Chelsio Unified Wire for FreeBSD

Installation and User's Guide

Version History

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1.0.0	03/04/2013
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1.0.7	05/10/2017
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TABLE OF CONTENTS

I. Chelsio Unified Wire

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** series is Chelsio's next generation of highly integrated, hyper-virtualized controllers. The adapters are 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 to true 100Gb 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.

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.

1.1. Features

Chelsio Unified Wire driver package for FreeBSD contains Network, iSCSI and iWARP drivers for Chelsio's Unified Wire adapters.

The Unified Wire Installer installs the following Chelsio drivers, features and software:

- **Network driver (NIC-TOE)**
- **iWARP**
- **iSCSI PDU Offload Target**
- **Classification and Filtering**
- **Offload IPv6**

Please refer to their respective sections for more information.

1.2. Hardware Requirements

The Chelsio Unified Wire supports all x64 architectures supporting PCIE (x4, x8, x16) slots.

- AMD CPUs, 64-bit (x86_64/amd64)
- Intel CPUs, 64-bit (x86_64)

> ⓘ Note   *The Chelsio Unified Wire supports 3.3v PCI bus only. Running an adapter on a PCI x4 slot is not recommended as performance will be significantly reduced by the limitations of PCI.*

1.3. Software Requirements

The Chelsio Unified Wire software has been developed to run on FreeBSD based platforms. To know more about the complete list of versions supported by each driver, please refer to their respective sections.

1.4. Package Contents

The Chelsio Unified Wire Source Package consists of the following files/directories:

- **kernel-head**: Source code for different drivers/software.
- **docs:** The *docs* directory contains support documents - README, Release Notes and User's Guide (this document) for the driver.
- **firmware**: Firmware binaries and firmware configuration files.
- **EULA:** Chelsio's End User License Agreement.

2. Hardware Installation

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 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/x16 slot as sometimes the process of securing the card causes the card to become unseated.
10. Connect a fiber/twinax cable, multi-mode for short range (SR) optics or single-mode for long range (LR) optics, to the Ethernet adapter or regular Ethernet cable for the 1Gb Ethernet adapter.
11. Power on your system.
12. Verify if the adapter was installed successfully by using the following command:
    a. For T6 adapters:

```
t6iov0@pci0:129:0:0:    class=0x020000 card=0x00001425 chip=0x60071425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T62100-LP-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
t6iov1@pci0:129:0:1:    class=0x020000 card=0x00001425 chip=0x60071425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T62100-LP-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
t6iov2@pci0:129:0:2:    class=0x020000 card=0x00001425 chip=0x60071425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T62100-LP-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
t6iov3@pci0:129:0:3:    class=0x020000 card=0x00001425 chip=0x60071425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T62100-LP-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
t6nex0@pci0:129:0:4:    class=0x020000 card=0x00001425 chip=0x64071425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T62100-LP-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
none150@pci0:129:0:5:    class=0x010000 card=0x00001425 chip=0x65071425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T62100-LP-CR Unified Wire Storage Controller'
    class      = mass storage
    subclass   = SCSI
none151@pci0:129:0:6:    class=0x0c0400 card=0x00001425 chip=0x66071425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T62100-LP-CR Unified Wire Storage Controller'
    class      = serial bus
    subclass   = Fibre Channel
```

b. For T5 adapters:

```
t5iov0@pci0:3:0:0:       class=0x020000 card=0x00001425 chip=0x50011425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T520-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
t5iov1@pci0:3:0:1:       class=0x020000 card=0x00001425 chip=0x50011425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T520-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
t5iov2@pci0:3:0:2:       class=0x020000 card=0x00001425 chip=0x50011425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T520-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
t5iov3@pci0:3:0:3:       class=0x020000 card=0x00001425 chip=0x50011425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T520-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
t5nex0@pci0:3:0:4:       class=0x020000 card=0x00001425 chip=0x54011425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T520-CR Unified Wire Ethernet Controller'
    class      = network
    subclass   = ethernet
none65@pci0:3:0:5:       class=0x010000 card=0x00001425 chip=0x55011425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T520-CR Unified Wire Storage Controller'
    class      = mass storage
    subclass   = SCSI
none66@pci0:3:0:6:       class=0x0c0400 card=0x00001425 chip=0x56011425 rev=0x00 hdr=0x00
    vendor     = 'Chelsio Communications Inc'
    device     = 'T520-CR Unified Wire Storage Controller'
    class      = serial bus
    subclass   = Fibre Channel
```

For Chelsio 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 card
- Physical function 5: for iSCSI
- Physical function 6: for FCoE
- Physical function 7: Currently not assigned

Once driver is installed and loaded, run the following commands and examine the output to see if the card is discovered.

```
[root@host~]#  sysctl dev.t5nex.0.%desc
dev.t5nex.0.%desc: Chelsio T520-LL RNIC (rev 0), S/N:RE16130313,
E/C:0000000000000000

[root@host~]#  dmesg
t5nex0: <Chelsio T520-LL-CR> mem 0xe5300000-0xe537ffff,0xe4000000-
0xe4ffffff,0xe5884000-0xe5885fff irq 16 at device 0.4 on pci1
t5nex0: PCIe x8, 2 ports, 14 MSI-X interrupts, 31 eq, 13 iq
```

The above outputs indicate the hardware configuration of the card as well as the Serial number of the card. As observed by the x8, the card is properly installed in an x8 slot on the machine and the card is using MSI-X interrupts.

> ⓘ 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 Ethernet network interface. However, for T5 40G and T420-BT 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

3.1. Compiling and Installing the kernel

1. Install FreeBSD 10.X/11.X from
   ftp://ftp.freebsd.org/pub/FreeBSD/releases/amd64/amd64/ISO-IMAGES/
2. If you haven't done so already, download the tar-ball ChelsioUwire-FBSD-x.x.x.x.*tar.gz* from
   Chelsio Download Center, http://service.chelsio.com

3. Untar the tar-ball using the following command:

```
[root@host~]#  tar xvf ChelsioUwire-FBSD-x.x.x.x.tar.gz
```

4. This package has the entire FreeBSD world (operating system). You need to build entire
   FreeBSD world since infiniband core driver compiles only within FreeBSD kernel and not
   separately as a module.

   Build the FreeBSD world (operating system) from the package as follows:

   a. Add the following entry in */etc/src.conf* file:

```
WITH_OFED='yes'
```

   b. Create a backup of existing kernel source.

```
[root@host~]#  mv /usr/src /usr/src_bkp
```

   c. Copy the contents of *ChelsioUwire-FBSD-x.x.x.x/kernel-head* to */usr/src/*
   d. Build and install the world as follows:

```
[root@host~]#  cd usr/src/
[root@host~]#  make buildworld
[root@host~]#  make installworld
```

e. Build and install the kernel as follows:

```
[root@host~]#  make buildkernel
[root@host~]#  make installkernel
```

f. Add the following entries to */boot/loader.conf* to enable capabilities:

```
hw.cxgbe.config_file="flash"
hw.cxgbe.iscsicaps_allowed=0xf
```

g. Reboot the machine for changes to take effect.

h. After reboot, check if you have booted to the right kernel by executing `uname -a`. You should see a similar output:

```
[root@     ~]# uname -a
FreeBSD kick 12.0-CURRENT FreeBSD 12.0-CURRENT #0 f061800bf4e8 (freebsd-head) tip: Thu Nov 10 20:02:53
 IST 2016     root@kick:/usr/obj/usr/src/sys/GENERIC  amd64
```

5. Verify that the kernel supports TOE:

```
[root@host~]#  config -x /boot/kernel/kernel | grep TCP_OFFLOAD
options TCP_OFFLOAD
```

3.2. Userland Tools

Build and install *cxgbetool*

```
[root@host~]#  cd /usr/src/usr.sbin/cxgbetool
[root@host~]#  make && make install
```

3.3. Firmware Update

Firmware will have to be loaded manually. Run the following commands for T6 adapters:

```
[root@host~]# kldload if_cxgbe
[root@host~]# cxgbetool t6nexX loadfw ChelsioUwire-FBSD-
x.x.x.x/firmware/t6fw-x.xx.xx.x.bin
[root@host~]# cxgbetool t6nexX loadcfg ChelsioUwire-FBSD-
x.x.x.x/firmware/t6-config.txt
```

Reboot system for changes to take effect.

Firmware version can be verified using:

```
[root@host~]#  sysctl -n dev.t6nex.X.firmware_version
```

ⓘ Note *For T5 adapters, use **t5nex** as the parent device, **t5fw-x.xx.xx.x.bin** as the firmware binary file and **t5-config.txt** as the firmware configuration file. Similarly, for T4 adapters, use **t4nex**, **t4fw-x.xx.xx.x.bin** and **t4-config.txt** respectively.*

4. 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.

II. Network (NIC-TOE)

1. Introduction

Chelsio's Unified Wire adapters provide extensive support for NIC operation, including all stateless offload mechanisms for both IPv4 and IPv6 (IP, TCP and UDP checksum offload, LSO aka TSO, and assist mechanisms for accelerating LRO. A high performance fully offloaded and fully featured TCP/IP stack meets or exceeds software implementations in RFC compliance. Chelsio's Terminator engine provides unparalleled performance through a specialized data flow processor implementation and a host of features designed for high throughput and low latency using standard size Ethernet frames. TCP offload is fully implemented in the hardware, thus freeing the CPU from TCP/IP overhead. The freed CPU can be used for any computing needs.

The Network (*cxgbe*) driver provides support for PCI Express Ethernet adapters based on the Chelsio Terminator ASIC.

1.1. Hardware Requirements

1.1.1. Supported Adapters

The following are the Chelsio adapters that are compatible with Chelsio network driver:

- T62100-CR
- T62100-LP-CR
- T62100-SO-CR
- T6425-CR
- T6225-CR
- T6225-LL-CR
- T6225-SO-CR
- T580-CR
- T580-LP-CR
- T580-SO-CR*
- T540-CR
- T520-CR
- T520-LL-CR
- T520-SO-CR*
- T420-CR
- T420-LL-CR
- T440-CR
- T440-LP-CR
- T422-CR
- T420-SO-CR*
- T420-CX
- T420-BT
- T404-BT

*Only NIC supported

1.2. Software Requirements

Currently the Network driver is available for the following version(s):

- FreeBSD 10.3-RELEASE
- FreeBSD 11.0-RELEASE

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

2. Software/Driver Loading

The driver(s) must be loaded by the root user. Any attempt to load the driver(s) as a regular user will fail.

2.1. Loading NIC driver

Load the NIC driver using the command given below:

```
[root@host~]#  kldload if_cxgbe
```

2.2. Loading TOE driver

The TOE driver module (*t4_tom.ko*) is needed only if you plan to use the TOE and iWARP capabilities, and must be loaded manually. Run the following command to do so:

```
[[root@host~]#  kldload t4_tom
```

ℹ Note   *The NIC module (if_cxgbe) by itself can be loaded / unloaded at any time, but once the TOE driver module (t4_tom) is loaded, it will prevent both the modules from being unloaded.*

3. Software/Driver Configuration and Fine-tuning

3.1. Enabling network interface

Enable any Chelsio T6 network interface using the following command:

```
[root@host~]#  ifconfig ccX <ip_address> up
```

For T5 and T4, use *cxlX* and *cxgbeX* respectively.

3.2. Enabling TCP Offload

Enable TCP offload on a T6 interface using *ifconfig*. An error usually indicates that *t4_tom* is not loaded.

```
[root@host~]#  ifconfig ccX toe
```

For T5 and T4, use *cxlX* and *cxgbeX* respectively.

If successful, TOE4 and TOE6 will be displayed in the list of the enabled options as shown in example below:

```
[root@     ~]# ifconfig cc0 toe
[root@     ~]# ifconfig cc0
cc0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> metric 0 mtu 1500
        options=ecc7bb<RXCSUM,TXCSUM,VLAN_MTU,VLAN_HWTAGGING,JUMBO_MTU,VLAN_HWCSUM,TSO4,TSO6,LRO,TOE4,
TOE6,VLAN_HWTSO,LINKSTATE,RXCSUM_IPV6,TXCSUM_IPV6>
        ether 00:07:43:04:b2:30
        inet 102.1.1.112 netmask 0xffffff00 broadcast 102.1.1.255
        nd6 options=29<PERFORMNUD,IFDISABLED,AUTO_LINKLOCAL>
        media: Ethernet 100GBase-CR4 <full-duplex>
        status: active
```

When a TOE capable interface is the outbound path to a destination to which a new connection is being established, the connection should be offloaded automatically. Verify with *netstat*:

```
[root@host~]#  netstat -np tcp | grep toe
```

T6 SO (Server Offload) adapters support limited number of offload connections. To see the maximum number of offload connections, run the following command:

```
[root@host~]# sysctl dev.t6nex.X.misc.tids
```


Where,

TID is the number of offload connections.
STID is the number of offload servers.

3.3. Enabling DDP

DDP is disabled by default. To enable it, run the *sysctl* command.

For T6 adapters:

```
[root@host~]#  sysctl -w dev.t6nex.X.toe.ddp=1
```

For T5 and T4, use *t5nex* and *t4nex* respectively.

3.4. Connection Offload Policies (COP)

Connection Offload Policies (COP) are policies applicable to offloaded connections that are created through TOM driver. COP compiles offload policies into a simple program using BPF, and that generated byte code can be loaded into the kernel and interpreted. These offload policies are used to determine the settings to be used for various connections based on matching filter specifications with program rules.

The following section explains the method to create and apply COP.

1. If not done already, load NIC and TOE drivers:

```
[root@host~]# kldload if_cxgbe
[root@host~]# kldload t4_tom
```

2. For T6, bring up the interface and enable TOE:

```
[root@host~]# ifconfig ccX up
[root@host~]# ifconfig ccX toe
```

For T5 and T4, use *cxlX* and *cxgbeX* respectively.

3. Create the policy_file.

Example:
The below policy will offload only connections to port number 5001.

```
[L] port 5001 => offload
[P] port 5001 => offload
```

4. Apply the policy using the cxgbetool.

```
[root@host~]# cxgbetool t6nexY policy <policy_file>
```

For T5 and T4, use *t5nexY* and *t4nexY* respectively.
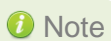
> ℹ️ Note   *For more information on additional parameters and examples, refer cxgbetool manual by running the* `man cxgbetool` *command*

3.5. Network Device Configuration

Please refer to the operating system documentation for administration and configuration of network devices.
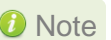
> ℹ️ Note   *Some operating systems may attempt to auto-configure the detected hardware and some may not detect all ports on a multi-port adapter. If this happens, please refer to the operating system documentation for manually configuring the network device.*

4. Software/Driver Unloading

4.1. Unloading the NIC driver module

To unload the NIC driver, stop all the running traffic and run the following command:

```
[root@host~]#  kldunload if_cxgbe
```

ⓘ Note   *NIC module cannot be unloaded if TOE module is loaded.*

4.2. Unloading the TOE driver module

To unload the TOE driver, reboot the system.

III. iWARP

1. Introduction

The iWARP (*iw_cxgbe*) driver provides support for iWARP including RDMA, DDP and MPA protocols.

1.1. Hardware Requirements

1.1.1. Supported Adapters

Following are the currently shipping Chelsio adapters that are compatible with the iWARP driver:

- T62100-CR
- T62100-LP-CR
- T6425-CR
- T6225-CR
- T6225-LL-CR
- T580-CR
- T580-LP-CR
- T540-CR
- T520-CR
- T520-LL-CR
- T420-CR
- T440-CR
- T422-CR
- T404-BT

1.2. Software Requirements

Currently the iWARP driver is available for the following version(s):

- FreeBSD 10.3-RELEASE
- FreeBSD 11.0-RELEASE

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

2. Software/Driver Loading

The driver must be loaded by the root user. Any attempt to load the driver as a regular user will fail.

1. If not done already, load NIC and TOE drivers:

```
[root@host~]#  kldload if_cxgbe
[root@host~]#  kldload t4_tom
```

2. For T6, bring up the interface and enable TOE:

```
[root@host~]#  ifconfig ccX up
[root@host~]#  ifconfig ccX toe
```

ⓘ Note   *For T5 and T4, use **cxlX** and **cxgbeX** respectively.*

3. Load the iWARP driver using the following command:

```
[root@host~]#  kldload iw_cxgbe
```

3. Software/Driver Configuration and Fine-tuning

3.1. Verifying iWARP Functionality

1. Load *krping* module using the following command:

```
[root@host~]#  kldload krping
```

2. Start *krping* server on one machine as:

```
[root@host~]#  echo
"verbose,count=5000,server,addr=<chelsioInterface>,port=<port>" >
/dev/krping
```

3. Start *krping* client on PEER machine as:

```
[root@host~]#  echo
"verbose,count=5000,client,addr=<Server_chelsioInterface>,port=<port>" >
/dev/krping
```

4. After starting the client, read the */dev/krping* on server as:

```
[root@host~]#  cat /dev/krping

krping:num device snd bytes snd msgs rcv bytes rcv msgs wr bytes wr msgs rd bytes rd msgs
krping: 1  listen    0        0        16        1      60085     70624    917184      0
```

4. Software/Driver Unloading

To unload the iWARP driver, stop all the running traffic and run the following command:

```
[root@host~]# kldunload iw_cxgbe
```

IV. iSCSI PDU Offload Target

1. Introduction

Chelsio iSCSI PDU Offload Target (*cxgbei.ko*) is the hardware accelerated iSCSI target module for Chelsio TOE capable adapters supported by NIC driver (*if_cxgbe*) and provides support for offloading iSCSI traffic.

On the host side the driver interacts with the storage stack via the ICL (iSCSI Common Layer) in the kernel. On the wire, standard iSCSI traffic (SCSI over TCP as per RFC 3720/7143 etc.) interoperates with all other standards compliant implementations. The driver is layered on top of the TOE driver (t4_tom) and promotes connections being handled by t4_tom in iSCSI ULP (Upper Layer Protocol) mode. The driver provides hardware assistance including:

- Full TCP processing.
- iSCSI PDU identification and recovery within the TCP stream.
- Header and/or data digest insertion (Tx) and verification (Rx).
- Zero copy (both Tx and Rx).

> *i* Note   *This product will be supported in the next release.*

1.1. Hardware Requirements

1.1.1. Supported Adapters

The following are the currently shipping Chelsio adapters that are compatible with iSCSI PDU Offload Target software:

- T580-CR
- T580-LP-CR
- T540-CR
- T520-CR
- T520-LL-CR
- T420-CR
- T420-LL-CR
- T440-CR
- T440-LP-CR
- T422-CR
- T420-CX
- T420-BT
- T404-BT

1.2. Software Requirements

`cxgbei.ko` is the iSCSI PDU offload target mode driver.

if_cxgbe, toecore and *t4_tom* modules are required by *cxgbei.ko* module to work.

1.2.1. FreeBSD Requirements

Currently the iSCSI PDU driver is available for the following version(s):

- FreeBSD 10.3-RELEASE
- FreeBSD 11.0-RELEASE

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

2. Software/Driver Loading

2.1. Module Installation

1. Compile and install iSCSI module

```
[root@host~]#  cd /usr/src/sys/modules/iscsi
[root@host~]#  make
[root@host~]#  make install
```

2. Compile and install *ctl* drivers

```
[root@host~]#  cd /usr/src/sys/modules/ctl
[root@host~]#  make
[root@host~]#  make install
```

3. Compile and install *ctld*

```
[root@host~]#  cd /usr/src/usr.sbin/ctld
[root@host~]#  make all install
```

4. Compile and install iSCSI PDU offload target module

```
[root@host~]#  cd /usr/src/sys/modules/cxgbe/cxgbei
[root@host~]#  make
[root@host~]#  make install
```

2.2. Module Loading

1. If not done already, load NIC and TOE drivers:

```
[root@host~]#  kldload if_cxgbe
[root@host~]#  kldload t4_tom
```

2. For T6, bring up the interface and enable TOE:

```
[root@host~]#   ifconfig ccX up
[root@host~]#   ifconfig ccX toe
```

> ⓘ Note   *For T5 and T4, use **cxlX** and **cxgbeX** respectively.*

3. Load iSCSI PDU offload target module:

```
[root@host~]#   kldload cxgbei
```

3. Software/Driver Configuration and Fine-tuning

3.1. Starting iSCSI Target

1. Make necessary changes in the iSCSI configuration file located in */etc/ctl.conf*. In order to use cxgbei as offload module, add *offload cxgbei* to regular configuration.

Sample:

```
root@          :~ # vi /etc/ctl.conf

portal-group pg0 {
        discovery-auth-group no-authentication
        listen 102.11.11.102
        offload cxgbei
}

target iqn.2017-05.com.chelsio.target:1 {
        auth-group no-authentication
        portal-group pg0

        lun 0 {
                path /dev/md0
        }
}
```

> *i* Note   *Refer to the official FreeBSD documentation for more information.*

2. Start iSCSI service:

```
[root@host~]#  service ctld onestart
```

4. Software/Driver Unloading

Use the following command to unload the iSCSI PDU offload target module:

```
[root@host~]#  kldunload cxgbei
```

V. Classification and Filtering

1. Introduction

Classification and Filtering feature enhances network security by controlling incoming traffic as they pass through network interface based on source and destination addresses, protocol, source and receiving ports, or the value of some status bits in the packet. This feature can be used in the ingress path to:

- Steer ingress packets that meet ACL (Access Control List) accept criteria to a particular receive queue.
- Switch (proxy) ingress packets that meet ACL accept criteria to an output port, with optional header rewrite.
- Drop ingress packets that meet ACL accept criteria.

1.1. Hardware Requirements

1.1.1. Supported Adapters

The following are the currently shipping Chelsio Adapters that are compatible with the Classification and Filtering feature:

- T62100-CR
- T62100-LP-CR
- T62100-SO-CR
- T6425-CR
- T6225-CR
- T6225-LL-CR
- T6225-SO-CR
- T580-CR
- T580-LP-CR
- T580-SO-CR
- T540-CR
- T520-CR
- T520-LL-CR
- T520-SO-CR
- T420-CR
- T420-LL-CR
- T440-CR
- T440-LP-CR
- T422-CR
- T420-SO-CR
- T420-CX
- T420-BT
- T404-BT

1.2. Software Requirements

1.2.1. FreeBSD Requirements

Currently the Classification and Filtering feature is available for the following versions:

- FreeBSD 10.3-RELEASE
- FreeBSD 11.0-RELEASE

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

2. Usage

2.1. Configuration

The Classification and Filtering feature is configured by specifying the filter selection combination set in the firmware configuration file *t6-config.txt (t5-config.txt and t4-config.txt for T5 and T4 adapters respectively).*

The following combination is set by default and packets will be matched accordingly:

```
filterMode = fragmentation, mpshittype, protocol, vlan, port, fcoe
```

Where,

fragmentation: Fragmented IP packets
mpshittype   : MAC address "match type" (0=unicast, 1=unicast hash, 2=multicast, 3=multicast hash, 4=PROM, 5=hyper PROM, 6=broadcast, 7=none)
protocol   : IP protocol number (ICMP=1, TCP=6, UDP=17, etc)
vlan   : Inner VLAN Tag
port   : Packet ingress port number
fcoe   : Fibre Channel over Ethernet frames

2.2. Creating Filter Rules

Network driver (*if_cxgbe*) and *cxgbetool* must be installed before setting the filter rule.

Run the following command to load the network driver:

```
[root@host~]# kldload if_cxgbe
```

Now, create filter rules using *cxgbetool*:

```
[root@host~]# cxgbetool t6nexY filter <index> action [pass/drop/switch]
```

Where,

t6nexY : Chelsio T6 interface. Use *t5nexY and t4nexY* for T5 and T4 adapters respectively.
index   : positive integer ranging from 0-495 set as filter id.

action : Ingress packet disposition.
pass : Ingress packets will be passed through set ingress queues.
switch : Ingress packets will be routed to an output port with optional header rewrite.
drop : Ingress packets will be dropped.

> ⓘ Note *In case of multiple filter rules, the rule with the lowest filter index takes higher priority.*

2.2.1. Examples

- *Drop* **action**

```
[root@host~]# cxgbetool t6nexY filter 0 action drop sip 192.168.1.5
```

The above filter rule will drop all ingress packets from IP 192.168.1.5

- *Pass* **action**

```
[root@host~]# cxgbetool t6nexY filter 0 action pass sport 10001 dport 355
queue 2
```

The above filter rule will pass all ingress packets that match source port 10001 and destination port 355 to the ingress queue with context id 2 for load balancing.

> ⓘ Note *The context id for a particular ingress queue can be obtained using [root@host~]# sysctl dev.cxgbe.X.rxq.Y.cntxt_id*

- *Switch* **action**

```
[root@host~]# cxgbetool t6nexY filter 0 action switch iport 0 eport 1 vlan 3
```

The above filter rule will route all ingress packets that match VLAN id 3 from port 0 of Chelsio adapter to port 1. Remaining packets will be sent to the host.

For offloaded ingress packets, use the `prio` argument with the above command:

```
[root@host~]# cxgebtool t5nexY filter <index> action <pass|drop|switch>
 prio 1
```

ⓘ Note   `prio` argument currently not supported with T6 adapters.

2.3. Listing Filter Rules

To list the filters set, run the following command:

```
[root@host~]# cxgbetool t6nexY filter list
```

2.4. Removing Filter Rules

To remove a filter, run the following command with the corresponding filter rule index

```
[root@host~]# cxgbetool t6nexY filter <index> delete
```

ⓘ Note   *For more information on additional parameters, refer cxgbetool manual by running the* `man cxgbetool` *command*

VI. Offload IPv6

1. Introduction

The growth of the Internet has created a need for more addresses than are possible with IPv4. Internet Protocol version 6 (IPv6) is a version of the Internet Protocol (IP) designed to succeed the Internet Protocol version 4 (IPv4). Chelsio's Offload IPv6 feature provides support to fully offload IPv6 traffic on to the Unified wire adapter.

1.1. Hardware Requirements

1.1.1. Supported Adapters

The following are the currently shipping Chelsio adapters that are compatible with Chelsio Offload IPv6 feature:

- T62100-CR
- T62100-LP-CR
- T62100-SO-CR
- T6425-CR
- T6225-CR
- T6225-LL-CR
- T6225-SO-CR
- T580-CR
- T580-LP-CR
- T540-CR
- T520-CR
- T520-LL-CR
- T420-CR
- T420-LL-CR
- T440-CR
- T440-LP-CR
- T422-CR
- T420-CX
- T420-BT
- T404-BT

1.2. Software Requirements

1.2.1. FreeBSD Requirements

Currently the Offload IPv6 feature is available for the following versions:

- FreeBSD 10.3-RELEASE
- FreeBSD 11.0-RELEASE

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

2. Software/Driver Configuration and Fine-tuning

i. Add the following entry in */etc/rc.conf* file:

```
ipv6_prefer="YES"
```

ii. Reboot the system.
iii. TOE driver (*t4_tom*) must be installed and loaded in order to use the Offload IPv6 feature. Also, the driver must be loaded by the root user. Any attempt to load the driver as a regular user will fail.
Load the TOE driver as:

```
[root@host~]#  kldload t4_tom
```

iv. For T6, bring up the interface and enable TOE:

```
[root@host~]#  ifconfig ccX up
[root@host~]#  ifconfig ccX toe
```

ⓘ Note   *For T5 and T4, use **cxlX** and **cxgbeX** respectively.*

All IPv6 traffic over Chelsio interfaces will be offloaded now.

VII. Appendix

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