



Deploying Solaris 11 with EqualLogic Arrays

Step-by-step guide to integrating an Oracle Solaris 11 server with a Dell EqualLogic PS Series Array

Dell Storage Engineering
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Revisions

Date	Description
February 2014	Initial release

Audience

The information in this guide is intended for technology professionals interested in using Dell EqualLogic storage in an Oracle Solaris environment.

Introduction

Storage plays a critical role in today's business operations. With the ever-growing presence of new applications and data, storage demands continue to grow. EqualLogic provides support for both block storage, with PS Series Firmware, and Network Attached Storage (NAS) with FS Series Firmware, delivering high performance, high availability, scalability and on-demand provisioning in a unified storage environment.

Objective

This document describes how to configure a Solaris iSCSI Initiator to discover volumes on an EqualLogic array. It also includes information about the limitations Solaris 11 has using Multipath I/O (MPIO) with EqualLogic arrays.

Table 1 Software and firmware used for this document

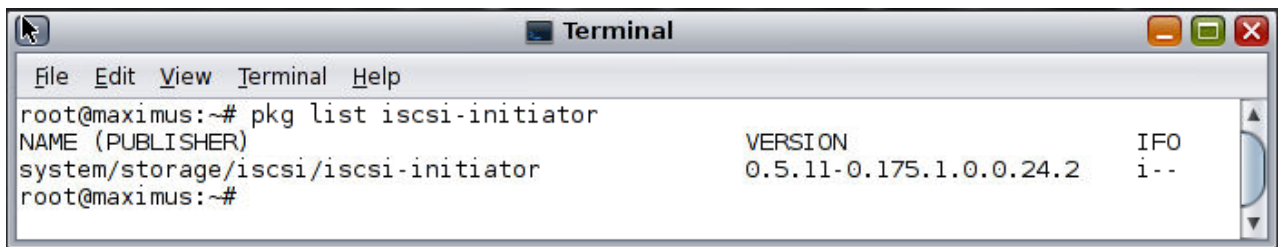
Vendor	Model	Software Revision
Dell	PS-6110X	7.0.0
Oracle	SPARC T4-1 Server	Solaris 11.1



1 Pre-configuration recommendations and requirements

The following are the pre-configuration recommendations and requirements to integrate a Solaris 11.1 server with Dell EqualLogic PS Series arrays.

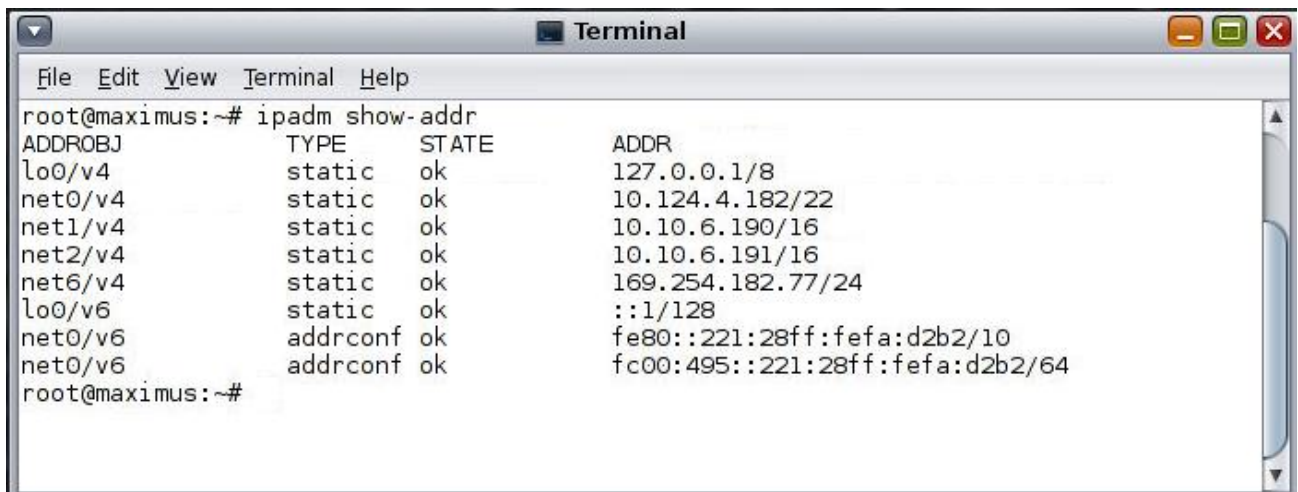
- Enable Flow Control on all Storage Area Network (SAN) interface cards.
- Enable Jumbo Frames on all SAN interface cards.
- The software package for the iSCSI Management Utilities (system/storage/iscsi/iscsi-initiator) must be installed on the Solaris host. Verify using the following command:
pkg list iscsi-initiator



```
root@maximus:~# pkg list iscsi-initiator
NAME (PUBLISHER)                                VERSION                                IFO
system/storage/iscsi/iscsi-initiator            0.5.11-0.175.1.0.0.24.2             i--
root@maximus:~#
```

Figure 1 The iscsi-initiator has been installed

- Separate the iSCSI SAN from the Local Area Network (LAN) by using a different network subnet and different switches. For this example, net0 is set up for the LAN and net1 and net2 are set up for the SAN. They are in separate subnets. Verify using the following command:
ipadm show-addr

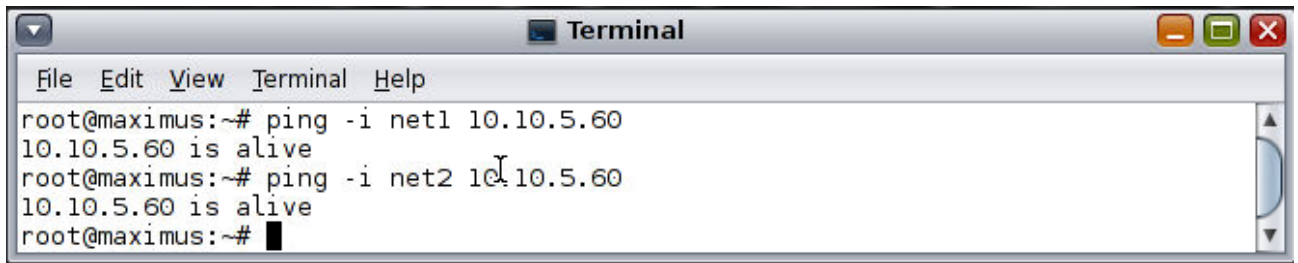


```
root@maximus:~# ipadm show-addr
ADDROBJ      TYPE      STATE      ADDR
lo0/v4       static    ok         127.0.0.1/8
net0/v4       static    ok         10.124.4.182/22
net1/v4       static    ok         10.10.6.190/16
net2/v4       static    ok         10.10.6.191/16
net6/v4       static    ok         169.254.182.77/24
lo0/v6       static    ok         ::1/128
net0/v6       addrconf ok         fe80::221:28ff:fe80:d2b2/10
net0/v6       addrconf ok         fc00:495::221:28ff:fe80:d2b2/64
root@maximus:~#
```

Figure 2 net0 is the LAN, net1 and net2 are set up for the SAN

- Verify that each Network Interface Card (NIC) being used for SAN traffic can access the PS Series Group IP address. For this example, the host has two NICs and the Group IP address is 10.10.6.50.
ping -i net1 10.10.5.60
ping -i net2 10.10.5.60

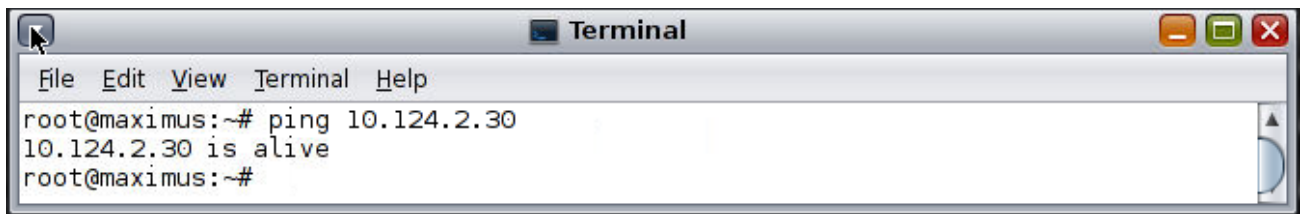




```
File Edit View Terminal Help
root@maximus:~# ping -i net1 10.10.5.60
10.10.5.60 is alive
root@maximus:~# ping -i net2 10.10.5.60
10.10.5.60 is alive
root@maximus:~#
```

Figure 3 Both host SAN NICs can access the array's Group IP address

- Verify that the host can also access the PS Series Management IP address (if the Management IP address has been implemented). In this example the Management IP address is 10.124.2.30.
ping 10.124.2.30



```
File Edit View Terminal Help
root@maximus:~# ping 10.124.2.30
10.124.2.30 is alive
root@maximus:~#
```

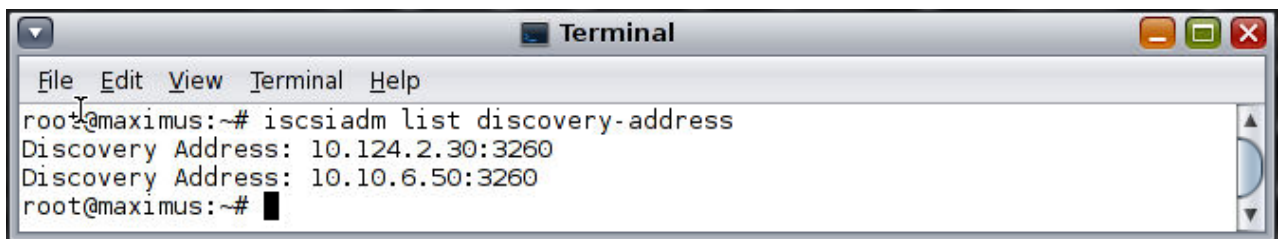
Figure 4 The Management IP address can be successfully accessed by the host

2 Integration of a Solaris 11 host and an EqualLogic array

This section gives step-by-step instructions on how to configure the iSCSI initiator, create an iSCSI LUN with a ZFS file system, monitor, and how to remove a discovered iSCSI target. A volume named solaris-vol1 was previously created on the EqualLogic array. For more information about configuring iSCSI on an Oracle Solaris host, see the [Oracle Solaris Administration](http://docs.oracle.com/cd/E23824_01/html/821-1459/docinfo.html#scrolltoc) documentation on Devices and File Systems at http://docs.oracle.com/cd/E23824_01/html/821-1459/docinfo.html#scrolltoc.

2.1 Configuring the Solaris 11 iSCSI Initiator

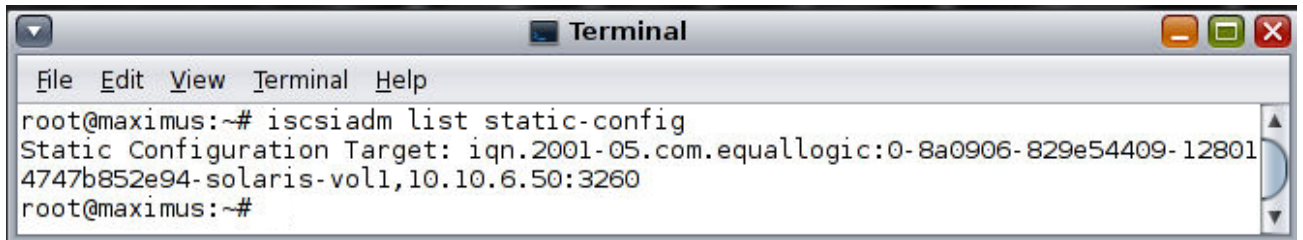
1. Enable the iSCSI initiator service.
svcadm enable network/iscsi/initiator
2. Add the array's Group IP address (10.10.6.50) for discovery of volumes.
iscsiadm add discovery-address 10.10.6.50
3. Verify that the discovery address was created.
iscsiadm list discovery-address



```
File Edit View Terminal Help
root@maximus:~# iscsiadm list discovery-address
Discovery Address: 10.124.2.30:3260
Discovery Address: 10.10.6.50:3260
root@maximus:~#
```

Figure 5 The discovery address 10.10.6.50:3250 was successfully created

4. List potential target volumes for log in. Find iqn and Target Address of the volume, (solaris1-vol1), from the list.
iscsiadm list discovery-address -v
5. Configure the target volume to be statically discovered using the iqn and Target Address from the previous step.
iscsiadm add static-config iqn.2001-05.com.equallogic:0-8a0906-829a54409-128014747b852e94-solaris-vol1,10.10.6.50
6. Verify the static configuration information.
iscsiadm list static-config

A terminal window titled "Terminal" with a menu bar (File, Edit, View, Terminal, Help). The command prompt shows the user is root@maximus. The command executed is `iscsiadm list static-config`. The output is: `Static Configuration Target: iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1,10.10.6.50:3260`. The prompt returns to `root@maximus:~#`.

```
root@maximus:~# iscsiadm list static-config
Static Configuration Target: iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1,10.10.6.50:3260
root@maximus:~#
```

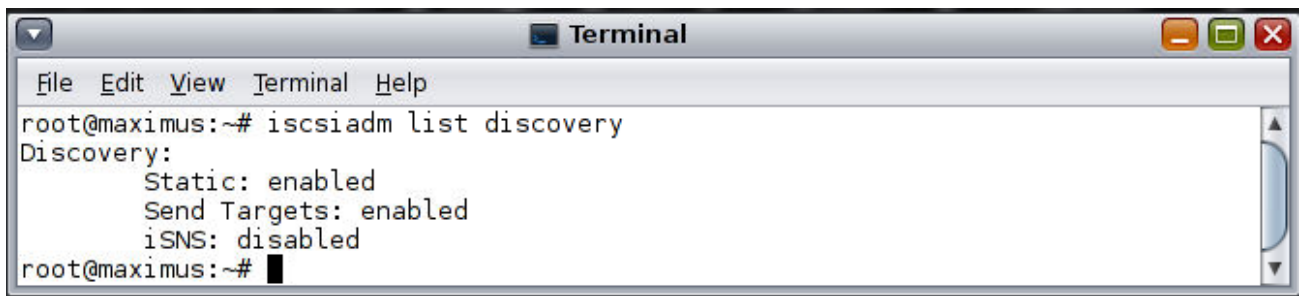
Figure 6 The Static Configuration Target was successfully configured

7. Enable the static target discovery method. There are two other target discovery methods, sendtargets and iSNS. The iSCSI connection will not be initiated until one of the discovery methods is enabled.

```
# iscsiadm modify discovery --static enable
```

8. Verify the static target discovery method was enabled.

```
# iscsiadm list discovery
```

A terminal window titled "Terminal" with a menu bar (File, Edit, View, Terminal, Help). The command prompt shows the user is root@maximus. The command executed is `iscsiadm list discovery`. The output is: `Discovery: Static: enabled Send Targets: enabled iSNS: disabled`. The prompt returns to `root@maximus:~#`.

```
root@maximus:~# iscsiadm list discovery
Discovery:
    Static: enabled
    Send Targets: enabled
    iSNS: disabled
root@maximus:~#
```


Figure 7 The Static target discovery method was enabled

9. List the currently configured target volume.

```
# iscsiadm list target -S
```

10. It might be necessary to reconfigure the /dev namespace to recognize the iSCSI disk if the previous command does not show the configured target volume.

```
# devfsadm -i iscsi
```

```
root@maximus:~# iscsiadm list target -S iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1
Target: iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1
Alias: -
TPGT: 1
ISID: 4000002a0001
Connections: 0

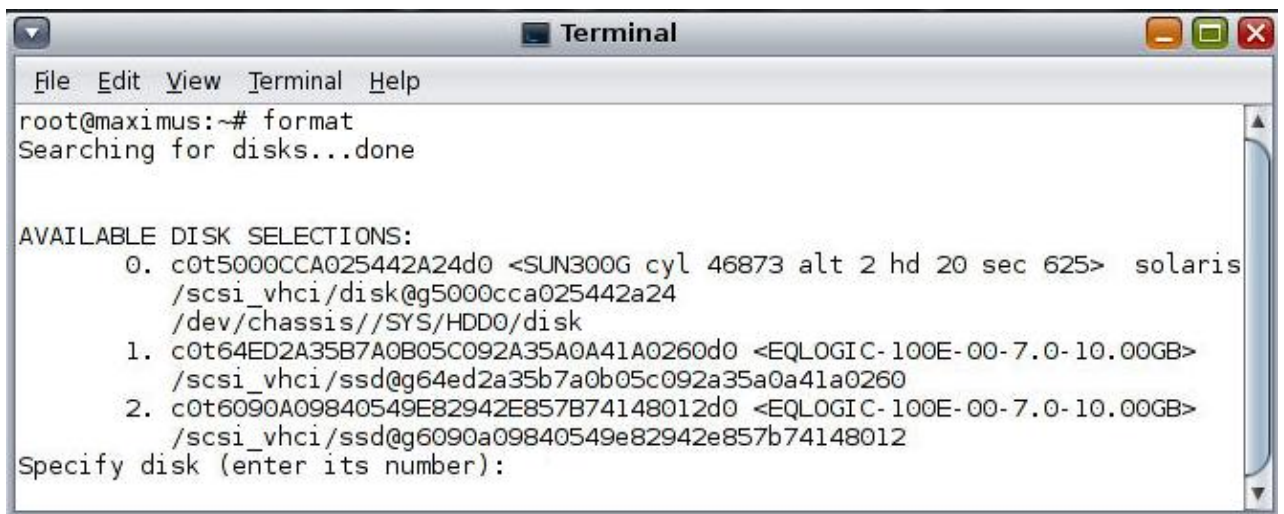
Target: iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1
Alias: solaris-vol1
TPGT: 1
ISID: 4000002a0000
Connections: 1
LUN: 0
Vendor: EQLOGIC
Product: 100E-00
OS Device Name: /dev/rdisk/c0t6090A09840549E82942E857B74148012d0s2

root@maximus:~#
```

Figure 8 The target volume, solaris-vol1, has been configured and has one connection

2.2 Accessing iSCSI disks from a Solaris host using ZFS

1. View iSCSI disks on the Solaris host by using the format utility. In the output below, disk2 is the iSCSI LUN.
format



```
root@maximus:~# format
Searching for disks...done

AVAILABLE DISK SELECTIONS:
  0. c0t5000CCA025442A24d0 <SUN300G cyl 46873 alt 2 hd 20 sec 625>  solaris
    /scsi_vhci/disk@g5000cca025442a24
    /dev/chassis//SYS/HDD0/disk
  1. c0t64ED2A35B7A0B05C092A35A0A41A0260d0 <EQLOGIC-100E-00-7.0-10.00GB>
    /scsi_vhci/ssd@g64ed2a35b7a0b05c092a35a0a41a0260
  2. c0t6090A09840549E82942E857B74148012d0 <EQLOGIC-100E-00-7.0-10.00GB>
    /scsi_vhci/ssd@g6090a09840549e82942e857b74148012
Specify disk (enter its number):
```

Figure 9 List of available disks - disk number 1 was used

2. Create a ZFS storage pool and ZFS file system on the iSCSI LUN. The pool-name is vols and the fs-name is solaris-vol1. The ZFS file system will be automatically mounted when created and will be mounted at boot time.
zpool create vols c0t64ED2A35B7A0B05C092A35A0A41A0260d0

zfs create vols/solaris-vol1
3. Verify the file system was created and mounted.
df -h

```

root@maximus:~# df -h
Filesystem                Size      Used    Available Capacity  Mounted on
rpool/ROOT/solaris        274G      4.3G      256G         2%      /
/devices                  0K         0K         0K         0%      /devices
/dev                      0K         0K         0K         0%      /dev
ctfs                      0K         0K         0K         0%      /system/contract
proc                      0K         0K         0K         0%      /proc
mnttab                    0K         0K         0K         0%      /etc/mnttab
swap                      12G       2.8M       12G          1%      /system/volatile
objfs                     0K         0K         0K         0%      /system/object
sharefs                   0K         0K         0K         0%      /etc/dfs/sharetab
fd                         0K         0K         0K         0%      /dev/fd
rpool/ROOT/solaris/var    274G      293M       256G         1%      /var
swap                      12G       64M       12G          1%      /tmp
rpool/VARSHARE            274G      168K       256G         1%      /var/share
rpool/export              274G       32K       256G         1%      /export
rpool/export/home         274G       31K       256G         1%      /export/home
rpool                     274G       73K       256G         1%      /rpool
/dev/dsk/c2t6d0s2         678M      678M         0K        100%      /media/Oracle_Solaris-11
_l-Text-SPARC
vols                       9.8G       32K       9.8G          1%      /vols
vols/solaris-vol1         9.8G       31K       9.8G          1%      /vols/solaris-vol1
root@maximus:~#

```


Figure 10 The file system /vols/solaris-vol1 was mounted successfully

2.3 Information about Multipath I/O

Solaris 11 Multiplexed I/O (MPxIO) gives you the ability to set up multiple redundant paths to a storage system and gives you the benefits of load balancing and failover. Unfortunately, MPxIO is not supported with EqualLogic arrays because EqualLogic arrays do not support bonding/trunking. In order to have true Multipathing on EqualLogic arrays, the Solaris iSCSI initiator would have to support the creation of unique iSCSI sessions from each NIC. Some redundancy can be achieved by combining MPxIO and IP network multipathing (IPMP), but this configuration would not be true MPIO.

2.4 Monitoring the iSCSI configuration

1. Display information about the iSCSI initiator.
iscsiadm list initiator-node

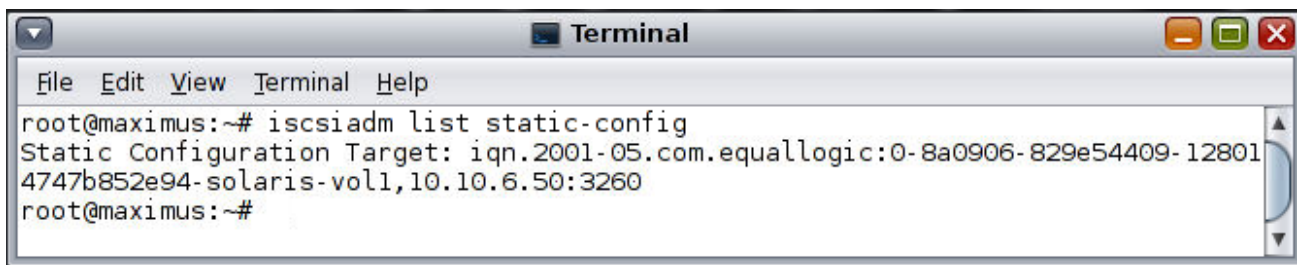


```
root@maximus:~# iscsiadm list initiator-node
Initiator node name: iqn.2001-05.com.equallogic:node1
Initiator node alias: equallogic
  Login Parameters (Default/Configured):
    Header Digest: NONE/-
    Data Digest: NONE/-
    Max Connections: 65535/-
  Authentication Type: NONE
  RADIUS Server: NONE
  RADIUS Access: disabled
  Tunable Parameters (Default/Configured):
    Session Login Response Time: 60/-
    Maximum Connection Retry Time: 180/-
    Login Retry Time Interval: 60/-
  Configured Sessions: 10.10.6.190 10.10.6.191
root@maximus:~#
```

Figure 11 Information about the initiator-node (host)

2. Display information about the Static Configuration Target.

```
# iscsiadm list static-config
```

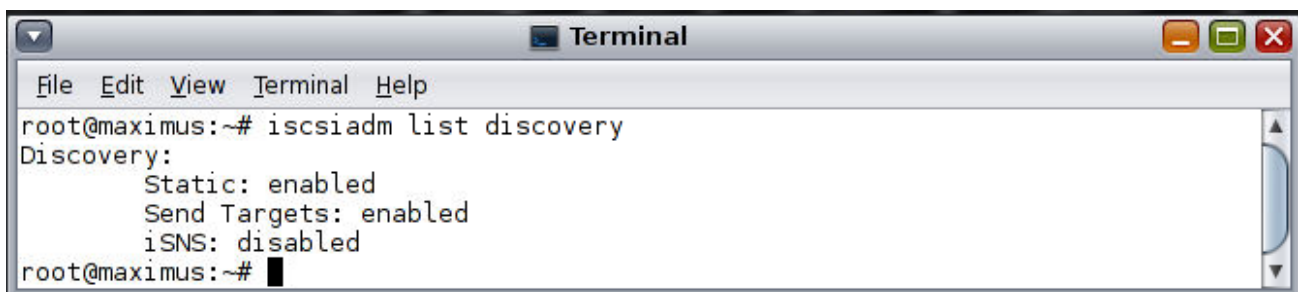


```
root@maximus:~# iscsiadm list static-config
Static Configuration Target: iqn.2001-05.com.equallogic:0-8a0906-829e54409-12801
4747b852e94-solaris-vol1,10.10.6.50:3260
root@maximus:~#
```

Figure 12 This displays the iqn, volume name and group IP address of the array

3. Display enabled discovery methods.

```
# iscsiadm list discovery
```

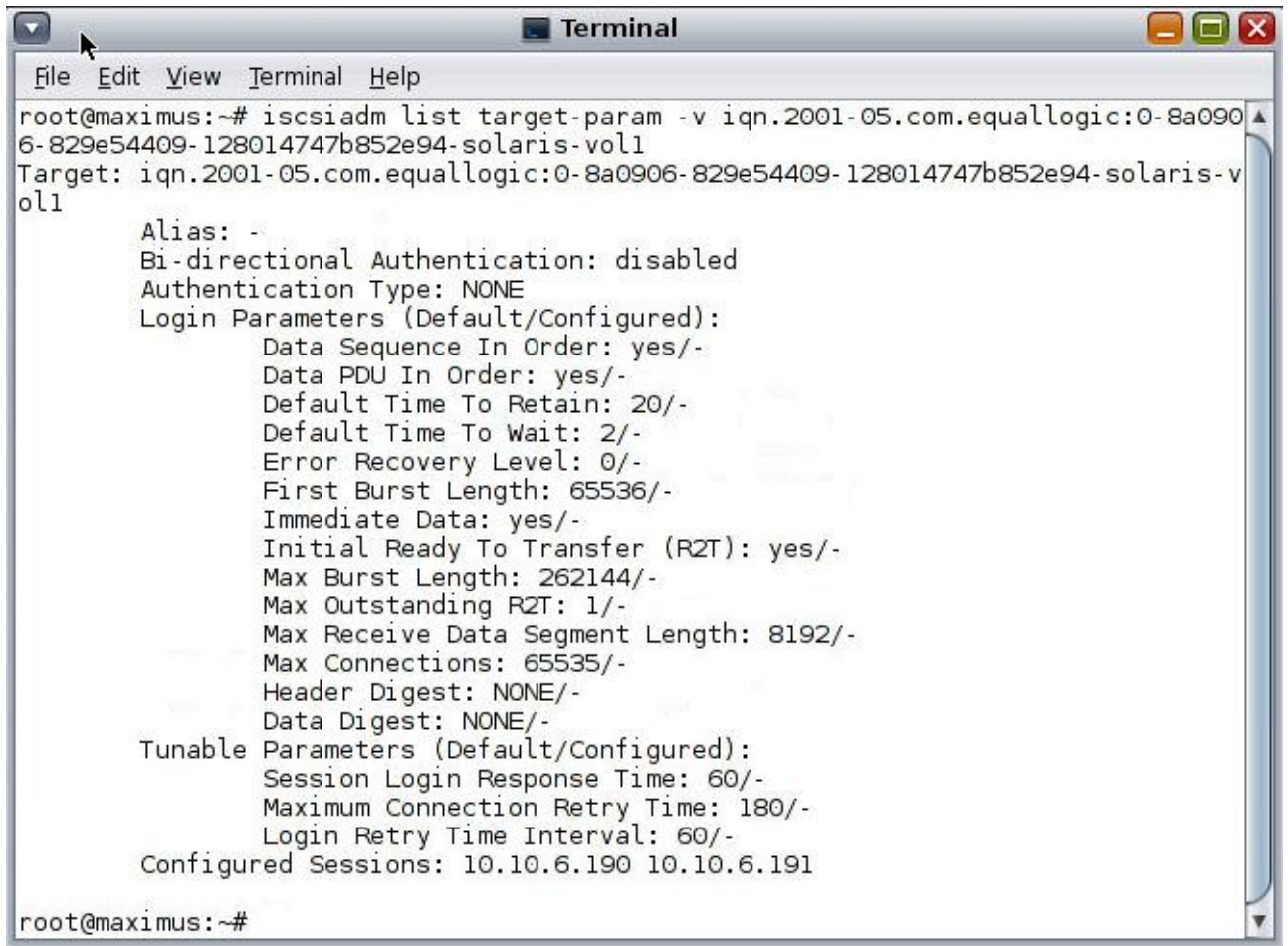


```
root@maximus:~# iscsiadm list discovery
Discovery:
  Static: enabled
  Send Targets: enabled
  iSNS: disabled
root@maximus:~#
```

Figure 13 The Static target discovery method has been enabled

4. Display information about a specific iSCSI target.

```
# iscsiadm list target-param -v iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1
```

A screenshot of a Linux terminal window titled "Terminal". The window has a menu bar with "File", "Edit", "View", "Terminal", and "Help". The terminal shows the command `iscsiadm list target-param -v iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1` being executed. The output displays various iSCSI target parameters, including authentication settings, login parameters, and tunable parameters. The prompt `root@maximus:~#` is visible at the bottom.

```
root@maximus:~# iscsiadm list target-param -v iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1
Target: iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1
Alias: -
Bi-directional Authentication: disabled
Authentication Type: NONE
Login Parameters (Default/Configured):
    Data Sequence In Order: yes/-
    Data PDU In Order: yes/-
    Default Time To Retain: 20/-
    Default Time To Wait: 2/-
    Error Recovery Level: 0/-
    First Burst Length: 65536/-
    Immediate Data: yes/-
    Initial Ready To Transfer (R2T): yes/-
    Max Burst Length: 262144/-
    Max Outstanding R2T: 1/-
    Max Receive Data Segment Length: 8192/-
    Max Connections: 65535/-
    Header Digest: NONE/-
    Data Digest: NONE/-
Tunable Parameters (Default/Configured):
    Session Login Response Time: 60/-
    Maximum Connection Retry Time: 180/-
    Login Retry Time Interval: 60/-
Configured Sessions: 10.10.6.190 10.10.6.191
root@maximus:~#
```

Figure 14 List of default and configurable target parameters and configured sessions

5. Display the parameters that were negotiated between the target and the initiator.

```
# iscsiadm list target -v iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1
```



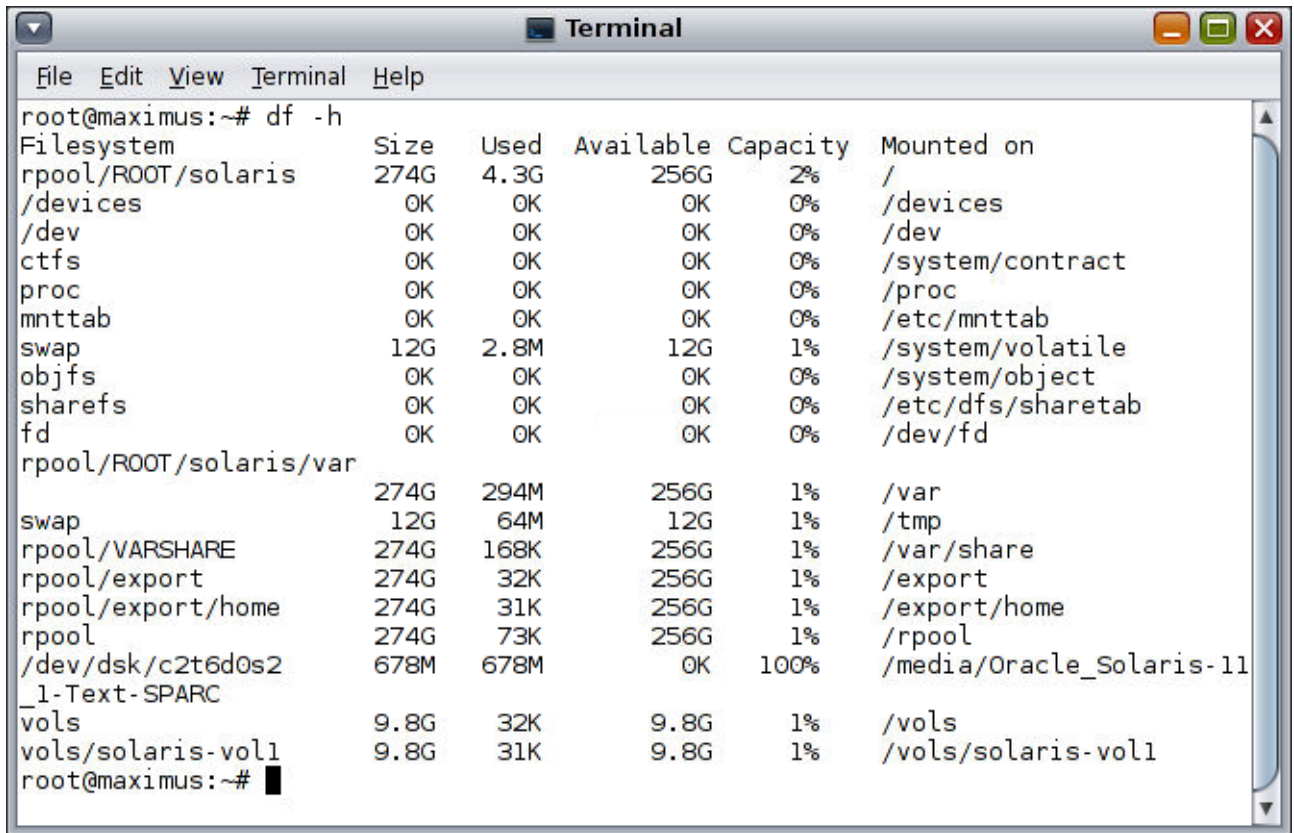
```
Terminal
File Edit View Terminal Help
root@maximus:~# iscsiadm list target -v iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-voll
Target: iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-voll
Alias: -
TPGT: 1
ISID: 4000002a0001
Connections: 0
Discovery Method: SendTargets
Login Parameters (Negotiated):
Data Sequence In Order: -
Data PDU In Order: -
Default Time To Retain: -
Default Time To Wait: -
Error Recovery Level: -
First Burst Length: -
Immediate Data: -
Initial Ready To Transfer (R2T): -
Max Burst Length: -
Max Outstanding R2T: -
Max Receive Data Segment Length: -
Max Connections: -
Header Digest: -
Data Digest: -
Target: iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-voll
Alias: solaris-voll
TPGT: 1
ISID: 4000002a0001
Connections: 1
CID: 0
IP address (Local): 10.10.6.190:39082
IP address (Peer): 10.10.6.57:3260
Discovery Method: SendTargets
Login Parameters (Negotiated):
Data Sequence In Order: yes
Data PDU In Order: yes
Default Time To Retain: 20
Default Time To Wait: 2
Error Recovery Level: 0
First Burst Length: 65536
Immediate Data: yes
Initial Ready To Transfer (R2T): yes
Max Burst Length: 262144
Max Outstanding R2T: 1
Max Receive Data Segment Length: 65536
Max Connections: 1
Header Digest: NONE
Data Digest: NONE
root@maximus:~#
```

Figure 15 Verbose list of target parameters

2.5 Removing a static iSCSI target

1. Display the ZFS file system to be removed.

```
# df -h
```



The image shows a terminal window titled "Terminal" with a menu bar (File, Edit, View, Terminal, Help). The command "df -h" has been executed, displaying a table of mounted file systems. The table has columns for Filesystem, Size, Used, Available, Capacity, and Mounted on. The output lists various file systems including rpool/ROOT/solaris, /devices, /dev, ctfs, proc, mnttab, swap, objfs, sharefs, fd, rpool/ROOT/solaris/var, rpool/VARSHARE, rpool/export, rpool/export/home, rpool, /dev/dsk/c2t6d0s2, _l-Text-SPARC, vols, and vols/solaris-vol1.

Filesystem	Size	Used	Available	Capacity	Mounted on
rpool/ROOT/solaris	274G	4.3G	256G	2%	/
/devices	OK	OK	OK	0%	/devices
/dev	OK	OK	OK	0%	/dev
ctfs	OK	OK	OK	0%	/system/contract
proc	OK	OK	OK	0%	/proc
mnttab	OK	OK	OK	0%	/etc/mnttab
swap	12G	2.8M	12G	1%	/system/volatile
objfs	OK	OK	OK	0%	/system/object
sharefs	OK	OK	OK	0%	/etc/dfs/sharetab
fd	OK	OK	OK	0%	/dev/fd
rpool/ROOT/solaris/var	274G	294M	256G	1%	/var
swap	12G	64M	12G	1%	/tmp
rpool/VARSHARE	274G	168K	256G	1%	/var/share
rpool/export	274G	32K	256G	1%	/export
rpool/export/home	274G	31K	256G	1%	/export/home
rpool	274G	73K	256G	1%	/rpool
/dev/dsk/c2t6d0s2	678M	678M	OK	100%	/media/Oracle_Solaris-11
_l-Text-SPARC					
vols	9.8G	32K	9.8G	1%	/vols
vols/solaris-vol1	9.8G	31K	9.8G	1%	/vols/solaris-vol1

Figure 16 Listing of the mounted file systems

2. Unmount the file system.

```
# umount /vols/solaris-vol1
```

3. Verify that the file system (solaris-vol1) has been unmounted.

```
# df -h
```

```

root@maximus:~# df -h
Filesystem                Size      Used    Available Capacity  Mounted on
rpool/ROOT/solaris        274G      4.3G      256G         2%      /
/devices                  OK        OK         OK         0%      /devices
/dev                      OK        OK         OK         0%      /dev
ctfs                      OK        OK         OK         0%      /system/contract
proc                      OK        OK         OK         0%      /proc
mnttab                    OK        OK         OK         0%      /etc/mnttab
swap                      12G       2.8M       12G          1%      /system/volatile
objfs                     OK        OK         OK         0%      /system/object
sharefs                    OK        OK         OK         0%      /etc/dfs/sharetab
fd                         OK        OK         OK         0%      /dev/fd
rpool/ROOT/solaris/var    274G      294M       256G         1%      /var
swap                      12G       64M       12G          1%      /tmp
rpool/VARSHARE             274G      168K       256G         1%      /var/share
rpool/export              274G       32K       256G         1%      /export
rpool/export/home         274G       31K       256G         1%      /export/home
rpool                     274G       73K       256G         1%      /rpool
/dev/dsk/c2t6d0s2         678M      678M         0K        100%      /media/Oracle_Solaris-11
_1-Text-SPARC
vols                       9.8G       32K       9.8G          1%      /vols
root@maximus:~#

```

Figure 17 The /vols/solaris-vol1 file system has been unmounted

4. Delete the ZFS pool.
zpool destroy vols
5. Verify that the pool (vols) has been deleted.
df -h

```

root@maximus:~# df -h
Filesystem                Size      Used    Available Capacity  Mounted on
rpool/ROOT/solaris        274G      4.3G      256G         2%      /
/devices                  OK        OK         OK         0%      /devices
/dev                      OK        OK         OK         0%      /dev
ctfs                      OK        OK         OK         0%      /system/contract
proc                     OK        OK         OK         0%      /proc
mnttab                    OK        OK         OK         0%      /etc/mnttab
swap                      12G       2.8M      12G          1%      /system/volatile
objfs                     OK        OK         OK         0%      /system/object
sharefs                   OK        OK         OK         0%      /etc/dfs/sharetab
fd                        OK        OK         OK         0%      /dev/fd
rpool/ROOT/solaris/var    274G      294M      256G         1%      /var
swap                      12G       64M      12G          1%      /tmp
rpool/VARSHARE            274G      168K      256G         1%      /var/share
rpool/export              274G       32K      256G         1%      /export
rpool/export/home         274G       31K      256G         1%      /export/home
rpool                     274G       73K      256G         1%      /rpool
/dev/dsk/c2t6d0s2         678M      678M         OK        100%     /media/Oracle_Solaris-11
_1-Text-SPARC
root@maximus:~#

```

Figure 18 The ZFS pool, vols, has been deleted

6. Disable discovery mode.
iscsiadm modify discovery --static disable
7. Verify discovery mode has been disabled.
#iscsiadm list discovery

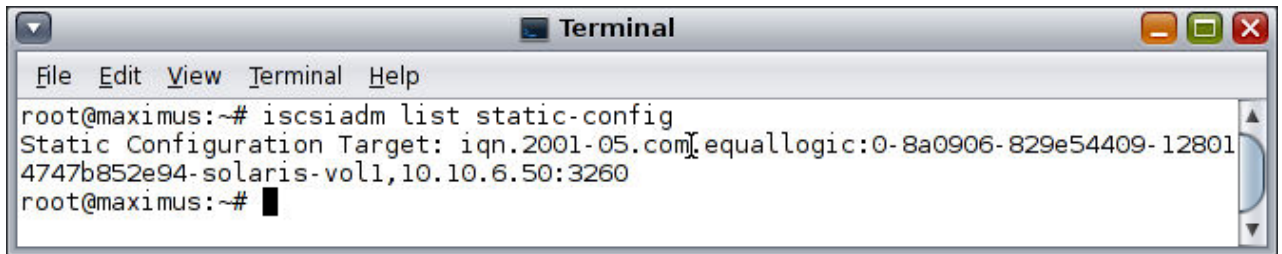
```

root@maximus:~# iscsiadm list discovery
Discovery:
    Static: disabled
    Send Targets: disabled
    iSNS: disabled
root@maximus:~#

```

Figure 19 The Static discovery mode has been disabled

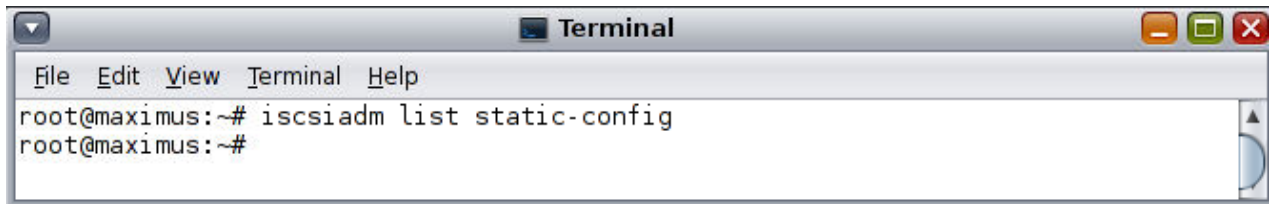
8. Display information about the Static Configuration Target.
iscsiadm list static-config



```
root@maximus:~# iscsiadm list static-config
Static Configuration Target: iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1,10.10.6.50:3260
root@maximus:~#
```

Figure 20 This information is needed to remove the Static Configuration Target

9. Remove the Static Configuration Target.
iscsiadm remove static-config iqn.2001-05.com.equallogic:0-8a0906-829e54409-128014747b852e94-solaris-vol1,10.10.6.50:3260
10. Verify that Static Configuration Target has been removed.
iscsiadm list static-config



```
root@maximus:~# iscsiadm list static-config
root@maximus:~#
```

Figure 21 The Static Configuration Target has been removed