; last &gt;&gt;</fre>											
Create \	/olume Local Clo	ne Options	]								

Figure 9-22 A Volume in Thin Provisioning Pool is Created



11. A volume has been created. If necessary, click the **Create Volume** button again to create others.



### **INFORMATION:**

SANOS supports instant RAID volume availability. The volume can be used immediately when it is initializing or rebuilding.



**TIP:** If the pool contains some disk drives of 4Kn type, it is not available to set 512, 1024, or 2048 block size. When the case happens, it will pop up a warning message and suggest changing the block size to 4096.

# 9.4.2. List Volumes and Operations on Volumes

Most operations are described in the chapter 8.5, <u>Configuring Volumes</u> section. For more information about list volume, please refer to the chapter 8.5.2, <u>List Volumes</u> section. For more information about operations on volumes, please refer to the chapter 8.5.3, <u>Operations on Volumes</u> section. We describe the operations about thin provisioning in the following.

### **Change Volume Properties**

Click ▼ -> Change Volume Properties to change the volume properties of the volume.



Change Volume Properties		
Volume Name:	Vol-2	0
Priority:	● High ○ Medium	○ Low
Background I/O Priority:	High	т
Cache Mode:	O Write-through	Cache 🖲 Write-back Cache 🔾 Read-Only 🛛 🚺
Video Editing Mode:	Disabled	· •
Read-ahead:	Enabled	· • •
Space Reclamation:	Enabled	- <b>v</b>
Volume Type:	RAID Volume	· • •
		OK Cancel

Figure 9-23 Change Volume Properties

### **Reclaim Space with Thin Provisioning Pool**

Click ▼ -> Space Reclamation to reclaim space from the volume when the volume is in a thin provisioning pool. For more information about space reclamation, please refer to the chapter 9.2.2, <u>Space Reclamation</u> section.

# 9.5. Configure LUN Mappings and Connect by Host Initiator

Next step, you can configure LUN mapping and connect by host initiator. For more information about LUN mapping, please refer to the chapter 8.6, <u>Configure LUN Mappings</u> section. For more information about host initiator, please refer to the chapter 8.7, <u>Connect by Host Initiator</u> section.

# **OSAN**

# 10. SSD Cache

This chapter describes an overview and operations of SSD cache. Now we provide two cache types, SSD read cache and read-write cache.



### **INFORMATION:**

SSD cache 2.0 with read and write cache is available in SANOS firmware 1.1.0.

# 10.1. Overview

Traditionally, data has been stored on traditional rotating memory, or HDDs (Hard Disk Drives) and SSDs (Solid-State Drives) are mainly used for mission-critical applications that demand high-speed storage systems, however tend to be costly. In recent years, the capacity of HDDs has increased, but their random I/O (Input / Output) has not kept pace. For some applications such as web commerce, clouds, and virtualization that require both high capacity and performance, HDDs, though capacious, simply are not fast enough and SSDs have increased capacity and have declined in cost, making them more attractive for caching in SAN storage networks.

Smart Response Technology (also known as SSD cache technology) leverages the strengths of both HDDs and SSDs, to cost-effectively meet the capacity and performance requirements of enterprise applications. Data is primarily stored on HDDs while SSDs serve as an extended HDD memory cache for many I/O operations. One of the major benefits of using SSD cache is the improved application performance, especially for workloads with frequent I/O activity. The read data of an application that is frequently accessed is copied to the SSD cache; the write data is stored to the SSD cache temporary and then flush to HDDs in bulk. So the application receives an immediate performance boost. QSAN SSD cache enables applications to deliver consistent performance by absorbing bursts of read/write loads at SSD speeds.

Another important benefit is improved TCO (Total Cost of Ownership) of the system. SSD cache copies the hot or frequency of data to SSDs in chunks. By offloading many if not most of the remaining IOPS after SSD cache, the user can fill the remainder of their storage needs with low cost, high capacity HDDs. This ratio of a small amount of SSD paired with a lot of HDD offers the best performance at the lowest cost with optimal power efficiency.



Generally, SSD read cache is particularly effective when:

- Reads are far more common than writes in the production environment, common in live database or web service applications.
- The inferior speeds of HDD reads cause performance bottlenecks.
- The amount of repeatedly accessed data is smaller than the capacity of the SSD cache.



Figure 10-1 SSD Read and Write Cache

SSD read-write cache is particularly effective when:

- Reads and writes mix in the production environment, common in file service applications.
- The inferior speeds of HDD reads and writes cause performance bottlenecks.
- Same as SSD read cache case; the size of repeatedly accessed data is smaller than the capacity of the SSD cache.



• Willing to take a little risk to increase write performance because it's write cache buffering at SSD cache pool. Of course, these write data in SSD cache can be used at the next read.

# 10.2. Theory of Operation

SSD cache allows an SSD to function as read cache or write buffer for a HDD volume. In SSD read cache, it is a secondary cache that improves performance by keeping frequently accessed data on SSDs where they are read far more quickly than from the HDD volume. When reads or writes are performed, the data from the HDDs are copied into the SSD cache. Although the data is duplicated to SSD cache pool, it does not matter if the read cache pool is corrupted.

In SSD write cache, SSDs are a write buffering storage that improves performance by storing the write data in SSDs temporary where they are write far more quickly than to the HDD volume. And then the write data will be flushed to the HDD volume at the appropriate time. It may take risk of losing data during the period that the write data is stored in SSD cache if the SSD cache pool is corrupted. The write data has not yet written back to the HDD volume. So the read-write cache pool needs data protection to protect the write data.



#### CAUTION:

Using SSD read-write cache may take risk of losing data if the SSD cache pool is corrupted. User has to monitor the health of the SSD cache pool carefully.

## 10.2.1. System Memory and SSD Cache Capacity

SSD cache function needs system memory to store metadata. The usable capacity of SSD cache is in proportion to the size of the controller system memory. The following table is the relationship between the system memory per controller and the maximum SSD cache capacity.



System Memory per Controller	Maximum SSD Cache Capacity per System
4GB	X (Not Support)
8GB ~ 15GB	2TB
16GB ~ 31GB	4TB
32GB ~ 63GB	8TB
64GB ~ 127GB	16TB
128GB	32TB

 Table 10-1
 The Relationship between System Memory and SSD Cache Capacity



### **CAUTION:**

SSD cache function is not supported when the system memory is under 8GB per controller.

# 10.2.2. SSD Cache Pool Architecture

A SSD cache pool is grouped to provide capacity for SSD cache usage of a dedicated storage pool. The maximum SSD cache pool quantity per system (either dual controller or single controller) is 4. The following is the storage architecture of SSD cache pool.



Figure 10-2 Storage Architecture of SSD Cache Pool

Take an example of SSD read cache; one or more SSDs with NRAID+ (which is described in the next section) are grouped into the "SSD Cache Pool 1" and assigned to the "Pool 1" for use. The maximum SSD quantity in an SSD cache pool is 8. When the SSD read cache is



performing, the capacity of the SSD cache can be increased by adding an SSD or decreased by removing an SSD.

Another example of SSD read-write cache; two SSDs with NRAID 1+ (which is also described in the next section) are grouped into an SSD group. One or more SSD groups combine to the "SSD Cache Pool 2" and assigned to the "Pool 2" for use. When the SSD read-write cache is performing, the capacity of the SSD cache can be increased only by adding an SSD group with two SSDs at a time. The SSD read-write cache pool can set SSDs as dedicated hot spares. The maximum dedicated spare SSD quantity in an SSD cache pool is 4. The following table is the summary of the SSD cache parameters.

Table TU-2 SSD Cache Parameter	Table 10-2
--------------------------------	------------

Item	Value
Maximum SSD cache pool quantity per system	4
(either dual controller or single controller)	
Maximum SSD quantity in an SSD cache pool	8
Maximum addressable capacity of an SSD cache pool	32TB
Maximum quantity of volume shared in an SSD cache pool	32
Maximum dedicated spare SSD quantity in an SSD cache	4
pool	



#### CAUTION:

Note that the capacity allocated to the SSD cache pool is not counted in the regular data storage.

The volumes in pool can be selected to enable SSD cache function. The following is the relationship between SSD cache pool and storage pool.





Figure 10-3 The Relationship between SSD Cache Pool and Storage Pool

The volumes enabled SSD cache with hot data will consume the capacity of the SSD cache pool. Users have to consider which volumes are enabled according to the SSD cache resources. When the SSD cache is performing, you can enable or disable the volume. The maximum quantity of volume shared in an SSD cache pool is 32.

# 10.2.3. RAID Level of SSD Cache Pool

### SSD read cache with NRAID+

Generally, SSD read cache uses NRAID (Non-RAID) or RAID 0 without data protection to create the SSD cache storage space. Our SSD read cache technology uses NRAID+ which is parallel NRAID without striping.

# **CSAN**



Figure 10-4 SSD Read Cache with NRAID+

NRAID is a method of combining the free space on multiple disk drives to create a spanned capacity. A NRAID is generally a spanned volume only, as it can contain disk drives of various types and various sizes. RAID 0 consists of striping, without mirroring or parity. Adding a disk drive into RAID 0 needs to re-stripe the data. For SSD cache, it will have terrible performance when performing SSD cache and migrating RAID 0 at the same time. Let alone remove a disk drive.

Compare to the NRAID or RAID 0, NRAID+ distributes cache data over all SSDs. This NRAID+ technology combines with the advantages of NRAID and has better random I/O than NRAID. It also has the advantage of easy to add/remove SSDs from the SSD cache pool to increase/decrease the capacity.

Although the SSD read cache is a technique of duplicating data. If the SSD cache pool corrupts, the original data will be safe but stop SSD read cache.

## SSD read-write cache with NRAID 1+

SSD read-write cache needs data protection, so it usually uses RAID 1 or RAID 10 level to create the SSD cache storage space. Our SSD read-write cache technology uses NRAID 1+ which is parallel NRAID with mirror.





Figure 10-5 SSD Read-write Cache with NRAID 1+

RAID 10 creates a striped set from a series of mirrored drives. The same, adding pair disk drives into RAID 10 needs to re-stripe the data. So it is hard to add SSDs into SSD cache pool.

Compare to the RAID 10, NRAID 1+ distributes cache data over all mirrored SSDs. This NRAID 1+ technology has the data protection and better random I/O than RAID 10. It also has the advantage of easy to add SSDs into the SSD cache pool to increase the capacity. In this case, we disallow the SSDs to be removed from the SSD cache pool because it has the risk of losing write cache data.

If one SSD failure occurs in the SSD cache pool, the status of the SSD cache pool will be changed to degrade. It will stop write cache and start flushing write cache data into HDDs. At this time, read cache data is still working but no more new read cache data will be added into SSD cache pool. The SSD read-write cache pool can set SSDs as dedicated hot spares to prevent SSD cache pool failure. After inserting an SSD as a hot spare, the SSD read-write cache pool will be rebuilt until it is completed. And then it reverts to SSD read-write cache service.

## 10.2.4. Read/Write Cache Cases

The following describes the cases of read/write cache. In SSD read cache, the processes of read/write data will be disassembled to the following cases.

• Read Data with Cache Miss



- Read Data with Cache Hit
- Write Data in SSD Read Cache

Besides, in SSD read-write cache, the processes of read data are the same as above. But the write data is different. The processes of write data will be described on following case.

• Write Data in SSD Read-write Cache

Each case will be described below.

### **Read Data with Cache Miss**

The following figure shows how the controller handles a host read request when some or all of the data are not in the SSD cache.



These steps are:

- 1. A host requests to read data. The system will check if the requested data is in memory cache or SSD cache. If not, it is called cache miss.
- 2. Data is read from the HDD volume because of cache miss.
- 3. The requested data is returned to the host. And the system will check whether the requested data is hot data.
- 4. If it is, the SSD cache is populated.





### INFORMATION:

The actions that read data from the HDD and then write to the SSD are called populating the cache. For more information, please refer to the chapter 10.2.5, <u>Populating the Cache</u> in the next section.

### **Read Data with Cache Hit**

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



These steps are:

- 1. A host requests a read data. The system finds that the data is in SSD cache, so it is called cache hit.
- 2. Data is read from the SSD cache.
- 3. The requested data is returned to the host.
- 4. If there is an SSD cache error, data is read from the HDD volume.

## Write Data in SSD Read Cache

The following figure shows how the controller handles a host write request in SSD read cache. The write data can also be frequently accessed data and populated into SSD cache for next read.

# **C**SAN



These steps are:

- 1. A host requests to write data.
- 2. Data is written to the HDD volume.
- 3. The status is returned to the host.
- 4. The SSD cache is populated if the write threshold is reached.

## Write Data in SSD Read-write Cache

The following figure shows how the controller handles a host write request in SSD readwrite cache. The write data stays in the SSD cache for a while, and will be flushed to the HDD volume at the appropriate time.



# **CSAN**

These steps are:

- 1. A host requests to write data.
- 2. Data is written to the SSD cache.
- 3. The status is returned to the host.
- 4. Data will be flushed to the HDD volume at the appropriate time.

### Flush Write Data to HDD Volume

In SSD read-write cache, the write data will be flushed to the HDD volume in the following situations.

- Flush data to the HDD volumes before the SSD cache pool is deleted.
- Flush data to the HDD volumes before the related volume is disabled.
- Flush data when the system is idle.



## CAUTION:

It will take times to flush data from SSD cache to HDD volumes. Please do not remove SSDs before complete flushing; otherwise it may take risk of losing data.

In addition, to avoid taking a long time to complete flushing, please make sure the front I/O traffic is not heavy when deleting SSD cache pool.

It won't flush data to the HDD volumes when system goes shutdown or reboots.

# 10.2.5. Populating the Cache

The actions that read data from the HDD and then write to the SSD are called populating the cache. Typically, this is a background operation that immediately follows a host read or write operation. As the goal of the cache is to store frequently accessed data, not every I/O operation should trigger a cache population, but only ones that pass a certain threshold, implemented as a counter. There are both a populate-on-read threshold, and a populate-on-write threshold.

## Populate-on-read Threshold



When the same data block to be read over the threshold, it is called hot data and populated to the SSD cache. The threshold must be greater than or equal to 1 in SSD read cache or SSD read-write cache. The value is forbidden to set 0 because of no action in read cache. The maximum of the threshold is 4. If larger than 4, the frequently accessed data is hard into SSD cache, so there is no obvious effect.

### Populate-on-write Threshold

When the same data block to be written over the threshold, it is called hot data and populated to the SSD cache. The threshold must be greater than or equal to 0. If it is set to 0, no action is performed for a write cache. The value must be greater than or equal to 1 in SSD read-write cache. The value is forbidden to set 0 because of no action in write cache. The same as above, the maximum of the threshold is 4. If larger than 4, there is no obvious effect.

### **Operation Process**

Each cache block on a HDD volume has a read and write counter associated. When a host requests to read data located in that cache block, the read count is increased. If the data is not found in the cache and the read count is greater than or equal to the populate-on-read threshold, then a cache-populate operation is performed concurrently with the host read operation. If a cache hit occurs, the data is immediately returned from the SSD cache and a populate operation is not performed. If the read count is smaller than the threshold, a populate operation is not performed.

Write cases are the same scenario as read.

## 10.2.6. SSD Cache Tuning

The SSD cache can be tuned to maximize its efficiency base on application usage. Cache block size, populate-on-read threshold and populate-on-write-threshold are the main parameters.

#### **Cache Block Size**

A large cache block suits applications where frequently accessed data is close to each other, known as a high locality of reference. A large cache block will also fill up the SSD cache quickly - this is known as the warm-up time. After the cache is warmed up, the performance would be quite good for applications with high locality of reference. Such as the file system or web service usage, the frequently accessed data are based on some



concentrated files which are usually in large block size. However large cache blocks will also generate larger I/O overhead, increasing response time, especially for cache misses.

A smaller cache block size suits applications with data that is less localized, meaning the data is accessed more randomly, such as database usage. The SSD cache will fill up slower, but with more cache blocks, there is greater chance of a cache hit, especially for data with less locality of reference. With a smaller cache block size, cache usage is usually less than with a larger cache block size, but overhead is less, so the penalty for cache misses is less severe.

### Population Threshold

The population threshold is the quantity of accesses at which point that cache block is copied to the SSD Cache. A higher number ensures that the cache only stores frequently accessed data so there will not be much cache turnover however it also means the cache will take longer to warm up and be fully effective. A lower number means the cache is warmed up quickly, but may cause excessive cache populations. A populate on read threshold of 2 is sufficient for many applications. Populate-on-write is useful when data that is written to is often read soon after. This is often the case in file systems. Other applications, such as database software, does not have this tendency so populate on write may sometimes even be disabled.

	Block Size	Populate-on-Read	Populate-on-Write
i/o rype	(Sectors)	Threshold	Threshold
Database	1MB (2,048)	2	0
File System	2MB (4,096)	2	2
Web Service	4MB (8,192)	2	0
Customization	1MB/2MB/4MB	≥ 1 and ≤ 4	$\geq$ 0 and $\leq$ 4

Table 10-3I/O Type Table for SSD Read Cache



І/О Туре	Block Size (Sectors)	Populate-on-Read Threshold	Populate-on-Write Threshold
Database	1MB (2,048)	2	1
File System	2MB (4,096)	2	1
Web Service	4MB (8,192)	2	1
Customization	1MB/2MB/4MB	≥ 1 and ≤ 4	$\geq$ 1 and $\leq$ 4

 Table 10-4
 I/O Type Table for SSD Read-write Cache

As you can see, there are tradeoffs for increasing or decreasing each parameter. Understanding the data locality of the application is essential and it can be useful to do some field testing to see what works best.

# 10.3. Configure SSD Cache

The **SSD Cache** provides **SSD Cache Pools** and **SSD Cache Statistics** function tabs to configure and monitor SSD cache. This section will describe the operations of configuring SSD cache.



Figure 10-10 SSD Cache Function Submenu

# 10.3.1. Enable SSD Cache License

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



SSD Cache License	
Download Request License file and send to your local s	ales to get a License Key.
Select the license file to enable SSD Cache:	Choose File No file chosen
Apply Request License	

Figure 10-11 Enable SSD Cache License

# 10.3.2. Create an SSD Cache Pool

Here is an example of creating an SSD cache pool with 2 SSDs configured in SSD read cache.

1. Select the **SSD Cache** function submenu; click the **Create SSD Cache Pool** button. It will scan available SSDs first.

Create SSD Cache Pool								
General	S SD	Cache Pool						
Enable SSD Cache	Pleas	e enter a pool na	me and se	elect the ca	che type.			
Summary	SSD	Cache Pool Nam	e:	RCPool-	1	0		
	Cach	e Type :		Read	Cache (NRAII	D+)	Read-write Cach	e (NRAID 1+)
	I/O Ty	/pe :		Databa	se	<b>v</b>		
	Cac	he Block Size :		1MB		v		
	Pop	ulate-on-read Thr	eshold :	2		<b>v</b>		
	Рор	ulate-on-write Th	reshold :	0		*		
	Selec	t SSDs						
	Enclo	sure ID:	0 (Head U	Init: XS521	.6)	×		
		Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model
		0	1	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
		0	2	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
		0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
								· · · · · · · · · · · · · · · · · · ·
								Next Cancel

Figure 10-12 Create an SSD Cache Pool Step 1

2. Enter an **SSD Cache Pool Name** for the pool. Maximum length of the pool name is 16 characters. Valid characters are [A~Z | a~z | 0~9 | -\_<>].



- 3. Select the Cache Type as Read Cache (NRAID+).
- 4. Select an **I/O Type** from the drop-down list according to your application.
- 5. Please select SSDs for SSD cache pool. Maximum quantity of disk is 8. Select an **Enclosure** from the drop-down list to select SSDs from expansion enclosures.
- 6. Click the **Next** button to continue.

Create SSD Cache Pool								
General	Selec	t a Pool						
Enable SSD Cache	Pleas	e select a pool	to enable SSD	cache. The p	ool can not be	change after select	tion.	
Summary	Pool I	Name:	Pool-1			Ŧ		
	Selec	t Volumes						
	Withir	the pool, che	ck volumes to e	nable SSD ca	ache, uncheck v	olumes to disable.		
		Volume Nam	ie Status	Health	Capacity			
	1	Vol-1	Online	Optimal	100.00 GB			
	1	Vol-2	Online	Optimal	100.00 GB			
Back								Next Cancel

Figure 10-13 Create an SSD Cache Pool Step 2

- 7. Select a **Pool Name** from the drop-down list which lists available pools to be assigned to.
- 8. Within the pool, check **Volumes** to enable SSD cache, uncheck **Volumes** to disable.
- 9. Click the **Next** button to continue.



Create SSD Cache Pool		
General	SSD Cache Pool Properties	
Enable SSD Cache	SSD Cache Pool Name :	RCPool-1
Summary	Cache Type :	Read Cache (NRAID+)
	Quantity of SSD :	2
	Capacity :	744.72 GB
	I/O Type :	Database
	Enabled Pool and Volumes	
	Pool Name :	Pool-1
	Quantity of Enabled Volume :	2
Back		Finish Cancel

Figure 10-14 Create an SSD Cache Pool Step 3

10. After confirmation at summary page, click the **Finish** button to create a pool.

	SSD Cache Pool Name	Status	Health	Total	Cache Type	RAID	Pool Name	I/O Type
RCPool-1		Online	Good	744.72 GB	Read Cache	NRAID+	Pool-1	Database
Create §	SSD Cache Pool							

Figure 10-15 An SSD Cache Pool is Created

- 11. An SSD cache pool has been created.
- 12. Follow the step 1 to 11 to create another SSD cache pool with Read-write Cache (NRAID 1+) and set the I/O type as File System.



	SSD Cache Pool Name	Status	Health	Total	Cache Type	RAID	Pool Name	I/O Type
▼	RCPool-1	Online	Good	744.72 GB	Read Cache	NRAID+	Pool-1	Database
▼	RWCPool-2	Online	Good	372.36 GB	Read Write Cache	NRAID 1+	Pool-2	File System
	·				·	·	·	
Create S	SSD Cache Pool							

Figure 10-16 Another SSD Cache Pool is Created

### TIP:

The **Create SSD Cache Pool** button will be grayed out when meet the following conditions.

- There are no available SSDs to create an SSD cache pool.
- There are no available pools which can be assigned to the SSD cache pool including the status of the pool is Migrating, Moving, Offline or the health of the pool is Failed.

# 10.3.3. List SSD Cache Pools

Select one of the SSD cache pools, it will display the related SSDs and enabled volumes. The pool properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific pool.



		SSD Cache Pool Name	Status	Health	Total	Cache Type	RAID	Pool Name	I/О Туре
l	▼	RCPool-1	Online	Good	744.72 GB	Read Cache	NRAID+	Pool-1	Database
[	▼	RWCPool-2	Online	Good	372.36 GB	Read Write Cache	NRAID 1+	Pool-2	File System

SSDs

No.	Enclosure ID	Slot	Status	Health	Capacity	Disk Type	Manufacturer	Model
1	0	1	Online	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
2	0	2	Online	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053

#### Enabled Volumes

Volume Name	Status	Health	Capacity	Total Cache Used	Read Cache Used	Write Cache Used
Vol-2	Online	Optimal	100.00 GB	0 MB	0 MB	0 MB
Vol-1	Online	Optimal	100.00 GB	0 MB	0 MB	0 MB
				·		

Create SSD Cache Pool

Figure 10-17 List SSD Cache Pools

This table shows the column descriptions.

Column Name	Description
SSD Cache Pool	The SSD cache pool name.
Name	
Status	The status of the pool:
	Online: The SSD cache pool is online.
	Offline: The SSD cache pool is offline.
	Rebuilding: The SSD cache pool is being rebuilt.
	Flushing: The SSD cache pool is being flushed.
Health	The health of the pool:
	Good: The SSD cache pool is good.
	Failed: The SSD cache pool has failed.
	• Degraded: The SSD cache pool is not healthy and not complete.
	The reason could be missing or failed SSDs.
Total	Total capacity of the SSD cache pool.
Cache Type	The SSD cache type:
	• Disabled.
	Enabled.
RAID	The RAID level of the SSD cache pool:

Table 10-5SSD Cache Pool Column Descriptions



	NRAID+: SSD read cache.
	NRAID 1+: SSD read-write cache.
Pool Name	Which pool the SSD cache pool assigns to.
I/O Туре	The I/O type of the SSD cache pool:
	Database.
	File System.
	Web Service.
	Customization.

### Table 10-6SSDs Column Descriptions

Column Name	Description					
No.	The number of the SSD or SSD group:					
	SSD Read Cache: The number of the SSD.					
	SSD Read-write Cache: The number of the SSD group.					
Enclosure ID	The enclosure ID.					
Slot	The position of the SSD.					
Status	The status of the SSD:					
	Online: The SSD is online.					
	Missing: The SSD is missing in the pool.					
	Rebuilding: The SSD is being rebuilt.					
	Flushing: The SSD is being flushed.					
Health	The health of the SSD:					
	Good: The disk drive is good.					
	Failed: The disk drive has failed.					
	Error Alert: S.M.A.R.T. error alerts.					
	Read Errors: The SSD has unrecoverable read errors.					
Capacity	The capacity of the SSD.					
Disk Type	The type of disk drive:					
	• [SAS SSD   SATA SSD ]					
	• [12.0Gb/s   6.0Gb/s   3.0Gb/s   1.5Gb/s ]					
Manufacturer	The manufacturer of the SSD.					
Model	The model name of the SSD.					

## Table 10-7Enabled Volume Column Descriptions

Column Name	Description
Volume Name	The volume is enabled SSD cache.
Status	The status of the volume:



	Online: The volume is online.
	Offline: The volume is offline.
	Rebuilding: The volume is being rebuilt.
	Flushing: The volume is being flushed.
Health	The health of the volume:
	• Optimal: the volume is working well and there is no failed disk in
	the RG.
	• Failed: the pool disk of the volume has single or multiple failed
	disks than its RAID level can recover from data loss.
	• Degraded: At least one disk from the pool of the volume has
	failed or plugged out.
	Partially optimal: the volume has experienced recoverable read
	errors. After passing parity check, the health will become Optimal.
Capacity	The capacity of the volume.
Total Cache	The capacity of total cache used.
Used	
Write Cache	The capacity of write cache used.
Used	

# 10.3.4. Operations on SSD Cache Pools

The options are available in this tab:

### Add or Remove SSDs

For an SSD read cache, click  $\vee$  -> Add / Remove SSDs to add into or remove SSDs from the SSD cache pool. Check SSDs to add into the SSD cache pool, and uncheck SSDs to remove from the SSD cache pool.



Add / Remove SSDs									
SSD Cache Pool									
SSD Cache Pool Name : RCPool-1									
Cache	Type :		Read Cach	ne (NRAID+)					
Capac	ity :		744.72 GB						
Select	t SSDs								
Check	SSDs to add into	the SSD	cache pool,	and uncheck S	SDs to remove from th	e SSD cache pool.			
Enclos	sure ID: 0 (Hea	d Unit: X	S5216)		*				
	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model	1	
	0	1	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053		
	0	2	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053		
	0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800		
	0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800		
	0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800		
	0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800		
								1	
-									
								OK Cancel	

Figure 10-18 Add / Remove SSDs from the SSD Cache Pool

For an SSD read-write cache, click ▼ -> Add SSDs to add SSDs into the SSD cache pool. Please select two SSDs at a time to add into the SSD cache pool.



Add \$\$Ds								
SSD Cache Pool								
SSD Cache Pool Name : RWCPool-2								
Cache	e Type :		Read-write	Cache (NRAII	D 1+)			
Сара	city :		372.36 GB	,	,			
Selec	t SSDs							
Pleas	e select two SSDs	at a time	to add into t	he SSD cache	pool.			
Enclo	sure ID: 0 (Hea	d Unit: X	S5216)		*			
	<b>F</b> 1 10			0 1	D: 1 T			
	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model	
	0	0	Good	744.96 GB	SAS SSD 12.0GD/s	MICRON	S630DC-800	
	U	0	Good	744.90 GD	SAS SSD 12.0GD/S	MICRON	5630DC-600	
								OK Cancel

Figure 10-19 Add SSDs into the SSD Cache Pool

### Delete an SSD Cache Pool

Click ▼ -> **Delete** to delete the SSD cache pool. If deleting an SSD read-write cache pool, it will take times to flush data from SSDs to HDDs. The SSD cache pool will be deleted after flushed, otherwise the data may be corrupt.

### More Information of the SSD Cache Pool

Click ▼ -> More Information to show the detail information of the SSD cache pool.

# 10.4. Monitor SSD Cache Statistics

This section will describe the monitoring of SSD cache statistics.



	SSD Cache Pool	SSD Cache Statistics	
STORAGE MANAGE	EMENT		
Disks			
Pools			
Volumes			
LUN Mappings			
SSD Cache			

Figure 10-20 SSD Cache Function Submenu

Select the **SSD Cache Statistics** function tab in the **SSD Cache** function submenu to monitor the SSD cache statistics. Here is an example of monitoring the volume of the SSD read-write cache pool.

1. Select an **SSD Cache Pool Name** and select an **Enabled Volumes** which you want to monitor.

	SSD Cache	Pool Name :	RWCPool-2	•
	SSD Cache	Type :	Read Cache (N	IRAID+)
4	SSD Cache	Pool Capacity :	744.72 GB	
ł	Pool Name :		Pool-2	
ł	Enabled Volu	umes :	Vol-3	•
С	ache Used			
	Current	Avg. 1 Day	Avg. 1 Week	Avg. 1 Month
	100.00 GB	99.99 GB	99.99 GB	99.99 GB
	125000			
_	100000			
Cache Used (MB)	75000			
	50000			
	25000			
	0			





Figure 10-21 SSD Cache Statistics

 The SSD cache statistics include Cache Used, Cache Hits, and Cache Hit Ratio. Each items have current value, average 1 day value, average 1 week value, and average 1 month value. The diagram displays the current value with 30 seconds refresh and total 4 hours.



Column Name	Description
Cache Used	How much capacity of the SSD cache pool is used by the volume?
	Unit is MB, GB, or TB.
Cache Hits	How many cache hits occurred by the volume? Unit is the number of
	times
Cache Hit Ratio	How many cache hit ratio occurred by the volume? Unit is
	percentage.

	Table 10-8	SSD Cache	Statistics	Descriptions
--	------------	-----------	------------	--------------

# **10.5. SSD Cache Notices**

The following are some notices about SSD cache.

- To support SSD cache 2.0, the resources will be redistributed. So executing COLD REBOOT is necessary after upgrade from firmware 1.0.x to 1.1.0.
- The SSD cache is optional; the SSD cache license can be extended to SSD cache 2.0 with read and write cache.
- The data structure of the SSD cache 2.0 is re-designed from the previous SSD cache. After upgrade to firmware 1.1.0 with SSD cache 2.0, you have to configure SSD cache again if you have already enabled SSD cache in firmware 1.0.x.
# **C**SAN

# **11. Auto Tiering**

This chapter describes an overview and operations of auto tiering.



#### **INFORMATION:**

Auto tiering 2.0 with flexible RAID and disk configurations is available in SANOS firmware 1.2.0.

# 11.1. Overview

From the perspective of storage features, the performance of SSD is high, but the cost is also high per GB. Relatively speaking, the cost of traditional hard drive is low, so as performance is relatively poor. If we follow the 80/20 rule to configure storage systems, all-SSD configuration is unreasonable for all but the most intensive applications. In fact, SSD will be needed in only a small part for most typical applications, regardless of whether or not a critical application, thus giving SSD resources for general storage needs is hugely cost-prohibitive. Although traditional hard disk performance is enough for general applications which I/O requirements are not high, the traditional all-hard-drive configuration is also gradually been inadequate.

On the other hand, the data itself has a lifecycle. Since the data in the course of its life cycle, it has experienced different levels of activity. In common usage, when creating the data, it is usually used. As the age of the data increases, it is accessed less often.

### The Solution

Therefore, to balance performance and cost factors, adapting hybrid storage architecture with a mixture of SSD and traditional HDD seems to be the most reasonable approach for modern IT environments. Generally, SSD-based storage capacity in 10 to 15% of the total storage capacity should be enough to fulfill the requirements of critical high I/O applications. An automated tiering pool is a simple and elegant solution for dynamically matching storage requirements with changes in the frequency of data access.

# **OSAN**



Figure 11-1 Auto Tiering Pool

# 11.1.1. Tier Categories

As the name suggestion, auto tiering must have two tiers at least. Automated tiering pool segregated disk drives into three categories for dual controllers and four for single controller.

- Tier 1: SSD drives for extreme performance tier
- Tier 2: SAS drives (15K or 10K RPM SAS HDD) for performance tier
- Tier 3: Nearline SAS drives (7.2K or lower RPM SAS HDD) for capacity tier
- Tier 4: SATA drives for capacity tier (for single controller only, not recommended)

# **CSAN**



Figure 11-2 3 Levels of Tiered Storage

### Tier 1 / SSD Tier / Extreme Performance Tier

Use the SSD tier when response time and performance are the most important criteria for storage. This tier uses flash technology that does not contain moving parts. This revolutionary technology eliminates the rotation latencies and can improve performance and save energy significantly.

Compared to traditional spinning drives, SSD drives have higher cost per gigabyte, but lower per IO cost. For the best practice, use the SSD drive to get data that requires fast response time and high IOPS. Auto tiering enables you to optimize the use of these high-performance resources because it automatically relocates "hot" data to the SSD tier.

### Tier 2 / SAS HDD Tier / Performance Tier

Use the SAS HDD tier to achieve a combination of performance and capacity. The SAS HDD tier provides high levels of performance, reliability, and capacity. SAS HDD stores data on a series of fast rotating disks based on mechanical hard disk drive technology.

This tier includes 15K and 10K RPM spinning drives, which are valuable because it provides a high level performance with consistent response time, high throughput and good bandwidth at moderate price.

### Tier 3 / NL-SAS HDD Tier / Capacity Tier

Use the NL-SAS HDD tier to reduce the cost per GB of data. This tier consists of 7.2K or lower RPM SAS HDD which is designed to achieve the maximum capacity at an appropriate performance level. While NL-SAS HDDs have slower speeds than SAS HDDs, NL-SAS HDDs



can significantly reduce power consumption and extend capacity in more expensive and higher performance storage tiers.

In a typical system, most of the application data has very little I/O activity. Because NL-SAS HDDs cost less per GB, they are the most appropriate media type for the "cold" data. NL-SAS HDDs consume less power than SAS HDDs and provide total cost of ownership improvement that take into purchase cost.

# 11.1.2. Flexible RAID and Disk Configurations

Auto Tiering 2.0 supports flexible RAID and disk configurations. You can create each tier (disk group) with different RAID level and different quantity of disk. For example, SSD tier uses 4 disks with RAID 10 for extreme performance, SAS tier uses 6 disks with RAID 6, and NL-SAS tier uses 8 disks with RAID 5 for capacity. This feature is very important for IT administrator to arrange storage plan flexibly.

RAID Configuration						
Please select RAID levels. SSD Tier						
RAID Level :	RAID 10	•				
Quantity of Subgroups :	2	•				
Quantity of SSD Disks : SAS Tier	4					
RAID Level :	RAID 6	•				
Quantity of SAS Disks : NL-SAS Tier	61					
RAID Level :	RAID 5	•				
Quantity of NL-SAS Disks :	8					

Figure 11-3 Flexible RAID and Disk Configurations

# 11.2. Theory of Operation

Auto tiering is the automated progression or demotion of data across different tiers (types) of storage devices and media. The movement of data takes place in an automated way with the help of software and is assigned to the ideal storage media according to performance and capacity requirements. It also includes the ability to define rules and policies that



dictate if and when data can be moved between the tiers, and in many cases provides the ability to pin data to tiers permanently or for specific periods of time.

### **11.2.1. Auto Tiering Architecture**

A newly created auto tiering pool is based on thin provisioning technology. Each tier works based on one or more disk groups. The following is the storage architecture of an auto tiering pool.



Figure 11-4 Storage Architecture of Auto Tiering Pool

To increase the capacity of an auto tiering pool, any tier (disk group) which contains either one tier of SSDs, SAS HDDs, or NL-SAS HDDs can be added to the pool any time. An auto tiering pool can have up to 32 disk groups with each disk group contains up to 64 disk drives. And the maximum disk drive quantity in a pool is 256. The maximum addressable capacity of each disk group is 64TB. So the maximum capacity in a system is 256TB. For more information about pool operation, please refer to the chapter 11.3, <u>Configuring Auto Tiering Pools</u> section.



Table TT-T Auto Tiering Pool Parameters	
Item	Value
Maximum disk group quantity in a pool	32
Maximum disk drive quantity in a disk group	64
Maximum RAID EE spare quantity in a disk group	8
Maximum disk drive quantity in a pool	256
(include dedicated spares)	
Maximum pool quantity per system	64
Maximum dedicated spare quantity in a pool	8
Maximum tiers	3
(include SSD, SAS HDD, NL-SAS HDD)	
Maximum addressable capacity of a disk group	64TB
Maximum addressable capacity of an auto tiering pool	256TB
Maximum addressable capacity of total auto tiering pools	1,024TB
(include thin provisioning pools)	
Provisioning granularity	1GB

Table 11.1 Auto Tiering Deal Deren

By design, the auto tiering feature allows selecting policies that define how data are moved between different tiers, and in many cases provides the ability to pin data to tiers permanently or for specific periods of time.

Auto tiering storage is the assignment of different categories of data to different disk types. It operates based on relocating the most active data up to the highest available tier and the least active data down to the lowest tier. Auto tiering works based on an allocation unit (granularity) of 1GB and relocates data by moving the entire unit to the appropriate tier, depending on the tiering policy selected for that particular volume.

In order to ensure sufficient space in the higher tiers, 10% of the space is reserved in each higher tier to prepare for the data allocation for those tiering policies which would allocate initial space in highest available tiers. By reclaiming this 10% headroom, the least active units within each tier move to lower tiers. The whole mechanism of auto tiering contains three steps, statistic collection by accessed counts, ranking hotness data by the statistic collection, and then relocation data via ranking.



# 11.2.2. Intelligent Auto Tiering Mechanism

Auto tiering storage management system manages the data relocation and monitors the data hotness ratio using half-life coefficient and advanced ranking algorithm. It operates on three major functions.

#### **Statistics Collection**

The volume space is divided into units of equal size in which the hotness is collected and analyzed per hour. Activity level of a sub LUN is determined by counting the quantity of read and write access on the sub LUN. Logical volume manager maintains a cumulative I/O count and weights each I/O by how recently it arrived. The new coming I/O is given a full weight. After approximately 24 hours, the weight of this IO is nearly cut in half and continues to decrease. The reduction weight is processing per hour by our precision algorism. This statistics collection occurs continuously in the background for auto tiering pool.

### Ranking

This analysis produces a rank ordering of each sub LUN within the pool. Note that the policies of volumes would affect how sub LUNs are ranked.

After analysis, the system would generate following information for each tier:

- The amount of data to be moved up
- The amount of data to be moved down
- The amount of data to be moved into a tier.



#### **INFORMATION:**

The hotness analysis process which includes statistics collection and ranking may take minutes to complete.

#### Relocation

According to the hotness analysis, relocation is processed during the user-defined relocation window, which is the number of minutes given to the relocation process. When the window closes, the relocation process would stop relocating data. The other parameter is relocation rate which controls speed of the relocation process. Valid value of relocation rate is Fast, Medium, and Slow.

Auto tiering promotes sub LUNs according to the candidate list that it created in the analysis stage. During relocation, it prioritizes relocating sub LUNs to higher tiers. At the



same time, sub LUNs are only relocated to higher tiers if the space they occupy is required for a higher priority. Using the mechanism, auto tiering makes sure that the higher performing drives are always used.

During I/O, as data is written to a pool, auto tiering attempts to move it to the higher tiers if space is available and the tiering policy allows for it. As we describe before, the relocation process will keep 10% of the free space in all tiers. This space is reserved for any new allocations of higher priority sub LUNs before the next relocation. Lower tiers are used for capacity when needed. The entire relocation process is complete automatically based on the user-defined relocation schedule, or manually if user triggers by himself. The following figure provides an illustration of how auto tiering can improve sub LUN placement in a pool.



Figure 11-5 Auto Tiering Relocation

# **11.2.3. Tiering Policies**

For a best performance in various environments, auto tiering has a completely automated feature that implements a set of tiering polices. Tiering policies determine how new allocations and ongoing relocations should apply within a volume for those requirements. Auto tiering uses an algorithm to make data relocation decisions based on the activity level of each unit. It ranks the order of data relocation across all volumes within each separate pool. The system uses this information in combination with the tiering policy per volume to create a candidate list for data movement. The following volume policies are available:



### Auto Tiering (Default)

It allows moving a small percentage of the "hot" data to higher tiers while maintaining the rest of the data in the lower tiers. This policy automatically relocates data to the most appropriate tier based on the activity level of each data. Sub LUNs are relocated based on the highest performance disk drives available and its hotness. Although this setting relocates data based on the performance statistics of the volume, the volume sets with "Highest available Tier" take precedence. Initial space is allocated in the tier which is healthier and has more free capacity than other tiers, then relocated according to hotness of the data. This is the recommended policy and it is the default policy for each newly created volume.

#### **Start Highest then Auto Tiering**

This takes advantage of the both "Highest Available Tier" and "Auto Tiering" policies. "Start Highest then Auto Tiering" sets the preferred tier for initial data allocation to the highest performing disks with available space, and then it relocates the volume's data based on the performance statistics and the auto-tiering algorithm. With this tiering policy, less active data is moved to lower tiers, making room for more active data in the higher tiers. Initial space is allocated in highest available tier first, then relocated according to hotness of the data.

#### **Highest Available Tier**

Use this policy when quick response times are a priority. This tier is effective for volumes which require high levels of performance whenever they are accessed. The policy starts with the "hottest" first and places them in the highest available tier until the tier's capacity or performance capability limit is hit. Then it places the sub LUNs into the second higher tier. Initial space is allocated in highest available tier. Auto tiering would prioritize sub LUNs with highest available tier selected above all other settings.

#### **Lowest Tier**

Use this policy when cost effectiveness is the highest priority. With this policy, data is initially placed on the lowest available tier with capacity. Select this policy for volumes that are not performance sensitive or response-time sensitive. Regardless of their activity level, all sub LUN of these volumes will remain on the lowest storage tier available in their pool. Data of volumes with "Lowest tier" policy would always reside in the lowest tier. Changing policy of a volume with data in higher tiers to "Lowest tier" would cause all its data in higher tier to be relocated down to the lowest tier.



#### No Data Movement

If a volume is configured with this policy, no sub LUN provisioned to the volumes is relocated across tiers. Data remains in its current position, but can still be relocated within the tier. The system still collects statistics on these sub LUNs after the tiering policy is changed. Initial space is allocated in the tier which is healthier and has more free capacity than other tiers. No relocation would be performed in a volume which selects "No data movement" tiering policy.

The following table summarizes the tiering policies.

Tiering Policy	Description
Auto Tiering	Sets the initial data placement to the optimized tier (disk group)
	and then relocates the data based on the statistics such that data
	is relocated among tiers according to the I/O activity.
Start Highest then	First sets the preferred tier for the initial data placement to the
Auto Tiering	highest tiers with available space, then relocates the data based on
	the statistics and the auto tiering algorithm.
Highest Available Tier	Sets the preferred tier for the initial data placement to the highest
	tiers with available space, and so as the succeeding data
	relocation.
Lowest Tier	Sets the preferred tier for the initial data placement to the lowest
	tiers with available space, and so as the succeeding data
	relocation.
No Data Movement	Sets the preferred tier for the initial data to the optimized tier, and
	retain the data without movement.

Table 11-2 Summary of Tiering Policies

# **11.3. Configure Auto Tiering Pools**

This section will describe the operations of configuring auto tiering pool.

Pools Auto Tiering



3	STORA	GE MANAGEMENT	
	Disks		
	Pools		
	Volum	es	
	LUN N	/lappings	
	SSD (	Cache	
Figu	re 11-	6 Pools Function Submenu	

# **11.3.1. Enable Auto Tiering License**

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

Auto Tiering License				
Download Request License file and send to your local sales to get a License Key.				
Select the license file to enable Auto Tiering:	Choose File No file chosen			
Apply Request License				

Figure 11-7 Enable Auto Tiering License

# 11.3.2. Create an Auto Tiering Pool

Here is an example of creating an auto tiering pool with 3 tiers, each tier has 3 disks configured in RAID 5. At the first time of creating an auto tiering pool, it may contain at least 2 tiers (disk groups) and the maximum quantity of disk in a tier (disk group) is 64.

1. Select the **Pools** function submenu, click the **Create Pool** button. It will scan available disks first.





#### TIP:

It may take  $20 \sim 30$  seconds to scan disks if your system has more than 200 disk drives. Please wait patiently.

Create Pool									
General	Pool Type								
Disk Selection	Please select a poel tupo								
RAID Configuration	Thick Dravisioning	Prease select a pool type.							
Disk Properties									
Summan	Thin Provisioning	Thin Provisioning							
Summary	Auto Tiering (Thin Pro	visioning Enabled)							
	Pool Properties								
	Please enter a pool name	e and select preferred (	controller setting.						
	Pool Name :	Pool-3	0						
	Preferred Controller :	Controller 1	*						
	The I/O resources will	be managed by the p	referred controller which you specified						
	SED Pool	so managoa sy aro p							
	Epoble SED Deal								
	Enabling SED pool wi	Il uso the secure SEDs	s to create a peak Intermitting SEDs and peak SEDs at	ra not supported in a pool					
	Enabling SED poor wi	in use the secure SEDs	s to create a poor. Internixing SEDs and non-SEDs an	e not supported in a pool.					
				Next Cancel					

Figure 11-8 Create an Auto Tiering Pool Step 1

- 2. Select the **Pool Type** as Auto Tiering (Thin Provisioning Enabled). This option is available when auto-tiering license is enabled.
- 3. Enter a **Pool Name** for the pool. The maximum length of the pool name is 16 characters. Valid characters are [ A~Z | a~z | 0~9 | -\_<> ].
- 4. Select a **Preferred Controller** from the drop-down list. The backend I/O resources in this pool will be processed by the preferred controller which you specified. This option is available when dual controllers are installed.
- 5. Check the **Enable SED Pool** checkbox. Enabling SED pool will use the secure SEDs to create a pool. Intermixing SEDs and non-SEDs are not supported in a pool.



6. Click the **Next** button to continue.

RAID Configuration	Enclo	ouro ID:	0 (Hoad	Unit: VCED	16)				
Disk Properties	Encio	sure ID.	o (Head	Unit: X552.	10)	•			
Summary		Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model	
		0	1	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	2	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	4	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053	
		0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800	
		0	9	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	10	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	11	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	12	Good	1.09 TB	SAS HDD 12.0Gb/s	SEAGATE	ST1200MM0088	
		0	13	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
		0	14	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	
		0	15	Good	5.46 TB	NL-SAS HDD 12.0Gb/s	SEAGATE	ST6000NM0014	

Figure 11-9 Create an Auto Tiering Pool Step 2

- Please select disks for pool and select at least two disk types of disks to add tiers an auto tiering pool. Each tier is a disk group. The maximum quantity of disk in a disk group is 64. Select an **Enclosure ID** from the drop-down list to select disks from expansion enclosures.
- 8. Click the **Next** button to continue.



Figure 11-10 Create an Auto Tiering Pool Step 3

- Select a RAID Level from the drop-down list which lists available RAID level only according to the disk selection for each tier. And also select a Quantity of Subgroups if the combination RAID level is selected.
- 10. Click the **Next** button to continue.

OSAN



Create Pool								
General	Disk Properties							
Disk Selection	Please configure the disk properties.							
RAID Configuration	✓ Enable Disk Write Cache							
<b>Disk Properties</b>	Enabling disk write cache will improve write I/O performance but risking data loss when power failure.							
Summary	Enable Disk Read-ahead System will preload data to disk buffer based on previously retrieved data. This feature will efficiently improve the performance of sequential data retrieved.							
	Enable Disk Command Queuing Send multiple commands to a disk at once to improve performance.							
	Enable Disk Standby The disks will spin down for power saving when they are idle for a period of time according to the setting.							
	Disk Standby : 30 seconds •							
	Enable High Latency Disk Warning The system will send event logs if there is a high latency disk in the disk group.							
Back	Next Cancel							

Figure 11-11 Create an Auto Tiering Pool Step 4

11. Disk properties can also be configured optionally in this step:

- **Enable Disk Write Cache**: Check to enable the write cache option of disks. Enabling disk write cache will improve write I/O performance but have a risk of losing data when power failure.
- **Enable Disk Read-ahead**: Check to enable the read-ahead function of disks. System will preload data to disk buffer based on previously retrieved data. This feature will efficiently improve the performance of sequential data retrieved.
- **Enable Disk Command Queuing**: Check to enable the command queue function of disks. Send multiple commands to a disk at once to improve performance.
- **Enable Disk Standby**: Check to enable the auto spin down function of disks. The disks will be spun down for power saving when they are idle for the period of time specified.
- **Enable High Latency Disk Warning**: Check to enable the high latency disk warning function in a disk group. When a disk drive is abnormal with high latency, the system



will send event logs to notify IT administrators in advance to avoid affecting overall performance.

12. Click the Next button to continue.

Create Pool				
General	Pool Properties		Schedule Relocation	
Disk Selection	Pool Type :	Auto Tiering	Schedule Type :	Daily
RAID Configuration	Pool Name :	Pool-3	Relocation Start Time :	00:00
Disk Properties	Preferred Controller :	Controller 1	Relocation Period :	0 Hours
Summary	RAID Configuration			0 Minutes
Summary	SSD Tier RAID Level : Quantity of SSD Disks : SAS Tier RAID Level : Quantity of SAS Disks : NL- SAS Tier RAID Level : Quantity of SAS Disks : Disk Properties Disk Write Cache : Disk Read-ahead : Disk Command Queuing : Disk Standby : High Latency Disk Warning :	RAID 1 2 RAID 6 4 RAID 5 4 Enabled Enabled Enabled Disabled Disabled	Relocation Rate :	Fast
Back				Finish Cancel

Figure 11-12 Create an Auto Tiering Pool Wizard Step 5

- By default, we set relocation schedule at 00:00 daily, relocation period set to 00:00 which means let relocation process run until it finishes, and relocation rate to fast.
- 14. After confirmation at summary page, click the **Finish** button to create a pool.

	Pool Name	Status	Health	Total	Free	Available	Thin Provisioning	Auto Tiering	Volumes	Current Controller
▼	Pool-3	Online	Good	18.92 TB	18.92 TB	18.92 TB	Enabled	Enabled	0	Controller 1
Create F	Pool									



Figure 11-13 An Auto Tiering Pool is Created

15. The pool has been created. If necessary, click the **Create Pool** button again to create others.

#### TIP:

Auto Tiering 2.0 supports flexible RAID and disk configurations. You can create each tier (disk group) with different RAID level and different quantity of disk. For example, SSD tier uses 4 disks with RAID 10 for extreme performance, SAS tier uses 6 disks with RAID 6, and NL-SAS tier uses 8 disks with RAID 5 for capacity.



#### **CAUTION:**

Because the auto tiering pool is based on thin provisioning technology, please always watch the system logs of thin provisioning pool. If the used capacity of the thin provisioning pool reaches 95% (default thin provisioning policy), the system will deactivate the pool to avoid data loss. So the host can't access the pool at this time. You have to expand the pool capacity, and then activate the pool to resolve the issue.

# 11.3.3. List Auto Tiering Pools

#### **Pool View**

Click a pool; it will display the related disk groups. Similarly, click a disk group; it will display the related disk drives. The pool properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific pool.



	Pool N	lame	Status	Health	Total	Free	Available	Thin I	Provisioning	g A	Auto Tiering	Enc	ryption	Volumes	Current Controller
T	Pool-3		Online	Good	18.92 TB	18.92 T	B 18.92 TB	TB Enabled			Enabled	Disabled			Controller 1
Disk Groups															
	No.	Status	Healt	h Total	Fre	e	Tier Level	RAID	Disks Us	ed	RAID EE Sp	ares			
▼	1	Online	Good	16.37	TB 16.	37 TB	NL-SAS	RAID 5	4		N/A				
▼	2	Online	Good	2.18	TB 2.1	8 TB	SAS	RAID 6	4		N/A				
T		Online	Good	371.0	0 GB 371	.00 GB	SSD	RAID 1							
Disks															
Enclosu	ire ID	Slot	Status	Health	Capacity	Disk	Туре	Manuf	acturer	Model	l .				
0		1	Online	Good	372.36 G	B SAS	SSD 12.0Gb/s	SEAG	ATE	ST400	0FM0053				
0		2	Online	Good	372.36 G	B SAS	SSD 12.0Gb/s	SEAG	ATE	ST400	0FM0053				
Create F	Pool														

*Figure 11-14 List Auto Tiering Pools* This table shows the column descriptions.

Table 11-3 Pool	Column Descriptions							
Column Name	Description							
Pool Name	The pool name.							
Status	The status of the pool:							
	Online: The pool is online.							
	Offline: The pool is offline.							
	Rebuilding: The pool is being rebuilt.							
	Migrating: The pool is being migrated.							
	Relocating: The pool is being relocated.							
	• EE Rebuilding: The pool is being RAID EE rebuilt.							
Health	The health of the pool:							
	Good: The pool is good.							
	• Failed: The pool has failed.							
	• Degraded: The pool is unhealthy and incomplete. The cause may							
	be a disk loss or failure.							
Total	Total capacity of the pool.							
Free	Free capacity of the pool.							
Available	Available capacity of the pool.							
Thin	The status of Thin provisioning:							
Provisioning	• Disabled.							
	Enabled.							
Auto Tiering	The status of Auto Tiering:							
	Disabled.							
	Enabled.							



	• Not Supported: The pool contains the disk groups with mixed disk
	type.
Encryption	The Data Secure Mode:
	Disabled: The pool is not encrypted.
	Enabled: The pool is encrypted.
Volumes	The quantity of volumes in the pool.
Current	The current running controller of the pool.
Controller	
(This option is	
only visible when	
dual controllers	
are installed.)	

Tahla 11_1	Disk Group	Column	Descriptions
	DISK GIOUP	COIUIIIII	Descriptions

Column Name	Description
No	The number of disk group.
Status	The status of the disk group:
	Online: The disk group is online.
	Offline: The disk group is offline.
	Rebuilding: The disk group is being rebuilt.
	Migrating: The disk group is being migrated.
	Relocating: The disk group is being relocated.
	• EE Rebuilding: The disk group is being RAID EE rebuilt.
Health	The health of the disk group:
	Good: The disk group is good.
	Failed: The disk group has failed.
	• Degraded: The disk group is not healthy and not completed. The
	reason could be lack of disk(s) or have failed disk.
Total	Total capacity of the disk group.
Free	Free capacity of the disk group.
RAID	The RAID level of the disk group.
Disks Used	The quantity of disk drives in the disk group.
RAID EE Spare	The quantity of RAID EE spare disk drives in the disk group.
	Traditional RAID level is display as N/A.

# **OSAN**

Table 11-5 Disk	Column Descriptions
Column Name	Description
Enclosure ID	The enclosure ID.
Slot	The position of the disk drive.
Status	The status of the disk drive:
	Online: The disk drive is online.
	• Missing: The disk drive is missing in the pool.
	Rebuilding: The disk drive is being rebuilt.
	• Transitioning: The disk drive is being migrated or is replaced by
	another disk when rebuilding occurs.
	Scrubbing: The disk drive is being scrubbed.
	• Check Done: The disk drive has been checked the disk health.
	Copying Back: The disk drive is being copied back.
Health	The health of the disk drive:
	Good: The disk drive is good.
	• Failed: The disk drive has failed.
	Error Alert: S.M.A.R.T. error alerts.
	• Read Errors: The disk drive has unrecoverable read errors.
Capacity	The capacity of the disk drive.
Disk Type	The type of the disk drive:
	• [SAS HDD   NL-SAS HDD   SAS SSD   SATA SSD ]
	• [12.0Gb/s   6.0Gb/s   3.0Gb/s   1.5Gb/s]
Manufacturer	The manufacturer of the disk drive.
Model	The model name of the disk drive.

#### **Auto Tiering View**

The Auto Tiering function tab in the Pools function submenu is only visible when auto tiering license is enabled. Click a pool; it will display the related tiering status. The pool properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific pool.



Po	ol Name	Status	Health T	otal	Free	Available	Volum	es Dis	ks	Current Controller	
▼ Po	ol-3	Online	Good 1	9.28 TB	18.25 TB	18.25 TB	5	12		Controller 1	
Pool Tiering	Status:		· · · ·							·,	
Tier Level	Tier Capaci	ity (GB)	Tier Used (GB	3) Move	e Up (GB)	Move Down (G	B) M	love In (GB	i) 1	īer Status	
SSD	742		669	0		0	0				
SAS	2230		383	0		0	0				
NL-SAS	16765		2	0		0	0				

Figure 11-15 Auto Tiering Pools and Status

This table shows the column descriptions.

Column Name	Description
Tier Level	Tier categories, there are SSD, SAS, Nearline SAS, and SATA. The
	system will hide the tiers without any disk groups.
Tier Capacity	Total capacity of the tier.
Tier Used	Used capacity of the tier.
Move Up	The capacity prepares to move up to higher tier.
Move Down	The capacity prepares to move down to lower tier.
Move In	The capacity prepares to move in from other tiers.
Tier Status	Bar chart to show the tier status:
	Light Blue: Used capacity.
	Orange: The data will move in.
	Gray: Unallocated.

Table 11-6 Pool Tiering Status Column Descriptions

### 11.3.4. Operations on Auto Tiering Pools

Most operations are described in the Configuring Storage Pools section. For more information, please refer to the chapter 8.4.3, <u>Operations on Thick Provisioning Pools</u> section and the chapter 9.3.3, <u>Operations on Thin Provisioning Pools</u> section. We describe the operations about auto tiering in the following.

#### **Schedule Relocation**

Click ▼ -> Schedule Relocation to setup the relocation schedule in auto tiering pool. If the **Relocation Period** sets as 00:00, it will let relocation process run until it finishes.

# **OSAN**

Schedule Relocation		
Pool Name :	Pool-3	
Frequency :	Daily	
	Weekly	
	Repeat Every 12	▼ Hours
Relocation Start Time (hh:mm) :	00:00 •	
Relocation Period (hh:mm) :	00 🔻 : 00	<ul> <li>(Set as 00:00 to let relocation process run until it finishes.)</li> </ul>
Relocation Rate :	Fast	v
		OK Cancel

Figure 11-16 Relocation Schedule

#### **Relocate Now**

Click ▼ -> **Relocate Now** to perform relocation right now in an auto tiering pool. Similarly, if **Relocation Period** sets as 00:00, it will let relocation process run until it finishes.



Relocate Now		
Pool Name :	Pool-3	
Relocation Period (hh:mm) :	00 • : 00	<ul> <li>(Set as 00:00 to let relocation process run until it finishes.)</li> </ul>
Relocation Rate :	Fast	т. Т
		OK Cancel

Figure 11-17 Relocate Now

#### **Stop Relocation**

Click ▼ -> Stop Relocation to stop relocation when there is a relocation process in an auto tiering pool. The task that is being relocated will stop until it completes.

# 11.3.5. Add a Tier (Disk Group) in an Auto Tiering Pool

The Add Disk Group function adds a disk group to a pool to increase the capacity.

# **C**SAN



Figure 11-18 Add a Disk Group in an Auto Tiering Pool

Here is an example of adding a disk group in thin provisioning pool.

1. Select a pool, click ▼ -> Add Disk Group to add a disk group in the auto tiering pool.



)i	sk Group						
	Sk Group						
ool	Туре						
hin F	Provisioning :		Enabled				
uto 1	Tiering :		Enabled				
AID	Level						
leas	e select a RAID I	level.					
AID	Level :		RAID 1	0	Ψ		
luan	tity of Subgroups	9.1. 1	2		•		
elec	t Disks						
leas	e select disks to	add a die	k aroup. The	a maximum qua	ntity of disk in a disk group	n is 64	
nelo		adu a dis	A group. The	d Holty VS5314		010-04.	
	Eastering ID	Clas		Constitu	Diala Tura	Manufacture	Madal
	Enclosure ID	2	Good			REACATE	
	0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
	0	4	Good	372.36 GB	SAS SSD 12.0Gb/s	MICRON	S1400FM0055
	0	6	Good	744.90 GB	SAS SSD 12.06b/s	MICRON	S630DC-800
•	0	7	Good	744.30 GB	SAS SSD 12.00b/s	MICRON	S630DC-800
	0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800

Figure 11-19 Add Disk Group

- 2. Select a **RAID Level** from the drop-down list and also select a **Quantity of Subgroups** if the combination RAID level is selected.
- Please select disks to add a disk group. The maximum quantity of disk in a disk group is
   64. Select an **Enclosure** from the drop-down list to select disks from the expansion enclosures.
- 4. Click the **OK** button to add a disk group.

# **CSAN**

# 11.3.6. Hot Spares in an Auto Tiering Pool

In an auto tiering pool, hot spare drives can only replace the drives of the same disk type. For example, a SSD tier can only be assigned SSD type drives as hot spares drives.

Slot	Status	Health	Encryption	SED / ISE Status	Capacity	Disk Type	Usage	Pool Name	Manufacturer	Model
1	Online	Good	None	N/A	372.36 GB	SAS SSD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST400FM00
2	Online	Good	None	N/A	372.36 GB	SAS SSD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST400FM0
3	Online	Good	None	N/A	372.36 GB	SAS SSD 12.0Gb/s	Dedicated Spare	Pool-3	SEAGATE	ST400FM0
4	Online	Good	None	N/A	372.36 GB	SAS SSD 12.0Gb/s	Free		SEAGATE	ST400FM0
5	Online	Good	None	N/A	744.96 GB	SAS SSD 12.0Gb/s	RAID	Pool-3	MICRON	S630DC-80
6	Online	Good	None	N/A	744.96 GB	SAS SSD 12.0Gb/s	RAID	Pool-3	MICRON	S630DC-8
7	Online	Good	None	N/A	744.96 GB	SAS SSD 12.0Gb/s	RAID	Pool-3	MICRON	S630DC-8
8	Online	Good	None	N/A	744.96 GB	SAS SSD 12.0Gb/s	RAID	Pool-3	MICRON	S630DC-8
9	Online	Good	None	N/A	1.09 TB	SAS HDD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST1200MM
10	Online	Good	None	N/A	1.09 TB	SAS HDD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST1200MM
11	Online	Good	None	N/A	1.09 TB	SAS HDD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST1200MM
12	Online	Good	None	N/A	1.09 TB	SAS HDD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST1200MM
13	Online	Good	None	N/A	5.46 TB	NL-SAS HDD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST6000NN
14	Online	Good	None	N/A	5.46 TB	NL-SAS HDD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST6000NM
15	Online	Good	None	N/A	5.46 TB	NL-SAS HDD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST6000NN
16	Online	Good	None	N/A	5.46 TB	NL-SAS HDD 12.0Gb/s	RAID	Pool-3	SEAGATE	ST6000NN

Disk Health Check View Disk Check Report Instant Erase

Figure 11-20 Hot Spares in Auto Tiering Pool

# 11.4. Configure Volumes

This section will describe the operations of configuring volume in auto tiering pool.

### 11.4.1. Create a Volume in an Auto Tiering Pool

Here is an example of creating a volume in an auto tiering pool.

1. Select the **Volumes** function submenu, click the **Create Volume** button.



Create Volume				
General	Volume General Se	ttings		
Advanced	Please enter a volum	ne name and configure th	ne volum	e general settings.
Summary	Volume Name :	Vol-3		0
	Pool Name :	Pool-3		(Available : 262144 GB)
	Capacity :	100		GB 🔻
	Volume Type :	RAID Volume		
	Select RAID Volu replication.	me for general RAID usa	age or Ba	ackup Volume for backup usage such as the target volume of local clone or remote
				Next Cancel

Figure 11-21 Create a Volume of Auto Tiering Pool Step 1

- 2. Enter a **Volume Name** for the pool. The maximum length of the volume name is 32 characters. Valid characters are [A~Z | a~z | 0~9 | -\_<> ].
- 3. Select a **Pool Name** from the drop-down list. It will also display the available capacity of the pool.
- 4. Enter required **Capacity**. The unit can be selected from the drop-down list.
- 5. Select **Volume Type**. The options are **RAID Volume** (for general RAID usage) and **Backup Volume** (for the target volume of local clone or remote replication).
- 6. Click the **Next** button to continue.

ate Volume					
General	Volume Advanced Settin	igs			
Advanced	Please configure the volu	me advanced settir	igs.		
Summary	Stripe Size :	64 KB			
	Block Size :	512 Byte			
	Background I/O Priority :	High		0	
	Tiering Policy :	Auto Tiering			
	Enable Cache Mode (V	Vrite-back Cache)	0		
	Enable Video Editing N	1ode 🚹			
	Enable Read-ahead	0			
	Enable Space Reclamation	ation			
Back					Next

Figure 11-22 Create a Volume of Auto Tiering Pool Step 2

**OSA** 

- 7. Volume advanced settings can also be configured optionally in this step:
  - Stripe Size: The options are 64KB to 1,024KB.
  - **Block Size**: The options are 512Bytes to 4,096Bytes.
  - **Background I/O Priority**: The options are High, Medium, and Low. It will influence volume initialization, rebuild, and migration.
  - Tiering Policy: The options are Auto Tiering, Start Highest then Auto Tiering, High Available Tier, Lowest Tier, and No Data Movement. Please refer to the chapter 11.2.3, <u>Tiering Policies</u> section for detail.
  - **Enable Cache Mode (Write-back Cache)**: Check to enable cache mode function of volume. Write back optimizes the system speed but comes with the risk where the data may be inconsistent between cache and disks in one short time interval.
  - Enable Video Editing Mode: Check to enable video editing mode function. It is optimized for video editing usage. Please enable it when your application is in video editing environment. This option provides a more stable performance figure without high and low peaks but slower in average.
  - **Enable Read-ahead**: Check to enable the read ahead function of volume. 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 disk's buffer. This feature will improve performance when the data being retrieved is sequential.



• **Enable Space Reclamation**: Check to enable the space reclamation function of the volume when the pool is auto tiering.



#### **INFORMATION:**

Stripe sizes from 64KB to 1,024KB support more than 8GB of memory for resource allocation. 4GB memory is only support 64KB stripe size.

8. Click the **Next** button to continue.

	1			
General	Configure Volume General Set	tings		
Advanced	Volume Name :	Vol-3		
Summary	Pool Name :	Pool-3		
	Capacity :	100 GB		
	Volume Type :	RAID Volume		
	Configure Volume Advanced	Settings		
	Stripe Size :	64 KB		
	Block Size :	512 Byte		
	Background I/O Priority :	High		
	Tiering Policy :	Auto Tiering		
	Cache Mode :	Enabled		
	Video Editing Mode :	Disabled		
	Read-ahead :	Disabled		
	Space Reclamation :	Enabled		
Deek			Tinin 0	

Figure 11-23 Create a Volume of Auto Tiering Pool Step 3

- 9. After confirmation at summary page, click **Finish** button to create a volume.
- 10. The volume has been created. It will be initialized in protection RAID level (e.g., RAID 1, 3, 5, 6, 0+1, 10, 30, 50, and 60).



<< first < prev 1 next > last >>													
	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name		
▼	Vol-3 Online Optimal 100.00 GB RAID Volume Disabled 0						0 MB / 0 MB	0 MB 0 N/A WB Pool-3					
<< first < prev 1 next> last>>													
Create \	/olume Local Clo	ne Options	]										

Figure 11-24 A Volume in Auto Tiering Pool is Created

11. A volume has been created. If necessary, click the **Create Volume** button to create another.



#### **INFORMATION:**

SANOS supports instant RAID volume availability. The volume can be used immediately when it is initializing or rebuilding.



#### TIP:

If the pool contains some disk drives of 4Kn type, it is not available to set 512, 1024, or 2048 block size. When the case happens, it will pop up a warning message and suggest changing the block size to 4096.

### 11.4.2. List Volumes and Operations on Volumes

Most operations are described in the chapter 8.5, <u>Configuring Volumes</u> section. For more information about list volume, please refer to the chapter 8.5.2, <u>List Volumes</u> section. For more information about operations on volumes, please refer to the chapter 8.5.3, <u>Operations on Volumes</u> section. We describe auto tiering operations below.

#### **Change Volume Properties**

Click ▼ -> Change Volume Properties to change the volume properties of the volume.



Change Volume Properties				
Volume Name:	Vol-3		0	
Priority:	● High ○ Mediur	n 🔾 Lov	v	
Background I/O Priority:	High	•		
iering Policy:	Auto Tiering	•		
Cache Mode:	O Write-through	h Cache	ullet Write-back Cache $igodoldoldoldoldoldoldoldoldoldoldoldoldol$	0
/ideo Editing Mode:	Disabled		0	
Read-ahead:	Enabled	•	0	
pace Reclamation:	Enabled	•		
Volume Type:	RAID Volume		0	

Figure 11-25 Change Volume Properties

#### **Reclaim Space with Thin Provisioning Pool**

Click ▼ -> **Space Reclamation** to reclaim space from the volume when the volume is in an auto tiering pool. For more information about space reclamation, please refer to the chapter 9.2.2, <u>Space Reclamation</u> section.

# 11.5. Configure LUN Mappings and Connect by Host Initiator

Next step you can configure LUN mapping and connect by host initiator. For more information about LUN mapping, please refer to the chapter 8.6, <u>Configure LUN Mappings</u> section for detail. For more information about host initiator, please refer to the chapter 8.7, <u>Connect by Host Initiator</u> section for detail.

# 11.6. Transfer to Auto Tiering Pool

This section describes thick provisioning pool or thin provisioning pool transfer to auto tiering one. If auto tiering license is enabled, the thick or thin provisioning pool without disk group of mixed disk type can be transferred to the auto tiering pool by **Add Disk Group** option.



Also note that the thick provisioning pool is preconfigured the space, after transferring to the auto tiering, the original disk group in the thick provisioning pool will be the lowest tier. When auto tiering mechanism is running, the hot data are copied to higher tier, but still occupy the space of the original block. If the data is cold, it will return to the original block space. So the total capacity of the pool does not change even adding the capacity of higher tiers.



Figure 11-26 Block Map of Thick Provisioning Pool Transferring to Auto Tiering

Thin provisioning is dynamic allocation of space, if the hot data is moved up to the higher tier; it will release the original block space. So the total capacity is the sum of all tiers.



Figure 11-27 Block Map of Thin Provisioning Pool Transferring to Auto Tiering



#### CAUTION:

The action of transferring to auto tiering is irreversible. Consider all possible consequences before making this change.



# **11.6.1. Transfer from Thick Provisioning Pool to Auto Tiering**

First of all, make sure the auto tiering license is enabled. For more information about enabling license operation, please refer to the chapter 11.3.1, <u>Enable Auto Tiering License</u> section. And then use **Add Disk Group** function to add another tier (disk group). Here is an example of transfer thick provisioning pool to auto tiering one.

	Pool N	ame	Sta	tatus Health T		Tot	tal	Free	Available	le Thin Provisioni		Provisioning Auto		Encryption	Volumes	Current Controller
V	Pool-1		Onl	line	Good 3.27 TB 3.		3.27 TB	.27 TB 3.27 TB		Disabled		Disabled	Disabled		Controller 1	
▼	Pool-2		Online Good		16.37 TB		16.37 TB	16.37 TB		Enabled		Disabled	Disabled	0	Controller 1	
Disk Gr	Disk Groups															
	No.	Status		Health	Total		Free	RAID	Disks Used		RAID 2.0 Sp	are				
•		Online	•	Good	3.27 1		3.27 TB	RAID 5		N/A						
Disks	Disks															
Enclosu	re ID	Slot	St	tatus	Health	C	apacity	Disk Typ	e Manufacturer		anufacturer	Model				
0		9	O	nline	Good	1.	.09 TB	SAS HD	D 12.0Gb/s	S	EAGATE	ST1	200MM0088			
0		10	O	nline	Good	1.	.09 TB	SAS HD	D 12.0Gb/s	S	EAGATE	ST1	200MM0088			
0		11	O	nline	Good	1.	.09 TB	SAS HD	D 12.0Gb/s	S	EAGATE	ST1	200MM0088			
0		12	O	nline	Good	1.	09 TB	SAS HD	D 12.0Gb/s	S	EAGATE	ST1	200MM0088			
Create F	200I															

1. Create a thick provisioning pool with SAS disk drives. Auto Tiering status is Disabled.

*Figure 11-28 Transfer Thick Provisioning Pool to Auto Tiering Step 1* 

Click ▼ -> Add Disk Group to transfer from a thick provisioning pool to an auto tiering pool. Select Enabled from the Auto Tiering drop-down list. The tier (disk group) must be added one at a time. Select the RAID Level and Select Disks, and then click the OK button.

# **OSAN**

ld Disk Group													
ool Type													
hin Provisioning :		Disabled	Disabled										
uto Tiering :		Disable											
AID Level		Disable	Disabled										
lease select a RAID	level.												
AID Level :		RAID 1		v									
elect Disks													
la ana antara diaka ta		-1 Th		and the statistic for a self-transmission									
lease select disks to	add a dis	sk group. The	e maximum qua	anuty of disk in a disk grou	ip is 64.								
nciosure ID :		0 (Head	d Unit: XS5216	5) <b>v</b>									
Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model							
✓ 0	1	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053							
✓ 0	2	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053							
0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053							
0	4	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053							
0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800							
0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800							
0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800							
0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800							

Figure 11-29 Transfer Thick Provisioning Pool to Auto Tiering Step 2

3. Use the same procedure to add another tier if necessary.



	Pool N	ame	Sta	atus	Health	Total	F	ree	Available	Thin F	Thin Provisioning		Auto Tiering	to Tiering Encryption		Volumes	Current Controller
V	Pool-1		On	nline	Good	3.27 T		.27 TB	3.27 TB	Disab	Disabled		Enabled	Dis	abled		Controller 1
T	Pool-2		Or	nline	Good	16.37	TB 10	6.37 TB	16.37 TB	Enabl	Enabled		Disabled	Disabled Dis		0	Controller 1
Disk Groups																	
	No.	Status	3	Health	Total		Free	Ti	ier Level	RAID	Disks Us	ed	RAID 2.0 S	pare			
▼	1	Online	•	Good	3.27	гв	3.27 TE	3 S	AS	RAID 5	AID 5 4		N/A				
T		Online	e	Good	372.0	0 GB	372.00		SD	RAID 1							
Disks																	
Enclosu	re ID	Slot	S	tatus	Health	Capa	ncity	Disk Ty	ре	Manufa	acturer	Mod	el				
0		1	0	Inline	Good	372.3	36 GB	SAS SS	SD 12.0Gb/s	SEAG	ATE	ST40	ST400FM0053				
0		2	0	Online	Good	372.3	36 GB	SAS SS	SD 12.0Gb/s	SEAG	ATE	ST40	00FM0053				
Create F	Pool																

Figure 11-30 Transfer Thick Provisioning Pool to Auto Tiering Step 3

4. **Auto Tiering** status is **Enabled**. The thick provisioning pool has been transferred to auto tiering.



#### CAUTION:

The total capacity of the pool does not change even adding the capacity of higher tiers.

The action of transferring from the thick provisioning pool to auto tiering is irreversible. Please consider carefully all possible consequences before taking this step.

# 11.6.2. Transfer from Thin Provisioning Pool to Auto Tiering

First of all, make sure the auto tiering license is enabled. For more information about enabling license operation, please refer to the chapter 11.3.1, <u>Enable Auto Tiering License</u> section. And then use **Add Disk Group** function to add another tier (disk group). Here is an example of transfer thin provisioning pool to auto tiering one.

1. Create a thin provisioning pool with NL-SAS disk drives. Auto Tiering status is Disabled.



	Pool N	lame	Status	s I	Health	Total	Fr	ee	Available	Thi	Thin Provisioning		uto Tiering	Encryption	Volumes	Current Controller
▼	Pool-1		Online	e (	Good	3.27 TB	3.2	27 TB	3.27 TB C		Disabled		nabled	Disabled	0	Controller 1
V	Pool-2	ool-2 Online Good 16.37 TB 16.37 TB 16.37 TB		16.37 TB	Enabled			sabled	Disabled		Controller 1					
Disk Gr	Disk Groups															
	No.	Status	6 H	lealth	Total	Free		RAID	Disks Use	ed	RAID 2.0 Spar	е				
V		Online	G	Bood	16.37	TB 16.3	7 TB	RAID 5			N/A					
Disks														_		
Enclosu	re ID	Slot	Statu	us	Health	Capacit	/	Disk Type		N	Manufacturer	Mod	del			
0		13	Onlin	ne	Good	5.46 TB		NL-SAS H	IDD 12.0Gb/s		SEAGATE	ST6	000NM0014			
0		14	Onlin	ne	Good	5.46 TB		NL-SAS H	IDD 12.0Gb/s	8	SEAGATE	ST6	000NM0014			
0		15	Onlin	ne	Good	5.46 TB		NL-SAS H	IDD 12.0Gb/s	5	SEAGATE	ST6	000NM0014			
0		16	Onlin	ne	Good	5.46 TB		NL-SAS H	IDD 12.0Gb/s		SEAGATE	ST6	000NM0014			
Create F	Pool	-									· · ·			_		

Figure 11-31 Transfer Thin Provisioning Pool to Auto Tiering Step 1

Click ▼ -> Add Disk Group to transfer from a thin provisioning pool to an auto tiering pool. Select Enabled from the Auto Tiering drop-down list. The tier (disk group) must be added one at a time. Select the RAID Level and Select Disks, and then click the OK button.


1	13.69						
F	Provisioning :		Enabled				
uto 7	Tiering :		Disable	d 🔻 🚹			
AID	Level		Disable Enable	d d			
eas	e select a RAID I	evel.					
AID	Level :		RAID 1		*		
elec	t Disks						
eas	e select disks to	add a dis	k aroup. The	e maximum qua	ntity of disk in a disk grou	o is 64.	
nclo	sure ID :		0 (Heat	d Unit: XS5216	;) <b>v</b>		
	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model
<b>v</b>	0	3	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
1	0	4	Good	372.36 GB	SAS SSD 12.0Gb/s	SEAGATE	ST400FM0053
	0	5	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800
	0	6	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800
	0	7	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800
	0	8	Good	744.96 GB	SAS SSD 12.0Gb/s	MICRON	S630DC-800

Figure 11-32 Transfer Thin Provisioning Pool to Auto Tiering Step 2

3. Use the same procedure to add another tier if necessary.



	Pool N	lame	Sta	atus	Health	Total	Free	Available	Thin F	Provisioning	g	Auto Tiering	Enc	ryption	Volumes	Current Controller
▼	Pool-1		Onl	line	Good	3.27 TB	3.27 T	В 3.27 ТВ	Disab	led		Enabled	Disa	abled	0	Controller 1
T	Pool-2		Onl	line	Good	16.74 T	B 16.74	TB 16.74 TB	Enab	led		Enabled	Disa	abled	0	Controller 1
Disk Gr	Disk Groups															
	No.	Status		Health	Total	F	ree	Tier Level	RAID	Disks Us	ed	RAID 2.0 Sp	oare			
▼	1	Online	•	Good	16.37	TB 1	16.37 TB	NL-SAS	RAID 5	4		N/A				
V	2	Online		Good	371.0	0 GB 3	371.00 GB	SSD	RAID 1	2		N/A				
Disks																
Enclosu	re ID	Slot	St	tatus	Health	Capac	ity Dis	k Type	Manufa	acturer	Mod	el				
0		3	O	nline	Good	372.36	GB SA	S SSD 12.0Gb/s	SEAG	ATE	ST40	00FM0053				
0		4	O	nline	Good	372.36	GB SA	S SSD 12.0Gb/s	SEAG	ATE	ST40	F400FM0053				
Create F	Pool															

Figure 11-33 Transfer Thin Provisioning Pool to Auto Tiering Step 3

4. **Auto Tiering** status is **Enabled**. The thin provisioning pool has been transferred to auto tiering.



### **INFORMATION:**

The total capacity of the pool is the sum of all tiers.



#### **CAUTION:**

The action of transferring from the thin provisioning pool to auto tiering is irreversible. Please consider carefully all possible consequences before taking this step.

# 11.7. SSD Cache vs. Auto Tiering

The SSD cache and auto tiering solutions can work together, and complement each other. A key difference between tiering and cache is that tiering moves data to SSD instead of simply caching it. Tiering can also move data both from slower storage to faster storage and vice versa. But SSD cache is essentially a one-way transaction. When the cache is done with the data it was accelerating it simply nullifies it instead of copying it back to HDD. The important difference between moves and copies is that a cache does not need to have the redundancy that tiering does. Tiering stores the only copy of data for potentially a considerable period of time so it needs to have full data redundancy like RAID or mirroring.





Total storage capacity in auto tiering is a sum of all individual tier capacities whereas in cache, the cache capacity does not add to the overall slower storage capacity. This is one of the key differences. In addition, SSD cache affects rapider than auto tiering because auto tiering will be affected by relocation the data in a period of time. So SSD cache warm-up timeframe is usually minutes/hours whereas tiering warm-up is usually in days.

SSD cache is used for highly frequent data access environment and is effective in a short term such as virtualization or video editing applications. However, auto tiering is used for predictable I/O workloads and is effective in a long term. It's suitable for web, file, or email server applications.

	SSD Cache	Auto Tiering
Total Capacity	HDD	HDD + SSD
When SSD is Damaged	Pool Works Fine	Pool Fails
Performance	Effective in Short Term	Effective in Long Term

Tahle 11-7	SSD Cache vs	Auto Tierina
	SSD Gaune VS.	Auto nenny



# 12. Data Backup

This chapter describes an overview and operations of data backup options in SANOS. SANOS provides built-in data backup services for protecting data from most unpredictable accidents including:

- Volume snapshot which is described in the Managing Snapshots section.
- Local volume cloning which is described in the <u>Manage Local Clones</u> section.
- Remote replication to have data duplicated to the remote sites, the function is described in the <u>Managing Remote Replications</u> section.

The **DATA BACKUP** function menu provides submenus of **Snapshots** and **Replications**. Clone function is built in the **Volumes** function tab of the **Volumes** function submenu.

# 12.1. Managing Snapshots

A volume snapshot is based on copy-on-write technology. It's a block-based and differential backup mechanism. Snapshot functionality is designed to be highly efficient, it keeps a point in time record of block-level, incremental data changes of the target LUN volume. Snapshot can help recover a LUN volume to a previous state quickly to meet enterprise SLA (Service Level Agreement) requirements of RPO (Recovery Point Objectives) and RTO (Recovery Time Objective).

Snapshot is the easiest and most effective measure to protect against ransomware attacks, virus attacks, accidental file deletion, accidental file modification, or unstable system hardware caused by a bad I/O cable connection, unstable power supply... etc.

# 12.1.1. Theory of Operation

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 Volume", is essentially a new volume which can be attached to a LUN provisioned to a host as a disk like other ordinary volumes in the system.





Figure 12-1 Copy-on-Write Technology

# **Snapshot Rollback**

Rollback restores the data back to the state of any time which was previously captured in case for any unfortunate reason it might be. Snapshot volume is allocated within the same pool in which the snapshot is taken, we suggest reserving 20% of the pool capacity or more for snapshot space.

# Writable Snapshot

Apart from the rollback function, snapshot allows direct access to the snapshot content with read or read/write permissions. There are two benefits: One is that it will not consume the free capacity of the storage pool. The other one is that it will not affect the content of the target volume. Before attaching a LUN to the snapshot, the snapshot needs to be exposed to be prepared for accessing. An example of these benefits would be, programmers or developers can easily test a previous version of their compiled codes simply by mounting an older snapshot version onto a LUN instead of rolling back the snapshot and overwriting the existing source codes.



# Integration with Windows VSS (Volume Shadow Copy Services)

Snapshot is fully compatible with Windows VSS (Volume Shadow Copy Services). VSS is a host memory flush mechanism for creating consistent point in time copies of data known as "shadow copies". A Windows agent utility is provided to bridge and synchronize the information between the SAN system and Windows operating system. After implementation, you can trigger a snapshot directly from the Windows operating system without any data consistency issues.



Figure 12-2 Volume Shadow Copy Services Workflow

Select **Snapshots** function submenu to setup snapshot space, take snapshots, list snapshots, setup snapshot schedule, and delete snapshots.



Snapshots
DATA BACKUP
Snapshots
Remote Replications
Figure 12-3 Snapshot Function Submenu

The maximum snapshot quantity per volume is 64, and the maximum volume quantity for snapshot is also 64. So a system can have 4,096 snapshots.

Table 12-1Snapshot Parameters

Item	Value
Maximum snapshot quantity per volume	64
Maximum volume quantity for snapshot	64
Maximum snapshot quantity per system	4,096 (= 64 x 64)

# 12.1.2. Configure Snapshot

## Set Snapshot Space

Before taking a snapshot, SANOS must reserve some storage space for saving variant data. Here's an example of setting snapshot space.

There are two methods to set snapshot space. Select the Snapshots function submenu, click the Set Snapshot Space button. Or select the Volumes function submenu, selects a volume, then click ▼ -> Set Snapshot Space.

Set Snapshot Space					
Volume Name:	Vol-1	Ŧ			
Capacity:	100		GB 🔻	Available: 1925GB Minimum: 5GB	
Free Capacity:	1925GB				
					OK Cancel

Figure 12-4 Set Snapshot Space

2. Enter a **Capacity** which is reserved for the snapshot space, and then click the **OK** button. The minimum capacity is suggested to set 20% of the volume. Now there are two



capacities in **Snapshot Space** column in the **Volumes** function tab. The first capacity is current used snapshot space, and the second capacity is reserved total snapshot space.

## Take a Snapshot

Here's an example of taking a snapshot of the volume.

 There are two methods to take snapshot. Select the Snapshots function submenu, click Take Snapshot button. Or select the Volumes function submenu, selects a volume, then click ▼ -> Take Snapshot.

Take Snapshot			
Volume Name:	Vol-1 🔻		
Snapshot Name:	Snap-Vol-1	0	
			OK Cancel

Figure 12-5 Take Snapshot

- 2. Enter a **Snapshot Name**. The maximum length of the snapshot name is 32 characters. Valid characters are [A~Z | a~z | 0~9 | -\_<> ].
- 3. Click the **OK** button. The snapshot is taken.

## **List Snapshots**

Select the **Snapshots** function submenu, the drop-down lists at the top enable you to switch the volumes.

Show snapshots for volume: Vol-1 •										
	Snapshot Name	Status	Health	Used	Exposure	Permission	LUN	Time Created		
▼	Snap-Vol-1	N/A	Good	0 MB	No	N/A	None	Wed Jul 12 13:24:46 2017		
Set Snapshot Space     Take Snapshot     Schedule Snapshots   Delete Snapshots										

Figure 12-6 List Snapshots

This table shows the column descriptions.



Column Name	Description							
Snapshot Name	The snapshot name.							
Status	The status of the snapshot:							
	N/A: The snapshot is normal.							
	Replicated: The snapshot is for clone or replication usage.							
	Undeletable: The snapshot is undeletable.							
	Aborted: The snapshot is over space and abort.							
Health	The health of the snapshot:							
	Good: The snapshot is good.							
	Failed: The snapshot has failed.							
Used	The amount of the snapshot space that has been used.							
Exposure	The snapshot is exposed or not.							
Permission	The permission 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	The LUN status of the snapshot:							
	None: The snapshot is not mapped any LUN.							
	Mapped: The snapshot is mapped a LUN.							
Time Created	The created time of the snapshot.							

Table 12-2Snapshot Column Descriptions

Select the **Volumes** function submenu, selects a volume, then click ▼ -> List Snapshots.

ist Snapshots							
Snapshot Name	Status	Health	Used	Exposure	Permission	LUN	Time Created
Snap-Vol-1	N/A	Good	0 MB	No	N/A	None	Wed Jul 12 13:24:46 2017
nap-Vol-1	N/A	Good	0 MB	No	N/A	None	Wed Jul 12 13:24:46 2017
							0

Figure 12-7 List Snapshots

# Expose Snapshot

Here's an example of exposing a snapshot.



1. Select the **Snapshots** function submenu, click **▼** -> **Expose Snapshot** to set writable snapshot capacity to expose the snapshot.

Expose Snapshot		
Capacity:	50	GB 🔻 🚹
Available Space:	95 GB	
		OK Cancel

Figure 12-8 Set Writable Snapshot Capacity to Expose Snapshot

- 2. Enter a **Capacity** which is reserved for the snapshot. If the size is 0, 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.
- 3. Click the **OK** button.
- Click ▼ -> Map LUN to map a LUN to the snapshot. Please refer to the chapter 8.6, <u>Configure LUN Mappings</u> section for detail.
- 5. Done. The Snapshot can be used as a volume.



### TIP:

If the capacity of exposed snapshot is set to 0, the snapshot is read only. If it is not 0, the snapshot can be writable and it becomes writable snapshot.

## **Unexpose Snapshot**

Here's an example of unexposing a snapshot.

- Select the Snapshots function submenu, click ▼ -> Unexpose Snapshot to unexposed snapshot
- 2. Click **OK** button.

## **Configure LUN Mappings**

- Select the Snapshots function submenu, click ▼ -> Map LUN to map a LUN to the snapshot. Please refer to the chapter 8.6, <u>Configure LUN Mappings</u> section for detail.
- 2. Click ▼ -> List LUNs to list all LUNs of the snapshot.



3. Click **▼** -> **Unmap LUNs** to unmap LUNs from the snapshot.

### **Delete One Snapshot**

Select **Snapshots** function submenu, click ▼ -> **Delete** to delete the snapshot. All snapshots after deleted one will be deleted.



### CAUTION:

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.

### **Delete All Snapshots**

To cleanup all the snapshots, please follow these steps.

- There are two methods to cleanup snapshots. Select the Snapshots function submenu, click Delete Snapshots button. Of select the Volumes function submenu, selects a volume. And then click ▼ -> Delete Snapshots.
- 2. Click the **OK** to apply. It will delete all snapshots of the volume and release the snapshot space.

# 12.1.3. Configure Rollback Snapshot

### **Rollback Snapshot**

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

- Select the Snapshots function submenu, selects a snapshot. And then click ▼ -> Rollback Snapshot to rollback the snapshot to the volume.
- 2. Click the **OK** to apply.

# **C**SAN



## CAUTION:

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

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.

# 12.1.4. Configure Schedule Snapshots

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

 There are two methods to set schedule snapshots. Select the Snapshots function submenu, click the Schedule Snapshots button. Or select the Volumes function submenu, selects a volume. And then click ▼ -> Schedule Snapshots.

Schedule Snapshots			
Vol-1			
Months to Take Snapshots:	All 01 02 03 04 05 06 07 08 09 10 11 12		
Weeks to Take Snapshots:	All 1 2 3 4 5		
Days to Take Snapshots:	✔ All ✔ Sun ✔ Mon ✔ Tue ♥ ✔ Thu ✔ Fri ✔ Sat	0 Wed	
Hours to Take Snapshots:	All 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23		
Minutes to Take Snapshots:	All 00 15 30 45		
Auto Mapping:			
	Allowed Hosts:	*	
			OK Cancel

Figure 12-9 Schedule Snapshots



- Check the schedules you want to set. They can be set by monthly, weekly, daily, or hourly. Check the **Auto Mapping** box to map a LUN automatically when the snapshot is taken. And the LUN is allowed to access by the **Allowed Hosts** column.
- 3. Click the **OK** to apply.

### **INFORMATION:**

Daily snapshot will be taken at 00:00 daily.

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

Monthly snapshot will be taken every first day of the month at 00:00.

# 12.1.5. Snapshot Notices

Snapshot function applies copy-on-write technique on volume 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.

# **Data Consistent Snapshot**

Before using snapshot, users should understand why sometimes the data becomes corrupted after rollback of snapshot. Please refer to the following diagram.

When the data is modified from the host computer, the data will pass through file system and memory of the host (write cache). 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 the storage device, it cannot control the behavior of the host side. It sometimes happens that when a snapshot is taken, some data is still in memory and did not flush to disk. Then the snapshot may have an incomplete image of the original data. The problem does not belong to the storage device. To avoid this data inconsistency issue between a snapshot and original data, the user has to make the operating system flushes the data from memory of the host (write cache) into disk before taking snapshot.

# **C**SAN



Figure 12-10 Host data I/O Route

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

Besides the **sync** tool, Microsoft developed **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 storage systems to make sure snapshots can occur without the problem of data-irregularities. For more information about the VSS, please refer to <a href="http://technet.microsoft.com/en-us/library/cc785914.aspx">http://technet.microsoft.com/en-us/library/cc785914.aspx</a>. QSAN storage systems fully support Microsoft VSS.



### CAUTION:

Snapshot function can only take the image of data which has been written into the corresponding volume, for the cached data that resides in the server's cache, that doesn't yet be flushed into the storage system, it is unable to protect, which means the taken snapshot might consist of inconsistent data/file/boot image, please make sure to take snapshot at the time point when there is no data I/O incoming to the storage system, to prevent the situation as much as possible. Any functionality that base on snapshot function to perform will have this kind of concern, e.g., local clone and remote replication.

## SUGGESTION:

It is recommended to use native remote replication function upon the corresponding Operating System to prevent the situation, e.g., vSphere Replication (VR), so that the cached data can be seamlessly replicated to the target site.

# **Run Out of Snapshot Space**

Before using snapshot, a snapshot space is needed from pool 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 volume 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.

# Maximum Snapshot Quantity per Volume

There are up to 64 snapshots can be created per volume. 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 user interface.

### **Rollback and Delete Snapshot**

When a snapshot has been rolled back, the related snapshots which are later 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.

# 12.2. Managing Local Clones

Local clone is used to make a duplicate copy of a volume in the same storage pool as well as in a separate storage pool within the same enclosure. In setting up local clone task, the first clone is a full copy. From now on, the cloning is a differential copy, created using snapshot functionality. Manual and scheduled tasks are available for management flexibility. In the event that the source volume is broken and it fails, IT managers can quickly switch to the cloned volume and resume data services.



Figure 12-11 Local Clone Diagram

# 12.2.1. Theory of Operation

At the beginning, copy all data from the source volume to target. It is also called full copy. Afterwards, take a snapshot on source volume and then copy delta data to perform the incremental copy.



## TIP:

Please be fully aware that the incremental copy needs to use snapshot to compare the data difference. Therefore, having enough snapshot space for the volume is very important.



Figure 12-12 Local Clone Steps



In general, local clone operates as follows:

- 1. Create a local clone task, 2 snapshots are taken on the Source Volume.
- 2. Data from the Source Snapshot T1 is copied to the Target Volume.
- 3. The Target Snapshot T1 is refreshed and becomes the common base.
- 4. Host keeps writing new data to the Source Volume.
- 5. At next synchronization, the Source Snapshot T2 is refreshed and copies only the changes since the last synchronization.
- 6. The Target Snapshot T2 is refreshed and becomes the common base.

The local clone operations are under the **Volumes** function tab which provides to setup local clone task, start or stop the tasks, setup local clone schedule, and delete tasks. The maximum clone task quantity per volume is 1, and the maximum clone task quantity per system is 64.

Item	Value
Maximum clone task quantity per volume	1
(Maximum clone pairs per source volume)	
Maximum clone task quantity per system	64

# **Rollback Local Clone**

Rollback local clone operates are in the following:

- 1. After completing the local clone task, the data can be rolled-back.
- 2. Exchange the roles of source and target volume, follow the operations on local clone to create a local clone task. Notice that the data in original volume will be destroyed. You have to comprehensive consideration before doing.
- 3. Or create a new target volume to backup to.

# **CSAN**



Figure 12-13 Rollback Local Clone

# 12.2.2. Configure Local Clone

# **Create a Local Clone Task**

Here's an example of creating a local clone from source volume to target one. Assume that we define the name in the example.

- Source Volume Name: Source-Vol-1
- Target Volume: Name: Target-Vol-2
- Before cloning, it must have a backup target volume. Select the Volumes function submenu, click the Create Volume button. And then select Volume Type to Backup Volume. Please refer to the chapter 8.5.1, <u>Create a Volume</u> section for detail.



Create Volume				
General	Volume General Settin	igs		
Advanced	Please enter a volume r	name and configure th	e volum	e general settings.
General       Volume General Settings         Advanced       Please enter a volume name and configure the volume general settings.         Summary       Volume Name :         Pool Name :       Pool-1         Pool Name :       Pool-1         Capacity :       11         GB *         Volume Type :       RAID Volume         Select RAID Volume to RAID Volume         Backup Volume         Sackup Volume for backup usage such as the target volume of local clone or reference				
	Pool Name :	Pool-1	•	(Available : 1107 GB)
	Capacity :	11		GB 🔻
	Volume Type :	RAID Volume	•	
	Select RAID Volume replication	fc RAID Volume Backup Volume	Ва	ackup Volume for backup usage such as the target volume of local clone or remote
				Next Cancel

Figure 12-14 Create Target Volume

<< first <	prev 1 next >	last >>									
	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name
▼	Source-Vol-1	Online	Optimal	10.00 GB	RAID Volume	Disabled	0 MB / 0 MB	0	N/A	WB	Pool-1
V	Target-Vol-2	Online	Optimal	11.00 GB	Backup Volume	Disabled	0 MB / 0 MB	0	N/A	WB	Pool-1
<< first <	prev <b>1</b> next >	last >>									
Create V	/olume Local Clo	ne Options	]								

Figure 12-15 List Source and Target Volumes for Local Clone

- 2. Select the source volume, and then click **▼** -> **Create Local Clone**.
- 3. Select a target volume, and then click the **OK** button.



prev 1 nex	t> last>>				
lume Name	Capacity	Status	Health	Pool Name	1
rget-Vol-2	11.00 GB	Online	Optimal	Pool-1	-
	prev <b>1</b> next lume Name rget-Vol-2	prev     1     next > last >>       lume Name     Capacity       rget-Vol-2     11.00 GB	prev 1 next > last >> lume Name Capacity Status rget-Vol-2 11.00 GB Online	prev     1     next > last >>       lume Name     Capacity     Status     Health       rget-Vol-2     11.00 GB     Online     Optimal	prev     1     next > last >>       lume Name     Capacity     Status     Health     Pool Name       rget-Vol-2     11.00 GB     Online     Optimal     Pool-1

Figure 12-16 Create Local Clone



### TIP:

The volume type of the target volume should be set as **Backup Volume**. Please refer to the chapter 8.5.1, <u>Create a Volume</u> in the Storage Management chapter.

- At this time, if the source volume has no snapshot space, it will be allocated snapshot space for clone usage automatically. The capacity will depend on the parameter of Cloning Options.
- 5. Done, now ready to start cloning volumes.

<< first <	prev 1 next >	last >>									
	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name
▼	Source-Vol-1	Online	Optimal	10.00 GB	RAID Volume	Disabled	1.58 GB / 21.58 GB	0	Target-Vol-2	WB	Pool-1
▼	Target-Vol-2	Online	Optimal	11.00 GB	Backup Volume	Disabled	0 MB / 0 MB	0	N/A	WB	Pool-1
<< first <	prev <b>1</b> next >	last >> ne Options	]								

Figure 12-17 List Source and Target Volumes

### Start Local Clone Task

To start cloning, please follow the procedures.

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



## Stop Local Clone Task

To stop cloning, please follow the procedures.

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

## **Delete Local Clone Task**

To clear the clone task, please follow the procedures.

- 1. Select the source volume, and then click **▼** -> **Delete Local Clone**.
- 2. Click the **OK** button to clear clone task.

# 12.2.3. Configure Schedule Local Clone Tasks

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

1. Select the source volume, and then click **▼** -> Schedule Local Clone.

Schedule Local Clone		
Set Local Clone Schedule: Sour	rce-Vol-1	
Months in the Year:	All 01 02 03 04 05 06 07 08 09 10 11 12	
Weeks in the Month:	All 1 2 3 4 5	
Days of the Week:	✔ All ✔ Sun ✔ Mon ✔ Tue ✔ Wed ✔ Thu ✔ Fri ✔ Sat	
Hours in the Day:	All         00       01       02       03         04       05       06       07         08       09       10       11         12       13       14       15         16       17       18       19         20       21       22       23	
Minutes in the Hour:	All 00 15 30 45	
		OK Cancel

Figure 12-18 Schedule Local Clone



2. Check the schedules which you want. They can be set by monthly, weekly, daily, or hourly. Click the **OK** button to apply.

i	<b>INFORMATION:</b> Daily snapshots will be taken at 00:00 daily.
	Weekly snapshot will be taken every Sunday at 00:00.
	Monthly snapshot will be taken every first day of the month at 00:00.

# 12.2.4. Local Cloning Options

Select the **Volumes** function submenu, click the **Local Clone Options** button. Three options are described in the following.



Figure 12-19 Local Cloning Options

- Automatic Snapshot Space Allocation Ratio: This setting is the ratio of the source volume and snapshot space. If the ratio is set to 2, when there is no snapshot space assigned for the volume, the system will automatically reserve a free pool space to set as the snapshot space with twice capacity of the volume. The options are 0.5 ~ 3.
- Automatic Snapshot Checkpoint 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 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 task 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 task again.

• **Restart the task an hour later if failed:** The setting will be effective after enabling a scheduled clone. When running out of snapshot space, the volume 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 capacity of source volume. That is the best value of our suggestion. If user sets snapshot space manually and lower than the default value, understand that if the snapshot space is not enough, the clone task will fail.

# 12.2.5. Local Clone Notices

While the clone is processing manually, the incremental data of the volume 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 "There is not enough of snapshot space for the operation". The user needs to clean up the snapshot space in order to use the clone feature. Each time the clone snapshot failed, it means that the system loses the reference value of incremental data. So it will need to make a full copy the next time a clone task starts.

# 12.3. Managing Remote Replications

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

# **CSAN**



Figure 12-20 Remote Replication Diagram

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

If the replication task requires more bandwidth, Remote replication allows multiple connections per task by intelligently balancing the backup task across multiple connections to enhance the bandwidth.

Both manual and scheduled replication tasks are supported for flexible management. To handle huge data remote replication, Remote replication allows transforming local cloning task into a remote replication task. You can perform the local clone first for the full copy. Then use disk roaming function to physically transport the disk drives that contain the cloned volume to the remote site. Lastly, use the function of transforming from the local clone task to the remote replication one.



Figure 12-21 Local Clone Transfers to Remote Replication

# 12.3.1. Remote Replication Topologies

Remote replication supports multiple topologies to suit various disaster recovery configurations. They are one-directional, bi-directional, one-to-many, many-to-one, and



many-to-many. Both the source volume and destination volume in a replication connection are exclusive to the pair. Either one can NOT be served as the source or destination volume of a different replication connection. Each SAN storage system can support up to 32 replication tasks concurrently. Below are the supported topologies.

## **One-Directional**



Figure 12-22 One-Directional Remote Replication

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

## **Bi-Directional**



Figure 12-23 Bi-Directional Remote Replication

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



### **One-to-Many**



Figure 12-24 One-to-Many Remote Replication

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

#### Site A Site A Site C Site C Site D Site D Site D Site D Site D Site D Site D

Many-to-One

Figure 12-25 Many-to One Remote Replication

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

# **OSAN**

# Many-to-Many



Figure 12-26 Many-to Many Remote Replication

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



## TIP:

Note that all supported topologies have a 1-to-1 configuration for each individual replication session in the topology.

The maximum replication task quantity per system is 32. It means that 32 systems are the maximum quantity of any many-to-one or one-to-many replication configuration.

# 12.3.2. Theory of Operation

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

# TIP:

Please be fully aware that the incremental copy needs to use snapshot to compare the data difference. Therefore, sufficient snapshot space for the volume is very important.





Figure 12-27 Remote Replication Steps

In general, remote replication operates in the following way.

- 1. Create a remote replication task, as the time going, two snapshots are taken on the Source Volume.
- 2. Data from the Source Snapshot T1 is copied to the Target Volume.
- 3. The Target Snapshot T1 is refreshed and becomes the common base.
- 4. Host keeps writing new data to the Source Volume.
- 5. At next synchronization, the Source Snapshot T2 is refreshed and copies only the changes since last synchronization.
- 6. The Target Snapshot T2 is refreshed and becomes the common base.

Select the **Remote Replications** function submenu to setup remote replication task, start, or stop tasks, setup remote replication schedule, delete tasks, and also setup traffic shaping.





The maximum replication task quantity per volume is 1, and the maximum replication task quantity per system is 32, and the maximum traffic shaping quantity per system is 8.



#### Table 12-4 Remote Replication Parameters

Item	Value
Maximum remote replication task quantity per volume	1
(Maximum remote replication pairs per source volume)	'
Maximum remote replication task quantity per system	32
Maximum traffic shaping quantity per system	8
Maximum iSCSI multi-path quantity in a remote replication	2
task	2
Maximum iSCSI multiple connection quantity per remote	Λ
replication task path	

# 12.3.3. Configure Remote Replication

### **Create a Remote Replication Task**

Here's an example of creating a remote replication task from source volume to target one. Assume that we define the name and the IP addresses in the example.



Figure 12-29 Example of Creating a Remote Replication Task

Site A Source Unit Configuration:

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

Site B Target Unit Configuration:

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



Operate SANOS web UI of Site B target unit:

 Before replication, it must have a backup target volume. Select the Volumes function submenu, click the Create Volume button. And then select Volume Type to Backup Volume. Please refer to the chapter 8.5.1, <u>Create a Volume</u> section in the Storage Management chapter.

Create Volume				
General	Volume General Settings	5		
Advanced	Please enter a volume nar	me and configure the volu	me general settings.	
Summary	Volume Name :	Target-Vol-2	0	
	Pool Name :	Pool-1	(Available : 1107 GB)	
	Capacity :	11	GB 🔻	
	Volume Type :	RAID Volume		
	Select RAID Volume for	RAID Volume Backup Volume	Backup Volume for backup usage such as the target volu	ume of local clone or remote
	replication.	Buckup Volume		
				Next Cancel

Figure 12-30 Create Target Volume in Site B

 After creating a target volume, please also setup snapshot space. So the snapshot of the source volume can replicate to the target volume. Please refer to the chapter 12.1.2, <u>Configure Snapshot</u> section.

<< first <	prev 1 next >	last >>									
	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name
V	Target-Vol-2	Online	Optimal	11.00 GB	Backup Volume	Disabled	1.58 GB / 11.00 GB	0	N/A	WB	Pool-1
<< first <	volume	last >> ne Options	]								

Figure 12-31 List Target Volume in Site B



3. Map a LUN of the target volume. Please refer to the chapter 8.6, <u>Configure LUN</u> <u>Mappings</u> section in the Storage Management chapter.

Operate web UI of Site A source unit:

4. Select the **Remote Replications** function submenu, click the **Create** button.

ote Replication - Sel	ect a Source V	olume					
irst < prev <b>1</b> nex	<pre>dt &gt; last &gt;&gt;</pre>			1		1	
Volume Name	Capacity	Status	LUN	Snapshots	Pool Name		
Source-Vol-1	10.00 GB	Online	None	0	Pool-1		
first < prev <b>1</b> nex	t > last >>						

Figure 12-32 Create a Remote Replication Task Step 1

5. Select a source volume, and then click the **Next** button.



Remote Replication - Set	t Source Port and Targe	et IP Add
Source Port:	Auto	•
Target IP Address:	10.10.1.101	
r		
Back		

*Figure 12-33* Create a Remote Replication Task Step 2

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



### TIP:

Leave the setting of the **Source Port** to **Auto** if you don't want to assign a fixed one. The system will try to connect to the target IP address automatically.



Remote Replication - Set Authentication Method and Select a Target Name										
Select a	n Authentica	ition Meth	od							
	o Authentica	tion Meth	od							
CI	НАР									
	CHAP Usern	ame:	chap1		0					
	CHAP Password				0					
						· ·				
Select a	Target Nam	e								
	No	Target N	ame							
	1	ign 2004	I-08 com asan:xsf	5216-000d40228	dev0.ctr1					
Back	]							Next Cancel		

Figure 12-34 Create a Remote Replication Task Step 3

 Select an Authentication Method and input the CHAP Username and CHAP Password if needed. Select a Target Name, and then click the Next button.

# TIP:

This CHAP account is the iSCSI authentication of the Site B target unit. For more information about CHAP, please refer to the chapter 7.3.4, <u>Configure iSCSI CHAP Accounts</u> section in the Host Configuration chapter.

Select **No Authentication Method** if there is no CHAP enabling in the Site B target unit.



temote Replication - Select a Target LUN												
/hen a remote replication task completes, it will take a snapshot on its target volume. Please make sure the sn pace of the backup volume on the target side is properly configured.												
	No. LUN Volume Name Capacity Manufacturer Model WWN											
۲	1	0	Target-Vol-2	11.00 GB	QSAN	XS5216	205a0013780a21c0					
Back							Finish					

Figure 12-35 Create a Remote Replication Task Step 4

8. Select a Target LUN in Site B target unit. Finally, click the **Finish** button.

Tasks														
	No.	Source Volume	Status	%	Shaping	Speed	Target Volume	Capacity	Sch	nedule	Time Created	Manufacturer	Model	WWN
T			Online				Target-Vol-2				Thu Jul 13 17:50:14 2017	QSAN		205a0013780a21c0
Task Paths														
	No.	Source Port	Target IP Add	iress	Target Name				LUN	Status				
▼	1	Auto	10.10.1.101		iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr1				0	Connec	ted			
Create	Create Rebuild Remote Replication Options Traffic Shaping Configuration													

Figure 12-36 Remote Replication Task is Created

9. The replication task is created. At this time, if the source volume has no snapshot space, it will be allocated snapshot space for replication usage automatically. The size will depend on the parameter of replication options.



## **Start Remote Replication Task**

To start the remote replication task, please follow the procedures.

Launch the SANOS web UI of Site A source unit:

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

### **Stop Remote Replication Task**

To stop remote replication task, please follow the procedures.

Launch the SANOS web UI of Site A source unit:

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

### **Delete Remote Replication Task**

To delele the remote replication task, please follow the procedures.

Launch the SANOS web UI of Site A source unit:

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

# 12.3.4. Configure Traffic Shaping

The traffic shaping function can help to reserve necessary bandwidth for non-replication I/O operations. There are eight shaping groups which can be set. In each shaping group, peak and off-peak time slot are provided for different bandwidth. Here's an example of setting shaping group.

### **Configure Traffic Shaping**

To configure traffic shaping groups, please follow the procedures.

Launch the SANOS web UI of Site A source unit:

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


ition	- Tra	ffic	Shaj	ping	Cor	nfigu	ratio	on																
iping Gr	oup	:					Sha	ping	Gro	oup1	L (Pe	eak:	100	MB	; Off	f-pea	ak: I	N/A)	•					
ak:							100							мв										
Enable (	Off-P	eak																						
Off-Pe	eak:					2	00						N	1B										
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sun																								
Mon																								
Tue																								
Wed																								
Thu																								
Fri																								
Sat																								

Figure 12-37 Shaping Setting Configuration

- 2. Select a **Shaping Group** to setup.
- 3. Input the bandwidth (MB) at the **Peak** time.
- 4. If needed, check the **Enable Off-Peak** box, and then input the bandwidth (MB) at **Off-Peak** time. And define the off-peak hour.
- 5. Click the **OK** button.

#### Set Traffic Shaping on Remote Replication Task

To set a shaping group on the remote replication task, please follow the procedures.

Operate web UI of Site A source unit:

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



Remote Replication - S	Set Traffic Shaping
Shaping Group:	Shaping Group1 (100MB) 🔻
	N/A
	Shaping Group1 (100MB)
	Shaping Group2 (100MB)
	Shaping Group3 (100MB)
	Shaping Group4 (100MB)
	Shaping Group5 (100MB)
	Shaping Group6 (100MB)
	Shaping Group7 (100MB)
	Shaping Group8 (100MB)
	OK Cancel

Figure 12-38 Set Traffic Shaping

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

## 12.3.5. Configure Schedule Remote Replication Tasks

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

Operate web UI of Site A source unit:

- Select the Remote Replications function submenu, 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 the **OK** button to apply.



#### **INFORMATION:**

Daily snapshot will be taken at 00:00 daily.

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

Monthly snapshot will be taken every first day of the month at 00:00.



Remote Replication - Set Remote	Replication Schedule	
Set Remote Replication Schedu	le: Source-Vol-1	
Months in the Year:	All 01 02 03 04 05 06 07 08 09 10 11 12	
Weeks in the Month:	All 1 2 3 4 5	
Days of the Week:	□ All □ Sun □ Mon □ Tue □ Wed □ Thu □ Fri □ Sat	
Hours in the Day:	<ul> <li>✓ AII</li> <li>✓ 00 Ø 01 Ø 02 Ø 03</li> <li>✓ 04 Ø 05 Ø 06 Ø 07</li> <li>Ø 08 Ø 09 Ø 10 Ø 11</li> <li>Ø 12 Ø 13 Ø 14 Ø 15</li> <li>Ø 16 Ø 17 Ø 18 Ø 19</li> <li>Ø 20 Ø 21 Ø 22 Ø 23</li> </ul>	
Minutes in the Hour:	All 00 15 30 45	
		OK Cancel

Figure 12-39 Schedule Remote Replication

# 12.3.6. Replication Options

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

Remote Replication Options		
Automatic Snapshot Space Allocation Ratio: 🚺	2	•
Automatic Snapshot Checkpoint Threshold: 🕕	50%	•
Restart the task an hour later if it failed:	Enabled	
	OK Can	cel

Figure 12-40 Replication Options

# **C**SAN

- Automatic Snapshot Space Allocation Ratio: This setting is the ratio of the source volume and snapshot space. If the ratio is set to 2, when there is no snapshot space assigned for the volume, the system will automatically reserve a free pool space to set as the snapshot space with twice capacity of the volume. The options are 0.5 ~ 3.
- Automatic Snapshot Checkpoint 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 task 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 snapshot space, the volume 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 capacity of source volume. 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.

# 12.3.7. Configure MPIO in Remote Replication Task

In remote replication scenario, MPIO (Multi-Path I/O) are support for redundancy. Normally, the remote replication task is running on the master controller (usually is controller 1) of source unit. The data is replicated from the master controller of source unit to the controller of target unit which target IP Address sets in creating remote replication task (usually is also controller 1). The second path from source unit can be added to the controller 2 of



target unit. The maximum MPIO in remote replication task is 2 paths. The following is the remote replication MPIO diagram.



Figure 12-41 Remote Replication MPIO Diagram

#### How Redundancy Works with Remote Replication

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



Figure 12-42 Remote Replication Source Controller Fail Diagram

In another scenario, when controller1 fails on the target unit, the replication connection will be failed over to the second path from the controller 1 of the source unit to controller 2 of target unit.





Figure 12-43 Remote Replication Target Controller Fail Diagram

#### Add Multipath in Remote Replication Task

Here's an example of adding the second path in the remote replication. Assume that we define the IP addresses in the example.

Site A Source Unit Configuration:

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

Site B Target Unit Configuration:

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

Operate web UI of Site A source unit:

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



emote Replication - Set	Source Port and Targe	t IP Address	
Source Port:	Auto	¥	
Toront TD Address			
Target IP Address:	10.10.1.103		
			Next Cance

Figure 12-44 Add Multipath in Remote Replication Step 1

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



#### TIP:

Leave the setting of **Source Port** to **Auto** if you don't want to assign. The system will try to connect to the target IP address automatically.



Remote I	Replication -	Set Authe	ntication Method an	d Select a Target Nar	me				
Select a	n Authentica	tion Meth	od						
	o Authentica	tion Meth	od						
● CI	HAP								
	CHAP Userna	ame:	chap1			0			
	CHAP Passw	ord:				6			
	01141 1 0551	oru.				× .			
Select a	Target Nam	e							
	Na	Terret							
	INO.	Target IN	lame	40,000,440,220,40	- 1-2				
	1	Iqn.2004	I-U8.com.qsan:xs52	16-000d40228:dev0.	.ctr2				
							_		
Back								Next	Cancel

Figure 12-45 Add Multipath in Remote Replication Step 2

 Select an Authentication Method and input the CHAP Username and CHAP Password if needed. Select a Target Name, and then click the Next button.

# TIP:

This CHAP account is the iSCSI authentication of the Site B target unit. For more information about CHAP, please refer to the chapter 7.3.4, <u>Configure iSCSI CHAP Accounts</u> section in the Host Configuration chapter.

Select **No Authentication Method** if there is no CHAP enabled on the Site B target unit.



No.       LUN       Volume Name       Capacity       Manufacturer       Model       WWN <ul> <li>1</li> <li>0</li> <li>Target-Vol-2</li> <li>11.00 GB</li> <li>QSAN</li> <li>XS5216</li> <li>205a0013780a21c0</li> </ul>			ion - Select	a Target LUN				
No.         LUN         Volume Name         Capacity         Manufacturer         Model         WWN           Image: 1         0         Target-Vol-2         11.00 GB         QSAN         XS5216         205a0013780a21c0	Vhen a pace o	a remote of the bac	replication ckup volum	task completes, it ne on the target sid	will take a sna le is properly c	apshot on its target onfigured.	t volume. Pl	ease make sure the s
I 0 Target-Vol-2 11.00 GB QSAN XS5216 205a0013780a21c0		No.	LUN	Volume Name	Capacity	Manufacturer	Model	WWN
	۲	1	0	Target-Vol-2	11.00 GB	QSAN	XS5216	205a0013780a21c0

Figure 12-46 Add Multipath in Remote Replication Step 3

Tacke

4. Select a Target LUN in Site B target unit. Finally, click **Finish** button.

	No	Source Volume	Statue	0/_	Shaning	Speed	Target Volume	Canacity	Scho	dulo	Time
	INU.	Source volume	Status	/0	Shaping	Speed	Target Volume	Сарасну	Sune	suule	Time
V		Source-Vol-1	Online		N/A	0 MB	Target-Vol-2	11.00 GB	N/A		Thu
fask Pat	hs										
	No.	Source Port	Target IP Add	dress	Target Nan	ne			LUN	Status	
▼	No. 1	Source Port Auto	Target IP Add 10.10.1.101	dress	Target Nan iqn.2004-0	ne 8.com.qsan	xs5216-000d40228:	dev0.ctr1	LUN 0	Status Conne	ected
<b>T</b>	No. 1 2	Source Port Auto Auto	Target IP Add 10.10.1.101 10.10.1.103	dress	Target Nan iqn.2004-0 iqn.2004-0	ne 8.com.qsan 8.com.qsan	xs5216-000d40228: xs5216-000d40228:	dev0.ctr1 dev0.ctr2	LUN 0 0	Status Conne Conne	ected

Figure 12-47 List Multipath in Remote Replication Task



5. The second path in remote replication task is added.

#### **Delete Multipath in Remote Replication Task**

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

Operate web UI of Site A source unit:

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

### 12.3.8. Configure MC/S in Remote Replication Task Path

MC/S (Multiple Connections per Session) is another feature in remote replication. If there are more than one iSCSI ports available on source unit, and they can connect to the other iSCSI ports of the target unit, MC/S can be added for increasing the replicating speed. The maximum MC/S per task path is 4 connections.

#### Add Connections in Remote Replication Task Path

Here's an example of adding the second connection in the remote replication task. Assume that we define the IP addresses in the example.

Site A Source Unit Configuration:

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

Site B Target Unit Configuration:

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



Operate web UI of Site A source unit:

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

Remote Replication - Add	Path Connection	
Source Port:	Auto	•
Target IP Address:	10.10.1.102	
		OK Cancel

Figure 12-48 Add Path Connection

TIP:

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



Leave the setting of **Source Port** to **Auto** if you don't want to assign. The system will try to connect to the target IP address automatically.

Tasks											
	No.	Source Volume	Status	%	Shaping	Speed	Target Volume	Capacity	Sch	edule	Time
T		Source-Vol-1	Online		N/A	0 MB	Target-Vol-2	11.00 GE	3 N/A		Thu
Task Path	IS	0	T		7 . 11						
	No.	Source Port	Target IP Add	ress	larget Nan	ne			LUN	Status	i .
T		Auto	10.10.1.101		iqn.2004-0	B.com.qsan:	xs5216-000d40228:	dev0.ctr1		Conne	ected
▼		Auto	10.10.1.102		iqn.2004-0	8.com.qsan:	xs5216-000d40228:	dev0.ctr1	0	Conne	ected
Create	Rebui	d Remote Rep	lication Options	Traffi	c Shaping Co	nfiguration					

Figure 12-49 List Multiple Connections in Remote Replication Task Path



3. The second connection in remote replication task path is added. If necessary, click ▼ -> Add Connection to add another.

#### **Delete Connections in Remote Replication Task Path**

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

1. Operate Site A source unit. Select the **Remote Replications** function submenu, select the task path, and then click **▼** -> **Delete Connection**.

No.         Source Port         Target IP Address         Status           1         Auto         10.10.1.101         Connect
1         Auto         10.10.1.101         Connect           2         Auto         40.404.402         0.404.402         0.404.402
2 0 Auto 40404.400 Oceano
2 Auto 10.10.1.102 Connec

Figure 12-50 Delete Path Connection

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



#### TIP:

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



## **12.3.9. Local Clone Transfers to Remote Replication**

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 users shorten the time of executing a full copy.

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



#### TIP:

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

2. The other way is to use local volume clone function, which is a local data copy function between volumes to execute full copy at the first time. Then carry all the physical disk drives of the target volume and move to the target unit. Finally, turn the local clone task into remote replication task with differential copy afterward.



Figure 12-51 Local Clone Transfers to Remote Replication Diagram



To do that volume disk local clone transfers to remote replication, please follow the procedures.

Launch SANOS web UI of Site A source unit:

- Select the Volumes function submenu, select a source volume, and click ▼ -> Create Local Clone to create a local clone task. For more information about local clone, please refer to the chapter 12.2.2, <u>Configure Local Clone</u> section.
- Click ▼ -> Start Local Clone to execute full copy the data from source volume to target one.
- Click ▼ -> Covert to Remote Replication to change the local clone task to a remote replication task.

<< first <	<pre><first 1="" <="" next="" prev=""> last&gt;&gt;</first></pre>														
	Volume Name	Status	Health	Capacity	Volume Type	SSD Cache	Snapshot Space	Snapshots	Clone	Write	Pool Name				
▼	Source-Vol-1	Online	Optimal	10.00 GB	RAID Volume	Disabled	3.04 GB / 23.04 GB	1	QRep	WB	Pool-1				
▼	Target-Vol-2	Online	Optimal	11.00 GB	Backup Volume	Disabled	0 MB / 0 MB	0	N/A	WB	Pool-2				
<< first <	prev 1 next >	last >>	]												

Figure 12-52 List Source and Target Volumes for Local Clone

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



#### **CAUTION:**

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

- 5. Select the **Pools** function submenu, select the pool, and click **▼** -> **Deactive**.
- 6. Plug out all the physical disk drives, and carry them to Site B, plug them into the target unit.

Operate web UI of Site B target unit:

- 7. Select the **Pools** function submenu, select the pool, and click ▼ -> Active.
- Select the Volumes function submenu, please setup snapshot space. So the snapshot of the source volume can replicate to the target volume. Please refer to the chapter 12.1.2, <u>Configure Snapshot</u> section.



9. Map a LUN of the target volume. Please refer to the chapter 8.6, <u>Configure LUN</u> <u>Mappings</u> section in the Storage Management chapter.

Launch SANOS web UI of Site A source unit:

10. Select the **Remote Replications** function submenu, click the **Rebuild** button to rebuild the remote replication task which is changed from a clone task formerly.

Volume Name	Capacity	Status	LUN	Snapshots	Pool Name		
Source-Vol-1	10.00 GB	Online	None	1	Pool-1	-	
prev 1 nex	xt > last >>						

Figure 12-53 Rebuild Clone Relationship Step 1

11. Select a source volume, and then click the **Next** button.



emote Replication - Set	Source Port and Targe	et IP Address
Source Port:	Auto	•
Target IP Address:	10.10.1.101	
ranget in Addressi	10.10.1.101	
Back		

Figure 12-54 Rebuild Clone Relationship Step 2

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



#### TIP:

Leave the setting of **Source Port** to **Auto** if you don't want to assign a fixed one. The system will try to connect to the target IP address automatically.



Remote	Replication	- Set Authe	ntication Method and	l Select a Target Nam	ie		
Select a	an Authentio	cation Meth	od				
0 N	lo Authentio	cation Meth	od				
• c	HAP						
	CHAP User	name:	chap1		0		
	CHAP Pass	word:	•••••		0		
Select a	a Target Na	me					
	No.	Target N	lame				
۲	1	iqn.2004	I-08.com.qsan:xs521	6-000d40228:dev0.c	:tr1		
		_					
Deri	Г					Г	
Back							Next Cancel

Figure 12-55 Rebuild Clone Relationship Step 3

13. Select an Authentication Method and input the CHAP Username and CHAP Password if needed. Select a Target Name, and then click the Next button.



#### TIP:

This CHAP account is the iSCSI authentication of the Site B target unit. For more information about CHAP, please refer to the chapter 7.3.4, <u>Configure iSCSI CHAP Accounts</u> section in the Host Configuration chapter.

Select **No Authentication Method** if there is no CHAP enabled on the Site B target unit.



Remote Replication - Select a Target LUN										
When a remote replication task completes, it will take a snapshot on its target volume. Please make sure the snapshot space of the backup volume on the target side is properly configured.										
	No.	LUN	Volume Name	Capacity	Manufacturer	Model	WWN	]		
۲	1	0	Target-Vol-2	11.00 GB	QSAN	XS5216	205a0013780a21c0	1		
								_		
Back							Finish	Cance		

Figure 12-56 Rebuild Clone Relationship Step 4

14. Select a Target LUN in Site B target unit. Finally, click the **Finish** button.

Tasks														
	No.	Source Volume	Status	%	Shaping	Speed	Target Volume	Capacity	Sch	edule	Time Created	Manufacturer	Model	WWN
V			Online			0 MB	Target-Vol-2	11.00 GB			Thu Jul 13 17:50:14 2017	QSAN		205a0013780a21c0
Task Path	ıs													
	No.	Source Port	Target IP Add	dress	Target Nan	ne			LUN	Status				
•	1	Auto	10.10.1.101		iqn.2004-0	iqn.2004-08.com.qsan:xs5216-000d40228:dev0.ctr1			0	Connect	ed			
Create	Image: 1     Auto     10.10.1.101     iqn.2004-08.com.qsan.xs5216-000d40228:dev0.ctr1     0     Connected       Create     Rebuild     Remote Replication Options     Traffic Shaping Configuration													

Figure 12-57 Remote Replication Task is Created

15. The replication task from local clone is created.



# 13. Monitoring

The **MONITORING** function menu provides submenus of **Log Center**, **Enclosures**, and **Performance**.

# 13.1. Log Center

Select the **Event Logs** function tab in the **Log Center** function submenu to show event messages. Select or unselect the checkbox of **Information**, **Warning**, or **Error** levels to show or hide those particular events.

	Event Logs
	IG
Log Center	
Enclosures	
Performanc	e
Figure 13-1	Log Center Function Submenu

Information Ø Warning Ø Error										
<< first < prev	<b>1</b> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u>	8 9 10 next > last >>								
Туре	Time	Content								
Information	Tue, 04 Oct 2016 15:43:02	[CTR1] Disk 10 has been freed from RAID group 'Pool-2'.								
Warning	Tue, 04 Oct 2016 15:43:02	[CTR1] RAID group 'Pool-2' is in degraded mode.								
Information	Tue, 04 Oct 2016 15:26:03	[CTR1] Virtual disk 'Vol-3' completed initialization.								
Information	Tue, 04 Oct 2016 15:26:03	[CTR1] The snapshot space of virtual disk 'Vol-3' is cleared.								
Information	Tue, 04 Oct 2016 15:25:51	[CTR1] Virtual disk 'Vol-3' has started initialization.								
Information	Tue, 04 Oct 2016 15:25:51	[CTR1] Set the snapshot space of virtual disk 'Vol-3' to 526336 MB.								
Information	Tue, 04 Oct 2016 15:25:39	[CTR1] The clone of virtual disk Vol-2' has been designated.								
Information	Tue, 04 Oct 2016 15:25:20	[CTR1] The QReplica of Vol-1 is no longer enabled.								
Information	Tue, 04 Oct 2016 15:25:20	[CTR1] iSCSI logout from iqn.2004-08.com.qsan:xs7216- 000d40000 (10.10.1.102:4109) was received, reason [close the session].								
Information	Tue, 04 Oct 2016 15:22:49	[CTR1] The QReplica of Vol-1 is enabled.								
<< first < prev	1 2 3 4 5 6 7	8 9 10 next > last >>								
Mute Buzzer	Download Clear									

Figure 13-2 Event Logs



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 disk drives of the head unit, each disk 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. If there are no disk drives in the first four slots, the event logs will keep in memory temporary, and will disappear after system reboots.

The event logs record all system events. Each event has time frame that identifies the type of event that occurred, and has one of the following severities:

- **Error:** A failure occurred that may affect data integrity or system stability. Correct the problem as soon as possible.
- **Warning:** A problem occurred that may affect system stability, but not data integrity. Evaluate the problem and correct it if necessary.
- Information: An operation recorded that may help to debug.

## **13.1.1. Operations on Event Logs**

The options are available on this tab:

#### Mute Buzzer

Click the **Mute Buzzer** button to stop alarm if the system alerts.

#### **Download Event Logs**

Click the **Download** button to save the event log as a file. It will pop up a filter dialog as the following.

Download Event Logs	
<ul> <li>Download all event logs</li> <li>The latest 10% of the event logs</li> <li>The latest 20% of the event logs</li> <li>The last 24 hours event logs</li> <li>The last 7 days event logs</li> <li>The last 31 days event logs</li> </ul>	
	OK Cancel

Figure 13-3 Download Event Logs

Select the options and then click the **OK** button to download event logs.



#### **Clear Event Logs**

Click the **Clear** button to clear all event logs.



Figure 13-4 Clear Event Logs

Select the options and then click the **OK** button to clear 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.

# **13.2. Monitoring Enclosures**

The **Enclosures** function submenu provides **Hardware Monitoring** and **SES** tabs to show and monitor enclosure information.



## 13.2.1. Hardware Monitoring

Select the **Hardware Monitoring** function tab in the **Enclosures** function submenu shows the information of current voltages, temperatures, status of power supply's, and fan modules.

# **C**SAN

#### Enclosure ID: 0 (Head Unit: XS5216)

Controller 1

Туре	ltem	Value	Low Critical	Low Warning	High Warning	High Critical	Status
Voltage	+3.3V	+3.29 V	+3.04 V	+3.14 V	+3.47 V	+3.56 V	Good
Voltage	Standby +3.3V	+3.31 V	+3.04 V	+3.14 V	+3.47 V	+3.56 V	Good
Voltage	CPU 10GbE MAC	+1.05 V	+0.98 V	+1.02 V	+1.07 V	+1.12 V	Good
Voltage	CPU South Complex	+1.00 V	+0.90 V	+0.95 V	+1.05 V	+1.10 V	Good
Voltage	CPU KR/KX PHY	+1.29 V	+1.23 V	+1.24 V	+1.35 V	+1.37 V	Good
Voltage	SAS Expander	+0.89 V	+0.81 V	+0.85 V	+0.95 V	+0.99 V	Good
Voltage	SAS IOC	+0.95 V	+0.87 V	+0.92 V	+1.03 V	+1.08 V	Good
Voltage	Battery	+3.16 V	+2.00 V	+2.30 V	+3.47 V	+3.56 V	Good
Voltage	+1.2V	+1.25 V	+1.08 V	+1.13 V	+1.28 V	+1.32 V	Good
Voltage	+0.82V	+0.82 V	+0.73 V	+0.77 V	+0.86 V	+0.90 V	Good
Voltage	VCore	+1.80 V	+1.40 V	+1.45 V	+1.97 V	+2.00 V	Good
Temperature	CPU	60.0°C / 140.0°F	0.0°C / 32.0°F	5.0°C / 41.0°F	82.0°C / 179.6°F	95.0°C / 203.0°F	Good
Temperature	SLOT1	55.1°C / 131.2°F	-20.0°C / -4.0°F	0.0°C / 32.0°F	80.0°C / 176.0°F	85.0°C / 185.0°F	Good
Temperature	SAS Expander	71.9°C / 161.4°F	0.0°C / 32.0°F	5.0°C / 41.0°F	90.0°C / 194.0°F	95.0°C / 203.0°F	Good

Controller 2

Туре	ltem	Value	Low Critical	Low Warning	High Warning	High Critical	Status
Voltage	+3.3V	+3.28 V	+3.04 V	+3.14 V	+3.47 V	+3.56 V	Good
Voltage	Standby +3.3V	+3.34 V	+3.04 V	+3.14 V	+3.47 V	+3.56 V	Good
Voltage	CPU 10GbE MAC	+1.05 V	+0.98 V	+1.02 V	+1.07 V	+1.12 V	Good
Voltage	CPU South Complex	+1.00 V	+0.90 V	+0.95 V	+1.05 V	+1.10 V	Good
Voltage	CPU KR/KX PHY	+1.28 V	+1.23 V	+1.24 V	+1.35 V	+1.37 V	Good
Voltage	SAS Expander	+0.89 V	+0.81 V	+0.85 V	+0.95 V	+0.99 V	Good
Voltage	SAS IOC	+0.95 V	+0.87 V	+0.92 V	+1.03 V	+1.08 V	Good
Voltage	Battery	+2.91 V	+2.00 V	+2.30 V	+3.47 V	+3.56 V	Good
Voltage	+1.2V	+1.25 V	+1.08 V	+1.13 V	+1.28 V	+1.32 V	Good
Voltage	+0.82V	+0.81 V	+0.73 V	+0.77 V	+0.86 V	+0.90 V	Good
Voltage	VCore	+1.79 V	+1.40 V	+1.45 V	+1.97 V	+2.00 V	Good
Temperature	CPU	62.0°C / 143.6°F	0.0°C / 32.0°F	5.0°C / 41.0°F	82.0°C / 179.6°F	95.0°C / 203.0°F	Good
Temperature	SLOT1	51.1°C / 124.0°F	-20.0°C / -4.0°F	0.0°C / 32.0°F	80.0°C / 176.0°F	85.0°C / 185.0°F	Good
Temperature	SAS Expander	67.5°C / 153.5°F	0.0°C / 32.0°F	5.0°C / 41.0°F	90.0°C / 194.0°F	95.0°C / 203.0°F	Good

#### Backplane

Туре	ltem	Value	Low Critical	Low Warning	High Warning	High Critical	Status
Voltage	+5V	+5.03 V	+4.50 V	+4.60 V	+5.40 V	+5.50 V	Good
Voltage	PSU +12V	+12.21 V	+10.80 V	+11.04 V	+12.96 V	+13.20 V	Good
Voltage	+3.3V	+3.32 V	+2.97 V	+3.04 V	+3.56 V	+3.63 V	Good
Voltage	Standby +3.3V	+3.33 V	+2.97 V	+3.04 V	+3.56 V	+3.63 V	Good
Temperature	Location Left	32.3°C / 90.1°F	-20.0°C / -4.0°F	0.0°C / 32.0°F	55.0°C / 131.0°F	70.0°C / 158.0°F	Good
Temperature	Location Middle	34.8°C / 94.6°F	-20.0°C / -4.0°F	0.0°C / 32.0°F	55.0°C / 131.0°F	70.0°C / 158.0°F	Good
Temperature	Location Right	34.5°C / 94.1°F	-20.0°C / -4.0°F	0.0°C / 32.0°F	55.0°C / 131.0°F	70.0°C / 158.0°F	Good

#### System Components

Туре	Item	Value	Low Critical	Low Warning	High Warning	High Critical	Status
Power Supply	PSU1	N/A					Good
Power Supply	PSU2	N/A					Good
Fan Module	FAN1	7458 RPM					Good
Fan Module	FAN2	7377 RPM					Good
Fan Module	FAN3	7377 RPM					Good
Fan Module	FAN4	7417 RPM					Good

Figure 13-6 Hardware Monitoring



#### **Monitoring Notifications**

The status of the voltage and temperature are Good if their values are between **Low Warning** and **High Warning**. If the value is lower than **Low Warning** or higher than **High Warning**, the system will send a warning event log. If it is lower than **Low Critical** or higher than **High Critical**, an error event log will be sent.



#### TIP:

For better protection and avoiding a single short period of abnormal voltage or temperature, its recommend to enable **Auto Shutdown** setting which could trigger an automatic shutdown. This is done using several sensors placed on key systems that the system checks every 30 seconds for present voltages or temperatures. The following items are trigger conditions.

- The value of voltage or temperature is lower than **Low Critical** or higher than **High Critical**.
- When one of these sensors reports above the threshold for three contiguous minutes, the system will be shutdown automatically.

For more information about auto shutdown, please refer to the chapter 6.3.1, <u>Boot Management Settings</u> section in the System Settings chapter.

#### Fan Module Mechanism

Fan speed will adjust automatically according to system thermal and the status of power and fan. For more information, please refer to the chapter 2.6, Fan Module and the chapter 6.3, Removing / Installing the Fan Module in the <u>XCubeSAN Hardware Manual</u>.

### 13.2.2. Configuring SES

SES (SCSI Enclosure Services) is an enclosure management standard. The host can communicate with the enclosure using a LUN and a specialized set of SCSI commands to monitor hardware characteristics. Select **SES** function tab in **Enclosure** function submenu to enable or disable the management of SES. Enable SES will map an iSCSI LUN or a FC LUN.



#### **Enable SES**

Here's an example of enabling SES.

1. Select **SES** function tab in **Enclosure** function submenu, click the **Enable SES** button.

Enable SES			
Allowed Hosts:	*		
Target:	0	Ψ.	

Figure 13-7 Enable SES

- 2. Select the **Protocol** as iSCSI.
- 3. Enter the Allowed Hosts with semicolons (;) or fill-in wildcard (\*) for access by all hosts.
- 4. Select a **Target** from the drop-down list.
- 5. Click the **OK** button to enable SES.

SCSI Enclosure Services SES (SCSI Enclosure Services) is an enclosure management standard					
Allowed Hosts	Target	LUN			
*	0	0			
Disable SES			a		

Figure 13-8 SES Status

#### **Disable SES**

Click the **Disable** button to disable SES.

#### SES Client Tool

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

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



# 13.3. Performance Monitoring

The **Performance** function submenu provides **Disk**, **iSCSI**, and **Fibre Channel** tabs to monitor performance.

		Disks	Volumes	iSCSI	Fibre Channel
	IONITORING	3			
_	Log Center				
	Enclosures				
	Performance				
Figur	e 13-9	Performanc	e Functio	n Subr	nenu

#### rigure ro y i chonnance runction oubmen

## 13.3.1. Disk Performance Monitoring

Select the **Disks** function tab in the **Performance** function submenu to display the throughput and latency of the disk drives. Check the slots which you want to monitor.



#### CAUTION:

Enabling performance monitoring will reduce I/O performance. Please use with caution.



Figure 13-10 Disk Performance Monitoring

### 13.3.2. Volume Performance Monitoring

Select the **Volume** function tab in the **Performance** function submenu to display throughput, IOPS, and latency of volumes. Each time you can monitor 10 volumes. Note that enabling performance monitoring may impact I/O performance. Please click the **Select Volumes** button to select the volumes for performance monitoring.



#### Select Volumes

Please check the volumes to enable performance monitoring. The maximum quantity of selected volumes is 10. Note that enabling performance monitoring may impact I/O performance.

		_	_
110			-
			_
		_	_

	Name	Status	Health	Capacity	Pool
	Vol-1	Online	Optimal	100.00 GB	Pool-1
	Vol-2	Online	Optimal	100.00 GB	Pool-1
	Vol-3	Online	Optimal	100.00 GB	Pool-1

1			
E.			
1			
1.1			

Figure 13-11 Select Volumes to Monitor

Please check the volumes to enable performance monitoring.



Figure 13-12 Volume Performance Monitoring

# **OSAN**

# 13.3.3. iSCSI Port Performance Monitoring

Select the **iSCSI** function tab in the **Performance** function submenu to display TX (Transmission) and RX (Reception) of the iSCSI ports. Check the interfaces which you want to monitor.



Figure 13-13 iSCSI Performance Monitoring

# 13.3.4. Fibre Channel Port Monitoring

Select the **Fibre Channel** function tab in the **Performance** function submenu display TX (Transmission) and RX (Reception) of the fibre channels. Check the interfaces which you want to monitor.



# 14. SED and ISE Support

With data security issues at the time, the company places a high priority on ensuring that sensitive data is protected from unauthorized access. Whether it is due to internal policies or external compliance, access to data remains a matter of high importance for all organizations. These organizations will seek out storage manufacturers that provide a stored data protection method, SED (Self-Encrypting Drive), that has both authentication and encryption features.

In addition, ISE (Instant Secure Erase) drive is designed to protect data on hard disk drives by instantly resetting the drive back to factory settings and changing the encryption key so that any data remaining on the drive is cryptographically erased. This means all data on the drive is permanently and instantly unreadable, as needed.



#### **INFORMATION:**

SED (Self-Encryption Drive) and ISE (Instant Secure Erase) drive support is available in SANOS firmware 1.3.0.

# 14.1. Overview

When disk drives are retired and moved outside from the data center into someone else's hands, the data on those drives is put at significant risk. IT administrators routinely retire drives for a variety of reasons, including:

- Returning drives for warranty, repair, maintenance, or expired lease agreements
- Removal and disposal of disk drives
- Repurposing drives to another storage

Through the study found that almost all drives eventually leave the enterprise or data center, but the corporate data resides on such drives, and when most leave the data center, the data they contain is still readable. Even data that has been striped across many drives in a RAID protection is vulnerable to data theft, because just a typical single stripe in today's high-capacity arrays is large enough to expose the sensitive and secured data.

# **OSAN**

### **Drive Control Challenges and Disposal Costs**

In an effort to avoid data breaches, corporations have tried many ways to erase the data on retired drives before they leave the houses and potentially fall into the bad guy. Current retirement practices are all expensive and time-consuming, such as:

- Overwriting drive data
- Degaussing or physically shredding
- Hire professional disposal services

These designed to make data unreadable rely on significant human involvement in the process, and are thus subject to both technical and human failure.

### The Solution

Every day, thousands of disk drives leave data centers as old systems are retired. But what if all those disk drives had been automatically and transparently encrypting that data, enabling it to be instantly and securely erased? SED comprehensively resolve these issues, making encryption for drive retirement both easy and affordable.

SED has build-in an encryption controller and an encryption key on the disk drive itself. It can provide instant secure erase (cryptographic erase or making the data no longer readable), and to enable auto-locking to secure active data if a drive is misplaced or stolen from a system while in use.

While ISE provides instant secure erase only. When it's time to retire or repurpose the drive, the owner sends a command to the drive to perform a cryptographic erase. Cryptographic erase simply replaces the encryption key inside the encrypted drive, making it impossible to ever decrypt the data encrypted with the deleted key.

### Benefits

SED & ISE reduce IT operating expenses by freeing IT from both drive control headaches and disposal costs. By using SED & ISE, they are without hindering IT efficiency. Furthermore, SED & ISE simplify decommissioning and preserve hardware value for returns and repurposing by:

- Securing warranty and expired lease returns
- Eliminating the need to overwrite or destroy the drive
- Enabling drives to be repurposed securely

In addition, the drive owner may choose to employ the SED in the auto-lock mode to help secure active data against theft. Utilizing the SED in auto-lock mode simply requires securing the drive during its normal use with an authentication key. When secured in this



manner, the drive's data encryption key is locked whenever the drive is powered down. In other words, the moment the SED is switched off or unplugged, it automatically locks down the drive's data.

When the SED is then powered back on, the SED requires authentication before being able to unlock its encryption key and read any data on the drive, thus protecting against misplacement and insider or external theft.

# 14.2. Theory of Operation

SED has two functions. There are authentication which is operated by AK (Authentication Key) and encryption data which is operated by DEK (Data Encryption Key). ISE drive has encryption data only by DEK but no authentication.

## 14.2.1. SED Operation Process

An AK is generated by a user entered password. After enabling authentication key successfully, recommend to export the key file to an external media (e.g.: external disk drive, USB drive, etc.) and store it in a safe location. You must be able to use the authentication key file to recover in case of an unforeseen event.



#### **CAUTION:**

Recommend backup the key, or you risk losing all data on the SEDs.

A new clean SED is not locked; it has to be written an AK into the SED first. It's called initiate SED. The following describes the steps that occur during the authentication process of a secured drive.

# **OSAN**



Figure 14-1 SED Operation Process

### Authentication

The storage system gets the AK from user entered and sends it to the correct locked drive. The drive hashes the AK and compares the result with the hash of the AK that's stored in a secure area of the disk. If the two hashed AK values do not match, the authentication



process ends, and the drive will not permit reading data from the disk. The drive remains locked.

#### Decrypt the DEK

If the two hashes match, the drive is then unlocked, and the drive uses the AK it received from the storage system to decrypt the DEK (which was previously encrypted with the AK) that's stored in a secure area of the disk. Once the authentication process is successfully completed, the drive is unlocked until the next time it is powered down. Note that this authentication process only occurs when the drive is first powered on. It does not repeat with each I/O.

#### The DEK Encrypts and Decrypts the Data

The DEK is then used to encrypt data to be written to the disk and to decrypt data that's being read from the disk. The drive now works in standard fashion during data transfers, with encryption and decryption transparently occurring in the background.

### 14.2.2. ISE Technology

Each ISE drive (SED as well) randomly generates an encryption key in the factory that is embedded on the drive. The ISE automatically performs full disk encryption; when a write is performed; clear text enters the drive and is first encrypted (using the DEK embedded within the drive) before being written to the disk. When a read is performed, the encrypted data on the disk is decrypted before leaving the drive. During normal operation an ISE is completely transparent to the system, appearing to be the same as a non-encrypting drive. The selfencrypting is constantly encrypting, encryption cannot be accidentally turned off.





Figure 14-2 ISE Technology

ISE technology greatly simplifies repurposing of the drive and disposal. An owner wishing to repurpose a drive simply performs a key erase to replace the encryption key. The drive deletes the encryption key and replaces it with a new encryption key generated randomly within the drive. After key erase, any data that had been written to the disk is unreadable; data that was encrypted with the previous key is unintelligible when decrypted with the new encryption key. The drive is left as it was delivered from the factory.

#### **Instant Erase Limitation**

If ISEs are free and not be used as any pool member, they can be performed instant erase. The same limitation as SEDs, however SEDs can be erased by the AK is enabled. Another case is that the unknown SED is put in lock mode, the way to erase it is to perform erase SED by PSID which is a unique number in each drive, printed on the disk label, and visible to anyone with physical access to the SED. The owner would simply perform a secure erase to replace the encryption key.





#### **INFORMATION:**

SEDs or ISE drives can be erased only if their usage status is free.

# 14.3. Configure Authentication Key

This section will describe the operations of configuring the AK.





## 14.3.1. Operations on Authentication Key

The options are available in this tab.

#### **Enable Authentication Key**

Before using SED, you have to enable an AK. Note that all SEDs in the system use this AK. Here is an example of enabling an AK.

1. Select the **Authentication Key** function tab in the **Disk Encryption** function submenu.

Disabled

Figure 14-4 Authentication Key is Disabled

2. Click the **Enable Authentication Key** button to enable.

# **CSAN**

Enable Authentication Key							
Authentication Key	Authentication Key						
The authentication key w Drive) in the system.	The authentication key will be generated based on the password. It will be used to secure each SED (Self-Encrypting Drive) in the system.						
Password :	•••••	0					
Confirm Password :	•••••						
Password Hint :	XS5216-D40000	0					
Auto Unlock							
Enable Auto Unlock							
Check to enable auto manually unlock the S	Check to enable auto unlock process of the installed SEDs when the system is powered on, or you will have to manually unlock the SEDs each time when the system is powered on.						
After enabling authentication key successfully, please click the Export Authentication Key button to export the authentication key file to an external media (e.g.: external disk drive, USB drive, etc.) and store it in a safe location. You must be able to use the authentication key file to recover in case of an unforeseen event. Recommend to backup the key, or you risk losing all data on the SEDs.							
And then click the Initiate	SEDs button in SEDs tab to set	t the authentication key to the SEDs in th	e system.				
			OK Cancel				

Figure 14-5 Enable Authentication Key

- 3. Enter a **Password** for generating the AK. The length of the password is between 4 to 12 characters. Valid characters are [A~Z | a~z | 0~9 | ~!@#\$%^&\*\_-+=`|\(){}[:;"'<>,.?/]. And enter it again at **Confirm Password**.
- Enter a Password Hint. It is the AK hint for recognizing the system. The default value is system name and can be changed. The maximum length of the password hint is 32 characters. Valid characters are [A~Z | a~z | 0~9 | \_- ].
- 5. Check the **Enable Auto Unlock** option will enable auto unlock process of the installed SEDs when the system is powered on, or you will have to manually unlock the SEDs each time when the system is powered on. The default value is enabled.
- 6. Click the **OK** button to enable.


Authentication Key			
Authentication Key Status :	Enabled		
Total Quantity of SED :	4		
Quantity of Enabled SED :	0		
Quantity of Locked SED :	0		
Quantity of Disabled SED :	4		
Quantity of Password Locke	ed SED : 0		
Quantity of Unknown SED :	0		
Quantity of SED Pool :	0		
			1
Export Authentication Key	Change Authentication Key	Disable Authentication Key	ļ
Auto Unlock			
Enable Auto Unlock			
Check to enable auto un manually unlock the SEE	lock process of the installed S Os each time when the system	EDs when the system is pow is powered on.	ered on, or you will have to
Apply			



After the AK is enabled fully, there are SED summary displayed in the page. In addition, **Auto Unlock** option can also be changed here. You can uncheck the **Enable Auto Unlock** option and then click the **Apply** button to take effect.

#### **Export Authentication Key**

After enabling the AK successfully, please click the **Export Authentication Key** button to export the AK file to an external media (e.g.: external disk drive, USB drive, etc.) and store it in a safe location. You must be able to use the AK file to recover in case of an unforeseen event.



CAUTION:

Recommend backup the key, or you risk losing all data on the SEDs.

## **CSAN**

Export Authenti	cation Key
Export File :	Authentication_Key_XS5216-D40000_2017xxxx-xxxxxx
Export the authors location.	entication key file to an external media (e.g.: external disk drive, USB drive, etc.) and store it in a safe
You must be ab key, or you risk	le to use the authentication key file to recover in case of an unforeseen event. Recommend to backup the losing all data on the SEDs.
	OK Cancel

Figure 14-7 Export Authentication Key

- 1. Enter an **Export File** name to export the AK file. The default vale is the password hint plus date and time.
- 2. Click the **OK** button to export.

#### **Change Authentication Key**

Click the **Change Authentication Key** button to change the AK. Before changing the AK, please stop all I/O of the encryption pools within the SEDs. The new AK will be regenerated based on the new password and set the new authentication key to all enabled SEDs in the system. If the I/O are still running, it may risk losing data during changing the AK. Here is an example of changing the AK.

1. Click the **Change Authentication Key** button to change.



Change Authentication Key		
Please stop all I/O of the encryptic new password and set the new au risk losing data during changing th	n pools within the SEDs. The n thentication key to all enabled s ie authentication key.	new authentication key will be regenerated based on the SEDs in the system. If the I/O are still running, it may
New Password :	•••••	0
Confirm New Password :	•••••	
Password Hint :	XS5216-D40000	0
After changing authentication key authentication key file to an extern must be able to use the authentica key, or you risk losing all data on t	successfully, please click the E al media (e.g.: external disk dri ition key file to recover in case he SEDs.	xport Authentication Key button to export the ive, USB drive, etc.) and store it in a safe location. You of an unforeseen event. Recommend to backup the
		OK

*Figure 14-8 Change Authentication Key* 

- Change the **Password** for generating the AK. The length of the password is between 4 to 12 characters. Valid characters are [A~Z | a~z | 0~9 | ~!@#\$%^&\*\_-+=`|\(){{[]:;"'<>,.?/]. And enter it again at **Confirm Password**.
- 3. Change the **Password Hint** if necessary. The maximum length of the password hint is 32 characters. Valid characters are [A~Z | a~z | 0~9 | \_- ].
- 4. Click the **OK** button to change. If there are enabled SEDs in the system, the system will change them one by one and display the results.

#### **Disable Authentication Key**

If you no longer use disk encryption and there are no encryption pools within the SEDs. The AK can be disabled. Click the **Disable Authentication Key** button to disable it.



Disable Authentication Key
Are you sure that you would like to disable the authentication key? After disalbing the authentication key, you will lose all data on the SEDs. Click the OK button to disable.
OK Cancel

Figure 14-9 Disable Authentication Key

Click the **OK** button to confirm.

TIP:



The **Disable Authentication Key** function can be operated when there is no encryption pools within the SEDs and the SED status of all SEDs is disabled or unknown.

## 14.4. Configure SEDs

The **SEDs** function tab in the **Disk Encryption** function submenu is only visible when the AK is enabled. Select the **SEDs** function tab to display the status of SEDs, initiate SEDs, unlock SEDs, or erase SEDs.



	Authentication Key	SEDs
SYSTEM SETTINGS	;	
General Settings		
Management Port		
Power Settings		
Notifications		
Maintenance		
Disk Encryption		

Figure 14-10 Disk Encryption Function Submenu

## 14.4.1. List SEDs

The drop-down lists at the top enable you to select the enclosure from head unit (SAN system) or expansion units (expansion enclosures).



#### **INFORMATION:**

Enclosure format: Enclosure ID ([Head Unit | Expansion Unit]: Model Name). For example: 0 (Head Unit: XS5216), 1 (Expansion Unit: XD5316)

Enclosure	ID: 0 (	(Head Unit:	XS3216)			<b>T</b>				
	Slot	Status	Health	SED Status	Capacity	Disk Type	Usage	Pool Name	Manufacturer	Model
▼	1	Online	Good	Disabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
▼	2	Online	Good	Disabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
▼	3	Online	Good	Disabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
▼	4	Online	Good	Disabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
Initiate S	BEDs	Unlock SED:	Erase :	SEDs		·			·	· · · · · · · · · · · · · · · · · · ·

Figure 14-11 List SEDs

This table shows the column descriptions.

Column Name	Description
Slot	The position of the disk drive.
Status	The status of the disk drive:
	Online: The disk drive is online.
	Rebuilding: The disk drive is being rebuilt.
	• Transitioning: The disk drive is being migrated or is replaced by

Table 14-1 Disk Column Descriptions



	another disk when rebuilding occurs.
	• Scrubbing: The disk drive is being scrubbed.
	• Check Done: The disk drive has been checked the disk health.
	• Copying Back: The disk drive is being copied back.
Health	The health of the disk drive:
	Good: The disk drive is good.
	• Failed: The disk drive has failed.
	Error Alert: S.M.A.R.T. error alerts.
	• Read Errors: The disk drive has unrecoverable read errors.
SED Status	The status of the SED:
	Enabled: The SED is enabled.
	• Locked: The SED is locked. It must be unlocked by the correct AK
	before it can be used.
	• Disabled: The SED is disabled. It must be initiated before it can be
	used.
	Password Locked: The SED is locked by entering the incorrect
	password too many times.
	Unknown: The SED is unknown.
	Initiating: The SED is being initiated.
	Unlocking: The SED is being unlocked.
	• Erasing: The SED is being erased.
	Changing Key: The SED is being changed the key.
Capacity	The capacity of the disk drive.
Disk Type	The type of the disk drive:
	• [SAS HDD   NL-SAS HDD   SAS SSD   SATA SSD]
	• [12.0Gb/s 6.0Gb/s 3.0Gb/s 1.5Gb/s]
Usage	The usage of the disk drive:
	Free: This disk drive is free for use.
	• RAID: This disk drive has been set to a pool.
	• SSD Cache: This SSD has been set to an SSD cache pool.
	• Dedicated Spare: This disk drive has been set as dedicated spare
	of a pool.
	Local Spare: This disk drive has been set as local spare of the     enclosure
	Global Spare: This disk drive has been set as global spare of
	whole system
	SSD Spare: This SSD has been set as dedicated SSD spare of an
	SSD cache pool



Pool Name	Which pool the disk drive belongs to.
Manufacturer	The manufacturer of the disk drive.
Model	The model name of the disk drive.

## 14.4.2. Operations on SEDs

The options are available in this tab:

#### Initiate SEDs

Click the **Initiate SEDs** button to initiate the selected SEDs. And then click the **OK** button to proceed.

Init	ate SEDs						
Sel	ect SEDs						
Ple	ase select SEDs to	o initiate					
	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model
	0	1	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205
	0	2	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205
	0	3	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205
	0	4	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205
							OK Cancel

Figure 14-12 Initiate SEDs

After proceeding, it will pop up a window to display the results.



Initiate SEDs	
Initiato SED Doculte	
initiale SED Results	
	-
Enclosure ID 0, 4	Success
Enclosure ID 0, 2	Success
Enclosure ID 0, 1	Success
Enclosure ID 0, 3.	Success
<i>,</i>	
-	

Figure 14-13 Initiate SED Results

If the results are successful, the SED status will become Enabled.

	Slot	Status	Health	SED Status	Capacity	Disk Type	Usage	Pool Name	Manufacturer	Model
▼	1	Online	Good	Enabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
▼	2	Online	Good	Enabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
▼	3	Online	Good	Enabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
▼	4	Online	Good	Enabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205

Figure 14-14 List SEDs



#### **INFORMATION:**

The **Initiate SEDs** function can be operated when the usage status of SEDs is free and the SED status is **Disabled**.

#### Unlock SEDs

Click the **Unlock SEDs** button to unlock the selected SEDs. Please select a method to unlock the SEDs. And then click the **OK** button to proceed.



Unloc	Unlock SEDs								
Auth	Authentication Key								
Please select a method of authentication key to unlock the SEDs. If the SEDs are roamed from other systems, they will be unlocked with their authentication keys, and then being replaced by the authentication key of the current system.									
۰ ر	Use the Authentication Key of the Current System								
O E	enter an Authenticat	ion Key Password							
P	assword								
0 I	mport an Authentica	ation Key File							
ſ	Choose File No file	chosen							
Select Pleas	et SEDs	be unlocked.							
	Password Hint	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model	
	XS5216-D40000	0	1	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205	
	XS5216-D40000	0	2	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205	
	XS5216-D40000	0	3	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205	
	XS5216-D40000	0	4	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205	
								OK Cancel	



You can select the **Use the Authentication Key of the Current System** to unlock the SEDs. Or if the SEDs are roamed from other systems, they will be unlocked with their AKs, and then being replaced by the AK of the current system. In this case, please select the **Enter an Authentication Key Password** or **Import and Authentication Key File** to unlock the SED.



#### **INFORMATION:**

The **Unlock SEDs** function can be operated when the SED status of SEDs is Locked.

#### Erase SEDs

If there are no encryption pools within the SEDs, these SEDs can be erased. Click the **Erase SEDs** button to erase the selected SEDs. And then click the **OK** button to proceed.



Erase SEDs							
Select SEDs							
Plea	se select SEDs to	o instant (	erase. Note	that this will de	elete all data on the SEE	).	
	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model
	0	1	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205
	0	2	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205
	0	3	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205
	0	4	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205
					·	·	
							OK Cancel

Figure 14-16 Erase SEDs

After proceeding, it will pop up a window to display the results. If the results are successful, the SED status will become Disabled.



#### **INFORMATION:**

The **Erase SEDs** function can be operated when the usage status of SEDs is free.



#### CAUTION:

Erasing the SEDs will change the DEK and delete all data on the SED. The data on SED can never be restored, please exercise caution.

#### Erase SED by PSID

If you don' know where the SED comes from, or the status of the SED is unknown and you don't know its password. The last method is to erase the SED by PSID (Physical Secure ID) which is on the label of the disk drive. Click ▼ -> Erase SED by PSID to erase the SED by PSID.



Erase \$	SED by PSID
Please the SE	enter the PSID which is on the label of the disk to erase the SED. Note that this will delete all data on D and it will return to the initial state.
PSID:	AZslxxxxyNNJxxxx4WG3
-	OK Cancel

Figure 14-17 Erase SED by PSID



#### **INFORMATION:**

The **Erase SED by PSID** function can be operated when the usage status of the SED is free.



#### CAUTION:

Erasing the SED by PSID will delete all data on the SED and it will return to the initial state. The data on SED can never be restored, please exercise caution.

## 14.5. Configure SED Pools

This section will describe the operations of configuring an SED pool.







## 14.5.1. Create an SED Pool

Here is an example of creating an SED pool with 3 SEDs configured in RAID 5. At the first time of creating a pool, it contains a disk group and the maximum quantity of disk in a disk group is 64.

1. Select the **Pools** function submenu, click the **Create Pool** button. It will scan available disks first.



#### TIP: It ma

It may take 20  $\sim$  30 seconds to scan disks if your system has more than 200 disk drives. Please wait patiently.

Create Pool	
Create Pool General Disk Selection RAID Configuration Disk Properties Summary	Pool Type         Please select a pool type. <ul> <li>Thick Provisioning</li> <li>Thin Provisioning</li> <li>Auto Tiering (Thin Provisioning Enabled)</li> </ul> Pool Properties         Please enter a pool name and select preferred controller setting.         Pool Name :       Pool-4         Preferred Controller :       Controller 1         The I/O resources will be managed by the preferred controller which you specified.         SED Pool           Ø Enable SED Pool         Enabling SED pool will use the secure SEDs to create a pool. Intermixing SEDs and non-SEDs are not supported in a pool.
	Next Cancel

Figure 14-19 Create an SED Pool Step 1

- 2. Select a Pool Type.
- 3. Enter a **Pool Name** for the pool. The maximum length of the pool name is 16 characters. Valid characters are [A~Z | a~z | 0~9 | -\_<>].



- 4. Select a **Preferred Controller** from the drop-down list. The backend I/O resources in this pool will be processed by the preferred controller which you specified. This option is available when dual controllers are installed.
- 5. Check the **Enable SED Pool** checkbox. Enabling SED pool will use the secure SEDs to create a pool. Intermixing SEDs and non-SEDs are not supported in a pool.
- 6. Click the **Next** button to continue.

General	Selec	t Disks									
Disk Selection	Pleas	e select disks to	add a dis	sk group in a	thick provisior	ning pool. The maximum	quantity of disk ir	n a disk group is 64.			
RAID Configuration	Enclo	sure ID:	0 (Head Unit: XS3216)								
Disk Properties		E-down ID	01-1	L La albia	Oit.	Dish Tara	M	M- J-1			
Summary		Enclosure ID	SIOT	Health		Disk Type	Manufacturer				
	•	0	1	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH0010BSS205			
	•	0	2	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205			
		0	3	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205			
		U	4	Good	92.91 GB	SAS SSD 12.0Gb/s	HGST	HUSMH8010BSS205			

Figure 14-20 Create an SED Pool Step 2

- 7. Please select disks for pool. The maximum quantity of disk in a disk group is 64. Select an **Enclosure ID** from the drop-down list to select disks from expansion enclosures.
- 8. Click the **Next** button to continue.

Create Pool			
General	RAID Configuration		
Disk Selection	Please select a RAID level.		
RAID Configuration	RAID Level :	RAID 0	
Disk Properties	Quantity of NL-SAS Disks :	RAID 0 RAID 1	
Summary		RAID 3	
		NALD 3	
Back			Next Cancel

Figure 14-21 Create an SED Pool Step 3

**OSAN** 

- 9. Select a **RAID Level** from the drop-down list which lists available RAID level only according to the disk selection. And also select a **Quantity of Subgroups** if the combination RAID level is selected.
- 10. Click the **Next** button to continue.



Create Pool											
General	Disk Properties										
Disk Selection	Please configure the disk properties.										
<b>RAID</b> Configuration											
Disk Properties	Enabling disk write cache will improve write I/O performance but risking data loss when power failure.										
Summary	<ul> <li>Enable Disk Read-ahead</li> <li>System will preload data to disk buffer based on previously retrieved data. This feature will efficiently improve the performance of sequential data retrieved.</li> <li>Enable Disk Command Queuing</li> </ul>										
	Send multiple commands to a disk at once to improve performance.										
	Enable Disk Standby The disks will spin down for power saving when they are idle for a period of time according to the setting.										
	Disk Standby : 30 seconds 🔻										
	Enable High Latency Disk Warning The system will send event logs if there is a high latency disk in the disk group.										
Back	Next Cancel										

Figure 14-22 Create an SED Pool Step 4

11. Disk properties can also be configured optionally in this step:

- **Enable Disk Write Cache**: Check to enable the write cache option of disks. Enabling disk write cache will improve write I/O performance but have a risk of losing data when power failure.
- **Enable Disk Read-ahead**: Check to enable the read-ahead function of disks. System will preload data to disk buffer based on previously retrieved data. This feature will efficiently improve the performance of sequential data retrieved.
- **Enable Disk Command Queuing**: Check to enable the command queue function of disks. Send multiple commands to a disk at once to improve performance.
- **Enable Disk Standby**: Check to enable the auto spin down function of disks. The disks will be spun down for power saving when they are idle for the period of time specified.
- **Enable High Latency Disk Warning**: Check to enable the high latency disk warning function in a disk group. When a disk drive is abnormal with high latency, the system



will send event logs to notify IT administrators in advance to avoid affecting overall performance.

12. Click the Next button to continue.

General Pool Properties	
r our roperues	
Disk Selection       Pool Type :         RAID Configuration       Pool Name :         Disk Properties       Preferred Controller :         Summary       RAID Configuration         RAID Level :       Quantity of SAS Disks         Disk Properties       Disk Write Cache :         Disk Command Queu       Disk Standby :         High Latency Disk Water       High Latency Disk Water	Thick Provisioning Pool-4 Controller 1 RAID 5 3 Enabled Enabled Disabled ning : Disabled
Back	Finish Cancel

Figure 14-23 Create an SED Pool Step 5

13. After confirmation of info on the summary page, click the **Finish** button to create a pool.

	Pool Name	Status	Health	Total	Free	Available	Thin Provisioning	Auto Tiering	Encryption	Volumes	Current Controller
▼	Pool-4	Online	Good	185.82 GB	185.82 GB	185.82 GB	Disabled	Disabled	Enabled	0	Controller 1
											-
Create F	2001										

Figure 14-24 An SED Pool is Created



14. An SED pool has been created. If necessary, click the **Create Pool** button again to create others.

## 14.5.2. List SED Pools

Click a pool; it will display the related disk groups. Similarly, click a disk group; it will display the related disk drives. The pool properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific pool.

	Pool N	ame	Status	Health	Total	Free		Available	Thi	in Provisio	oning	Auto Tiering	Encryptic	on Volur	mes	Current Controller
•	Pool-4		Online	Good	185.82	GB 185.8	82 GB	185.82 G	B Dis	abled		Disabled	Enabled	•		Controller 1
Disk Gr	Disk Groups															
	No.	Status	Healt	h Total	F	Free	RAID	Disks	Used	RAID 2	2.0 Spare					
V		Online	Good	185.0	0 GB 1	185.00 GB	RAID 5									
Disks													_			
Enclosu	re ID	Slot	Status	Health	Capac	city Disk	к Туре		Manufac	cturer	Model					
0		1	Online	Good	92.91	GB SAS	SSD 12.	0Gb/s	HGST		HUSMH8	010BSS205				
0		2	Online	Good	92.91	GB SAS	SSD 12.	0Gb/s	HGST		HUSMH8	010BSS205				
0		3	Online	Good	92.91	GB SAS	SSD 12.	0Gb/s	HGST		HUSMH8	010BSS205				
Create F	Pool															

Figure 14-25 List SED Pools

This table shows the column descriptions.

Column Name	Description
Pool Name	The pool name.
Status	The status of the pool:
	Online: The pool is online.
	Offline: The pool is offline.
	Rebuilding: The pool is being rebuilt.
	Migrating: The pool is being migrated.
	Relocating: The pool is being relocated.
	• EE Rebuilding: The pool is being RAID EE rebuilt.
Health	The health of the pool:
	Good: The pool is good.
	• Failed: The pool has failed.

Table 14-2Pool Column Descriptions



	Degraded: The pool is unhealthy and incomplete. The cause may
	be a disk loss or failure.
Total	Total capacity of the pool.
Free	Free capacity of the pool.
Available	Available capacity of the pool.
Thin	The status of Thin provisioning:
Provisioning	Disabled: The pool is thick provisioned.
	Enabled: The pool is thin provisioned.
Auto Tiering	The status of Auto Tiering:
	Disabled: The pool is auto tiering disabled.
	Enabled: The pool is auto tiering enabled.
	Not Supported: The pool contains the disk groups with mixed disk
	type.
Encryption	The Data Secure Mode:
	Disabled: The pool is not encrypted.
	Enabled: The pool is encrypted.
Volumes	The quantity of volumes in the pool.
Current	The current running controller of the pool.
Controller	
(This option is	
only visible when	
dual controllers	
are installed.)	

#### Table 14-3Disk Group Column Descriptions

Column Name	Description
No	The number of disk group.
Status	The status of the disk group:
	Online: The disk group is online.
	Offline: The disk group is offline.
	Rebuilding: The disk group is being rebuilt.
	• Migrating: The disk group is being migrated.
	Relocating: The disk group is being relocated.
	• EE Rebuilding: The disk group is being RAID EE rebuilt.
Health	The health of the disk group:
	Good: The disk group is good.
	• Failed: The disk group has failed.



	• Degraded: The disk group is not healthy and not completed. The
	reason could be lack of disk(s) or have failed disk.
Total	Total capacity of the disk group.
Free	Free capacity of the disk group.
RAID	The RAID level of the disk group.
Disks Used	The quantity of disk drives in the disk group.
RAID 2.0 Spare	The quantity of RAID 2.0 spare disk drives in the disk group. Display
	N/A is the RAID level is traditional.

#### Table 14-4Disk Column Descriptions

Column Name	Description					
Enclosure ID	The enclosure ID.					
Slot	The position of the disk drive.					
Status	The status of the disk drive:					
	Online: The disk drive is online.					
	• Missing: The disk drive is missing in the pool.					
	Rebuilding: The disk drive is being rebuilt.					
	• Transitioning: The disk drive is being migrated or is replaced by					
	another disk when rebuilding occurs.					
	Scrubbing: The disk drive is being scrubbed.					
	• Check Done: The disk drive has been checked the disk health.					
	Copying Back: The disk drive is being copied back.					
Health	The health of the disk drive:					
	Good: The disk drive is good.					
	Failed: The disk drive has failed.					
	• Error Alert: S.M.A.R.T. error alerts.					
	Read Errors: The disk drive has unrecoverable read errors.					
Capacity	The capacity of the disk drive.					
Disk Type	The type of the disk drive:					
	• [SAS HDD   NL-SAS HDD   SAS SSD   SATA SSD ]					
	• [12.0Gb/s   6.0Gb/s   3.0Gb/s   1.5Gb/s ]					
Manufacturer	The manufacturer of the disk drive.					
Model	The model name of the disk drive.					



### 14.5.3. Operations on SED Pools

Most operations are described in the Configuring Storage Pools section. For more information, please refer to the chapter 8.4.3, <u>Operations on Thick Provisioning Pools</u> section. We describe the restrictions about SED pool in the following.

#### Add a Disk Group

Click ▼ -> Add Disk Group to add a disk group. Disks can only choose SEDs. Select SEDs and then click the OK button.

#### Move Disk Group Member Disks

Click ▼ -> Move Disk Group in disk group to move the member SEDs of the disk group to other SEDs. They cannot move to non SED. Select SEDs and then click the OK button.

#### 14.5.4. Rebuild on SED Pools

Rebuilding an SED pool will use SED as spare disk, whether it is from global, local, or dedicated spare.

#### 14.5.5. Create an SSD Cache Pool on SED Pools

Most operations are described in the SSD Cache chapter. For more information, please refer to the chapter 10.3.2, <u>Create an SSD Cache Pool</u> section. We describe the restrictions about creating an SSD cache pool on an SED pool in the following.

#### Create an SSD Cache Pool

Select the **SSD Cache** function submenu; click the **Create SSD Cache Pool** button. It will scan available SSDs with SED only.

#### 14.5.6. Data Backup on Encrypted Volumes

Most operations are described in the Data Backup chapter. For more information, please refer to the chapter 12, <u>Data Backup</u> chapter. We describe the tips about data backup on encrypted volumes in the following.



#### Local Clone on Encrypted Volume

If executing local clone from an encrypted volume to a non-encrypted volume, it will pop up a warning message.

#### **Remote Replication on Encrypted Volume**

If executing remote replication from an encrypted volume, It will pop up a warning message.

## 14.6. Configure ISE Drives

Select the **Disks** function submenu to display the status of the SED and ISE drives.



Figure 14-26 Disks Function Submenu

This section will describe the operations of configuring ISE drives. They can only be operated by instant erased.

### 14.6.1. List ISE Drives

The drop-down lists at the top enable you to select the enclosure from head unit (SAN system) or expansion units (expansion enclosures). The disk properties can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific disk drive.



#### **INFORMATION:**

Enclosure format: Enclosure ID ([Head Unit | Expansion Unit]: Model Name). For example: 0 (Head Unit: XS5216), 1 (Expansion Unit: XD5316)



	Slot	Status	Health	Encryption	SED / ISE Status	Capacity	Disk Type	Usage	Pool Name	Manufacturer	Model
	1	Online	Good	SED	Enabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
	2	Online	Good	SED	Enabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
	3	Online	Good	SED	Enabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
	4	Online	Good	SED	Enabled	92.91 GB	SAS SSD 12.0Gb/s	Free		HGST	HUSMH8010BSS205
	5	Online	Good	ISE	Normal	10.91 TB	NL-SAS HDD 12.0Gb/s	Free		HGST	HUH721212AL5200
	6	Online	Good	ISE	Normal	10.91 TB	NL-SAS HDD 12.0Gb/s	Free		HGST	HUH721212AL5200
	7	Online	Good	ISE	Normal	10.91 TB	NL-SAS HDD 12.0Gb/s	Free		HGST	HUH721212AL5200
٦	8	Online	Good	ISE	Normal	10.91 TB	NL-SAS HDD 12.0Gb/s	Free		HGST	HUH721212AL5200

Disk Health Check View Disk Check Report Instant Erase

Figure 14-27 List SEDs and ISE Drives

This table shows the column descriptions.

Table 14-5 Disk	Column Descriptions
Column Name	Description
Slot	The position of the disk drive.
Status	The status of the disk drive:
	Online: The disk drive is online.
	Rebuilding: The disk drive is being rebuilt.
	• Transitioning: The disk drive is being migrated or is replaced by
	another disk when rebuilding occurs.
	• Scrubbing: The disk drive is being scrubbed.
	• Check Done: The disk drive has been checked the disk health.
	Copying Back: The disk drive is being copied back.
Health	The health of the disk drive:
	Good: The disk drive is good.
	• Failed: The disk drive has failed.
	Error Alert: S.M.A.R.T. error alerts.
	Read Errors: The disk drive has unrecoverable read errors.
Encryption	The data security mode of the disk drive:
	• SED: The disk drive is a Self-Encryping Drive.
	ISE: The disk drive is an Instant Secure Erase drive.
	None: The disk drive does not have encryption function.
SED / ISE Status	The status of the SED:
	Enabled: The SED is enabled.
	• Locked: The SED is locked. It must be unlocked by the correct AK
	before it can be used.
	• Disabled: The SED is disabled. It must be initiated before it can be
	used.



	Password Locked: The SED is locked by entering the incorrect								
	password too many times.								
	Unknown: The SED is unknown.								
	Initiating: The SED is being initiated.								
	Unlocking: The SED is being unlocked.								
	Erasing: The SED is being erased.								
	Changing Key: The SED is being changed the key.								
	The status of the ISE:								
	• Normal: The ISE is normal.								
	• Erasing: The ISE is being erased.								
	Unknown: The ISE is unknown.								
	The status of the Non SED/ISE:								
N/A: The field is not applicable.									
Capacity	The capacity of the disk drive.								
Disk Type	The type of the disk drive:								
	• [SAS HDD   NL-SAS HDD   SAS SSD   SATA SSD ]								
	• [12.0Gb/s 6.0Gb/s 3.0Gb/s 1.5Gb/s]								
Usage	The usage of the disk drive:								
	Free: This disk drive is free for use.								
	RAID: This disk drive has been set to a pool.								
	• SSD Cache: This SSD has been set to an SSD cache pool.								
	<ul> <li>Dedicated Spare: This disk drive has been set as dedicated spare of a pool.</li> </ul>								
	Local Spare: This disk drive has been set as local spare of the								
	enclosure.								
	• Global Spare. This disk drive has been set as global spare of whole system.								
	• SSD Spare: This SSD has been set as dedicated SSD spare of an								
	SSD cache pool.								
Pool Name	Which pool the disk drive belongs to.								
Manufacturer	The manufacturer of the disk drive.								
Model	The model name of the disk drive.								



## 14.6.2. Operations on ISE Drives

Most operations are described in the Working with Disk Drives section. For more information, please refer to the chapter 8.3, <u>Working with Disk Drives</u> section. We describe the operations about an ISE drive in the following.

#### **Instant Erase**

If there are no pools within the ISE drives, these ISE drives can be erased. Click the **Instant Erase** button to erase the selected ISEs. And then click **OK** button to proceed.

Instant Erase										
Select ISE Disk Drives										
Please select ISE disk drives to instant erase. Note that this will delete all data on the ISE disk drives.										
	Enclosure ID	Slot	Health	Capacity	Disk Type	Manufacturer	Model			
	0	5	Good	10.91 TB	NL-SAS HDD 12.0Gb/s	HGST	HUH721212AL5200			
-	0	6	Good	10.91 TB	NL-SAS HDD 12.0Gb/s	HGST	HUH721212AL5200			
	0	7	Good	10.91 TB	NL-SAS HDD 12.0Gb/s	HGST	HUH721212AL5200			
	0	8	Good	10.91 TB	NL-SAS HDD 12.0Gb/s	HGST	HUH721212AL5200			
							OK Cancel			

Figure 14-28 Instant Erase ISE drives

After proceeding, it will pop up a window to display the results.



Figure 14-29 Instant Erase Results





#### INFORMATION:

The **Instant Erase** function can be operated when the usage status of ISE drives is free.



#### CAUTION:

Erasing the ISE drives will change the DEK and delete all data on the ISE drive. The data on ISE drive can never be restored, please exercise caution.



## **15. QoS (Quality of Service)**

This chapter describes an overview and operations of volume QoS (Quality of Service).



**INFORMATION:** The volume QoS is available in SANOS firmware 1.4.0.

## 15.1. Overview

QoS is a term used in the field of packet switched networks to refer to the probability that a network will satisfy a given business contract. In many cases, informally refers to the probability that a packet will pass between two points in the network. QoS has a control mechanism that provides different priorities for different users or different data streams, or ensures that the performance of the data stream reaches a certain level according to the requirements of the application.

QoS features exist in everything from network devices to hypervisors to storage. When multiple workloads share limited resources, QoS helps control how resources are shared and prevents the noisy applications from damaging the performance of all other applications on the same system.

In the early days of the Internet, it didn't realize the needs of QoS application, so the entire Internet operation was like a "best-effort" system. According to the sender and the receiver, many things happen during the packet transmissions from the start point to the end point, and the following problematic results are produced:

- Lost packet: When the packet arrives at a buffer full, it means that the transmission failed. The system will decide to discard part, or discard all packets according to the status of the network, and the application at the receiving end must request retransmission at this time, which may also cause a serious delay in the overall transmission.
- **Latency**: It may take a long time to transfer the packet to the destination because it can be delayed by a long queue. In short, the delay is very difficult to predict.
- **Incorrect transmission sequence**: When a group of related packets are routed through the Internet, different packets may choose different ways, which will result in different



delays for each packet. The order in which the last packet arrives at the destination is inconsistent with the order in which the packet is sent from the sender.

Although some specific forms of network data flow need to define service quality. QoS is developed to set priorities for data flows and set guaranteed limits of effectiveness, throughput, latency, etc. QoS guarantees are important for networks with limited bandwidth, especially for streaming multimedia applications such as VoIP (Voice over Internet Protocol) and IPTV (Internet Protocol Television), as these applications often require a fixed transmission rate and are sensitive to latency.

## 15.1.1. QoS in Storage System

The same situation exists in the storage system. QoS refers to service priority and resource reservation control mechanisms. QoS is the ability to provide different priorities for different volumes to guarantee a certain level of performance for a data stream.

Generally, a single service does not need QoS because it has the whole system resources. But for business-critical applications in multi-tenant, QoS is a key technology to deliver consistent primary storage performance and this predictable performance is also an important indicator.

## 15.1.2. Benefit of QoS

If different applications share the same storage platform, we can predict that the following issues may occur:

- Workloads with I/O conflicts, such as OLTP (Online Transaction Processing) and data warehousing.
- Tiering storage access restrictions, such as development and production applications.
- Peak demand processing for critical applications and maintenance activities.

Although raw storage performance is important, predictable and consistent performance delivery ensures that every application has the required resources to run without interruptions. QoS feature enables the storage system when serving these workloads.

- Prioritize the storage bandwidth and capacity resources.
- Consistently deliver predictable performance across multiple applications.
- Reduce unpredictable I/O patterns.
- Eliminate manual adjustments to adapt to changing workload demands.
- Allow application scale to grow without disrupting the system.



QoS feature makes it easier for users to assign I/O priorities. And it ensures a better service consolidation when serving these workloads.

## 15.1.3. QoS Use Cases

QoS is best for multi-tenant systems running different workloads with unpredictable requirements. Multi-tenant systems allow the flexibility to meet your business needs. Therefore, QoS is particularly effective at the following applications:

- Mission critical database applications: real-time transactional database (Exchange server, SQL server, RDBMS, DB2), OLTP (On-Line Transaction Processing).
- Consolidation a virtualization: virtualized data center, VMware, Hyper-V, Citrix.
- Private cloud computing and big data analytics.

## 15.2. Theory of Operation

Mention the evolution of the storage system, in order to meet different application performance requirements, the storage industry developed SSD cache and auto tiering technologies based on the traditional disk drives. These solutions apply complex algorithms and predictive methods to transfer data to the right media at the right time to improve performance. These approaches are costly and complex, and only apply to some form of certain data distribution, but may not meet the predictable performance requirements of mission-critical applications.

QoS is developed to resolve this difference. Each volume is configured with priority, target response time, or maximum IOPS and maximum throughput values that are strictly enforced within the system. The priority and target response time provides a guarantee for performance, as system resources allow. The maximum IOPS and maximum throughput values limit the allocation of performance and deliver consistent performance to workloads. The QoS feature ensures that multiple applications can run on a single storage platform without affecting each other.

After enabling QoS feature, we provide two options to configure. One is priority and target response time; the other is maximum IOPS and maximum throughput. Describe on the following.





Figure 15-1 Without and With QoS

## 15.2.1. Priority and Target Response Time

Set performance limits for each connected server based on priority. By prioritizing data access and dynamically managing any I/O conflicts, you can guarantee the high performance of high-priority applications while using capacity more efficiently.

To define the QoS volumes two parameters can be set:

- 1. **Priority:** Defines the service level of the volume that represents its priority. The volume priority can be set to high, medium, or low.
- 2. **Target response time:** Define the performance of each volume as the average of the read and write response times for that volume. The volume with high priority can be set the target response time. After setting, the performance of the volume is adjusted based on the defined target response time.

The QoS mechanism shares less I/O resources to the volumes with low priority. Volumes of higher priorities are granted greater processing I/O capabilities and achieve better response times as they approach the target.



#### **INFORMATION:**

The volume which sets to the high priority can be set the target response time.



#### TIP:

When the target response time is set properly and the system resources are sufficient, the latency of the volume will reach the target response time.



The system keeps checking the current value and the target response time. It is performed bandwidth adjustment if the measured volume response time does not match the expected target performance. After achieving the performance goal, QoS will continue to monitor the latency and adjust the resources as necessary. If the performance goal is not met, please view the volume configuration and QoS settings and change the tuning parameters properly.

## 15.2.2. Maximum IOPS and Maximum Throughput

Other than the priority option, the maximum IOPS and/or the maximum throughput can be configured to limit the volume processing I/O capabilities and bandwidth. It limits the maximum resources of the volume to not exceed, and reserved for other volumes.

To define the QoS volumes two options can be chosen:

- 1. Unlimited: Defines the service level of the volume that is no limit.
- 2. **Maximum IOPS and Maximum Throughput:** Define the performance of each volume as the maximum IOPS and/or throughput for that volume. The threshold can be set to two or one of. After setting, the performance of the volume is adjusted based on the defined values.

The QoS mechanism monitors the IOPS and throughput of the volume. It will block the I/O processing when the threshold is reached. Volumes with these settings are predictable and consistent performance delivery.



#### **INFORMATION:**

The maximum IOPS and maximum throughput settings can be set to two or one of.

## 15.3. Configure QoS Settings

This section will describe the operations of enabling QoS. Select the **QoS Settings** function tab in the **Volumes** function submenu to configure QoS the settings.

## **C**SAN

		Volumes	QoS Settings	
STORAGE I	MANAGE	EMENT		
Disks				
Pools				
Volumes				
LUN Mappi	ngs			
SSD Cache	Э			
Figure 15-2	QoS	Settings I	- unction Ta	ab

## 15.3.1. Operations on QoS Settings

The options are available in this tab.

#### **Enable QoS Settings**

Before using QoS, you have to enable the QoS settings.

1. Select the **QoS Settings** function tab in the **Volumes** function submenu.



Figure 15-3 QoS Setting is Disabled

- 2. Check the **Enable QoS** checkbox to enable.
- 3. Select an option of **Priority and Target Response Time** or **Maximum IOPS and Maximum Throughput**.
- 4. Click the **Apply** button to enable.



QoS Settings	
dee orange	
✓ Enable QoS	
Priority and Target Response Time	
Maximum IOPS and Maximum Throughput	
Apply	
Summary	
Total Quantity of Volumes with QoS:	2
Total Quantity of Volumes with High Priority:	0
Total Quantity of Volumes with Middle Priority:	2
Total Quantity of Volumes with Low Priority:	0
Total Quantity of Volumes with Target Response Time:	0
Figure 15-4 QoS Setting with Priority and Target Response	è

After the QoS setting is enabled, the relevant QoS summary is displayed in the page.

#### **Change QoS Settings**

The QoS settings can be changed dynamically.

- 1. Change the option of QoS setting.
- 2. Click the **Apply** button to change.



Figure 15-5 QoS Setting with Maximum IOPS and Maximum Throughput



The same, the relevant QoS summary is displayed in the page.

#### **Disable QoS Settings**

- 1. Uncheck the **Enable QoS** checkbox to disable.
- 2. Click the **Apply** button to disable.

## 15.4. Configure QoS Volumes

The **QoS Volumes** function tab in the **Volumes** function submenu is only visible when the QoS is enabled. Select the **QoS Volumes** function tab to display the status of QoS volumes, or configure the QoS volumes.

	Volumes	QoS Settings	QoS Volumes
STORAGE MANA	GEMENT		
Disks			
Pools			
Volumes			
LUN Mappings			
SSD Cache			
Figure 15-6 Qo	S Volumes	Function Tal	Ь

### 15.4.1. List QoS Volumes

The QoS settings can be configured by clicking the functions button  $\mathbf{\nabla}$  to the left side of the specific volume.

	Volume Name	Status	Health	Capacity	Priority	Current IOPS	Target Response Time	Current Response Time
▼	Vol-1	Online	Optimal	100.00 GB	Middle	0	N/A	0 msec.
▼	Vol-2	Online	Optimal	110.00 GB	Middle	0	N/A	0 msec.

Figure 15-7 List QoS Volumes with Priority and Target Response



	Volume Name	Status	Health	Capacity	Maximum IOPS	Current IOPS	Maximum Throughput	Current Throughput
▼	Vol-1	Online	Optimal	100.00 GB	Unlimited	0	Unlimited	0 KBps
▼	Vol-2	Online	Optimal	110.00 GB	Unlimited	0	Unlimited	0 KBps

Figure 15-8 List QoS Volumes with Maximum IOPS and Maximum Throughput

This table shows the column descriptions.

Column Name	Description						
Volume Name	The volume name.						
Status	The status of the volume:						
	Online: The volume is online.						
	Offline: The volume is offline.						
	• Erasing: The volume is being erased if the Erase Volume Data						
	option is set.						
	Initiating: The volume is being initialized.						
	Rebuilding: The volume is being rebuilt.						
	Migrating: The volume is being migrated.						
	Rollback: The volume is being rolled back.						
	Parity Checking: The volume is being parity check.						
	Relocating: The volume is being relocated.						
	• EE Rebuilding: The volume is being RAID EE rebuilt.						
Health	The health of the volume:						
	• Optimal: the volume is working well and there is no failed disk in						
	the RG.						
	• Failed: the pool disk of the volume has single or multiple failed						
	disks than its RAID level can recover from data loss.						
	Degraded: At least one disk from the pool of the volume has						
	failed or plugged out.						
	• Non-optimal: the volume has experienced recoverable read errors.						
	After passing parity check, the health will become Optimal.						
Capacity	Total capacity of the volume.						

Table 15-1QoS Volume Descriptions

Table 15-2	<b>OoS Volume Descr</b>	iptions with Priorit	v and Target Res	sponse Time
			y ana rargernee	

Column Name	Description			
Priority	The priority of the volume:			
	• High			



	Middle			
	• Low			
Current IOPS	Current IOPS of the volume.			
Target Response	Target response time setting, N/A is not configured.			
Time				
Current	Current response time of the volume.			
Response Time				

 Table 15-3
 QoS Volume Descriptions with Maximum IOPS and Maximum Throughput

Column Name	Description			
Maximum IOPS	The maximum IOPS setting.			
Current IOPS	Current IOPS of the volume.			
Maximum	The maximum throughput setting.			
Throughput				
Current	Current throughput of the volume.			
Throughput				

## 15.4.2. Operations on QoS Volumes

The options are available in this tab.

#### Set Priority and Target Response Time

- 1. If the QoS setting is **Priority and Target Response Time**, select a volume, and then click
  - ▼ -> Set Priority to configure.

# **C**SAN

Set Priority				
The target response time can be set if the priority sets to High.				
Priority:	High 🔻 🚺			
Target Response Time:	30 msec. 🚺			
	OK Close			

Figure 15-9 Set Priority

- Select a Priority from the drop-down list. The default setting is Middle. The Target Response Time can be configured when the Priority is set to High.
- 3. If necessary, check the **Target Response Time** checkbox and enter a number. The number is between 1 and 10,000 milliseconds.
- 4. Click the **OK** button to set.

	Volume Name	Status	Health	Capacity	Priority	Current IOPS	Target Response Time	Current Response Time
▼	Vol-1	Online	Optimal	100.00 GB	High	0	30 msec.	0 msec.
▼	Vol-2	Online	Optimal	110.00 GB	Middle	0	N/A	0 msec.

Figure 15-10 Priority and Target Response Time are Set

#### Set Maximum IOPS and Maximum Throughput

 If the QoS setting is Maximum IOPS and Maximum Throughput, select a volume, and then click ▼ -> Set Maximum IOPS and Maximum Throughput to configure.
Set Maximum IOPS and Maximum Throughput						
The threshold can be set to two or one of.						
Unlimited						
Maximum IOPS: 5000						
Maximum Throughput: 50 MBps 🔻 🚺						
OK Close						

Figure 15-11 Set Maximum IOPS and Maximum Throughput

- 2. Select the **Unlimited** or **Maximum IOPS and Maximum Throughput** radio button.
- 3. If it is set to **Maximum IOPS and Maximum Throughput**, enter numbers for the maximum IOPS and/or the maximum throughput. The threshold can be set to two or one of. The maximum IOPS number is between 100 and 10,000,000. The maximum throughput number is between 50KBps and 100GBps.
- 4. Click the **OK** button to set.

	Volume Name	Status	Health	Capacity	Maximum IOPS	Current IOPS	Maximum Throughput	Current Throughput
▼	Vol-1	Online	Optimal	100.00 GB	5000	0	50 MBps	0 KBps
▼	Vol-2	Online	Optimal	110.00 GB	Unlimited	0	Unlimited	0 KBps

Figure 15-12 Maximum IOPS and Maximum Throughput are set



## 16. Troubleshooting

## 16.1. Fault Isolation Methodology

This section presents the basic methodology used to quickly locate faults within the storage system.

## 16.1.1. Basic Steps

The basic fault isolation steps are listed below:

- Gather fault information, including using system LEDs. Please refer to the chapter 5, Description of LEDs and Buttons in the <u>XCubeSAN Hardware Manual</u> for detail.
- Review event logs. Please refer to the chapter 13.1, <u>Log Center</u> section in the Monitoring chapter.
- Determine where the fault is occurring in the system. If the fault is occurring from hardware, please refer to the chapter 6, Quick Maintenance in the <u>XCubeSAN Hardware</u> <u>Manual</u> for detail.
- If required, isolate the fault to a disk drive, configuration, or system. Please refer to the chapter 15.1.3, <u>Diagnostic Steps</u> section.
- If all troubleshooting steps are inconclusive, please contact support for help.

## 16.1.2. Stopping I/O

When troubleshooting disk drive and connectivity faults, it's necessary to stop I/O to the affected volume data from all hosts and remote systems as a data protection precaution. As an additional data protection precaution, it is helpful to conduct regularly scheduled backups of your data.

## 16.1.3. Diagnostic Steps

The diagnostic steps are listed below:

• If disk drive errors in the event logs are occurring, we suggest replacing a healthy one. For more information, please refer to the chapter 15.2, <u>Rebuild</u> section.



- If the fault is occurring from volume configuration. For example, the pool or volume configuration is deleted by accident. Please refer to the chapter 15.3, <u>Volume</u>
   <u>Restoration</u> section for disaster recovery.
- If the fault is occurring from other hardware components of the system, the faulty component will need to be replaced.

## 16.2. Rebuild

If any single disk drive of the storage pool in protection RAID level (e.g., RAID 1, 3, 5, 6, 0+1, 10, 30, 50, and 60) fails or has been removed, then the status of pool will be changed to degraded mode. At the same time, the system will search the spare disk to execute volume rebuild the degraded pool into complete one.

There are three types of spare disk drive which can be set in function menu **Disks**:

- **Dedicated Spare**: Set a spare disk drive to a dedicated pool.
- **Local Spare**: Set a spare disk drive to the pools which located in the same enclosure. The enclosure is either in head unit or in one of expansion units.
- **Global Spare**: Set a spare disk drive to all pools which located whether in head unit and expansion unit.

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 rebuild.

- 1. When there is no global spare disk or dedicated spare disk in the system, the pool 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 pool is **Online**. Thus, it will not conflict with the online roaming feature.
- 3. In degraded mode, the health of the pool is **Degraded**. When rebuilding, the status of pool and volume disk will display **Rebuilding**, the column **R%** in volume 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 pool or the pool is set to RAID level 0.

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

Operation	Description
RAID 0	Disk striping. No protection for data. Pool fails if any disk drive fails or
	unplugs.
RAID 1	Disk mirroring over 2 disks. RAID 1 allows one disk drive fails or
	unplugging. Need one new disk 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 disk drives failure or unplugging.
RAID 3	Striping with parity on the dedicated disk. RAID 3 allows one disk drive
	failure or unplugging.
RAID 5	Striping with interspersed parity over the member disks. RAID 5 allows
	one disk drive failure or unplugging.
RAID 6	2-dimensional parity protection over the member disks. RAID 6 allows
	two disk drives failure or unplugging. If it needs to rebuild two disk
	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 disk drive failures
	or unplugging, but at the same array.
RAID 10	Striping over the member of RAID 1 volumes. RAID 10 allows two disk
	drive failure or unplugging, but in different arrays.
RAID 30	Striping over the member of RAID 3 volumes. RAID 30 allows two disk
	drive failure or unplugging, but in different arrays.
RAID 50	Striping over the member of RAID 5 volumes. RAID 50 allows two disk
	drive failures or unplugging, but in different arrays.
RAID 60	Striping over the member of RAID 6 volumes. RAID 60 allows four disk
	drive failures or unplugging, every two in different arrays.

Table 16-1 RAID Rebuild



## 16.3. Volume Restoration

The **Volume Restoration** can restore the volume configuration from the volume creation history. It is used for pool corruption 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 an expert before executing this function.

The volume restoration can restore your previous volume configurations when a pool corruption or a mis-delete occurs. Before restoration, please make sure that all the member disks are instal lost data will be recovered. Please contact for support before using this function.

Enclosure ID: 0 (Head Unit: XS5216) •

	Pool Name	RAID	Volume Name	Volume Capacity	Disks Used	Disk Slot	Time	Event Logs
'	Pool-1	RAID 5	Source-Vol-1	10 GB	4	0:1, 0:2, 0:3, 0:4	2017/07/12 13:48:50 CST	The snapshot space has initialized
	Pool-1	RAID 5	Target-Vol-2	11 GB	4	0:1, 0:2, 0:3, 0:4	2017/07/12 13:46:20 CST	The volume is created.
	Pool-1	RAID 5	Target-Vol-2	11 GB	4	0:1, 0:2, 0:3, 0:4	2017/07/12 13:44:06 CST	The volume is created.
	Pool-1	RAID 5	Source-Vol-1	10 GB	4	0:1, 0:2, 0:3, 0:4	2017/07/12 13:43:13 CST	The volume is created.
	Pool-1	RAID 5	Vol-1	100 GB	3	0:9, 0:10, 0:11	2017/07/12 13:23:53 CST	The snapshot space has initialized
	Pool-1	RAID 5	Target-Vol-2	110 GB	3	0:9, 0:10, 0:11	2017/07/12 10:11:59 CST	The volume is created.
	Pool-1	RAID 5	Vol-2	100 GB	5	0:9, 0:10, 0:11, 0:1, 0:2	2017/07/11 17:55:13 CST	The volume is created.
	Pool-1	RAID 5	Vol-1	100 GB	5	0:9, 0:10, 0:11, 0:1, 0:2	2017/07/11 17:55:02 CST	The volume is created.
	Pool-1	RAID 5	Vol-1	150 GB	3	0:9, 0:10, 0:11	2017/07/11 17:12:07 CST	The volume is created.
	Pool-1	RAID 5	Vol-1	150 GB	5	0:9, 0:10, 0:11, 0:1, 0:2	2017/07/11 11:01:53 CST	The volume is expanded.
	Pool-1	RAID 5	Target-Vol-2	110 GB	5	0:9, 0:10, 0:11, 0:1, 0:2	2017/07/11 10:58:28 CST	The volume is created.
	Pool-1	RAID 5	Vol-1	100 GB	5	0:9, 0:10, 0:11, 0:1, 0:2	2017/07/11 10:28:02 CST	The volume is created.

Figure 16-1 Volume Restoration

This table shows the column descriptions.

Column Name	Description
Pool Name	The original pool name.
RAID	The original RAID level.
Volume	The original volume name.
Volume Capacity	The original capacity of the volume.
Disks Used	The original quantity of physical disk in the pool.
Disk Slot	The original physical disk locations.
Time	The last action time of the volume.
Event Logs	The last event of the volume.

Table 16-2 Volume Restoration Column Descriptions



### TIP:

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



#### CAUTION:

Performing 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 assume all risk when attempting data recovery procedures.

## 16.3.1. Configure Volume Restoration

The options are available in this tab:

### **Restore the Volume**

Click ▼ -> **Restore** to restore the deleted volume in the pool. And then click the **OK** button to proceed.

## 17. Support and Other Resources

## 17.1. Getting Technical Support

After installing your device, locate the serial number on the sticker located on the side of the chassis or from the SANOS UI -> **SYSTEM SETTING** -> **Maintenance** -> **System Information** and use it to register your product at <u>https://www.qsan.com/business\_partnership</u>. We recommend registering your product in QSAN partner website for firmware updates, document download, and latest news in eDM. To contact QSAN Support, please use the following information.

- Via the Web: https://www.qsan.com/technical\_support
- Via Telephone: +886-2-77206355 (Service hours: 09:30 - 18:00, Monday - Friday, UTC+8)
- Via Skype Chat, Skype ID: qsan.support (Service hours: 09:30 - 02:00, Monday - Friday, UTC+8, Summer time: 09:30 - 01:00)
- Via Email: <u>support@qsan.com</u>

#### Information to Collect

- Product name, model or version, and serial number
- Operating system name and version
- Firmware version
- Error messages or capture screenshots
- Product-specific reports and logs
- Add-on products or components installed
- Third-party products or components installed

#### Information for Technical Support

The following system information is necessary for technical support. Please refer to following for what and where to get the information of QSAN product.

If the technical support requests you to download the Service Package, please navigate in the SANOS UI -> **SYSTEM SETTING** -> **Maintenance** -> **System Information**, and then click the **Download Service Package** button to download. Then the system will automatically generate a zip file the default download location of your web browser.

#### System

Item	Information
System Name	XS5216-D40000
Model Name	XS5216
System Serial Number	QW316016010021001
System Controller Status	Dual Controller, Active-Active
Master Controller	Controller 1

#### **Controller 1**

Item	Information
Controller Serial Number	50013780080A0440
CPU	Intel(R) Xeon(R) Processor D-1500 4 Cores
Memory	8 GB
Host Card Slot 1	Empty
Host Card Slot 2	Empty
Firmware Version	1.2.0
SAS IOC Firmware Version	07.00.01.00
SAS Expander Firmware Version	1000

#### **Controller 2**

Item	Information
Controller Serial Number	50013780080A0380
CPU	Intel(R) Xeon(R) Processor D-1500 4 Cores
Memory	8 GB
Host Card Slot 1	Empty
Host Card Slot 2	Empty
Firmware Version	1.2.0
SAS IOC Firmware Version	07.00.01.00
SAS Expander Firmware Version	1000

#### Backplane

Item	Information
Backplane Serial Number	001378D40000
Backplane ID	QW316
MCU Version	1.2.0

#### Licenses

Item	Information
SSD Cache	Enabled
Auto Tiering	Enabled

## Download Service Package

Figure 17-1 Download Service Package in the SANOS UI



## 17.2. Online Customer Support

For better customer support, QSAN product includes the console cable for online support. Please follow the procedures below to setup the online help environment for QSAN support team.

The following procedure will help you to setup the serial console via the console cable that is enclosed in the shipping carton. The following image is the appearance of the console cable.



Figure 17-2 Appearance of a Console Cable

## Procedures to Setup the Serial Console

1. Setup the serial cable between the controller and one server/host like in the below image.



Figure 17-3 Connect the Console Cable



2. You must use terminal software such as HyperTerminal or Putty to open the console after the connection is made.

INFORMATION: For more information about terminal software, please refer to HyperTerminal: <u>http://www.hilgraeve.com/hyperterminal/</u> PuTTY: <u>http://www.putty.org/</u>

3. Here we first demonstrate HyperTerminal. 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

🎨 1 - HyperTerminal	
Ele Edit View Call Transfer Help	
	Data bits:     8       Bits per second:     115200       Data bits:     8       Baity:     None       Stop bits:     1       Elow control:     None       Bestore Defaults     0K
Disconnected Auto detect Auto dete	t SCROLL CAPS NUM Capture Print echo



🖳 - HyperTerminal		_ 🗆 🗙
File Edit View Call Tra	ansfer Help	
New Connection		
Open		
Save		+
Save As	— Qsan Technology	1
Page Setup		<b>:</b>
Print	_llation	
(Properties )	iguration	
Evit à lta EA	-guration	
*M*aintenanc *L≈ogout	e	
+ <u>lume_conf</u>	iguration	*
		+



Figure 17-4 The Procedures of Setup Serial Console by HyperTerminal

4. If you are using PuTTY instead, please refer to below

## **OSAN**

tegory:		
- Session	Basic options for ye	our PuTTY session
Logging	Specify the destination you want to connect to	
- Terminal	Serial line	
- Keyboard	Сом1	115200
Bell	Connection turns:	( ] · · · · · · ·
realures Window	C Baw C Telnet C B	login C SSA @ Serial
Appearance		
Behaviour	Load, save or delete a stored	d session
- Translation	Saved Sessions	
- Selection		
L. Colours	Default Settings	Load
Connection		
Data		Save
Proxy		Dalaha
- I einet		Delete
- Filogin		
u⊞- 55H		
Condi	Close window on exit:	C Only on alcone suit
	Aimays Micrel	··· Only on clean exit
About 	n	Open Cancel
About PuIIY Configuratio tegory:	n Options controllin	Open Cancel
About PuTTY Configuratio tegory: Session Logging	n Options controllin	Open Cancel
About PuTTY Configuratio tegory: Session Logging Terminal	n Options controllin Select a serial line	Open Cancel g local serial lines
About PuTTY Configuratio tegory: Session Logging Terminal Keyboard	n Options controllin Select a serial line Serial line to connect to	Open Cancel g local serial lines COM1
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to	Dpen Cancel g local serial lines COM1
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line	Dpen Cancel g local serial lines CDM1
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud)	Dpen Cancel g local serial lines CDM1 115200
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits	Dpen Cancel g local serial lines CDM1 115200 8
About PuTTY Configuratio tegory:	n  Options controllin  Select a serial line  Serial line to connect to  Configure the serial line  Speed (baud) Data bits  Stop bits	Dpen Cancel g local serial lines CDM1 115200 8 1
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits	Open Cancel glocal serial lines COM1 115200 8 1
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity	Dpen Cancel glocal serial lines CDM1 115200 8 1 None
About PuTTY Configuratio tegory:	n  Options controllin  Select a serial line Serial line to connect to  Configure the serial line  Speed (baud) Data bits Stop bits Parity Flow control	Open Cancel g local serial lines COM1 115200 8 1 None ▼ None
About PuTTY Configuratio tegory: Cogging Terminal Keyboard Bell Features Window Appearance Behaviour Translation Selection Colours Connection Data	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity Flow control	Dpen Cancel g local serial lines COM1 115200 8 1 None None None
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity Flow control	Dpen Cancel g local serial lines CDM1 115200 8 1 None None XON/XOFF
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity Flow control	Dpen Cancel glocal serial lines COM1 115200 8 1 None None XDN/XOFF RTS/CTS DS/DTB
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity Flow control	Dpen Cancel g local serial lines COM1 115200 8 1 None None XDN/X0FF RTS/CTS DSR/DTR
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity Flow control	Dpen Cancel g local serial lines COM1 115200 8 1 None None None XDN/XDFF RTS/CTS DSR/DTR
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity Flow control	Dpen Cancel g local serial lines CDM1  115200 8 1 None None XDN/XDFF RTS/CTS DSR/DTR
About PuTTY Configuratio tegory:	n Options controllin Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity Flow control	Open     Cancel       g local serial lines       COM1       115200       8       1       None       None       XON/XOFF       RTS/CTS       DSR/DTR



<ul> <li>Session</li> <li>Logging</li> <li>Terminal</li> <li>Keyboard</li> <li>Bell</li> <li>Features</li> <li>Window</li> <li>Appearance</li> <li>Behaviour</li> <li>Translation</li> <li>Selection</li> <li>Colours</li> <li>Connection</li> <li>Data</li> <li>Proxy</li> <li>Telnet</li> <li>Rlogin</li> <li>SSH</li> <li>Serial</li> </ul>	Options controlling the effects of keys
	Change the sequences sent by:
	The Backspace key C Control-H  © Control-? (127)
	The Home and End keys • Standard
	The Function keys and keypad C ESC[n~ C Linux C Xterm R6 C VT400 • VT100+ C SC0
	Application keypad settings: Initial state of cursor keys: Normal
	Enable extra keyboard features: AltGr acts as Compose key Control-Alt is different from AltGr

Figure 17-5 The Procedures of Setup Serial Console by PuTTY

5. Users should be able to login the controller system via console cable by following the procedures above.

#### Setup the Connection for Online Support

Following is the procedure to setup the connection for online support via TeamViewer:

- 1. Please download the TeamViewer from following hyper link: <u>https://www.teamviewer.com/en/download/</u>
- 2. Install TeamViewer.
- 3. Please provide the ID/password showed on the application to QSAN support team member to join the online support session.

## 17.3. Accessing Product Updates

To download product updates, please visit QSAN website:

https://www.qsan.com/download\_center



## **17.4. Documentation Feedback**

QSAN is committed to providing documentation that meets and exceeds your expectations. To help us improve the documentation, email any errors, suggestions, or comments to <u>docsfeedback@qsan.com</u>.

When submitting your feedback, include the document title, part number, revision, and publication date located on the front cover of the document.



## **Appendix**

## **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.
Disk	The Physical Disk belongs to the member disk of one specific RAID
	group.
Pool	A collection of removable media. One pool consists of a set of
	volumes and owns one RAID level attribute.
Volume	Each pool could be divided into several volumes. The volumes from
	one pool 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).
WebUI	Web User Interface.
WT	Write-Through cache-write policy. A cache 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 cache 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 virtual disks.
SCSI	Small Computer System 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
SCM	Super Capacitor 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	Multipath 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**

ltem	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.

# **OSAN**

## **End-User License Agreement (EULA)**

Please read this document carefully before you use our product or open the package containing our product.

YOU AGREE TO ACCEPT TERMS OF THIS EULA BY USING OUR PRODUCT, OPENING THE PACKAGE CONTAINING OUR PRODUCT OR INSTALLING THE SOFTWARE INTO OUR PRODUCT. IF YOU DO NOT AGREE TO TERMS OF THIS EULA, YOU MAY RETURN THE PRODUCT TO THE RESELLER WHERE YOU PURCHASED IT FOR A REFUND IN ACCORDANCE WITH THE RESELLER'S APPLICABLE RETURN POLICY.

### General

QSAN Technology, Inc. ("QSAN") is willing to grant you ("User") a license of software, firmware and/or other product sold, manufactured or offered by QSAN ("the Product") pursuant to this EULA.

## License Grant

QSAN grants to User a personal, non-exclusive, non-transferable, non-distributable, nonassignable, non-sub-licensable license to install and use the Product pursuant to the terms of this EULA. Any right beyond this EULA will not be granted.

## **Intellectual Property Right**

Intellectual property rights relative to the Product are the property of QSAN or its licensor(s). User will not acquire any intellectual property by this EULA.

## **License Limitations**

User may not, and may not authorize or permit any third party to: (a) use the Product for any purpose other than in connection with the Product or in a manner inconsistent with the design or documentations of the Product; (b) license, distribute, lease, rent, lend, transfer, assign or otherwise dispose of the Product or use the Product in any commercial hosted or service bureau environment; (c) reverse engineer, decompile, disassemble or attempt to discover the source code for or any trade secrets related to the Product, except and only to the extent that such activity is expressly permitted by applicable law notwithstanding this limitation; (d) adapt, modify, alter, translate or create any derivative works of the Licensed Software; (e) remove, alter or obscure any copyright notice or other proprietary rights notice on the Product; or (f) circumvent or attempt to circumvent any methods employed by QSAN to control access to the components, features or functions of the Product.



#### Disclaimer

QSAN DISCLAIMS ALL WARRANTIES OF PRODUCT, INCLUDING BUT NOT LIMITED TO ANY MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, WORKMANLIKE EFFORT, TITLE, AND NON-INFRINGEMENT. ALL PRODUCTS ARE PROVIDE "AS IS" WITHOUT WARRANTY OF ANY KIND. QSAN MAKES NO WARRANTY THAT THE PRODUCT WILL BE FREE OF BUGS, ERRORS, VIRUSES OR OTHER DEFECTS.

IN NO EVENT WILL QSAN BE LIABLE FOR THE COST OF COVER OR FOR ANY DIRECT, INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR SIMILAR DAMAGES OR LIABILITIES WHATSOEVER (INCLUDING, BUT NOT LIMITED TO LOSS OF DATA, INFORMATION, REVENUE, PROFIT OR BUSINESS) ARISING OUT OF OR RELATING TO THE USE OR INABILITY TO USE THE PRODUCT OR OTHERWISE UNDER OR IN CONNECTION WITH THIS EULA OR THE PRODUCT, WHETHER BASED ON CONTRACT, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHER THEORY EVEN IF QSAN HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

#### **Limitation of Liability**

IN ANY CASE, QSAN'S LIABILITY ARISING OUT OF OR IN CONNECTION WITH THIS EULA OR THE PRODUCT WILL BE LIMITED TO THE TOTAL AMOUNT ACTUALLY AND ORIGINALLY PAID BY CUSTOMER FOR THE PRODUCT. The foregoing Disclaimer and Limitation of Liability will apply to the maximum extent permitted by applicable law. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the exclusions and limitations set forth above may not apply.

#### Termination

If User breaches any of its obligations under this EULA, QSAN may terminate this EULA and take remedies available to QSAN immediately.

#### Miscellaneous

- QSAN reserves the right to modify this EULA.
- QSAN reserves the right to renew the software or firmware anytime.
- QSAN may assign its rights and obligations under this EULA to any third party without condition.
- This EULA will be binding upon and will inure to User's successors and permitted assigns.



• This EULA shall be governed by and constructed according to the laws of R.O.C. Any disputes arising from or in connection with this EULA, User agree to submit to the jurisdiction of Taiwan Shilin district court as first instance trial.