

An Oracle Technical White Paper

May 2015

Microsoft Windows Server Multiprotocol Multipathing with the Oracle ZFS Storage Appliance



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Introduction

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The Oracle ZFS Storage Appliance is formed by a combination of advanced hardware and software architecture with the purpose of offering a multiprotocol Storage Subsystem. The unified storage model enables you to simultaneously run a variety of application workloads while benefitting from advanced data services. The first-class performance characteristics of the Oracle ZFS Storage Appliance are illustrated by the results of industry standard benchmarks like SPC-1, SPC-2 and SPECsfs.

As a unified storage platform, the Oracle ZFS Storage Appliance offers the ability to access storage through multiple protocols, for both file and block.

This paper describes the ability to access a block storage volume through iSCSI and Fibre-Channel (FC) simultaneously in a Microsoft Windows Server 2008 R2 or later environment. This can be a very useful tool to provide a high-resilience architecture allowing high-bandwidth access through the relatively expensive (fiscally and administratively) FC connections falling back to the more traditional network-based iSCSI protocol to protect data availability.

Building High Availability into the Storage Network Infrastructure

High availability is or should be at the core of any storage network infrastructure design – whether it is FC or iSCSI. This design methodology should lead to redundant paths in the infrastructure design, which can effectively result in multiple mirrored sub-configurations. For example, in a standard resilient FC deployment, traditionally a dual fabric design is produced where the individual fabrics are duplicated.



Figure 1. Example dual fabric FC SAN for high availability architecture

Similarly, any IP-based storage protocol should have a similar resilience built in with the server and storage straddling multiple subnets or VLANs.

Adding an Ethernet switch to provide TCP/IP connectivity between the servers and the Oracle ZFS Storage Appliance will allow the FC-presented volumes to also be presented through iSCSI to the server(s) when all the components are properly configured.

In the unlikely event of failure of all FC paths, the servers can be configured to use these additional iSCSI links. Given the unlikelihood of multiple failures causing loss of data access in a well designed SAN/power infrastructure, it may be desirable to deploy older, lower bandwidth network equipment for this task, but remember that these paths will carry all the traffic in the event of such a failure and bandwidth to data will be reduced to the level of the deployed network equipment for the period of the downtime.

If relatively low bandwidth equipment is deployed, the link(s) should be used in normal operation but only when absolutely necessary to preserve data access, albeit in a degraded fashion.

Updating the example shown in Figure 1, Figure 2 shows that the network infrastructure now includes an additional Gigabit Ethernet (GbE) switch to provide the network backup carrying iSCSI traffic.



Figure 2. Dual fabric FC SAN with added GbE switch

Assumptions

For the purposes of this paper, it is assumed that the iSCSI Initiator service is not enabled but the Windows Multipathing (MPIO) service is (as would be the case where primary data access is over FC) and that the volumes being accessed are primarily presented over the FC interfaces and already configured using the Microsoft Device Specific Module (DSM).

The following sections describe how to enable the iSCSI Initiator service, assuming that the Windows Multipathing (MPIO) service is already enabled.

It is advisable to enable CHAP authentication but this is not covered in this document.

Windows Server iSCSI Initiator Service

The first step is to ensure that the Windows Server iSCSI Initiator service has been enabled, which can be done using the following steps:

Windows Environment Details

- 1. Log on to the Windows Server using an administrative account.
- 2. Navigate to the Control Panel.
- 3. Open the iSCSI control as shown in Figure 3.



Figure 3. iSCSI control panel in Windows Server

4. If the iSCSI service has not been previously used, the following dialog box is shown. To maintain the iSCSI connection as the fallback, click the "**Yes**" button to ensure that the iSCSI initiator service is automatically started at every boot.

Microso	oft iSCSI	X
The Microsoft iSCSI service is not running. T iSCSI to function correctly. To start the servi automatically each time the computer resta	The service is required to be start ice now and have the service star rts, click the Yes button.	ed for t
	Yes	<u>N</u> o

Figure 4. iSCSI autostart dialog window

The iSCSI Control panel will then be displayed as shown in Figure 5.

<u>T</u> arge	t:		Quick Connect
Discov	ered targets		Refresh
Name	2	Status	2
To cor	nnect using advanced options, select a target and then		Connect
To cor click C To cor then c For ta select	nect using advanced options, select a target and then onnect. npletely disconnect a target, select the target and lick Disconnect. rget properties, including configuration of sessions, the target and dick Properties.		Connect Disconnect

Figure 5. iSCSI Initiator Properties window

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5. Select the **Configuration** tab. The Windows server IQN is shown as the Initiator Name. This IQN is used to assign exclusive access for a particular server or servers to a volume. It is analogous to LUN masking in FC SANs. Copy this IQN in order to configure the Oracle ZFS Storage Appliance initiator.

iSCSI Initiator Properties
Targets Discovery Favorite Targets Volumes and Devices RADIUS Configuration
Configuration settings here are global and will affect any future connections made with the initiator.
Any existing connections may continue to work, but can fail if the system restarts or the initiator otherwise tries to reconnect to a target.
When connecting to a target, advanced connection features allow specific control of a particular connection.
Initiator Name:
iqn.1991-05.com.microsoft:myserver.example.org
To modify the initiator name, dick Change.
To set the initiator CHAP secret for use with mutual CHAP, CHAP
To set up the IPsec tunnel mode addresses for the initiator, dick IPsec.
To generate a report of all connected targets and devices on <u>Report</u> the system, dick Report.
ОК Cancel Apply

Figure 6. iSCSI initiator qualified name details

With this information in hand, you can now configure the Oracle ZFS Storage Appliance.

Configuring iSCSI on the Oracle ZFS Storage Appliance

The following outlined steps are basic instructions for configuring iSCSI on the Oracle ZFS Storage Appliance. A more comprehensive tutorial on Oracle ZFS Storage Appliance configuration for iSCSI (including CHAP authentication) is available at

http://www.oracle.com/technetwork/articles/servers-storage-admin/oll-129-iscsi-lunswindows-522255.html

- 1. Log on to the Oracle ZFS Storage Appliance in an Internet browser as a user with the following permissions assigned:
- stmf Configure
- nas.*.*.*: changeAccessProps, changeProtocolProps, changeGeneralProps
- 2. Enter an address in the URL field of a Web browser that includes the IP address or hostname of the Oracle ZFS Storage Appliance:

```
https://<ip-address or hostname>:215
```

The login dialog window shown in Figure 7 is displayed.

Username	admin	
Password	••••••	
	LOGIN	ô

Figure 7. Oracle ZFS Storage Appliance login

3. Enter a Username and Password and click LOGIN.

Defining an iSCSI Target Group

A target group is created on the Oracle ZFS Storage Appliance to define the ports and the protocol by which the LUN to be presented to the Windows Server is accessed.

To define an iSCSI target group on the Oracle ZFS Storage Appliance, complete these steps:

- Click Configuration > SAN to display the Storage Area Network (SAN) screen as shown in Figure 8.
- 2. Click **iSCSI** on the right hand side of the panel and **Targets** on the left hand side of the panel as shown in Figure 8.

Ų	Config	guration	Mainte	nance	Shar	es	Status	Ar	nalytics
	SERVICES	STORAGE	NETWORK	SAN	CLUSTER	USERS	PREFER	ENCES	ALERTS
Storage Area Network (SAN)						Fibre C	hannel	iscsi	SRP
To share LUNs only via particular targets or to particula respectively. To create a group or add to an existing on	r initiators, build Ta ie, drag the entity f	rget Groups and Ir rom the left to the	nitiator Groups, table on the right.				REVER	RT	APPLY
			Target (Groups					
No iSCSI targets de	afined		NAME	TAR	GETS				
Click the O button above to crea	ate an iSCSI tar	get.	default	[AL	L TARGETS]				

Figure 8. Configuring an iSCSI target in the Oracle ZFS Storage Appliance BUI

- 3. Click the + icon at the left of **Targets** to display the Create iSCSI Target dialog shown in Figure 9.
- 4. Fill in the displayed fields:
 - Enter an Alias for the target and select the Initiator authentication mode.
 - Additionally, choose the network interfaces over which iSCSI LUNs will be presented.

Create iSCSI Target	CANCEL OK
Target IQN	 Auto-assign
Alias	iSCSI-fallback-target
Initiator authentication mode	None CHAP RADIUS
Target CHAP name	
Target CHAP secret	
	nge0
Network interfaces	Y

Figure 9. Create iSCSI Target dialog window

- 5. Click **OK** to confirm.
- 4. To create an iSCSI target group that includes the iSCSI target just defined, place the cursor over the new **iSCSI-Targets** entry in the left panel. The Move icon ⊕ appears to the left of the entry as shown in Figure 10.

Ú	Configuration	-	Mainte	enanc	e Sha	ires	Status	A	nalytics
SERVICES	STORAGE I	NETW	ORK	SAN	CLUSTER	USERS	PREFERE	NCES	ALERTS
Storage Area Network (SAN)						Fibre	Channel	iscsi	SRP
To share LUNs only via particular targets or to particular initiato respectively. To create a group or add to an existing one, drag	rs, build Target Groups an the entity from the left to th	nd Initia ne table	tor Groups, on the right.				REVE	RT	APPLY
O Targets Initiators			Target 0	Groups					
iSCSI-fallback-target ion 1986-03 com sup 02:5d152bd1-c029-cd63-e3cb-	a/h5f0a3778/		NAME	ТА	ARGETS				
	540015801104		default	[/	ALL TARGETS	1			

Figure 10. Selecting the iSCSI target entry

Click the
 i icon and drag it to the iSCSI Target Groups panel on the right. A new entry
 (highlighted in yellow) appears at the bottom of the iSCSI Target Groups column as shown
 in Figure 11.

0	Configuration	Mainten	ance Sha	ares	Status	An	alytics
SERVICES	STORAGE NE	TWORK SA	N CLUSTER	USERS	PREFERE	NCES	ALERTS
Storage Area Network (SAN)				Fibre	Channel	iscsi	SRP
To share LUNs only via particular targets or to particular initiator respectively. To create a group or add to an existing one, drag t	rs, build Target Groups and I	Initiator Groups, table on the right.			REVE	RT	APPLY
······································	alo onaly non alo lot to alo i	⁰					
O Targets ⊨ Initiators		Target Gr	oups				
Cargets Initiators iSCSI-fallback-target		Target Gr	DUDS TARGETS				
Targets Initiators iSCSI-fallback-target iqn.1986-03.com.sun:02:5d152bd1-c029-cd63-e3cb-e	94b5f9a37784	Target Gro	DUPS TARGETS [ALL TARGETS	1			
Targets Initiators ISCSI-fallback-target ign.1986-03.com.sun:02:5d152bd1-c029-cd63-e3cb-e	94b5f9a37784	Target Gro NAME default	TARGETS [ALL TARGETS selected iSCSI target he] ere to create a	i new target grou	ip, or onto a	n existing target
Targets Initiators ISCSI-fallback-target ign.1986-03.com.sun:02:5d152bd1-c029-cd63-e3cb-e	94b5f9a37784	Target Gro NAME default	TARGETS [ALL TARGETS selected ISCSI target he ISCSI-fallback-target] ere to create a	new target grou	ip, or onto a	n existing target

Figure 11. Creating an iSCSI target group

6. Move the cursor over the new target group and release the mouse button. A new iSCSI target group is created with a name targets-n, where n is an integer, as shown in Figure 12.

orage Area Network (SAN)		Fibre Channel iSCSI S
share LUNs only via particular targets or to particular initiators, build Target Groups sectively. To create a group or add to an existing one, drag the entity from the left f	s and Initiator Groups, to the table on the right.	REVERT
Targets Initiators	Target Gr	ouns
Targets Initiators	Target Gr	Dups TARGETS
Targets Initiators iSCSI-fallback-target iqn.1986-03.com.sun:02:5d152bd1-c029-cd63-e3cb-e4b5f9a37784	Target Gro NAME default	TARGETS

Figure 12. Selecting the new target group for editing

- 7. Click the edit icon (\mathbb{A}) to display the dialog seen in the preceding figure.
- 8. In the **Name** field, replace the default name with the name to be used for the iSCSI target group and click **OK**. For this example, the name iscsi-FallbackGroup is used.

Name iSCS	SI-FallbackGro	oup			
Targets					

Figure 13. Renaming the iSCSI target group

9. Click APPLY. The changes are shown in the iSCSI Targets panel on the left.

Stora	age Area Network (SAN)		Fibre Channel iSCSI	SRP		
To share LUNs only via particular targets or to particular initiators, build Target Groups and Initiator Groups, respectively. To create a group or add to an existing one, drag the entity from the left to the table on the right.						
© Tar	© Targets i Initiators Target Groups					
•	ISCSI-fallback-target iqn.1986-03.com.sun:02:5d152bd1-c029-cd63-e3cb-e4b5f9a37784	NAME default	TARGETS [ALL TARGETS]			
		iSCSI-Fallb	iqn.1986-03.com.sun:02:5d152bd1-c029-cd63-e3cb-e4b5f9a37784			

Figure 14. Viewing the new iSCSI target group

Defining an iSCSI Initiator

An iSCSI initiator is defined to restrict which servers have access to a particular volume. If more than one host can write to a given volume concurrently, inconsistency in file system caching between hosts can cause corruption in the on-disk image, unless there is a multi-concurrency-aware file system built on the volume. Typically, a single initiator is given access to a volume, unless a specialized cluster file system is being used.

The iSCSI initiator serves to define the "host" from the point of view of the Oracle ZFS Storage Appliance. To identify the Windows Server to the Oracle ZFS Storage Appliance, the Windows Server iSCSI initiator IQN must be registered with the Oracle ZFS Storage Appliance by completing the following steps:

- 1. Click **Configuration >SAN** to display the Storage Area Network (SAN) screen shown in the following figure.
- 2. Click the iSCSI tab at the right and then select Initiators at the top of the left panel.

SERVICES STORAGE NETWORK SAN CLUSTER USERS PREFERENCES ALERTS Storage Area Network (SAN) Fibre Channel ISCSI SRP To share LUNs only via particular targets or to particular initiators, build Target Groups and Initiator Groups, respectively. To create a group or add to an existing one, drag the entity from the left to the table on the right. REVERT APPLY Targets Cinitiators Initiator Groups No iSCSI initiators identified. NAME INITIATORS	Ů	Config	guration	Mainte	nance	Shar	es	Status	A	nalytics
Storage Area Network (SAN) Fibre Channel [ISCS] SRP To share LUNs only via particular targets or to particular initiators, build Target Groups and Initiator Groups, respectively. To create a group or add to an existing one, drag the entity from the left to the table on the right. REVERT APPLY Targets Cinitiators Initiator Groups No ISCSI initiators identified. NAME INITIATORS Original of Groups in the left of the GODU of the Initiator Groups in the left of the Initiator Groups Initiator Groups	SER	RVICES	STORAGE	NETWORK	SAN	CLUSTER	USERS	PREFE	RENCES	ALERTS
To share LUNs only via particular targets or to particular initiators, build Target Groups and Initiator Groups, respectively. To create a group or add to an existing one, drag the entity from the left to the table on the right. Targets Cinitiators Initiator Groups No iSCSI initiators identified. NAME INITIATORS	Storage Area Network (SAN)						Fibre (Channel	iscs	SRP
Targets Cinitiators No iSCSI initiators identified. NAME No iSCSI initiators identified. NAME	To share I UNs only via particular targets or to particular initial	atore build Ta	reat Croups and In	itiator Orouno				0.000	cor l	ADDLY
No iSCSI initiators identified. NAME INITIATORS Optimization of output dofmit CALL INITIATORS	respectively. To create a group or add to an existing one, dra	ag the entity f	from the left to the f	able on the right.				REV	ERI	APPLY
No iSCSI initiators identified. INTIA IORS	respectively. To create a group or add to an existing one, dra	ag the entity f	from the left to the t	table on the right.	Crowna			REV	ERI	APPLY
	Targets : Cinitiators	ag the entity f	from the left to the f	Initiator Groups, able on the right.	Groups			REV	ERI	APPLT

Figure 15. Selecting the iSCSI Initiators panel

- 3. Click the + icon to the left of **Initiators** to display the Identify iSCSI Initiator dialog window seen in the following figure.
- 4. Enter the **Initiator IQN** for the Windows server (as determined in the previous section). Enter a more meaningful symbolic name as the **Alias**.

Identify iSCSI Initiator	CANCELOK
Initiator IQN Alias	iqn. 1991-05. com. microsoft:m iSCSI-fallback-myserver
Initiator CHAP name Initiator CHAP secret	

Figure 16. Configuring a new iSCSI initiator

5. Click OK.

Defining an iSCSI Initiator Group

Related iSCSI initiators can be combined into logical groups to allow single commands to be executed on multiple iSCSI initiators; for instance, assigning LUN access to all iSCSI initiators in a group with one command. For this example, the iSCSI initiator group will contain one initiator, but in a cluster, where multiple servers are treated as a single logical entity, the initiator group may contain multiple initiators.

To create an iSCSI initiator group, complete these steps:

1. Select Configuration > SAN to display the Storage Area Network (SAN) screen.

Select the iSCSI tab at the right and then click Initiators at the top of the title panel.

Place the cursor over the entry for the iSCSI initiator created in the previous section. The Move icon \oplus appears to the left of the entry as shown in Figure 17.

Storage Area Network (SAN)				Fibre Channel	iscsi	SRP
To share LUNs only via particular targets or to particular initiators, build Target G respectively. To create a group or add to an existing one, drag the entity from the	Groups and Inities of the test of	tiator Groups, ble on the right.		REVER	AT A	PPLY
Targets O Initiators		Initiator	Groups			
iscSI-fallback-myserver iqn.1991-05.com.microsoft:myserver.example.com	2 1	NAME default	INITIATORS [ALL INITIATORS]			

Figure 17. Displaying the Move icon for a new iSCSI initiator

 Click the
 ticon and drag it to the Initiator Groups panel on the right. A new entry (highlighted in yellow) appears at the bottom of the Initiators Groups panel as shown in Figure 18.

Move the cursor over the new entry box and release the mouse button. A new iSCSI initiator group is created with a name initiators -n, where n is an integer, as shown in Figure 19.

Storage Area Network (SAN)	Fibre Channel iSCSI SRP
To share LUNs only via particular targets or to particular initiators, build Target Groups and Init respectively. To create a group or add to an existing one, drag the entity from the left to the tab	tor Groups, s on the right.
Targets 🗄 O Initiators	Initiator Groups
iSCSI-fallback-myserver iqn.1991-05.com.microsoft:myserver.example.com	NAME INITIATORS default [ALL INITIATORS]
	Drop the selected ISCSI initiator here to create a new initiator group, or onto an existing SCSI-fallback-myserver iqn.1991-05.com.microsoft:myserver.example.com

Figure 18. Creating an iSCSI initiator group

3. Move the cursor over the entry for the new initiator group. Two icons appear to the right of the target group box as shown in Figure 19.

Initiator Groups					
NAME	INITIATORS				
default	[ALL INITIATORS]	_			
initiators-0	iqn.1991-05.com.microsoft:myserver.example.com	+ 🖉 🗈			

Figure 19. Selecting the iSCSI initiator group

4. Click the edit icon (\mathbb{Z}) to display the following dialog window.

-		CARCEL	ĸ
Name	iSCSI-Fallback		
Initiate	ors		

Figure 20. Replacing the default name with a new name for the iSCSI initiator group

In the **Name** field, replace the default name with the name to be used for the iSCSI initiator group and click **OK**. For this example, the name "iSCSI-Fallback" may be appropriate here.

5. Click **APPLY** on the SAN configuration screen to confirm all the modifications, as shown in the following figure.

Storage Area Network (SAN)		Fi	bre Channel	iSCSI	SRP
To share LUNs only via particular targets or to particular initiators, build Target Groups and Initiator Groups, respectively. To create a group or add to an existing one, drag the entity from the left to the table on the right.					PLY
Targets O Initiators	Initiator Gro	ups			
iSCSI-fallback-myserver iqn.1991-05.com.microsoft:myserver.example.com	NAME default	INITIATORS [ALL INITIATORS]			
	iSCSI-fallback	ign.1991-05.com.microsoft:m	yserver.example.com	n	

Figure 21. Completing the iSCSI initiator configuration

Windows Server Multipathing

The next configuration steps will create additional paths to the Windows Server connectivity.

Prior to taking any administrative actions, verify the number of paths that currently exist. Do this from the Windows Server Control Panel MPIO Properties panel under '**Configuration Snapshot**' as shown in the following figure.

MPIO Properties X
MPIO Devices Discover Multi-Paths DSM Install Configuration Snapshot
Snapshot
To capture a snapshot of the current MPIO configuration on the system, please specify a filename where this information will be written to and then click Capture.
Eilename: lows\System32\MPIO_Configuration.log Browse
Open File upon capture
Capture
OK Cancel

Figure 22. Windows Server MPIO Properties

The following example is a configuration snapshot showing one volume connected with FC using the default Microsoft DSM, which is appropriate for the Oracle ZFS Storage Appliance.

Registered DSMs: 1							
+						+	
DSM Name	Version	PRP	RC	RI	PVP	PVE	
Microsoft DSM	006.0003.09600.17476	0020	0003	0001	030	False	
+						+	
Microsoft DSM							
MPIO Disk0: 02 Paths, Round Robin, Symmetric Access							
SN: 600144F0AE323ECA00005	4DE03C30004						
Supported Load Balance Po	licies: FOO RR RRWS L	QD WP	LB				

	Path ID	State	SCSI Address	Weight
	000000077030000 * TPG_State: Act: Adapter: Emulex 1 Controller: 4661	Active/Optimized ive/Optimized , TPC LightPulse HBA - Sto 5B65436F6E74726F6C60	003 000 000 000 G_Id: 0, TP_Id: 2 Derport Mini (B 26572 (State: Activ	0 D F: 019 000 001) /re)
	0000000077020000 * TPG_State: Act: Adapter: Emulex 1 Controller: 46616	Active/Optimized ive/Optimized , TPC LightPulse HBA - Sto 5865436F6E74726F6C60	002 000 000 000 G_Id: 0, TP_Id: 1 prport Mini (B 26572 (State: Activ	0 D F: 019 000 000) re))
MSDSM-wi No targe	de default load b t-level default l ========	alance policy: N\A oad balance policie	s have been set.	

As reflected in the example, there are two paths to the FC volume – one for each fabric. Both are active and online and carry equal weight, as the standard path selection policy is 'round-robin.'

This can be confirmed by accessing the volume on the Oracle ZFS Storage Appliance BUI under **Shares > LUNs** and verifying that the GUID, highlighted in following figure example from the BUI, matches the Serial Number (SN) in the output of the MPIO configuration. The corresponding volume details are shown in Figure 23.

Filesystems O LUNs 1 Total			٩
NAME .	VOLSIZE	GUID	ENCRYPTED
 multiprotocol 	8G	600144F0AE323ECA000054DE03C30004	

Figure 23. LUN details displayed in the Oracle ZFS Storage Appliance BUI

Presenting the Volume to Both iSCSI and FC Initiators

At this point, the volume is already being presented to FC initiators, so the next step is to present the volume to the appropriate iSCSI initiator(s). Use the following steps to change the configuration of the volume access:

1. From the Oracle ZFS Storage Appliance BUI, select **Shares** > **LUNs** (and optionally, the relevant project from the Projects panel on the left of the BUI).

Projects	⊢ MP	IOI	Shares	General	Protocols	Access	Snapshots	Replication
		ESRPDB/local/MPIO						
Usage 0.1% of	12.5T	Filesystems 🗄 C LUNs	1 Total					Q,
Referenced data	8.00G							
Total space	8.00G	NAME A		vo	LSIZE GUID			ENCRYPTED
		 multiprotocol 		8G	600144F0A	E323ECA000054	DE03C30004	
Static Propert	ies							
Creation date	2015-4-16							
Compression	1.00x							
Encryption	Off							

Figure 24. Selecting the volume to be modified

2. Verify the volume to be modified from the GUID information shown on the BUI and the Windows Server MPIO report shown previously. In this example, the displayed volume is

the correct one, as the GUID (600144F0AE323ECA000054DE03C30004) matches the LUN serial number.

3. Select the volume from the BUI by moving the mouse onto the appropriate volume line so that the pencil icon () appears as shown in Figure 25. Click on the pencil icon.

Projects	⊢ MP	IOI	Shares	General	Protocols	Access	Snapshots	Replication
		ESRPDB/local/MPIO						
Usage 0.1% of	12.5T	Filesystems OLUNs	1 Total					Q,
Referenced data	8.00G							
Total space	8.00G	NAME A		VO	LSIZE GUID			ENCRYPTED
		o 😡 multiprotocol I		8G	600144F04	E323ECA000054	DE03C30004	@
Static Proper	ties							
Creation date	2015-4-16							
Compression	1.00x							
Encryption	Off							

Figure 25. Volume edit icon

4. Select the Protocols tab and click on the **Initiator group: LU number** "Edit" link as shown.

Projects	► MPIO	► multiprotoco I	Ger	neral	Protocols	Snapshots	Replication
		pool0/local/MPIO/multiprotocol				REVERT	APPLY
Usage 0.2% of 8.	04T	Sharing Options					
Referenced data	18G		Online 🕑				
Total space	18G		Target group F	C7330d	•		
Static Propertie	25	Initiator	group: LU number 🖉	Edit 450-1-tc:	U		
Creation date	2015-3-5						
Compression	1.00x	Write Cache Behavior					
Volume block size	8K	White Gache Benavior	the settion off attacks		house and if an I	en daulas is susibilit	with a sufframe of a
Encryption	Off	I his setting controls whether the LON caches whether is suffers significantly. Turning this setting on can therefor shutdown unless the client application understands the client application documentation before turning this on.	e dramatically improve wi semantics of a volatile wri	rite perform ite cache a	ance, but can also nd properly flushes	result in data corruptio the cache when nece	n on unexpected ssary. Consult your

Figure 26. Edit Initiator groups

5. The "Edit Initiator Group(s)" dialog window will be shown as in Figure 27.

Edit Initiator Group(s)		CANCEL	ОК
Initiator Groups 3 Total			
NAME A	LU #	LU POLICY	PERSIST
All initiators	-	🔍 0 💿 Auto-assign	
iSCSI-Fallback		🔘 0 💿 Auto-assign	
✓ x4450-1-fc	0	0 O Auto-assign	



As seen in the example, the volume is currently assigned as LUN 0 to the Initiator Group x4450-1-fc. In order to allow access to the volume by the iSCSI initiator, the volume needs to be assigned a LUN number. Unless there is a particular reason to alter the LUN number, it is a good practice to let the Oracle ZFS Storage Appliance choose the appropriate LUN number by leaving the Policy at **Auto-assign**. Select the checkbox to the left of the appropriate initiator group.

Click **OK** to continue.

6. Next, the volume has to be presented to all the target groups as it is not possible to select multiple, particular target groups. This means that while the volume is potentially present over all the Oracle ZFS Storage Appliance configured target interfaces, it will only be accessible by the initiator groups nominated in the previous step. For added security, iSCSI access should be configured with CHAP authentication to ensure a further level of security over the volume access.

► MPIO ► multiprotoco I	General	Protocols	Snapshots	Replication
pool0/local/MPIO/multiprotocol			REVERT	APPLY
Sharing Options				
	Online 🗹			
	Target group All targe	ts 🔻		
Initiator gro	oup: LU number & Edit iSCSI-Fa	llback:0, x4450-1-	fc:0	

Figure 28. Selecting all target groups for presentation

Click Apply to continue.

The FC and iSCSI initiators associated with the Windows Server are allowed access to the volume and, while the volume is discoverable on all the assigned and configured interfaces, access is only granted to these initiators explicitly nominated.

Configuring iSCSI Multipathing

It may be necessary to explicitly enable iSCSI Multipathing in the Windows Server environment. This option only becomes available after at least one iSCSI volume is accessible to the Windows Server.

To enable iSCSI MPIO, follow these steps:

- Select Control Panel > MPIO. If the text MSFT20005iSCSI BusType_0x9 is present, iSCSI Multipathing is already configured and the rest of the steps in this section can be skipped.
- 2. Select the Discover Multi-Paths tab as shown in the following figure. Enable the checkbox for 'Add support for iSCSI devices' and select the Add button.

	MPIO Prop	oerties		x
MPIO Devices Disco	over Multi-Paths DS	M Install	Configuration S	napshot
<u>SPC-3 compliant</u>				
Device Hardwar	e Id			
Add support f	or iSCSI devices			
Add support f	or SAS d <u>e</u> vices	1		
			Add	
Others				
Device Hardwar	e Id			
			A <u>d</u> d	
			OK (Cancel

Figure 29. Enabling iSCSI Multipathing in the Windows Server interface

3. It may now be necessary to reboot the server to complete the operation. If this is the case, a "**Reboot Required**" dialog box will open. Click **Yes** if it is appropriate to reboot the server at this time.

	Reboot Required	x
▲	A reboot is required to complete the operation. Reboot Now?	
	<u>Y</u> es <u>N</u> o	

Figure 30. Reboot Required display

NOTE: If the iSCSI selection line from figure 28 is greyed out and cannot be selected, it may be necessary to open either a PowerShell or CMD session and run the following command:

C:\>mpclaim -r -i -d "MSFT2005iSCSIBusType_0x9" This may cause the server to reboot automatically to allow the MPIO framework to claim control of the iSCSI volumes.

7. Once the server has rebooted, log in as an administrator and open **Control Panel** > **MPIO** once again.

The list of supported devices should now include the string MSFT2005iSCSIBusType_0x9 as shown in Figure 31.

	MPIO P	roperties		X
MPIO Devices	Discover Multi-Paths	DSM Install	Configuration	Snapshot
To add suppo Product Ids as Devices can b To remove su then dick Rem	rt for a new device, dir s a string of 8 characte e specified using semi- oport for currently MPI iove.	ck Add and en rs followed by colon as the d O'd devices, s	iter the Vendor / 16 characters lelimiter. select the devic	and . Multiple :es and
Devices:				
Device Hard	ware Id			
SUN ZFS	Storage 7330			
Vendor 8Pro	duct 16			
		<u>A</u> dd	<u>R</u> emo	ve
More about a	dding and removing MP	<u>IO support</u>		
			ОК	Cancel

Figure 31. iSCSI MPIO configuration

Verifying iSCSI Multipathing

The volume presented to both iSCSI and FC target groups on the Oracle ZFS Storage Appliance should now be accessible by the existing FC connections and also the iSCSI adapter. To verify, rerun the **Configuration Snapshot** from the **MPIO** control panel.

Registered DSMs: 1							
+							-+
DSM Name	Version	PRP	RC	RI	PVP	PVE	
							-
Microsoft DSM	006.0002.09200.16384	0020	0003	0001	030	Fals	e
+							-+
Minus as ft. DOM							
MICROSOLL DSM							
NDTO D'abor 02 Datha Da ad Dah's							
MPIO DiskU: 03 Paths, Round Robin,	Symmetric Access						
SN: 60144F0AE323ECA0054DE3	3C304						
Supported Load Balance Pol	icies: FOO RR RRWS LQ	QD WP	LB				
Path ID State	SCSI Address	We	eight				
							-
0000000077040001 Active/Optimi	zed 004 000 001 000	0 0					
* TPG_State: Active/Optimize	ed , TPG_Id: 0, TP_IC	d: 13					
Adapter: Microsoft iSCSI]	Initiator	(B D F	: 000	000	000)
Controller: 46616B65436F6E	74726F6C6C6572 (State	e: Act	ive)				
0000000077030000 Active/Optimi	zed 003 000 000 000	0 0					
* TPG_State: Active/Optimize	ed , TPG_Id: 0, TP_Id	1: 2					

```
Adapter: Emulex LightPulse HBA - Storport Mini... (B|D|F: 019|000|001)
Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077020000 Active/Optimized 002|000|000|000 0
* TPG_State: Active/Optimized , TPG_Id: 0, TP_Id: 1
Adapter: Emulex LightPulse HBA - Storport Mini... (B|D|F: 019|000|000)
Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MSDSM-wide default load balance policy: N\A
No target-level default load balance policies have been set.
```

Comparing the latest MPIO configuration snapshot with the earlier one, the difference is that the Microsoft iSCSI Initiator controlled volumes are now forming part of the multipath set.

Most probably, access to the volumes through the iSCSI route is only desirable in the case in which both FC connections are inoperable. In Microsoft MPIO, this setup is facilitated by assigning each path to storage a priority value or weight or by marking the iSCSI path as a standby path – the method used depends on which allocation strategy is being used.

From the Oracle ZFS Storage Appliance advanced analytics screen, you can verify the access through iSCSI or FC paths. In the example shown in Figure 31, the LUN is being accessed reasonably symmetrically through both iSCSI and FC.



Figure 32. Verifying access through iSCSI and FC paths

The MPIO settings for the Windows Server can be changed by selecting the Properties dialog from the list of volumes in an explorer window.

Navigate to a display of the hardware properties, as seen in figure 32, by selecting the Hardware tab, then the "disk drive" SUN ZFS Storage, and click Properties.

Shadow Copies Previous Versions Quota Customize General Tools Hardware Sharing Security All disk drives: Name Type Introduction HITACHI H103014SCSUN146G SCSI Disk drives Introduction Disk drives Disk drives Introduction Portice Disk drives Intreturn Disk drives Disk drives	Ne	w Volume (G:) Pro	operties	X
General Tools Hardware Sharing Security All disk drives: Name Type Image: HITACHI H103014SCSUN146G SCSI Disk drives Image: HITACHI H103014SCSUN146G SCSI Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives Image: SUN ZFS Storage 7330 Multi-Path Disk Disk drives	Shadow Copies	Previous Versions	Quota	Customize
All disk drives: Name Type HITACHI H103014SCSUN146G SCSI Disk drives HITACHI H103014SCSUN146G SCSI Disk drives SUN ZFS Storage 7330 Multi-Path Disk Disk drives SUN ZFS Storage 7330 Multi-Path Disk Disk drives TEAC DV-W28SS-R USB Device DVD/CD Device Properties Manufacturer: Manufacturer: (Standard disk drives) Location: Pot(2.3) Bus 0, Target ID 0, LUN 0 Device status: This device is working property.	General Too	ls Hardware	Sharing	Security
Device Properties Manufacturer: (Standard disk drives) Location: Port(2,3) Bus 0, Target ID 0, LUN 0 Device status: This device is working property. Properties	All disk drives: Name HITACHI H10 HITACHI H10 SUN ZFS Sto TEAC DV-W2	3014SCSUN146G SCS 3014SCSUN146G SCS rage 7330 Multi-Path D 8SS-R USB Device	Type SI Disk (SI Disk (Disk Disk (DVD)	drives drives drives /CD
Device status: This device is working property. Properties	Device Propertie: Manufacturer: (s Standard disk drives) Port(2:3) Bus (): Tarroet ()		
Device status. This device is working property. Properties	Device station 1	Dia device is wedding a		
	Device status.		Prop	Apply

Figure 33. Volume Properties in the Windows Server MPIO interface

The following window showing the properties for the selected hardware contains the tab for MPIO, where the MPIO policy can be set.

UN ZFS Stor	age 7330 Multi	-Path D	isk Devio	e Proper
General Polici	es Volumes MPIO	Driver	Details E	vents
Select the <u>M</u> P	IO policy: Round	Robin		~
Description				
The round n to all proces	bin policy attempts to sing paths.	evenly dis	stribute incom	ing requests
DSM Name:	Microsoft DSM			<u>D</u> etails
This <u>d</u> evice ha	as the following paths:			
Path Id	Path State	TPG	TPG State	Wei
77030000	Active/Optimi	0	Active/Opt	imi
77020000	Active/Optimi	0	Active/Opt	imi
77040000	Active/Optimi	0	Active/Opt	imi
<	II	I		>
To edit the par path and click To apply the p click Apply. More informati	th settings for the MPIC Edit. ath settings and select	D policy, s ted MPIO	elect a policy,	Edit
		[ОК	Cancel

Figure 34. Hardware Properties MPIO

There are multiple solutions for configuring the iSCSI path to provide the necessary standby. The following subsections list some of those options.

Failover

When the MPIO policy for a LUN is set to Failover, no load balancing is performed. This setting is not recommended, as only one path can be set as active/optimized and all other paths are active/ unoptimized, standby or unavailable. When the active/optimized path fails, the other paths are then tried sequentially until an available path is found.

Round Robin

Round Robin policy instructs Windows to use each Active/Optimized path in turn. This is the default setting and may not be optimal, depending on the application, as I/O requests are evenly distributed without any recognition of unbalanced requests.

This policy does not allow any paths to be manually configured as Standby. Do not choose Round Robin if the LUN will be configured with both FC and iSCSI access.

Round Robin with Subset

Round Robin with Subset is similar to Round Robin but does allow particular paths to be set as Standby. To set the iSCSI path to be the standby path, select the MPIO Path Details from the Hardware Properties dialog.

The Path State drop-down should be modified to show Standby as shown in Figure 35.

MPIO Path Details	
Path Information	
Path ID:	77040000
Path State:	Standby
Weight:	Preferred Failed
Scsi Address:	Port: 4 Bus: 0 Target: 0 Lun: 0
Path Component Information	
Adapter Name: Microsoft iSCSI Initiator	
Controller ID:	46616B65436F6E74726F6C6(State: Active
Target Port Group Information	
Identifier:	0 ✓ Preferred
Target Port Identifier: 13	
Basic Statistics	
Number Of Rea	ds: 18874 Bytes Read: 4946018304
Number Of Wri	tes: 20398 Bytes Written: 5145568768
	Clear
More information about MPIO Path details	
	<u>Q</u> K <u>C</u> ancel

Figure 35. MPIO path details

If the FC paths fail, the iSCSI path becomes the Active one and I/O resumes using only the iSCSI path.

When the FC paths are returned to service, failback automatically stops I/O on the iSCSI path and continues on the FC ones.



Figure 36. Round Robin with subset path failure and recovery

Least Queue Depth

Least Queue Depth is analogous to Round Robin but the I/O request is assigned to the path with the smallest queue of outstanding requests. It is not possible to assign a path as Standby with Least Queue Depth or to assign a preference of path choice, so this policy should not be chosen for implementing the multiprotocol multipathing. Since iSCSI is usually higher latency and lower bandwidth than FC, choosing to use both types would present performance challenges. Typical operation would use the higher bandwidth interface exclusively until a failure occurs in all the paths provided by that interface.

Weighted Paths

In Weighted Paths, a number is assigned to each path that represents the priority by which the path will be chosen relative to the other assigned weights. The higher the number, the lower the priority of that path. In practice, the favored FC paths should be assigned a very low weight and the iSCSI path a relatively high number.

For the purposes of the examples, the low weight was set at 0 and the high one at 100. These designations result in all the I/O being allocated to the FC channels when they are in service.

As shown in the following two figures, path failure detection and retries can take approximately 30 seconds (depending on the DSM timer settings).



Figure 37. Weighted Path failover and recovery

Conclusion

The unified approach to storage provided by the Oracle ZFS Storage Appliance family can be used to provide the framework for high resilience at low cost and management overhead. By simultaneously presenting LUNs for access by multiple protocols, the complete dependence on a single protocol is removed, allowing for a higher level of resilience to be designed into architecture deployments.

By using relatively low-cost networking infrastructure components, high availability is an affordable option when deployed with Fibre-Channel dual-fabric configurations.

References

See the following resources for additional information relating to the products covered in this document.

- Oracle ZFS Storage Appliance White Papers and Subject-Specific Resources <u>http://www.oracle.com/technetwork/server-storage/sun-unified-</u> <u>storage/documentation/index.html</u>
- Oracle ZFS Storage Appliance Product Information
 <u>https://www.oracle.com/storage/nas/index.html</u>
- Oracle ZFS Storage Appliance Documentation Library, including Installation, Analytics, Customer Service, and Administration guides: <u>http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html</u>
- The Oracle ZFS Storage Appliance Administration Guide is also available through the Oracle ZFS Storage Appliance help context.
 The Help function in Oracle ZFS Storage Appliance can be accessed through the browser user interface.



Microsoft Windows Server Multiprotocol Multipathing with the Oracle ZFS Storage Appliance May 2015 Version 1.0

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