

Getting to know Linux-IO: Building a quick and easy iSCSI SAN on Linux

Kirk Kosinski

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About me

- Citrix Systems / Cloud.com
 - Senior Escalation Engineer
 - Citrix CloudPlatform / Apache CloudStack
 - Apache CloudStack Committer
- Twitter – [@kirkkosinski](https://twitter.com/kirkkosinski)
- Blog – <https://kirkkosinski.com/>
- Certs
 - Citrix – XenDesktop, XenServer
 - VMware – VCP 4, 5
 - Microsoft – MCSA: 2003, 2008; MCITP: EA, VA

Why care about shared storage?

- Common uses
 - Clustering
 - Virtualization
- Learning
 - Certs, personal development
- Test / staging environment
- Production

Shared storage types

- File-based
- Block-based

Shared storage types (continued)

- File-based
 - Shares
 - “NAS”
 - NFS, SMB/CIFS
- Block-based
 - LUNs
 - “SAN”
 - Fibre Channel, iSCSI

iSCSI basics

- Software based
- Client/server model
 - Client is the “initiator”
 - Server is the “target”
 - 3260/tcp
- IQN
 - iqn.2015-02.org.socallinuxexpo:targetname-1234
 - iqn.1994-05.com.redhat:abcd1234
- LUN
- iSNS

Free, “easy” solutions

- Openfiler
- FreeNAS
- Nexenta
- StarWind

Free, “easy” solutions (continued)

- Openfiler
 - Linux
- FreeNAS
 - FreeBSD
- Nexenta
 - Solaris
- StarWind
 - Windows

Solutions included with OS

- Linux
- *BSD
- Solaris
- Windows

Solutions included with OS (continued)

- Linux
 - Linux-IO, md
- *BSD
 - istgt, OpenZFS
- Solaris, OpenIndiana
 - COMSTAR, ZFS
- Windows Server
 - 2008 R2: Optional download
 - 2012: iSCSI Target Server role

Linux iSCSI history

- IET
 - <http://iscsitarget.sourceforge.net/>
- SCST
 - <http://scst.sourceforge.net/>
- STGT
 - <http://stgt.sourceforge.net/>
- Linux-IO
 - <http://linux-iscsi.org/wiki/LIO>

Preparing for Linux-IO

- Install Linux
 - Fedora, Ubuntu, Arch, etc.
- Prepare disks
 - Configure hardware RAID arrays, md, etc.
- Configure network, firewall
 - Open ports, allow IPs of initiators, etc.

Installing Linux-IO

- Subsystem included with Linux kernel
 - Enable `CONFIG_ISCSI_TARGET`
 - `target_core_mod`, `iscsi_target_mod`
- Libraries
 - RTSLib
 - “`python-rtslib`” package (Fedora, Ubuntu)
- UI
 - `targetcli`
 - “`targetcli`” package (Fedora, Ubuntu)

Installing Linux-IO (Fedora 21)

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help
--> Running transaction check
--> Package pyparsing.noarch 0:2.0.3-1.fc21 will be installed
--> Package python-kmod.x86_64 0:0.9-6.fc21 will be installed
--> Package python-urwid.x86_64 0:1.2.1-2.fc21 will be installed
--> Finished Dependency Resolution

Dependencies Resolved

=====
Package           Arch    Version      Repository  Size
=====
Installing:
targetcli          noarch  2.1.fb39-1.fc21   updates     65 k
Installing for dependencies:
pyparsing          noarch  2.0.3-1.fc21   updates     103 k
python-configshell  noarch  1:1.1.fb17-1.fc21  updates     72 k
python-ethtool       x86_64  0.11-3.fc21   fedora      37 k
python-kmod          x86_64  0.9-6.fc21   fedora      70 k
python-rtplib         noarch  2.1.fb52-1.fc21  updates     91 k
python-urwid          x86_64  1.2.1-2.fc21  fedora     768 k

Transaction Summary
=====
Install 1 Package (+6 Dependent packages)

Total download size: 1.2 M
Installed size: 4.8 M
Is this ok [y/d/N]: █
```

Configuring Linux-IO (basics)

- target service
 - Loads modules, applies the configuration
 - /etc/target/saveconfig.json
- targetcli
 - Creates the configuration
 - Follows some *nix conventions (e.g. ls, cd)
 - Multiple modes
 - Interactive shell
 - Tab completion

Configuring Linux-IO (targetcli use)

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help
[root@localhost ~]# targetcli ls
Warning: Could not load preferences file /root/.targetcli/prefs.bin.
o- /
  o- backstores ..... [ ... ]
    | o- block ..... [Storage Objects: 0]
    | o- fileio ..... [Storage Objects: 0]
    | o- pscsci ..... [Storage Objects: 0]
    | o- ramdisk ..... [Storage Objects: 0]
    | o- user ..... [Storage Objects: 0]
    o- iscsi ..... [Targets: 0]
    o- loopback ..... [Targets: 0]
    o- vhost ..... [Targets: 0]
[root@localhost ~]# targetcli
targetcli shell version 2.1.fb39
Copyright 2011-2013 by Datera, Inc and others.
For help on commands, type 'help'.

/> ls
o- /
  o- backstores ..... [ ... ]
    | o- block ..... [Storage Objects: 0]
    | o- fileio ..... [Storage Objects: 0]
    | o- pscsci ..... [Storage Objects: 0]
    | o- ramdisk ..... [Storage Objects: 0]
    | o- user ..... [Storage Objects: 0]
    o- iscsi ..... [Targets: 0]
    o- loopback ..... [Targets: 0]
    o- vhost ..... [Targets: 0]
(root) 192.168.122.41
```

Configuring Linux-IO (overview)

- 1) Create backstore(s) (files, block devices)
- 2) Create target
- 3) Create portal group for target from 2)
- 4) Add initiators to portal group from 3)
- 5) Create LUN in portal group from 3) for backstore(s) from 1)
- 6) Configure or disable authentication for portal group
- 7) Save configuration
- 8) Configure initiators to access target

Configuring Linux-IO (backstore)

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help
/> cd backstores/block
/backstores/block> create bs0 /dev/vdb
Created block storage object bs0 using /dev/vdb.
/backstores/block> ls
o- block ..... [Storage Objects: 1]
  o- bs0 ..... [/dev/vdb (8.0GiB) write-thru deactivated]
/backstores/block> cd /
/> ls
o- _ ..... [...]
  o- backstores ..... [...]
    | o- block ..... [Storage Objects: 1]
    |   | o- bs0 ..... [/dev/vdb (8.0GiB) write-thru deactivated]
    | o- fileio ..... [Storage Objects: 0]
    | o- pscsci ..... [Storage Objects: 0]
    | o- ramdisk ..... [Storage Objects: 0]
    | o- user ..... [Storage Objects: 0]
    o- iscsi ..... [Targets: 0]
    o- loopback ..... [Targets: 0]
    o- vhost ..... [Targets: 0]
/>
```

Configuring Linux-IO (target)

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help
/> cd iscsi
/iscsi> create
Created target iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa.
Created TPG 1.
Global pref auto_add_default_portal=true
Created default portal listening on all IPs (0.0.0.0), port 3260.
/iscsi> cd /
/> ls
o- _ ..... [ ... ]
  o- backstores ..... [ ... ]
    | o- block ..... [Storage Objects: 1]
    |   | o- bs0 ..... [/dev/vdb (8.0GiB) write-thru deactivated]
    | o- fileio ..... [Storage Objects: 0]
    | o- pscsi ..... [Storage Objects: 0]
    | o- ramdisk ..... [Storage Objects: 0]
    | o- user ..... [Storage Objects: 0]
  o- iscsi ..... [Targets: 1]
    | o- iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa ..... [TPGs: 1]
      o- tpg1 ..... [no-gen-acls, no-auth]
        o- acls ..... [ACLs: 0]
        o- luns ..... [LUNs: 0]
        o- portals ..... [Portals: 1]
          o- 0.0.0.0:3260 ..... [OK]
  o- loopback ..... [Targets: 0]
  o- vhost ..... [Targets: 0]
/>
```

Configuring Linux-IO (portal group)

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help
/> cd iscsi/iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa/tpg1/portals
ls/
/iscsi/iqn.20.../tpg1/portals> delete 0.0.0.0 ip_port=3260
Deleted network portal 0.0.0.0:3260
/iscsi/iqn.20.../tpg1/portals> create 192.168.122.41
Using default IP port 3260
Created network portal 192.168.122.41:3260.
/iscsi/iqn.20.../tpg1/portals> cd /
/> ls
o- / ..... [...]
  o- backstores ..... [...]
    o- block ..... [Storage Objects: 1]
      | o- bs0 ..... [/dev/vdb (8.0GiB) write-thru deactivated]
    o- fileio ..... [Storage Objects: 0]
    o- pscsi ..... [Storage Objects: 0]
    o- ramdisk ..... [Storage Objects: 0]
    o- user ..... [Storage Objects: 0]
  o- iscsi ..... [Targets: 1]
    o- iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa ..... [TPGs: 1]
      o- tpg1 ..... [no-gen-acls, no-auth]
        o- acls ..... [ACLs: 0]
        o- luns ..... [LUNs: 0]
        o- portals ..... [Portals: 1]
          o- 192.168.122.41:3260 ..... [OK]
    o- loopback ..... [Targets: 0]
    o- vhost ..... [Targets: 0]
/>
```

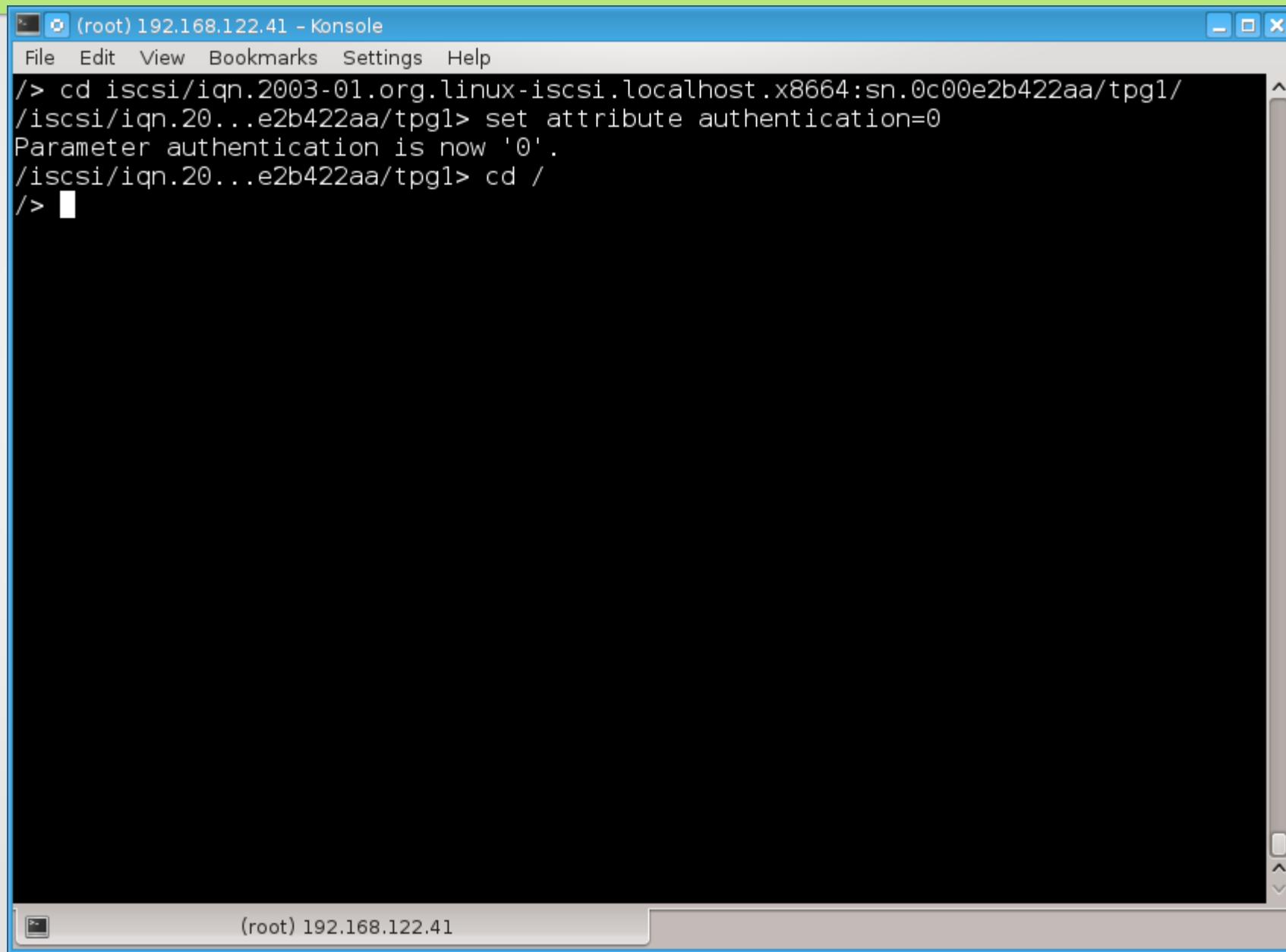
Configuring Linux-IO (initiators)

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help
/> cd iscsi/iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa/tpg1/acls
/iscsi/iqn.20...2aa/tpg1/acls> create iqn.1994-05.com.redhat:a9727874c152
Created Node ACL for iqn.1994-05.com.redhat:a9727874c152
/iscsi/iqn.20...2aa/tpg1/acls> create iqn.1994-05.com.redhat:7ba3eaf293b5
Created Node ACL for iqn.1994-05.com.redhat:7ba3eaf293b5
/iscsi/iqn.20...2aa/tpg1/acls> cd /
/> ls
o- .
o- backstores
| o- block ..... [Storage Objects: 1]
| | o- bs0 ..... [/dev/vdb (8.0GiB) write-thru deactivated]
| o- fileio ..... [Storage Objects: 0]
| o- pscsi ..... [Storage Objects: 0]
| o- ramdisk ..... [Storage Objects: 0]
| o- user ..... [Storage Objects: 0]
o- iscsi ..... [Targets: 1]
| o- iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa ..... [TPGs: 1]
| | o- tpg1 ..... [no-gen-acls, no-auth]
| | | o- acls ..... [ACLs: 2]
| | | | o- iqn.1994-05.com.redhat:7ba3eaf293b5 ..... [Mapped LUNs: 0]
| | | | o- iqn.1994-05.com.redhat:a9727874c152 ..... [Mapped LUNs: 0]
| | | o- luns ..... [LUNs: 0]
| | | o- portals ..... [Portals: 1]
| | | | o- 192.168.122.41:3260 ..... [OK]
o- loopback ..... [Targets: 0]
o- vhost ..... [Targets: 0]
/>
```

Configuring Linux-IO (LUN)

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help
/> cd iscsi/iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa/tpg1/luns
/iscsi/iqn.20...2aa/tpg1/luns> create /backstores/block/bs0
Created LUN 0.
Created LUN 0->0 mapping in node ACL iqn.1994-05.com.redhat:7ba3eaf293b5
Created LUN 0->0 mapping in node ACL iqn.1994-05.com.redhat:a9727874c152
/iscsi/iqn.20...2aa/tpg1/luns> cd /
/> ls
o- .
o- backstores
| o- block ..... [Storage Objects: 1] [/dev/vdb (8.0GiB) write-thru activated]
| | o- bs0 ..... [/dev/vdb (8.0GiB) write-thru activated]
| o- fileio ..... [Storage Objects: 0]
| o- pscsi ..... [Storage Objects: 0]
| o- ramdisk ..... [Storage Objects: 0]
| o- user ..... [Storage Objects: 0]
o- iscsi ..... [Targets: 1]
| o- iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa ..... [TPGs: 1]
| | o- tpg1 ..... [no-gen-acls, no-auth]
| | | o- acls ..... [ACLs: 2]
| | | | o- iqn.1994-05.com.redhat:7ba3eaf293b5 ..... [Mapped LUNs: 1]
| | | | | o- mapped_lun0 ..... [lun0 block/bs0 (rw)]
| | | | | o- iqn.1994-05.com.redhat:a9727874c152 ..... [Mapped LUNs: 1]
| | | | | o- mapped_lun0 ..... [lun0 block/bs0 (rw)]
| | | o- luns ..... [LUNs: 1]
| | | | o- lun0 ..... [block/bs0 (/dev/vdb)]
| | | o- portals ..... [Portals: 1]
| | | | o- 192.168.122.41:3260 ..... [OK]
o- loopback ..... [Targets: 0]
```

Configuring Linux-IO (authentication)



The screenshot shows a terminal window titled '(root) 192.168.122.41 - Konsole'. The window contains the following command-line session:

```
/> cd iscsi/iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa/tpg1/
/iscsi/iqn.20...e2b422aa/tpg1> set attribute authentication=0
Parameter authentication is now '0'.
/iscsi/iqn.20...e2b422aa/tpg1> cd /
/> █
```

The terminal window has a blue header bar with standard menu options: File, Edit, View, Bookmarks, Settings, Help. The status bar at the bottom also displays the root prompt and IP address.

Configuring Linux-IO (save)

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help

/> ls
o- /
  o- backstores
    | o- block ...
    | | o- bs0 ... [/dev/vdb (8.0GiB) write-thru activated]
    | o- fileio ...
    | o- pscsi ...
    | o- ramdisk ...
    | o- user ...
  o- iscsi
    o- iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa [TPGs: 1]
      o- tpg1 [no-gen-acls, no-auth]
        o- acls
          | o- iqn.1994-05.com.redhat:7ba3eaf293b5 [Mapped LUNs: 1]
          | | o- mapped_lun0 [lun0 block/bs0 (rw)]
          | o- iqn.1994-05.com.redhat:a9727874c152 [Mapped LUNs: 1]
          | | o- mapped_lun0 [lun0 block/bs0 (rw)]
        o- luns
          | o- lun0 [block/bs0 (/dev/vdb)]
        o- portals
          o- 192.168.122.41:3260 [OK]
  o- loopback ...
  o- vhost ...
/> saveconfig
Last 10 configs saved in /etc/target/backup.
Configuration saved to /etc/target/saveconfig.json
/>
```

Configuring Linux-IO (check port)

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help
/> exit
Global pref auto_save_on_exit=true
Last 10 configs saved in /etc/target/backup.
Configuration saved to /etc/target/saveconfig.json
[root@localhost ~]# netstat -plnt
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address       State      PI
D/Program name
tcp      0      0 192.168.122.41:3260     0.0.0.0:*
                                         LISTEN
tcp      0      0 0.0.0.0:22              0.0.0.0:*
                                         LISTEN      66
8/sshd
tcp6     0      0 :::22                  :::*          LISTEN      66
8/sshd
[root@localhost ~]#
```

Configuring Initiators (Fedora)

```
(root) 192.168.122.56 - Konsole
File Edit View Bookmarks Settings Help
[root@localhost ~]# cat /etc/iscsi/initiatorname.iscsi
InitiatorName=iqn.1994-05.com.redhat:a9727874c152
[root@localhost ~]# iscsiadadm -m discovery -t sendtargets -p 192.168.122.41
192.168.122.41:3260,1 iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b422aa
[root@localhost ~]# iscsiadadm -m node -T iqn.2003-01.org.linux-iscsi.localhost.x866
4:sn.0c00e2b422aa -l -p 192.168.122.41
Logging in to [iface: default, target: iqn.2003-01.org.linux-iscsi.localhost.x8664
:sn.0c00e2b422aa, portal: 192.168.122.41,3260] (multiple)
Login to [iface: default, target: iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0
c00e2b422aa, portal: 192.168.122.41,3260] successful.
[root@localhost ~]# fdisk -lu /dev/sda

Disk /dev/sda: 8 GiB, 8589934592 bytes, 16777216 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 4294963200 bytes
[root@localhost ~]# iscsiadadm -m node -T iqn.2003-01.org.linux-iscsi.localhost.x866
4:sn.0c00e2b422aa -u -p 192.168.122.41
Logging out of session [sid: 1, target: iqn.2003-01.org.linux-iscsi.localhost.x866
4:sn.0c00e2b422aa, portal: 192.168.122.41,3260]
Logout of [sid: 1, target: iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.0c00e2b4
22aa, portal: 192.168.122.41,3260] successful.
[root@localhost ~]#
```

Configuring Initiators (vSphere)

The screenshot shows the vSphere Web Client interface for managing storage adapters. On the left, the 'Storage Adapters' section lists various controllers and their ports. The 'SB700 SATA Controller [AHCI Mode]' section shows ports vmhba0 through vmhba37, all listed as 'Block SCSI'. The 'iSCSI Software Adapter' section shows port vmhba38, which is an 'iSCSI' adapter with iSCSI Name 'iqn.1998-01.com.vmware:esxi3-6f81207b' and iSCSI Alias 'vmhba38'. Below this, the 'Details' section provides summary information: Connected Targets: 1, Devices: 1, Paths: 1. The 'View' dropdown is set to 'Devices', and the table below shows one entry: 'LIO-ORG iSCSI Disk (naa.6001405d...)' with Runtime Name 'vmhba38:C0:T0:L0' and Mount Path '/'. On the right, the 'iSCSI Initiator (vmhba38) Properties' dialog is open, specifically the 'Dynamic Discovery' tab. It displays a table of discovered targets, with one entry for 'iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.C'. A modal dialog titled 'Add Static Target Server' is shown, prompting for 'ISCSI Server' (192.168.122.41), 'Port' (3260), and 'ISCSI Target Name' (iqn.2003-01.org.linux-iscsi.localhost.x8664:sn.C). A note indicates that authentication may need to be configured before establishing a session. Buttons for 'CHAP...', 'Advanced...', 'OK', 'Cancel', and 'Help' are visible.

Troubleshooting Linux-IO

```
(root) 192.168.122.41 - Konsole
File Edit View Bookmarks Settings Help
[root@localhost ~]# systemctl status target
● target.service - Restore LIO kernel target configuration
  Loaded: loaded (/usr/lib/systemd/system/target.service; enabled)
  Active: active (exited) since Sat 2015-02-21 00:38:40 PST; 1h 32min ago
    Process: 671 ExecStart=/usr/bin/targetctl restore (code=exited, status=0/SUCCESS)
   Main PID: 671 (code=exited, status=0/SUCCESS)
     CGroup: /system.slice/target.service

Feb 21 00:38:40 localhost.localdomain target[671]: No saved config file at /etc...g
Hint: Some lines were ellipsized, use -l to show in full.
[root@localhost ~]# targetcli sessions
(no open sessions)
[root@localhost ~]# netstat -plant | grep 3260
tcp      0      0 192.168.122.41:3260      0.0.0.0:*
                  LISTEN      -
[root@localhost ~]# █
```

Q&A