Chelsio T5 iSCSI PDU Offload Target with SCST support for Linux

Installation and User's Guide

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1. Introduction

Thank you for choosing Chelsio Unified Wire adapters. These high speed, single chip, single firmware cards provide enterprises and data centers with high performance solutions for various Network and Storage related requirements.

The Terminator 5 (T5) is Chelsio's next generation of highly integrated, hyper-virtualized 40/10GbE controllers. The T5 is built around a programmable protocol-processing engine, with full offload of a complete Unified Wire solution comprising NIC, TOE, iWARP RDMA, ISCSI, FCoE and NAT support. It scales true 40Gb line rate operation from a single TCP connection to thousands of connections, and allows simultaneous low latency and high bandwidth operation thanks to multiple physical channels through the ASIC.

The adapters can fully offload TCP, UDP, iSCSI, iWARP and FCoE over a single Unified Wire. The adapters also fully support SR-IOV, EVB/VNTag, DCB, Traffic Management and Filtering.

Ideal for all data, storage and high performance clustering applications, the adapters enable a unified fabric over a single wire by simultaneously running all unmodified IP sockets, Fibre Channel and InfiniBand applications over Ethernet at line rate.

Designed for deployment in virtualized data centers, cloud service installations and high performance computing environments, Chelsio adapters bring a new level of performance metrics and functional capabilities to the computer networking industry.

This guide describes how to install, use and configure iSCSI PDU Offload Target software with SCST support (known as 'iSCSI Target driver', 'iSCSI Target software', 'driver' or 'software, henceforth) for use as a key element in your iSCSI SAN. SCST is an easy-to-use and scalable in-kernel SCSI target implementation in Linux, which provides advanced functionality, high performance and reliability. The target driver acts as a SCSI target for remote SCSI initiators, i.e. accepts remote connections, passes incoming SCSI requests to SCST and sends SCSI responses from SCST back to their originators. Currently *Passthrough*, *FILEIO* and *BLOCKIO* modes are supported.

The iSCSI Target software runs on Linux-based systems that use Chelsio or non-Chelsio based Ethernet adapters. However, to guarantee highest performance, Chelsio recommends using Chelsio adapters. Chelsio's adapters include offerings that range from stateless offload adapters (regular NIC) to the full line of TCP/IP Offload Engine (TOE) adapters.

The software implements RFC 3720, the iSCSI standard of the IETF. The software has been fully tested for compliance to that RFC and others and it has been exhaustively tested for interoperability with the major iSCSI vendors.

The software implements most of the iSCSI protocol in software running in kernel mode on the host with the remaining portion, which consists of the entire fast data path, in hardware when used with Chelsio's TOE adapters. When standard NIC Adapters are used the entire iSCSI protocol is executed in software.

The performance of this iSCSI stack is outstanding and when used with Chelsio's hardware it is enhanced further. Because of the tight integration with Chelsio's TOE adapters, this software has a distinct performance advantage over the regular NIC. The entire solution, which includes this software, Chelsio TOE hardware, an appropriate base computer system – including a high end disk subsystem, has industry leading performance. This can be seen when the entire solution is compared to others based on other technologies currently available on the market in terms of throughput and IOPS.

1.1. Features

Chelsio's iSCSI driver stack supports the iSCSI protocol in the Target mode. The iSCSI Target software provides the following high level features:

- Expanded NIC Support
  - Chelsio TCP Offload Engine (TOE) Support
    - T5 Based HBAs (T5xx Series cards)
  - Non-Chelsio
    - Runs on regular NICs
- Chelsio Terminator ASIC Support
  - Offloads iSCSI Fast Data Path with Direct Data Placement (DDP)
  - Offloads iSCSI Header and Data Digest Calculations
  - Offload Speeds at 1 Gb, 10 Gb and 40Gb
  - Offloads TCP/IP for NAS simultaneously with iSCSI
  - Supports iSCSI Segmentation Offload
- Target Specific features
  - Full compliance with RFC 3720
  - Error Recovery Level 0 (ERL 0)
  - CHAP support for both discovery and login including mutual authentication
  - Internet Storage Name Service (iSNS) Client
  - Target Access Control List (ACL)
  - Multiple Connections per Session
  - Multiple Targets
  - Multiple LUNs per Target
  - Multi Path I/O (MPIO)
  - Greater than 2 TB Disk Support
  - Reserve / Release for Microsoft Cluster© Support
  - Persistent Reservation
  - Dynamic LUN Resizing
  - iSCSI Target Redirection
  - Multiple Target device types
    - Block
    - Virtual Block (LVM, Software RAID, EVMS, etc.)

- Built in RAM Disk
- Built in zero copy RAM Disk
- Supports iSCSI Boot Initiators
- An Intuitive and Feature Rich Management CLI

1.2. Hardware Requirements

1.2.1. Supported Adapters

The following are the currently shipping Chelsio Adapters that are compatible with iSCSI Target driver:

- T580-CR
- T580-LP-CR
- T540-CR
- T520-CR
- T520-LL-CR

1.2.2. Adapter Requirements

The Chelsio iSCSI Target driver can be used with or without hardware protocol offload technology. There are two modes of operation using the iSCSI PDU Offload Target software on Ethernet-based adapters:

- Regular NIC – The software can be used in non-offloaded (regular NIC) mode. Please note however that this is the least optimal mode of operating the software in terms of performance.
- iSCSI HW Acceleration – In addition to offloading the TCP/IP protocols in hardware (TOE), this mode also takes advantage of Chelsio's ASIC capability of hardware assisted iSCSI data and header digest calculations as well as using the direct data placement (DDP) feature.

1.2.3. Storage Requirements

When using the Chelsio iSCSI target, a minimum of one hardware storage device is required. This device can be any of the device types that are supported (block, virtual block, RAM disk). Multiple storage devices are allowed by configuring the devices to one target or the devices to multiple targets. The software allows multiple targets to share the same device but use caution when doing this.

Chelsio's implementation of the target iSCSI stack has flexibility to accommodate a large range of configurations. For quick testing, using a RAM Disk as the block storage device works nicely. For deployment in a production environment a more sophisticated system would be needed. That typically consists of a system with one or more storage controllers with multiple disk drives attached running software or hardware based RAID.

1.3. Software Requirements

cxgb4, toecore, t4_tom, chiscsi_base and scst modules are required by *chiscsi_t4.ko* module to work in offloaded mode supporting SCST. Whereas in iSCSI non-offloaded target (NIC) mode, only *cxgb4* and *scst* are needed by *chiscsi_base.ko* module.

1.3.1. Linux Requirements

Currently the iSCSI Target driver is available for the following versions:

- Ubuntu 14.04.1, 3.13.0-32-generic
- Kernel 3.13 (with scst_exec_req_fifo-<kernel-version> patch) compiled on Ubuntu 14.04.1

Other kernel versions have not been tested and are not guaranteed to work.

1.3.2. Requirements for Installing the iSCSI Software

When installing the iSCSI software, it is required that the system have Linux kernel source or its headers installed in order to compile the iSCSI software as a kernel module. The source tree may be only header files, as for RHEL6 as an example, or a complete tree. The source tree needs to be configured and the header files need to be compiled. Additionally, the Linux kernel must be configured to use modules.

1.4. Package Contents

The iSCSI PDU Offload Target Driver package for Linux consists of the following:

- **debrules**: This directory contains packaging specification files required for building Debian packages.
- **docs**: The directory contains support documents - README, Release Notes and User's Guide (this document) for the software.
- **scripts**: Support script used by the installer.
- **src**: The directory contains driver source code and T5 firmware binary and configuration files.
- **tools**:
    - **cudbg**: Chelsio Unified Debug tool which facilitates collection and viewing of various debug entities like register dump, Devlog, CIM LA, etc.
    - **cxgbtool:** The cxgbtool queries or sets various aspects of Chelsio network interface cards. It complements standard tools used to configure network settings and provides functionality not available through such tools. Please find more details on this tool in its manual page (run `man cxgbtool` command).
    - **chdebug**: This script collects operating system environment details and debug information which can be sent to the support team, to troubleshoot Chelsio hardware/software related issues.

- **chiscsi_set_affinity.sh**: This shell script is used for mapping iSCSI Worker threads to different CPUs.
- **Makefile**: The Makefile for building and installing from the source.
- **t4_latencytune.sh**: Script used for latency tuning of Chelsio Adapters.
- **t4_perftune.sh:** This shell script is to tune the system for higher performance. It achieves it through modifying the IRQ-CPU binding. This script can also be used to change Tx coalescing settings.

- **EULA**: Chelsio End User License Agreement.

2. Hardware Installation

Follow these steps to install Chelsio Adapter in your system:

1. Shutdown/power off your system.
2. Power off all remaining peripherals attached to your system.
3. Unpack the Chelsio adapter and place it on an anti-static surface.
4. Remove the system case cover according to the system manufacturer's instructions.
5. Remove the PCI filler plate from the slot where you will install the Ethernet adapter.
6. For maximum performance, it is highly recommended to install the adapter into a PCIe x8/x16 slot.
7. Holding the Chelsio adapter by the edges, align the edge connector with the PCI connector on the motherboard. Apply even pressure on both edges until the card is firmly seated. It may be necessary to remove the SFP (transceiver) modules prior to inserting the adapter.
8. Secure the Chelsio adapter with a screw, or other securing mechanism, as described by the system manufacturer's instructions. Replace the case cover.
9. After securing the card, ensure that the card is still fully seated in the PCIE x8 slot as sometimes the process of securing the card causes the card to become unseated.
10. Connect a fiber cable, multi-mode for short range (SR) optics or single-mode for long range (LR) optics, to the 40/10Gb Ethernet adapter or regular Ethernet cable for the 1Gb Ethernet adapter.
11. Power on your system.
12. Run *update-pciids* command to download the current version of PCI ID list

```
[root@host~]# update-pciids
%   Total  %   Received  %  Xferd  Average Speed  Time   Time   Time  Current
                                   Dload  Upload Total  Spent Left  Speed
100 198k  100  198k     0   0      491k   0 --:--:-- --:--:-- --:--:-- 626k
Done.
```

13. Verify if the adapter was installed successfully by using the *lspci* command

```
[root@host~]# lspci |grep -i Chelsio
07:00.0 Ethernet controller: Chelsio Communications Inc T520-LL-CR Unified
Wire Ethernet Controller
07:00.1 Ethernet controller: Chelsio Communications Inc T520-LL-CR Unified
Wire Ethernet Controller
07:00.2 Ethernet controller: Chelsio Communications Inc T520-LL-CR Unified
Wire Ethernet Controller
07:00.3 Ethernet controller: Chelsio Communications Inc T520-LL-CR Unified
Wire Ethernet Controller
07:00.4 Ethernet controller: Chelsio Communications Inc T520-LL-CR Unified
Wire Ethernet Controller
```

```
07:00.5 SCSI storage controller: Chelsio Communications Inc T520-LL-CR
Unified Wire Storage Controller

07:00.6 Fibre Channel: Chelsio Communications Inc T520-LL-CR Unified Wire
Storage Controller
```

For Chelsio T5 adapters, the physical functions are currently assigned as:

- Physical functions 0 - 3: for the SR-IOV functions of the adapter
- Physical function 4: for all NIC functions of the adapter
- Physical function 5: for iSCSI
- Physical function 6: for FCoE
- Physical function 7: Currently not assigned

Once driver package is installed and loaded, examine the output of `dmesg` to see if the card is discovered.

```
eth0: Chelsio T520-CR rev 0 1000/10GBASE-SFP RNIC MSI-X, Offload capable
0000:08:00.4: S/N: PT02141133, P/N: 110116050D0
```

The above outputs indicate the hardware configuration of the adapters as well as the Serial numbers.
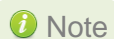
> *ⓘ Note* *Network device names for Chelsio's physical ports are assigned using the following convention: the port farthest from the motherboard will appear as the first network interface. However, for T5 40G adapters, the association of physical Ethernet ports and their corresponding network device names is opposite. For these adapters, the port nearest to the motherboard will appear as the first network interface.*

3. Software/Driver Installation

i.   Download the iSCSI PDU Offload Target driver package from Chelsio Download Center, http://service.chelsio.com/

ii. Untar the tarball using the following command:

```
[root@host~]# tar zxvfm Chelsio-iSCSI-scst-x.x.x.x.tar.gz
```

iii. Change your current working directory to *Chelsio-iSCSI-scst-x.x.x.x* directory and run the following command to start the installation:

```
[root@host~]# make install
```

iv. Reboot system for changes to take effect.

⚠ Important   *Any existing version of SCST in the system will be replaced with v3.0.2 (available in the package) by the installer.*

ⓘ Note   *Installation/uninstallation will neither remove the configuration file nor rename it. It will always be intact. However, it's recommended to always take a backup of the file.*

4. Software/Driver Loading

⚠ **Important**   *Please ensure that all inbox drivers are unloaded before proceeding.*

There are two main steps to installing the Chelsio iSCSI PDU Offload Target software. They are:

1. **Installing the iSCSI software** – The majority of this section deals with how to install the iSCSI software.
2. **Configuring the iSCSI software** – Information on configuring the software can be found in a section further into this user's guide.

4.1. Latest iSCSI Software Stack Driver Software

The iSCSI software is available for use with most installations of the Linux kernel. The software is dependent on the underlying NIC adapter driver and thus the limitation on what version of the Linux kernel it can run on is mostly dependent on the NIC driver's limitations.

The iSCSI driver will be installed in the
`/lib/modules/<linux_kernel_version>/updates/kernel/drivers/scsi/chiscsi`
directory. The modules database will be updated by the installer. This allows the iSCSI driver to be located when using the `modprobe` utility. The actual module `chiscsi_t4.ko` can be found inside the package under /build/src/chiscsi/t4.

The `iscsictl` tool and the `chisns` tool will be installed in `/sbin`. The `chisns` tool starts the iSNS client. The `iscsictl` tool is provided for configuring and managing the iSCSI targets and iSNS client. It also provides control for iSCSI global settings.

● Loading driver and starting iSCSI Target

i.   Load the iSCSI driver with SCST support by running *modprobe* as:

```
[root@host~]# modprobe -v chiscsi_t4
[root@host~]# modprobe -v scst_disk
[root@host~]# modprobe -v scst_vdisk
```

ℹ Note   *Pass-through dev handlers (handler "dev_disk") will work only if the kernel patch scst_exec_req_fifo-<kernel-version> was applied on the kernel.*

ii. Configure an iSCSI Target. You can refer the sample configuration files placed in your system during installation. A sample iSCSI configuration file will be installed in */etc/chelsio-iscsi/chiscsi.conf* and a sample SCST configuration file in */etc/chelsio-iscsi/scst.conf*. You can also view the files here (for iSCSI) and here (for SCST).

Please note that SCST LUN order in *chiscsi.conf* and *scst.conf* files should be same. For example, if we have the following device configuration in *chiscsi.conf*:

```
TargetDevice=/tmp/file1,SCST ==> LUN-0
TargetDevice=/tmp/file2,SCST ==> LUN-1
```

The above LUNs should be configured in the same order with SCST also. i.e. *scst.conf* should look like:

```
HANDLER vdisk_fileio {
    DEVICE disk01 {
           filename /tmp/file1
           nv_cache 1

    }
    DEVICE disk02 {

           filename /tmp/file2
           nv_cache 1

    }
}


TARGET_DRIVER CHISCSI {
     enabled 1
     TARGET iqn.2004-05.com.chelsio.target1{

           LUN 0 disk01
           LUN 1 disk02
           enabled 1

     }
}
```

iii. Start the iSCSI Target

```
[root@host~]# iscsictl -S target=ALL
```

iv. Apply LUN configuration to SCST:

```
[root@host~]# scstadmin -force -clear_config /etc/chelsio-iscsi/scst.conf
[root@host~]# scstadmin -config /etc/chelsio-iscsi/scst.conf
```

• Auto-start iSCSI service at boot-up

The `chelsio-target` service scripts are installed to `/etc/init.d` and the parameters for the script are installed at `/etc/sysconfig/chiscsi`. The script is installed as a system service.

To auto-start the iSCSI target service at a certain runlevel, e.g. runlevel 3, `chkconfig` can be used on Red Hat and Novell / SuSE based systems as follows:

```
[root@host~]# chkconfig --level 3 chelsio-target on
```

The `chelsio-target` service scripts do basic checks before starting the iSCSI target service, loads the driver, and starts all the targets configured by default. It can also be used to stop the targets, and restart/reload configuration.

Note	• *For the script to execute properly, make sure the following flag is set on all kernel.org kernels.* *# CONFIG_MODULE_FORCE_LOAD=y* • *The script will not work on Ubuntu platforms and also when SCST configuration is used.*

5. Software/Driver Configuration and Fine-tuning

The Chelsio iSCSI software needs configuration before it can become useful. The following sections describe how this is done.

There are two main components used in configuring the Chelsio iSCSI software: the **configuration file** and the **iSCSI control tool**. This section describes in some detail what they are and their relationship they have with one another.

5.1. Command Line Tools

There are two command line tools, one for control of the iSNS client and one for control of the iSCSI target nodes.

5.1.1. iscsictl

The Chelsio iSCSI control tool, `iscsictl`, is a Command Line Interface (CLI) user space program that allows administrators to:

- Start/Stop the iSCSI Target
- Start the iSNS client
- Get/Set the iSCSI driver global settings
- Get/Set/Remove the iSCSI Target configuration settings
- Retrieve active sessions' information of an iSCSI Target
- Manually flush data to the iSCSI Target disks
- Reload the iSCSI configuration file
- Update the iSCSI configuration file
- Save the current iSCSI configuration to a file

5.1.2. chisns

The Chelsio iSNS client, `chisns`, can be started independently of `iscsictl`.

5.2. iSCSI Configuration File

The iSCSI configuration file is the place where information about the Chelsio iSCSI software is stored. The information includes global data that pertains to all targets as well as information on each specific iSCSI target node. Most of the information that can be placed in the configuration file has default values that only get overwritten by the values set in the configuration file. There are only a few global configuration items that can be changed.

There are many specific parameters that can be configured, some of which are iSCSI specific and the rest being Chelsio specific. An example of an iSCSI specific item is "HeaderDigest" which is defaulted to "None" but can be overridden to "CRC32C". An example of a Chelsio

specific configurable item is "ACL" (for Access Control List). "ACL" is one of the few items that have no default.

Before starting any iSCSI target, an iSCSI configuration file must be created. An easy way to create this file is to use the provided sample configuration file and modify it. This file can be named anything and placed in any directory but it must be explicitly specified when using iscsictl by using the -f option. To avoid this, put configuration file in the default directory (`/etc/chelsio-iscsi`) and name it the default file name (`chiscsi.conf`).

5.2.1. "On the fly" Configuration Changes

Parameters for the most part can be changed while an iSCSI node is running. However, there are exceptions and restrictions to this rule that are explained in a later section that describes the details of the iSCSI control tool `iscsictl`.

5.3. A Quick Start Guide for Target

This section describes how to get started quickly with a Chelsio iSCSI target. It includes:

- Basic editing of the iSCSI configuration file.
- Basic commands of the iSCSI control tool including how to start and stop a target.

5.3.1. A Sample iSCSI Configuration File

The default Chelsio iSCSI configuration file is located at `/etc/chelsio-iscsi/chiscsi.conf`. If this file doesn't already exist, then one needs to be created.

To configure a iSCSI target, there are three required parameters (in the form of key=value pairs) needed as follows:

- TargetName – A worldwide unique iSCSI target name.
- PortalGroup – The portal group tag associating with a list of target IP address (es) and port number(s) that service the login request. The format of this field is a Chelsio specific iSCSI driver parameter which is described in detail in the configuration file section.
- TargetDevice – A device served up by the associated target. A device can be:
  - A block device (for example, /dev/sda)
  - A virtual block device (for example, /dev/md0)
  - A RAM disk
  - A regular file

A target can serve multiple devices, each device will be assigned a Logical Unit Number (LUN) according to the order it is specified (i.e., the first device specified is assigned LUN 0, the second one LUN 1, …, and so on and so forth). Multiple TargetDevice key=value pairs are needed to indicate multiple devices.

Here is a sample of a minimum iSCSI target configuration located at `/etc/chelsio-iscsi/chiscsi.conf`:

```
target:
        TargetName=iqn.2006-02.com.chelsio.diskarray.san1
        TargetDevice=/dev/sda,SCST
        PortalGroup=1@192.0.2.178:3260
```

The `TargetDevice` value must match with the storage device in the system and the same should be referenced in SCST configuration. The `PortalGroup` value must have a matching IP address of the Ethernet adapter card in the system.

For more information about TargetDevice configuration see **Target Storage Device Configuration**.

5.3.2. Basic iSCSI Control

Control of the Chelsio iSCSI software is done through `iscsictl`, the command line interface control tool. The following are the basic commands needed for effective control of the target.

Start Target: To start all of the iSCSI targets specified in the iSCSI configuration file, execute `iscsictl` with the "`-S`" option followed by "`target=ALL`".

```
[root@host~]# iscsictl –S target=ALL
```

To start a specific target execute `iscsictl` with "`-S`" followed by the target.

```
[root@host~]# iscsictl –S target=iqn.2006-02.com.chelsio.diskarray.san1
```

Stop Target: To stop the all the iSCSI target(s), execute `iscsictl` with "`-s`" option followed by "`target=ALL`".

```
[root@host~]# iscsictl –s target=ALL
```

To stop a specific target execute `iscsictl` with "`-s`" followed by the target name.

```
[root@host~]# iscsictl –s target=iqn.2006-02.com.chelsio.diskarray.san1
```

View Configuration: To see the configuration of all the active iSCSI targets, execute `iscsictl` with "`-c`" option.

```
[root@host~]# iscsictl –c
```

To see the more detailed configuration settings of a specific target, execute `iscsictl` with "`-c`" option followed by the target name.

```
[root@host~]# iscsictl –c target=iqn.2006-02.com.chelsio.diskarray.san1
```

View Global Settings: To see Chelsio global settings, execute `iscsictl` with "`-g`" option.

```
[root@host~]# iscsictl –g
```

Change Global Settings: To change Chelsio global settings, execute `iscsictl` with "`-G`" option.

```
[root@host~]# iscsictl –G iscsi_login_complete_time=300
```

View Help: To print help to stdout, execute `iscsictl` with "`-h`" option.

```
[root@host~]# iscsictl –h
```

5.4. The iSCSI Configuration File

The iSCSI configuration file consists of a series of blocks consisting of the following types of iSCSI entity blocks:

1. global
2. target

There can be only one global entity block whereas multiple target entity blocks are allowed. The global entity block is optional but there must be at least one target entity block.

An entity block begins with a block type (global or target). The content of each entity block is a list of parameters specified in a "key=value" format. An entity-block ends at the beginning of the next entity block or at the end-of-file.

The parameter list in an entity block contains both:

- iSCSI parameters that override the default values
- Parameters that facilitate passing of control information to the iSCSI driver

All lines in the configuration file that begin with "#" character are treated as comments and will be ignored. White space is not significant except in key=value pairs.

For the "key=value" parameters the <value> portion can be a single value or a list of multiple values. When <value> is a list of multiple values, they must be listed on one line with a comma "," to separate their values. Another way to list the values instead of commas is to list their values as key=value pairs repeatedly, each on a new line, until they are all listed.

There are three categories of "key=value" parameter, the first category belongs to the global entity block whereas the second and third categories belong to target entity block:

1. The Chelsio Global Entity Settings of key=value pairs
2. The iSCSI Entity Settings of key=value pairs
3. The Chelsio Entity Settings of key=value pairs

The following sub-sections describe these three categories and list in tables the details of their key=value parameters.

5.4.1. Chelsio System Wide Global Entity Settings

Description

Chelsio System Wide Global Entity Parameters pass system control information to the iSCSI software which affects all targets in the same way. More detail of these parameters below can be found in a later section entitled "System Wide Parameters".

Table of Chelsio Global Entity Settings

Key	Valid Values	Default Value	Multiple Values	Description
iscsi_auth_order	"ACL" "CHAP"	"CHAP"	No	Authorization order for login verification on the target. Valid only when a target's ACL_Enable=Yes **ACL**: ACL first then CHAP **CHAP**: CHAP first then ACL *Applies to Target(s) Only*
DISC_AuthMethod	"CHAP" "NONE"	None	No	To choose an authentication method for discovery phase.
DISC_Auth_CHAP_Policy	"Oneway" "Mutual"	"Oneway"	No	Oneway or Mutual (two-way) CHAP
DISC_Auth_CHAP_Target	"<user id>" :"<secret>"		Yes	CHAP user id and secret for the target. **<user id>** must be less than 256 characters. Commas "," are not allowed. **<secret>** must be between 6 and 255 characters. Commas "," are not allowed. The target user id and secret are used by the initiator to authenticate the target while doing mutual chap. *NOTE: The double quotes are required as part of the format.*
DISC_Auth_CHAP_Initiator	"<user id>" :"<secret>"		Yes	CHAP user id and secret for the initiator. **<user id>** must be less than 256 characters. Commas "," are not allowed. **<secret>** must be between 6 and 255 characters. Commas "," are not allowed. The initiator user id and secret are used by the target to authenticate the initiator. *NOTE: The double quotes are required as part of the format.*
iscsi_chelsio_ini_idstr	a string of maximum of 255 characters	"cxgb4i"	No	To enable additional optimization when Chelsio Adapters and drivers are used at both ends (initiator and target) systems. Make sure the initiator name contain the substring set in iscsi_chelsio_ini_idstr when using Chelsio iscsi initiator

				driver.
`iscsi_target_vendor_id`	a string of maximum of 8 characters	"CHISCSI"	No	The target vendor ID part of the device identification sent by an iSCSI target in response of SCSI Inquiry command.
`iscsi_login_complete_time`	0 to 3600	300	No	Time allowed (in seconds) for the initiator to complete the login phase. Otherwise, the connection will be closed *NOTE: value zero means this check is NOT performed.*

5.4.2. iSCSI Entity Settings

Description

iSCSI Entity Parameters pass iSCSI protocol control information to the Chelsio iSCSI driver. This information is unique for each entity block. The parameters follow the IETF iSCSI standard RFC 3720 in both definition and syntax. The descriptions below are mostly from this RFC.

Table of iSCSI Entity Settings

Key	Valid Values	Default Value	Multiple Values	Description
MaxConnections	1 to 65535	1	No	Initiator and target negotiate the maximum number of connections requested/acceptable.
InitialR2T	"Yes" "No"	"Yes"	No	To turn on or off the default use of R2T for unidirectional and the output part of bidirectional commands.
ImmediateData	"Yes" "No"	"Yes"	No	To turn on or off the immediate data.
FirstBurstLength	512 to 16777215 (2^{24} - 1)	65536	No	The maximum negotiated SCSI data in bytes of unsolicited data that an iSCSI initiator may send to a target during the execution of a single SCSI command.
MaxBurstLength	512 to 16777215 (2^{24} - 1)	262144	No	The maximum negotiated SCSI data in bytes, of a Data-In or a solicited Data-Out iSCSI sequence between the initiator and target.
DefaultTime2Wait	0 to 3600	2	No	The minimum time, in seconds, to wait before attempting an explicit / implicit logout or connection reset between initiator and target.
DefaultTime2Retain	0 to 3600	20	No	The maximum time, in seconds, after an initial wait.
MaxOutstandingR2T	1 to 65535	1	No	The maximum number of outstanding R2Ts per task.
DataPDUInOrder	"Yes" "No"	"Yes"	No	To indicate the data PDUs with sequence must be at continuously increasing order or can be in any order. *Chelsio only supports "Yes".*
DataSequenceInOrder	"Yes" "No"	"Yes"	No	To indicate the Data PDU sequences must be transferred in continuously

				non-decreasing sequence offsets or can be transferred in any order. *Chelsio only supports "Yes".*
ErrorRecoveryLevel	0 to 2	0	No	To negotiate the recovery level supported by the node. *Chelsio only supports 0.*
HeaderDigest	"None" "CRC32C"	"None"	Yes	To enable or disable iSCSI header Cyclic integrity checksums.
DataDigest	"None" "CRC32C"	"None"	Yes	To enable or disable iSCSI data Cyclic integrity checksums.
AuthMethod	"CHAP" and "None"	"None, CHAP"	Yes	To choose an authentication method during login phase.
TargetName	"<target name>"		No	A worldwide unique iSCSI target name. *Target only.*
TargetAlias	"<target alias>"		No	A human-readable name or description of a target. It is not used as an identifier, nor is it for authentication. *Target only.*
MaxRecvDataSegmentLength	512 to 16777215 (2^{24} - 1)	8192	No	To declare the maximum data segment length in bytes it can receive in an iSCSI PDU.
OFMarker	"Yes" "No"	"No"	No	To turn on or off the initiator to target markers on the connection. *Chelsio only supports "No".*
IFMarker	"Yes" "No"	"No"	No	To turn on or off the target to initiator markers on the connection. *Chelsio only supports "No".*
OFMarkInt	1 to 65535	2048	No	To set the interval for the initiator to target markers on a connection.
IFMarkInt	1 to 65535	2048	No	To set the interval for the target to initiator markers on a connection.

5.4.3. Chelsio Entity Settings

Description

Chelsio Entity Parameters pass control information to the Chelsio iSCSI driver. The parameters are specific to Chelsio's implementation of the iSCSI node (target or initiator) and are unique for each entity block. The parameters consist of information that can be put into three categories:

1. Challenge Handshake Authentication Protocol (CHAP).
2. Target specific settings. All of the following parameters can have multiple instances in one target entity block (i.e., they can be declared multiple times for one particular target).

- Portal Group
- Storage Device
- Access Control List (ACL)

Table of Chelsio Entity Settings

Key	Valid Values	Default Value	Multiple Values	Description
		Chelsio CHAP Parameter (Target)		
Auth_CHAP_Target	"<user id>" :"<secret>"		No	CHAP user id and secret for the target. **<user id>** must be less than 256 characters. Commas "," are not allowed. **<secret>** must be between 6 and 255 characters. Commas "," are not allowed. The target user id and secret are used by the initiator to authenticate the target while doing mutual chap. *NOTE: The double quotes are required as part of the format.*
Auth_CHAP_Initiator	"<user id>" :"<secret>"		Yes	CHAP user id and secret for the initiator. **<user id>** must be less than 256 characters. Commas "," are not allowed. **<secret>** must be between 6 and 255 characters. Commas "," are not allowed. The initiator user id and secret are used by the target to authenticate the initiator. *NOTE: The double quotes are required as part of the format.*
Auth_CHAP_Challenge Length	16 to 1024	16	No	CHAP challenge length
Auth_CHAP_Policy	"Oneway" or "Mutual"	"Oneway"	No	Oneway or Mutual (two-way) CHAP
		Chelsio Target Specific Parameter		
PortalGroup	<portal group tag> @<target IP address> [:<port number>] . . . [,<target IP address> [:<port number>]] [,timeout= <timeout value		Yes	The portal group name associates the given target with the given list of IP addresses (and optionally, port numbers) for servicing login requests. It"s required to have at least one per target. **<portal group tag>** is a unique tag identifying the portal group. It must be a positive integer. **<target IP address>** is the IP address associated with the portal group tag.

	`in milliseconds>] [,[portalgroup tag1, portalgrouptag 2,… portalgrouptag n]`			**<port number>** is the port number associated with the portal group tag. It is optional and if not specified the well-known iSCSI port number of 3260 is used. **<timeout>** is optional, it applies to all the portals in the group. The timeout value is in milliseconds and needs to be multiple of 100ms. It is used to detect loss of communications at the iSCSI level. *NOTE: There can be multiple target IP address/port numbers per portal group tag. This enables a target to operate on multiple interfaces for instance.* **<portalgrouptagX>**The portalgroup to which login requests should be redirected to. *NOTE: There can be multiple redirection target portalgroups specified for a particular target portal group and the redirection will happen to these in a round robin manner.*
ShadowMode	`"Yes"` `"No"`	`"No"`	No	To turn ShadowMode on or off for iSCSI Target Redirection
TargetSessionMaxCmd	1 to 2048	64	No	The maximum number of outstanding iSCSI commands per session.
TargetDevice*	`<path/name> [,FILE|MEM|BLK ] [,NULLRW] [,SYNC] [,RO] [,size=xMB] [,ID=xxxxxx] [,WWN=xxxxxxxx x] [,SN= xxxxxx][,SCST]`		No	A device served up by the associated target. The device mode can be a: • Block Device (e.g. `/dev/sda`) • Virtual Block Device (e.g. `/dev/md0`) • `RamDisk` • `Regular File` **<path/name>** is the path to the device - with the exception of when a RAM Disk is specified, where it is a unique name given to the device. If multiple RAM Disks are used for a target then each name must be unique within the target. **NULLRW** specifies that random data is returned for reads, and for writes data is dropped. Useful for

				testing network performance.
				SYNC specifies that the device will function in the write-through mode (i.e., the data will be flushed to the device before the response is returned to the initiator). *NOTE: SYNC is only applicable with FILE mode.*
				RO specifies the device as a read-only device.
				FILE specifies this device should be accessed via the kernel"s VFS layer. This mode is the most versatile, and it is the default mode in the cases where there is no mode specified.
				BLK specifies this device should be accessed via the kernel"s block layer. This mode is suitable for high-speed storage device such as RAID Controllers.
				MEM specifies this device should be created as a RAM Disk.
				size=xMB is used with "MEM", to specify the RamDisk size. If not specified, the default RamDisk size is 16MB (16 Megabytes). The minimum value of x is 1 (1MB) and the maximum value is limited by system memory.
				SN is a 16 character unique value. **ID** is a 24 character unique value. **WWN** is a 16 character unique value.
				SCST specifies the device using SCST backend. All SCST LUNs are treated as pass-through by *chiscsi*. The incoming SCSI requests will be passed to SCST and SCSI responses from SCST will be sent back to their originators.
				It is recommended when using a multipath aware initiator, the optional ID (short form for SCSI ID), SN and WWN values should be set manually for the TargetDevice. These values will be returned in Inquiry response (VPD 0x83).
				Multiple TargetDevice key=value

				pairs are needed to indicate multiple devices. There can be multiple devices for any particular target. Each device will be assigned a Logical Unit Number (LUN) according to the order it is specified (i.e., the first device specified is assigned LUN 0, the second one LUN 1, …, and so on and so forth). *NOTE: **FILE** mode is the most versatile mode, if in doubt use **FILE** mode.*
ACL_Enable	"Yes" "No"	"No"	No	Defines if Chelsio'sAccess Control List (ACL) method will be enforced on the target: **Yes:** ACL is enforced on the target **No:** ACL is not enforced on the target *NOTE*: ACL flag is not allowed to be updated on the fly. Target must be restarted for new ACL flag to take effect.
ACL	[iname=<name1>][;<sip=<sip1>][;dip=<dip1>][;lun=<lun_list:permissions>]		Yes	The ACL specifies which initiators and how they are allowed to access the LUNs on the target. **iname=<Initiator Name>** specifies one or more initiator names, the name must be a fully qualified iSCSI initiator name. **sip=<Source IP address>** specifies one or more IP addresses the initiators are connecting from. **Dip=<Destination IP address>** specifies one or more IP addresses that the iSCSI target is listening on (i.e., the target portal IP addresses). *NOTE: when configuring an ACL at least one of the above three must be provided:* • *iname, and/or* • *sip, and/or* • *dip.* **lun=<lun list>:<permission>** controls how the initiators access the luns. The supported value for **<lun list>** is **ALL**. **<permissions>** can be:

				R: Read Only RW or WR: Read and Write If permissions are specified then the associated LUN list is required. If no **lun=<lun list>:[R|RW]** is specified then it defaults to **ALL:RW**. *NOTE: For the Chelsio Target Software release with lun-masking included,* ***<lun list>** is in the format of **<0..N | 0~N | ALL>*** *Where:* ***0..N**: only one value from **0** through **N*** ***0~N**: a range of values between **0** through **N*** ***ALL**: all currently supported LUNs.* *Multiple lists of LUN numbers are allowed. When specifying the list separate the LUN ranges by a comma.*
`RegisteriSNS`	"Yes" "No"	"Yes"	No	To turn on or off exporting of target information via iSNS

5.4.4. Sample iSCSI Configuration File

Following is a sample configuration file. While using iSCSI node (target), irrelevant entity block can be removed or commented.

```
#
# sample iSCSI configuration file with 1 target
#


# iSCSI Global Settings
global:
# change iscsi_offload_mode to TOE or ULP if desired
    # perform CHAP authentication first before ACL
        iscsi_auth_order=CHAP


    # Authentication configuration
    # Use DISC_AuthMethod=CHAP to force chap
    DISC_AuthMethod=None


    # oneway chap, Use DISC_Auth_CHAP_Policy=Mutual for mutual chap
```

```
      DISC_Auth_CHAP_Policy=Oneway


      # Auth_CHAP_ChallengeLength=16
      # CHAP id and secret should be enclosed in double quotes and
      # separated by :
      DISC_Auth_CHAP_Initiator="initiator_id1":"initiator_sec1"
      # Required for Mutual CHAP
      DISC_Auth_CHAP_Target="target_id1":"target_secret1"


# change the target vendor ID to "Chelsio"
#       iscsi_target_vendor_id=Chelsio


# Target Settings Block, Multiple such Target Blocks allowed.
# An iSCSI target called "iscsitarget1" is being served by
# the PortalGroupTag 1, with one block device and one ramdisk attached.
target:
      TargetName=iqn.2004-05.com.chelsio.target
      TargetAlias=chiscsit1
      MaxRecvDataSegmentLength=8192
      HeaderDigest=None,CRC32C
      DataDigest=None,CRC32C
      ImmediateData=Yes
      InitialR2T=Yes
      MaxOutstandingR2T=1
      MaxConnections=4


      # TargetDevice specific a block device/volume/ramdisk, served up
      # by this target.
      # There can be multiple of TargetDevice=xxx. The sequence of them
      # specified determines the LUN, (i.e., the 1st one specified
      # with TargetDevice has LUN 0, the 2nd one will be assigned
      # LUN 1, ..., and so on and so forth)
      # flag "MEM" means ramdisk. The default ramdisk size is 16MB. To obtain
      # a ramdisk with a size other than 16MB, use "size=xxMB".
      # flag "NULLRW" means no actual read or write (i.e., if specified,
      # for read, random contents will be returned; for write,
      # data will be dropped. It is useful to test for network
      # performance.
```

```
# flag "SYNC" means for every write request, sync to the disk before
# send back the response
# flag "DIF" means end to end (initiator to target backend) pi
# protection is enabled.
# flag "DIX" means target HBA to target backend pi protection is
# enabled. All luns on a node should have same the value
# (DIF or DIX) for protection.


# lun 0: a Pass-Through SCST disk device
TargetDevice=/dev/sdb,SCST


# lun 1: a FILEIO SCST device
TargetDevice=/tmp/file1,SCST


# lun 2: a BLOCKIO SCST device
TargetDevice=/dev/vg1/lv1,SCST


# lun 3: a ramdisk, with default size of 16MB
#TargetDevice=ramdisk1,MEM


# lun 4: a ramdisk, with a minimum size of 16MB, and no actual read or
#     write of data.
#TargetDevice=ramdisk2,MEM,NULLRW,size=16MB


# Target Portal group information, adjust to your system specifc
PortalGroup=1@192.168.1.1:3260
PortalGroup=2@192.168.1.2:3260


#
#Access Control List settings
#
#     ACL_Enable=[Yes|No]
#     ACL=[iname=<initiator name>;][;<sip=src ip>][;<dip=dst ip>]
#               [;<lun=ALL:R|RW>]
#
#ACL_Enable=Yes


# initiator iqn.2004-08.com.chelsio.test1 is allowed r/w access on all
```

```
    # available luns
    #ACL=iname=iqn.2004-08.com.chelsio.test1
    #
    # any initiator from 192.164.1.100 is allowed r/w access on all luns
    #ACL=sip=192.164.1.100


    # any initiator connected via 192.0.2.50 is allowed read-only access
    # on all luns
    #ACL=dip=192.0.2.50;lun=ALL:R


    # initiator iqn.2004-08.com.chelsio.test3 from source 192.164.1.103 is
    # allowed to read only access to all available luns on 192.1.2.50
    #ACL=iname=iqn.2004-
08.com.chelsio.test3;sip=192.164.1.103;dip=192.1.2.50;lun=ALL:R


    # Authentication configuration
    # Use AuthMethod=CHAP to force chap
    AuthMethod=None
    # oneway chap, Use Auth_CHAP_Policy=Mutual for mutual chap.
    Auth_CHAP_Policy=Oneway
    #Auth_CHAP_ChallengeLength=16
    # CHAP id and secret should be enclosed in double quotes and
    # separated by :
    Auth_CHAP_Target="target_id1":"target_secret1"
    Auth_CHAP_Initiator="initiator_id1":"initiator_sec1"
    Auth_CHAP_Initiator="initiator_id2":"initiator_sec2"
```

5.4.5. Sample SCST Configuration File

```
# Pass-Through device "/dev/sdb"
HANDLER dev_disk {

    DEVICE 2:0:0:0

}


# FILEIO device
HANDLER vdisk_fileio {

    DEVICE disk02 {

            filename /tmp/file1

            nv_cache 1

    }

}


# BLOCKIO devices
HANDLER vdisk_blockio {

    DEVICE disk03 {

            filename /dev/vg1/lv1

            nv_cache 1

    }

}


TARGET_DRIVER CHISCSI {

    enabled 1

    TARGET iqn.2004-05.com.chelsio.target {

            LUN 0 2:0:0:0

            LUN 1 disk02

            LUN 2 disk03

            enabled 1

    }

}
```

5.5. Challenge-Handshake Authenticate Protocol (CHAP)

CHAP is a protocol that is used to authenticate the peer of a connection and uses the notion of a challenge and response, (i.e., the peer is challenged to prove its identity).

The Chelsio iSCSI software supports two CHAP methods: **one-way** and **mutual**. CHAP is supported for both login and discovery sessions.

5.5.1. Normal Session CHAP Authentication

For a normal Session, the CHAP authentication is configured on a per-target basis.

5.5.2. Oneway CHAP authentication

With **one-way** CHAP (also called unidirectional CHAP) the target uses CHAP to authenticate the initiator. The initiator does not authenticate the target. This method is the default method.

For **one-way** CHAP, the initiator CHAP id and secret are configured and stored on a per-initiator with Chelsio Entity parameter "Auth_CHAP_Initiator".

5.5.3. Mutual CHAP authentication

With **mutual** CHAP (also called bidirectional CHAP), the target and initiator use CHAP to authenticate each other.

For **mutual** CHAP, in addition to the initiator CHAP id and secret, the target CHAP id and secret are required. They are configured and stored on a per target basis with Chelsio Entity parameter "Auth_CHAP_Target".

5.5.4. Adding CHAP User ID and Secret

A single `Auth_CHAP_Target` key and multiple `Auth_CHAP_Initiator` keys could be configured per target:

```
target:
      TargetName=iqn.2006-02.com.chelsio.diskarray.san1
      TargetDevice=/dev/sda PortalGroup=1@192.0.2.178:8000
      Auth_CHAP_Policy=Oneway
      Auth_CHAP_Initiator="remoteuser1":"remoteuser1_secret"
      Auth_CHAP_Initiator="remoteuser2":"remoteuser2_secret"
      Auth_CHAP_Target="targetid1":"target1_secret"
```

In the above example, target `iqn.2005-com.chelsio.diskarray.san1` has been configured to authenticate two initiators, and its own id and secret are configured for use in the case of mutual CHAP.

5.5.5. AuthMethod and Auth_CHAP_Policy Keys

By setting the iSCSI keys `AuthMethod` and `Auth_CHAP_Policy`, a user can choose whether to enforce CHAP and if mutual CHAP needs to be performed.

The `AuthMethod` key controls if an initiator needs to be authenticated or not. The default setting of `AuthMethod` is `None,CHAP`

The `Auth_CHAP_Policy` key controls which CHAP authentication (one-way or mutual) needs to be performed if CHAP is used. The default setting of `Auth_CHAP_Policy` is `Oneway`

On an iSCSI node, with `AuthMethod=None,CHAP`

- `Auth_CHAP_Policy=Oneway`, Chelsio iSCSI target will accept a relevant initiator if it does
  a) no CHAP
  b) CHAP Oneway or
  c) CHAP Mutual

- `Auth_CHAP_Policy=Mutual`, the Chelsio iSCSI target will accept a relevant initiator if it does
  a) no CHAP or
  b) CHAP Mutual

With `AuthMethod=None`, regardless the setting of the key Auth_CHAP_Policy, the Chelsio iSCSI target will only accept a relevant initiator if it does no CHAP.

With `AuthMethod=CHAP`, CHAP is enforced on the target:

i. `Auth_CHAP_Policy=Oneway`, the iSCSI target will accept a relevant initiator only if it does
  a) CHAP Oneway or
  b) CHAP Mutual
ii. `Auth_CHAP_Policy=Mutual`, the iSCSI node will accept a relevant initiator only if it does
  a) CHAP Mutual

5.5.6. Discovery Session CHAP

CHAP authentication is also supported for the discovery sessions where an initiator queries of all available targets.

Discovery session CHAP is configured through the global section in the configuration file. List of keys to provision discovery CHAP are:

- DISC_AuthMethod: None or CHAP.
- DISC_Auth_CHAP_Policy: Oneway or Mutual (i.e., two-way) authentication.
- DISC_Auth_CHAP_Target: target CHAP user id and secret
- DISC_Auth_CHAP_Initiator: initiator CHAP user id and secret.

Sample:

```
#
# Chelsio iSCSI Global Settings
#
global:
        DISC_AuthMethod=CHAP
        DISC_Auth_CHAP_Policy=Mutual
        DISC_Auth_CHAP_Target="target_id1":"target_secret1"
        DISC_Auth_CHAP_Initiator="initiator_id1":"initiator_sec1"
```

5.6. Target Access Control List (ACL) Configuration

The Chelsio iSCSI target supports iSCSI initiator authorization via an Access Control List (ACL).

ACL configuration is supported on a per-target basis. The creation of an ACL for a target establishes:

- Which iSCSI initiators are allowed to access it
- The type of the access: read-write or read-only
- Possible SCSI layer associations of LUNs with the initiator

More than one initiator can be allowed to access a target and each initiator"s access rights can be independently configured.

The format for ACL rule is as follows:

```
ACL=[iname=<initiator name>][;<sip=<source ip addresses>]
    [;dip=<destination ip addresses>][;lun=<lun_list>:<permissions>]

 target:
      TargetName=iqn.2006-02.com.chelsio.diskarray.san1
      TargetDevice=/dev/sda

      PortalGroup=1@102.50.50.25:3260
      PortalGroup=2@102.60.60.25:3260

      # initiator "iqn.2006-02.com.chelsio.san1" is allowed
      # full read-write access to this target
      ACL=iname=iqn.2006-02.com.chelsio.san1
```

```
# any initiator from IP address 102.50.50.101 is allowed full
# read-write access of this target
ACL=sip=102.50.50.101

# any initiator connected via the target portal 102.60.60.25
# is allowed full read-write access to this target
ACL=dip=102.60.60.25

# initiator "iqn.2005-09.com.chelsio.san2" from 102.50.50.22
# and connected via the target portal 102.50.50.25 is allowed
# read only access of this target
ACL=iname=iqn.2006-
02.com.chelsio.san2;sip=102.50.50.22;dip=102.50.50.25;lun=ALL:R
```

5.6.1. ACL Enforcement

To toggle ACL enforcement on a per-target base, a Chelsio keyword `ACL_Enable` is provided:

- Setting `ACL_Enable=Yes` enables the target to perform initiator authorization checking for all the initiators during login phase. And in addition, once the initiator has been authorized to access the target, the access rights will be checked for each individual LU the initiator trying to access.
- Setting `ACL_Enable=No` disable the target to perform initiator authorization checking.

When a target device is marked as read-only (RO), it takes precedence over ACL's write permission (i.e., all of ACL write permission of an initiator is ignored).

5.7. Target Storage Device Configuration

An iSCSI Target can support one or more storage devices. The storage device can either be the built-in RAM disk or actual backend storage.

Configuration of the storage is done through the Chelsio configuration file via the key-value pair `TargetDevice`.

When option `NULLRW` is specified, on writes the data is dropped without being copied to the storage device, and on reads the data is not actually read from the storage device but instead random data is used. This option is useful for measuring network performance.

The details of the parameters for the key `TargetDevice` are found in the table of Chelsio Entity Settings section earlier in this document.

⚠ **Important**   *No other Target Device flags are supported along with SCST pass-through device.*

5.7.1. RAM Disk Details

For the built-in RAM disk:

- The minimum size of the RAM disk is 1 Megabyte (MB) and the maximum is limited by system memory.
- To use a RAM disk with a Windows Initiator, it is recommended to set the size >= 16MB.

To configure an ramdisk specify `MEM` as the device mode:

```
TargetDevice=<name>,MEM,size=xMB
```

Where: `<name>`   Is a unique name given to the RAM disk. This name identifies this particular ramdisk. If multiple RAM disks are configured for the same target, the name must be unique for each RAM Disk.

`x`   Is the size of the RAM disk in MB. It's an integer between (1-max), where max is limited by system memory. If this value is not specified, the default value is 16 MB.

```
target:
#<snip>
  # 16 Megabytes RAM Disk named ramdisk1
  TargetDevice=ramdisk1,MEM,size=16MB
#<snip>
```

ⓘ Note   *Chelsio's Inbuilt RAMDISK cannot be used for SCST pass-through.*

5.7.2. FILE Mode Storage Device Details

The FILE mode storage device is the most common and versatile mode to access the actual storage attached to the target system:

- The FILE mode can accommodate both block devices and virtual block devices.
- The device is accessed in the exclusive mode. The device should not be accessed (or active) in any way on the target system.
- Each device should be used for one and only one iSCSI target.
- "SYNC" can be used with FILE mode to make sure the data is flushed to the storage device before the Target responds back to the Initiator.

To configure a FILE storage device specify `FILE` as the device mode:

```
TargetDevice=<path to the storage device>[,FILE][,SYNC]
```

Where: `<path>`   Is the path to the actual storage device, such as /dev/sdb for a block device or /dev/md0 for a software RAID. The path must exist in the system.

           `SYNC`   When specified, the Target will flush all the data in the system cache to the storage driver before sending response back to the Initiator.

5.7.3. Example Configuration of FILE Mode Storage

Below is an example:

```
target:
#<snip>
 # software raid /dev/md0 is accessed in FILE mode
TargetDevice=/dev/md0,FILE
#<snip>
```

5.7.4. BLK Mode Storage Device Details

The BLK mode storage device is suitable for high-speed storage attached to the target system:

- The BLK mode can accommodate only block devices.
- The device is accessed in the exclusive mode. The device should not be accessed (or active) in any way on the target system.
- Each device should be used for one and only one iSCSI target.

To configure a block storage device specify BLK as the device mode:

```
TargetDevice=<path to the storage device>,BLK
```

Where: `<path>`   Is the path to the actual storage device, such as /dev/sdb. The path must exist in the system.

```
target:
#<snip>
 # /dev/sdb is accessed in BLK mode
 TargetDevice=/dev/sdb,BLK
#<snip>
```

5.7.5. Multi-path Support

To enable multi-path support on the initiator, it is highly recommended that the following options are specified:

- *[,ID=xxxxxx]*: SCSI ID, a twenty-four (24) bytes alpha-numeric string
- *[,WWN=xxxxxxxxx]*: SCSI World Wide Name (WWN), a sixteen (16) bytes alpha-numeric string
- *[,SN= xxxxxx]*: SCSI SN, a sixteen (15) bytes alpha-numeric string.

The user should make sure the three values listed above are the same for the target LUNs involved in the multipath.

5.8. Target Redirection Support

An iSCSI Target can redirect an initiator to use a different IP address and port (often called a portal) instead of the current one to connect to the target. The redirected target portal can either be on the same machine, or a different one.

5.8.1. ShadowMode for Local vs. Remote Redirection

The *ShadowMode* setting specifies whether the Redirected portal groups should be present on the same machine or not. If *ShadowMode* is enabled, the redirected portal groups are on a different system. If it is disabled then the redirected portal groups must be present on the same system otherwise the target would fail to start.

Below is an example with *ShadowMode* enabled:

```
target:
 #<snip>
     # any login requests received on 10.193.184.81:3260 will be
     # redirected to 10.193.184.85:3261.

     PortalGroup=1@10.193.184.81:3260,[2]
     PortalGroup=2@10.193.184.85:3261

     # the PortalGroup "2" is NOT presented on the same system.
     ShadowMode=Yes
 #<snip>
```

Below is an example with *ShadowMode* disabled:

```
target:
 #<snip>
     # any login requests received on 10.193.184.81:3260 will be
     # redirected to 10.193.184.85:3261


    PortalGroup=1@10.193.184.81:3260,[2]
    PortalGroup=2@10.193.184.85:3261
    # the PortalGroup "2" IS present on the same system
    ShadowMode=No
#<snip>
```

5.8.2. Redirecting to Multiple Portal Groups

The Chelsio iSCSI Target Redirection allows redirecting all login requests received on a particular portal group to multiple portal groups in a round robin manner.

Below is an example Redirection to Multiple Portal Groups:

```
target:
 #<snip>
     # any login requests received on 10.193.184.81:3260 will be
     # redirected to 10.193.184.85:3261 and 10.193.184.85:3262 in a
     # Round Robin Manner.

    PortalGroup=1@10.193.184.81:3260,[2,3]
    PortalGroup=2@10.193.184.85:3261
    PortalGroup=3@10.193.184.85:3262
    ShadowMode=No
#<snip>
```

5.9. The command line interface tools "iscsictl" & "chisns"

5.9.1. iscsictl

`iscsictl` is the tool Chelsio provides for controlling the iSCSI target. It is a Command Line Interface (CLI) that is invoked from the console. Its usage is as follows:

```
iscsictl <options> <mandatory parameters> [optional parameters]
```

The mandatory and optional parameters are the **key=value** pair(s) defined in RFC3720, or the **var=const** pair(s) defined for Chelsio iSCSI driver implementation. In this document, the key=value is referred to as "pair", and var=const is referred to as "parameter" to clarify between iSCSI protocol"s pair value(s), and Chelsio iSCSI driver"s parameter value(s). Note that all **value** and **const** are case sensitive.

5.9.2. chisns

`chisns` is the command line tool for controlling the iSNS client. This is a simple tool that starts the iSNS client with a client and server parameter.

5.9.3. iscsictl options

Options	Mandatory Parameters	Optional Parameters	Description
-h			Display the help messages.
-v			Display the version.
-f	`<[path/] filename>`		Specifies a pre-written iSCSI configuration text file, used to start, update, save, or reload the iSCSI node(s). This option must be specified with one of the following other options: "**-S**" or "**-W**". For the "**-S**" option "**-f**" must be specified first. All other options will ignore this "**-f**" option. If the "**-f**" option is not specified with the commands above the default configuration file will be used. It"s name and location is: `/etc/chelsio-iscsi/chiscsi.conf` The configuration file path and filename must conform to Linux standards. For the format of the iSCSI configuration file, please see "Format of The iSCSI Configuration File" section earlier in this document.
-k	`<key>[=<val>]`		Specifies an iSCSI Entity or Chelsio Entity parameter. This option can be specified after "**-c**" option to retrieve a parameter setting..
-c	`target=<name> [,name2 . . . ,<nameN>]`		Display the Chelsio iSCSI target configuration. **target=<name>** parameter: Where **name** is the name of the node whose information will be returned. **name** can be one or more string of names, separated by a comma, **<name1[,name2,…,nameN] | ALL>** A **name** of **ALL** returns information on all targets. **ALL** is a reserved string that must be uppercase. Example:

			iscsictl -c target=iqn.com.cc.it1 **Iscsictl -c target=iqn.com.cc.target1 -k TargetAlias** The **<name>** parameter can also be specified as one or more parameter on the same command line, separated by a comma, **target=<name1>, <name2>, … ,<nameN>** The **target=<name>** parameter(s) are optional and if not specified all active Chelsio iSCSI targets(s) configuration(s) will be displayed. If **target=ALL** is specified or no parameters are specified the output will be abbreviated. Specify specific targets to get detailed configuration data. If the **target=<name>** option is specified, the -k <key> option can optionally be specified along with this option to display only the selected entity parameter setting. Example: **iscsictl -c target=iqn.com.cc.target1 -k HeaderDigest**
-F		`target=<name>` `-k lun=<value>`	Flush the cached data to the target disk(s). **target=<name>** parameter: Where **name** is the name of the target to be flushed. **name** can be one or more string of names, separated by a comma, **<name1[,name2,…,nameN]	ALL>** A **name** of **ALL** will cause all the target data to be flushed. **ALL** is a reserved string that must be uppercase. The **target=name** parameter is optional. If no **target=name** parameter is specified, it is the same as specifying **target=ALL**. The -k lun=<value> option is optional. It can be used to further specify a particular lun to be flushed. Example: To flush all the targets in the system: **iscsictl -F** To flush a particular target: **iscsictl -F target=iqn.com.cc.it1** To flush only the lun 0 of a particular target: **iscsictl -F target=iqn.com.cc.it1 -k lun=0**
-g			Display the Chelsio iSCSI Global Entity Settings.
-G	`<var=const>`		Set the Chelsio iSCSI Global Entity Settings. **var=const** parameter: Where **var=const** can be any key listed under Chelsio Global Entity Settings.

			Example: **iscsictl -G iscsi_auth_order=ACL** The **var=const** parameter(s) are mandatory. If the **var=const** parameter is not specified, the command will be denied. If any of the specified **var=const** parameter is invalid, the command will reject only the invalid parameters, but will continue on and complete all other valid parameters if any others are specified.
`-s`	`target=<name>`		Stop the specified active iSCSI targets. **target=\<name\>** parameter: *See the description of option -c for the target=\<name\> parameter definition.* The **target=\<name\>** parameter is mandatory. If no **target=\<name\>** parameter is specified, the command will be denied. If the **target=\<name\>** parameter is specified, only the specified targets from the **target=\<name\>** parameters will be stopped. If **target=ALL** is specified, all active targets will stop.
`-S`	`target=<name>`		Start or reload the iSCSI targets. **target=\<name\>** parameter: Where **name** is the name of the target(s) that will be started or reloaded. The **target=\<name\>** parameter can be specified as one or more parameter on the same command line, separated by a space, **target=\<name1\> target=\<name2\> … target=\<nameN\>** The **target=\<name\>** parameter can also be, **target=ALL** A **name** of **ALL** starts or reloads all targets specified in the configuration file. **ALL** is a reserved string that must be uppercase. The **target=\<name\>** parameter is optional. If this command line option is specified without the -f option, the default configuration file `/etc/chelsio-iscsi/chiscsi.conf` will be used. Rules, 1. If the **target=\<name\>** parameter is specified, only the targets from the list will be started or reloaded. 2. If **target=ALL** is specified, all targets specified from the iSCSI configuration file will

			be started or reloaded. 3. If the **target=<name>** parameter is not specified, all active targets configurations will be reloaded from the configuration file while those targets are running. All non-active targets specified will not be loaded / started. For Rules 1-3, if the specified targets are currently active (running), they will get reloaded. For Rules 1 & 2, if the specified targets are not currently active, they will be started. For Rules 2 & 3, please note the differences – they are not the same! The global settings are also reloaded from the configuration file with this option.
-r	target=<name>	-k initiator=<name>	Retrieve active iSCSI sessions under a target. **target=<name>** parameter: Where **name** must be a single target name. If **target=<name>** parameter is specified as target=<name>, the sessions can be further filtered based on the remote node name with optional –k initiator=<name> option. Examples: **iscsictl -r target=iqn.com.cc.it1** **iscsictl -r target=iqn.com.cc.it1 -k initiator=iqn.com.cc.ii1** The first **target=<name>** parameter is mandatory. If it is not specified, the command will be denied.
-D	<Session handle in hex>		Drop initiator session. This option should be specified with the handle of the session (in hex) that needs to be dropped. The session handle can be retrieved using the previous mentioned iscsictl option (-r used to retrieve active iSCSI sessions under a target).
-W			Overwrite the specified iSCSI configuration file with ONLY the current iSCSI global settings and the active iSCSI targets" configuration to the specified iSCSI configuration file. *Will delete any non-active targets' configuration from the specified file.* The -f option MUST be specified along with this option.
-h			Display the help messages.
	server=<IP address> [:<port>]	id=<isns entity id> query=<query interval>	Start the Chelsio iSNS client. **server=<IP address>[:<port>]** where **server** is the iSNS server address. The port is optional and if it"s not specified it defaults to 3205. The server with the ip address is mandatory and if it"s not specified the, the command will be

			denied.
			id=\<isns entity id> where **id** is the iSNS entity ID used to register with the server. It defaults to \<hostname>.
			query=\<query interval> where **query** is the initiator query interval (in seconds). It defaults to 60 seconds.
			Examples: chisns server=192.0.2.10 chisns server=192.0.2.10:3205 id=isnscln2 query=30
			In the first example the minimum command set is given where the IP address of the iSNS server is specified.
			In the second example a fully qualified command is specified by also setting three optional parameters. Here, the mandatory IP address and the corresponding optional port number are specified. Also set is the iSNS entity ID to "isnscln2" as well as the query interval to 30 seconds.

5.9.4. chisns options

Options	Mandatory Parameters	Optional Parameters	Description
-h			Display the help messages.
	server=\<IP address> [:\<port>]	id=\<isns entity id> query=\<query interval>	Start the Chelsio iSNS client. **server=\<IP address>[:\<port>]** where **server** is the iSNS server address. The port is optional and if it's not specified it defaults to 3205. The server with the ip address is mandatory and if it's not specified the, the command will be denied. **id=\<isns entity id>** where **id** is the iSNS entity ID used to register with the server. It defaults to \<hostname>. **query=\<query interval>** where **query** is the initiator query interval (in seconds). It defaults to 60 seconds. Examples: chisns server=192.0.2.10 chisns server=192.0.2.10:3205 id=isnscln2 query=30 In the first example the minimum command set is given where the IP address of the iSNS server is specified. In the second example a fully qualified command is specified by also setting three optional parameters.

			Here, the mandatory IP address and the corresponding optional port number are specified. Also set is the iSNS entity ID to 'isnscln2' as well as the query interval to 30 seconds.

5.10. Rules of Target Reload (i.e. "on the fly" changes)

After a target has been started its settings can be modified via reloading of the configuration file (i.e., `iscsictl -S`).

The following parameters cannot be changed once the target is up and running otherwise the target reload would fail:

- TargetName
- TargetSessionMaxCmd
- ACL_Enable
- ACL

The following parameters **CAN** be changed by reloading of the configuration file. The new value will become effective **IMMEDIATELY** for all connections and sessions:

- TargetDevice

PortalGroupThe following parameter **CAN** be changed by reloading of the configuration file. The new value will **NOT** affect any connections and sessions that already completed login phase:

- TargetAlias
- MaxConnections
- InitialR2T
- ImmediateData
- FirstBurstLength
- MaxBurstLength
- MaxOutstandingR2T
- HeaderDigest
- DataDigest
- MaxRecvDataSegmentLength
- AuthMethod
- Auth_CHAP_Initiator
- Auth_CHAP_Target
- Auth_CHAP_ChallengeLength
- Auth_CHAP_Policy

The following parameters **SHOULD NOT** be changed because only one valid value is supported:

- DataPDUInOrder   (support only "Yes")
- DataSequenceInOrder   (support only "Yes")

- ErrorRecoveryLevel   (support only "0")
- OFMarker   (support only "No")
- IFMarker   (support only "No")

The following parameters can be changed but would not have any effect because they are either not supported or they are irrelevant:

- DefaultTime2Wait   (not supported)
- DefaultTime2Retain   (not supported)
- OFMarkInt   (irrelevant because OFMarker=No)
- IFMarkInt   (irrelevant because IFMarker=No)

5.11. System Wide Parameters

The Chelsio Global Entity Settings are system wide parameters that can be controlled through the configuration file or the use of the command line "`iscsictl -G`". The finer points of some of these parameters are described in detail here:

5.11.1. iscsi_login_complete_time

Options: An integer value between 0 and 3600 (seconds). Default value is 300 (seconds).

This is the login timeout check. The parameter controls the maximum time (in seconds) allowed to the initiator to complete the login phase. If a connection has been in the login phase longer than the set value, the target will drop the connection.

Value zero turns off this login timeout check.

5.11.2. iscsi_auth_order

Options: "ACL" or "CHAP", defaults to "CHAP"

On an iSCSI target when `ACL_Enable` is set to `Yes`, `iscsi_auth_order` decides whether to perform CHAP first then ACL or perform ACL then CHAP.

- **ACL:** When setting `iscsi_auth_order=ACL`, initiator authorization will be performed at the start of the login phase for an iSCSI normal session: upon receiving the first iscsi_login_request, the target will check its ACL. If this iSCSI connection does not match any ACL provisioned, the login attempt will be terminated.

- **CHAP**: When setting `iscsi_auth_order=CHAP`, initiator authorization will be performed at the end of the login phase for an iSCSI normal session: before going to the full feature phase, the target will check its ACL. If this iSCSI connection does not match any ACL provisioned, the login attempt will be terminated.

> 🛈 Note   *iscsi_auth_order has no meaning when* `ACL_Enable` *is set to* `No` *on a target.*

5.11.3. iscsi_target_vendor_id

Options: A string of maximum of 8 characters, defaults to `CHISCSI`

The `iscsi_target_vendor_id` is part of the device identification sent by an iSCSI target in response of a SCSI Inquiry request.

5.11.4. iscsi_chelsio_ini_idstr

Options: A string of maximum of 255 characters, defaults to "cxgb4i".

For an iscsi connection, more optimization can be done when both initiator and target are running Chelsio adapters and drivers.

This string is used to verify the initiator name received, and identify if the initiator is running Chelsio drivers: if the initiator name contains the same substring as `iscsi_chelsio_ini_idstr` it is assumed the initiator is running with the Chelsio iscsi initiator driver and additional offload optimization is performed.

5.12 Performance Tuning

In order to auto tune the system for best performance, Chelsio recommends:

- Disabling virtualization, c-state technology, VT-d, Intel I/O AT and SR-IOV in the BIOS settings.
- Installing the adapter into a PCIe Gen3 x8/x16 slot.
- Disable SELinux and firewall.
- Installing the driver package will copy `t4_perftune.sh` script to **/sbin** directory. Run the script to map the adapter queues to different CPUs:

```
[root@host~]# t4_perftune.sh
```

Also, follow the steps mentioned below to lower your latency:

i.   If not already done, load the iSCSI target driver.
ii. Run the following script to disable few services.

```
[root@host~]# t4_latencytune.sh <interface>
```

iii. Set sysctl param *net.ipv4.tcp_low_latency* to 1

```
[root@host~]# sysctl -w net.ipv4.tcp_low_latency=1
```

iv. Map iSCSI worker threads to different CPUs.

```
[root@host~]# chiscsi_set_affinity.sh
```

5.13. Firmware Update

The T5 firmware is installed on the system, typically in *lib/firmware/cxgb4*, and the driver will auto-load the firmware if an update is required. The kernel must be configured to enable userspace firmware loading support:

Device Drivers -> Generic Driver Options -> Userspace firmware loading support

The firmware version can be verified using ethtool:

```
[root@host~]# ethtool -i <iface>
```

6. **Software/Driver Unloading**

To unload the iSCSI Target driver, follow the steps mentioned below:

i.   Log out from the initiator.
ii. Clear the SCST configuration:

```
[root@host~]# scstadmin -force -noprompt -clear_config /etc/chelsio-
iscsi/scst.conf
```

iii. Stop all running targets:

```
[root@host~]# iscsictl -s target=ALL
```

iv. Unload the driver:

```
[root@host~]# rmmod chiscsi_t4
[root@host~]# rmmod chiscsi_base
```

OR,

```
[root@host]# modprobe –v –r chiscsi_t4
```

7. Software/Driver Uninstallation

i.   Change your working directory to *Chelsio-iSCSI-scst-x.x.x.x*

ii.   Run the following command:

```
[root@host~]# make uninstall
```

8. Software/Driver Update

For any distribution specific problems, please check README and Release Notes included in the release for possible workaround.

Please visit Chelsio support web site http://service.chelsio.com/ for regular updates on various software/drivers. You can also subscribe to our newsletter for the latest software updates.

9. Appendix

9.1. Chelsio End-User License Agreement (EULA)

Installation and use of the driver/software implies acceptance of the terms in the Chelsio End-User License Agreement (EULA).

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