Chelsio Communications

Accelerate

Chelsio Unified Boot

Installation and User's Guide

Chelsio Communications (Headquarters)
209 North Fair Oaks Avenue,
Sunnyvale, CA 94085
U.S.A

www.chelsio.com

Tel: 408.962.3600
Fax: 408.962.3661

Chelsio (India) Private Limited
Subramanya Arcade, Floor 3, Tower B
No. 12, Bannerghatta Road,
Bangalore-560029
Karnataka,
India

Tel: +1-91-80-4039-6800

Chelsio KK (Japan)
Yamato Building 8F,
5-27-3 Sendagaya,
Shibuya-ku,
Tokyo 151-0051,
Japan

Sales
For all sales inquiries please send email to sales@chelsio.com

Support
For all support related questions please send email to support@chelsio.com

Document History

Version	Revision Date
1.0.0	05/18/2012
1.0.1	07/30/2012
1.0.2	10/05/2012
1.0.3	16/05/2012
1.0.4	07/31/2013
1.0.5	04/29/2014
1.0.6	09/05/2014
1.0.7	09/26/2014
1.0.8	10/13/2014
1.0.9	02/24/2015
1.1.0	05/05/2015
1.1.1	07/07/2015
1.1.2	09/22/2016
1.1.3	11/18/2016
1.1.4	10/03/2017
1.1.5	08/07/2018
1.1.6	10/17/2018
1.1.7	05/19/2020

TABLE OF CONTENTS

I. Unified Boot Option ROM

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 1/10/25/40/50/100GbE 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 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.

Ideal for all data, storage and high-performance clustering applications, the Unified Wire 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.

PXE is short for Preboot eXecution Environment and is used for booting computers over an Ethernet network using a Network Interface Card (NIC). FCoE SAN boot process involves installation of an operating system (OS) to an FC/FCoE disk and then booting from it. iSCSI SAN boot process involves installation of an OS to an iSCSI disk and then booting from it.

This section of the guide explains how to configure and use Chelsio Unified Boot Option ROM which flashes PXE, iSCSI and FCoE Option ROM onto Chelsio's adapters. It adds functionalities like PXE, FCoE and iSCSI SAN boot.

1.1. Hardware Requirements

1.1.1. Supported Adapters

The following are the currently shipping Chelsio Adapters that are compatible with Unified Boot Option ROM software:

- 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*
- T580-OCP-SO*
- T540-CR
- T540-LP-CR
- T520-CR
- T520-LL-CR
- T520-SO-CR*
- T520-OCP-SO*
- T520-BT
- T540-BT

** Only PXE supported*

1.1.2. Supported Hardware

The following hardware platforms are supported by Chelsio Unified Boot Option ROM software:

- Dell T5600
- DELL PowerEdge 2950
- DELL PowerEdge T110
- DELL PowerEdge T710
- DELL PowerEdge R220
- DELL PowerEdge R720
- IBM X3650 M2
- IBM X3650 M4*
- HP Proliant DL180 gen9
- HP ProLiant DL385G2
- Supermicro X7DWE
- Supermicro X8DTE-F
- Supermicro X8STE
- Supermicro X8DT6
- Supermicro X9SRL-F
- Supermicro X9SRE-3F
- Supermicro-X10DRi
- ASUS P5KPL
- ASUS P8Z68
- Lenovo X3650 M5
- Intel DQ57TM

* If system BIOS version is lower than 1.5 and both Legacy and uEFI are enabled, system will hang during POST. Please upgrade the BIOS version to 1.5 or higher to avoid this issue.

1.1.3. Supported Switches

The following switches are supported by Chelsio Unified Boot Option ROM software:

- Cisco Nexus 5010 with 5.1(3) N1 (1a) firmware.

- Arista DCS-7124S-F
- Mellanox SX_PPC_M460EX

Other platforms/switches have not been tested and are not guaranteed to work.

1.2. Software Requirements

Chelsio Unified Boot Option ROM software requires Disk Operating System to flash Option ROM onto Chelsio adapters.

The installation of the following Linux distributions is supported using Chelsio inbox drivers.

Linux Distribution	Drivers
RHEL 8.2, 4.18.0-193.el8	PXE, FCoE, iSCSI
RHEL 8.1, 4.18.0-147.el8	
RHEL 7.8, 3.10.0-1127.el7	PXE, iSCSI
RHEL 7.7, 3.10.0-1062.el7	

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

1.3. Pre-requisites

- A DOS bootable USB flash drive or Floppy Disk is required for updating firmware, option ROM, creating DUD, etc.
- Secure Boot should be disabled in the system BIOS.

1.4. Package Contents

Chelsio Unified Boot Option ROM package contains the following:

- **OptionROM**: This directory contains Unified Boot Option ROM image (*cubt4.bin*), uEFI driver (*ChelsioUD.efi*), default boot configuration file (*bootcfg*) and a flash utility (*cfut4.exe*), which can be used to flash the option ROM onto Chelsio's adapters. It also contains Firmware files.
- **EULA:** Chelsio's End User License Agreement.
- **docs:** The docs directory contains support documents - README, Release Notes and User's Guide (this document) for the software package.

2. Hardware Installation

i. Shutdown/power off your system.
ii. Power off all remaining peripherals attached to your system.
iii. Unpack the Chelsio adapter and place it on an anti-static surface.
iv. Remove the system case cover as per the system manufacturer's instructions.
v. Remove the PCI filler plate from the slot where you will install the Ethernet adapter.
vi. For maximum performance, it is highly recommended to install the adapter into a PCIe x8/x16 slot.

Note *All 4-ports of T6425-CR adapter will be functional only if PCIe x8 -> 2x PCIe x4 slot bifurcation is supported by the system and enabled in BIOS. Otherwise, only 2-ports will be functional.*

vii. 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.
viii. Secure the Chelsio adapter with a screw, or other securing mechanism, as described by the system manufacturer's instructions. Replace the case cover.
ix. 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.
x. 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.
xi. Power on your system.
xii. On Linux systems, run *update-pciids* command to download the current version of PCI ID list

```
[root@[redacted] ~]# update-pciids
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  227k  100  227k    0     0  68592      0  0:00:03  0:00:03 --:--:-- 68610
Done.
```

xiii. Verify if the adapter was installed successfully:
- On Linux and ESXi systems, run *lspci* command and you should see a similar output:

```
[root@[redacted] ~]# lspci | grep -i Chelsio
81:00.0 Ethernet controller: Chelsio Communications Inc T62100-LP-CR Unified Wire Ethernet Controller
81:00.1 Ethernet controller: Chelsio Communications Inc T62100-LP-CR Unified Wire Ethernet Controller
81:00.2 Ethernet controller: Chelsio Communications Inc T62100-LP-CR Unified Wire Ethernet Controller
81:00.3 Ethernet controller: Chelsio Communications Inc T62100-LP-CR Unified Wire Ethernet Controller
81:00.4 Ethernet controller: Chelsio Communications Inc T62100-LP-CR Unified Wire Ethernet Controller
81:00.5 SCSI storage controller: Chelsio Communications Inc T62100-LP-CR Unified Wire Storage Controller
81:00.6 Fibre Channel: Chelsio Communications Inc T62100-LP-CR Unified Wire Storage Controller
```

- On Windows systems, follow these steps:
  a. Open **Device Manager** in **Control Panel**.
  b. Under **Other devices** section, Chelsio adapter should be listed as ***Ethernet Controller.*** If the adapter is not listed, right-click on the system name or click on the **Actions** menu and select ***Scan for hardware changes.***

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 adapter
- Physical function 5: for iSCSI
- Physical function 6: for FCoE
- Physical function 7: Currently not assigned

xiv. Based on the operating system, install the appropriate network driver. Install and load *cxgb4* for Linux systems, *VBD* and *NDIS* for Windows systems, and *cxl* for ESXi systems.

xv. Finally, verify if the card is discovered:

- For Linux systems, examine the output of *dmesg* and you should see a similar output:

```
[ 1119.854346] cxgb4 0000:81:00.4: Chelsio T62100-LP-CR rev 0
[ 1119.854347] cxgb4 0000:81:00.4: S/N: RE41160042, P/N: 11012106003
[ 1119.854348] cxgb4 0000:81:00.4: Firmware version: [redacted]
[ 1119.854349] cxgb4 0000:81:00.4: Bootstrap version: 255.255.255.255
[ 1119.854350] cxgb4 0000:81:00.4: TP Microcode version: 0.1.23.2
[ 1119.854351] cxgb4 0000:81:00.4: No Expansion ROM loaded
[ 1119.854351] cxgb4 0000:81:00.4: Serial Configuration version: 0x7002000
[ 1119.854352] cxgb4 0000:81:00.4: VPD version: 0x52
[ 1119.854354] cxgb4 0000:81:00.4: Configuration: NIC MSI-X, non-Offload capable
[ 1119.854355] eth0: Chelsio T62100-LP-CR (eth0) 100GBASE-CR4_QSFP
```

  The above output indicates the hardware configuration of the adapters as well as the Serial numbers.

- For Windows systems, open **Device Manager** again. Expand **Network adapters** section and now Chelsio adapter should be listed.
- For ESXi systems, examine the output of *dmesg* and you should see a similar output:

```
2017-09-26T04:09:20.207Z cpu6:66032)cxl1.0: cxl_port_init:874: mbox 0 pf 0 chan 0 viid c0
2017-09-26T04:09:20.209Z cpu6:66032)DMA: 646: DMA Engine 'cxl-0000:04:00.0' created using mapper 'DMANull'.
2017-09-26T04:09:20.209Z cpu6:66032)cxl1.0: cxl_config_queues:1091: max_filters 120
2017-09-26T04:09:20.209Z cpu6:66032)VMK_PCI: 765: device 0000:04:00.0 allocated 32 MSIX interrupts
2017-09-26T04:09:20.209Z cpu6:66032)cxl1.0: cxl_intr_alloc_msix:2581: net q 14 rss q 16 non rss q 13 tx q 8
2017-09-26T04:09:20.211Z cpu6:66032)cxl1.0: cxl_rss_do_init:5221: pool 0 rss viid c1
2017-09-26T04:09:20.212Z cpu6:66032)cxl1.0: cxl_rss_init:2501: pool 0 rss mode 31
2017-09-26T04:09:20.212Z cpu6:66032)Chelsio T6225-CR rev 0 25G NIC PCIe 8 GT/s x8 MSI-X S/N: RE35160002, P/N: 11012096002
```

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. Flashing Firmware and Option ROM

Depending on the boot mode selected, Chelsio Unified Boot provides the following methods to flash Firmware and Option ROM onto Chelsio adapters:

- Legacy mode: cfut4
- uEFI mode:
  - HII
  - drvcfg
  - Firmware Manager Protocol (FMP)

These methods also provide the functionality to update/erase Hardware configuration and Phy Firmware files.

3.1. Preparing USB flash drive

This document assumes that you are using a USB flash drive as a storage media for the necessary files. Follow the steps below to prepare the drive:

i. Create a DOS bootable USB flash drive. (Click here for instructions)

ii. Create a directory *CHELSIO* on the USB flash drive.

iii. If you haven't done already, download *Chelsio-Uboot-x.x.x.xx.zip* from Chelsio Download Center

iv. Unzip the downloaded package and change your working directory to *OptionROM* directory.

```
[root@host~]# unzip Chelsio-Uboot-x.x.x.xx.zip
[root@host~]# cd Chelsio-Uboot-x.x.x.xx/OptionROM
```

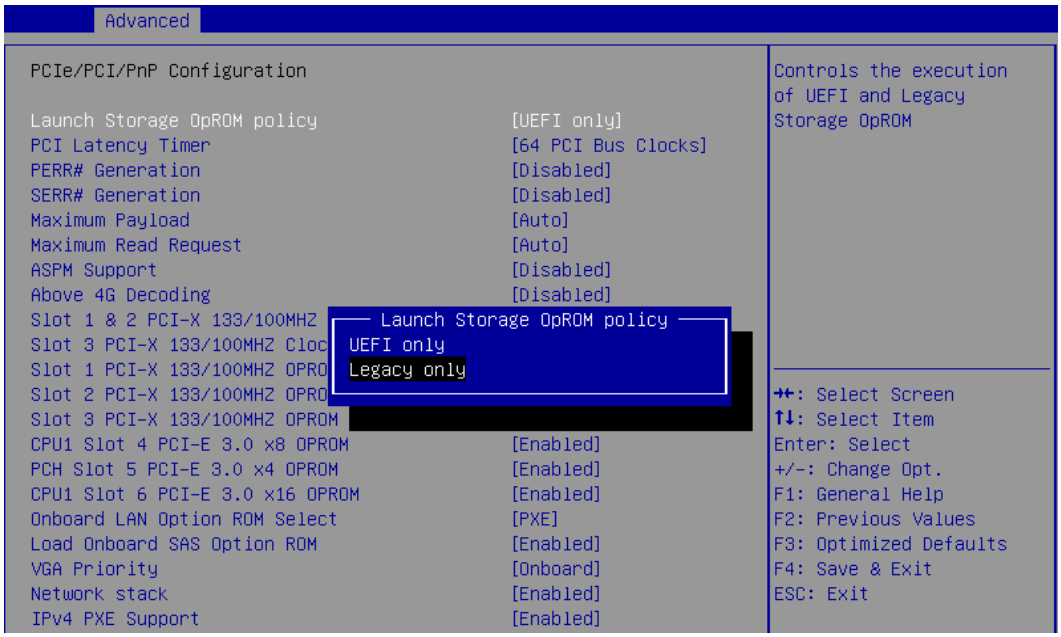
v. Copy all the files and place them in the *CHELSIO* directory created on the USB flash drive.

vi. Plug-in the USB flash drive in the system on which the Chelsio adapter is installed.

vii. Reboot the system.

3.2. Legacy

i. In BIOS, configure the system having Chelsio adapter to boot in Legacy mode.



ii. Boot the system from the plugged in USB flash drive and change your working directory to CHELSIO directory.

```
C:\>cd CHELSIO
```

iii. Run the following command to list all Chelsio adapters present on the system. The list displays a unique index for each adapter found.

```
C:\CHELSIO>cfut4 -l
```

iv. Delete any previous version of Option ROM flashed on the adapter.

```
C:\CHELSIO>cfut4 -d <idx> -xb
```

Here, `idx` is the adapter index found in step iii (0 in this case).

```
C:\CHELSIO>cfut4 -d 0 -xb

 Chelsio T5/T6 Flash Utility v1.5

 Erasing serial flash sector(s) ... Done
 Reboot machine for changes to take effect
```

v. Delete any previous firmware using the following command.

```
C:\CHELSIO>cfut4 -d <idx> -xh -xf
```

```
C:\CHELSIO>cfut4 -d 0 -xh -xf

 Chelsio T5/T6 Flash Utility v1.5

 Erasing serial flash sector(s) ... Done
 Erasing serial flash sector(s) ... Done
 Reboot machine for changes to take effect
```

vi. Delete any previous Option ROM settings.

```
C:\CHELSIO>cfut4 -d <idx> -xc
```

```
C:\CHELSIO>cfut4 -d 0 -xc

 Chelsio T5/T6 Flash Utility v1.5

 Erasing serial flash sector(s) ... Done
 Reboot machine for changes to take effect
```

vii. Run the following command to flash the appropriate firmware.

```
C:\CHELSIO>cfut4 -d <idx> -uf <firmware_file>.bin
```

Here, `firmware_file` is the firmware image file present in the *CHELSIO* directory.

```
C:\CHELSIO>cfut4 -d 0 -uf T6FW-1~1.BIN

 Chelsio T5/T6 Flash Utility v1.5

 Erasing serial flash sector(s) ... Done
 Writing Image at Base 00080000 ... Done
 Writing Image at Base 00088000 ... Done
 Writing Image at Base 00090000 ... Done
 Writing Image at Base 00098000 ... Done
 Writing Image at Base 000a0000 ... Done
 Writing Image at Base 000a8000 ... Done
 Writing Image at Base 000b0000 ... Done
 Writing Image at Base 000b8000 ... Done
 Writing Image at Base 000c0000 ... Done
 Writing Image at Base 000c8000 ... Done
 Writing Image at Base 000d0000 ... Done
 Writing Image at Base 000d8000 ... Done
 Writing Image at Base 000e0000 ... Done
 Writing Image at Base 000e8000 ... Done
 Writing Image at Base 000f0000 ... Done
 Writing Image at Base 000f8000 ... Done
 Reboot machine for changes to take effect
```

viii. Flash the unified Option ROM onto the Chelsio adapter using the following command.

```
C:\CHELSIO>cfut4 -d <idx> -ub cubt4.bin
```

Here, `cubt4.bin` is the unified option ROM image file present in the *CHELSIO* directory.

```
C:\CHELSIO>cfut4 -d 0 -ub cubt4.bin

 Chelsio T5/T6 Flash Utility v1.5

 Erasing serial flash sector(s) ... Done
 Writing Image at Base 00000000 ... Done
 Writing Image at Base 00008000 ... Done
 Writing Image at Base 00010000 ... Done
 Writing Image at Base 00018000 ... Done
 Writing Image at Base 00020000 ... Done
 Writing Image at Base 00028000 ... Done
 Writing Image at Base 00030000 ... Done
 Writing Image at Base 00038000 ... Done
 Writing Image at Base 00040000 ... Done
 Writing Image at Base 00048000 ... Done
 Writing Image at Base 00050000 ... Done
 Writing Image at Base 00058000 ... Done
 Writing Image at Base 00060000 ... Done
 Writing Image at Base 00068000 ... Done
 Erasing serial flash sector(s) ... Done
 Writing Image at Base 00070000 ... Done
 Reboot machine for changes to take effect
```

ix. To configure the base MAC address (optional), use the below command.

```
C:\CHELSIO>cfut4 -d <idx> -um <Hex MAC Address>
```

Example:

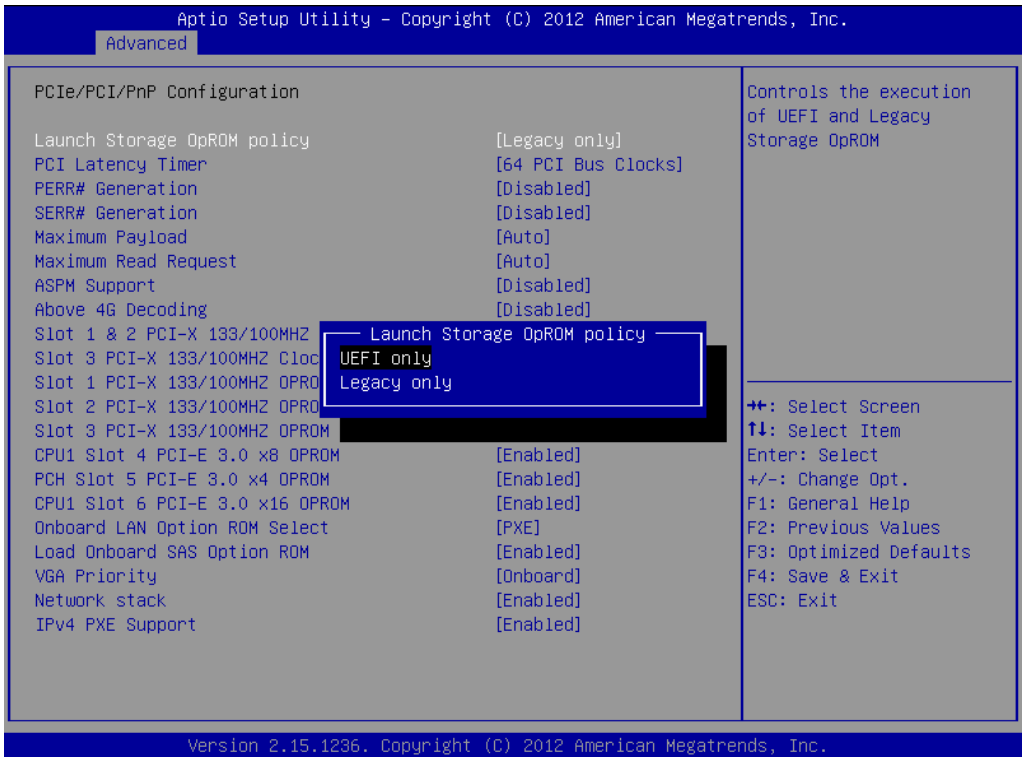
```
C:\CHELSIO>cfut4 -d 0 -um 000743000123
```

x. Reboot the system for changes to take effect.

3.3. uEFI

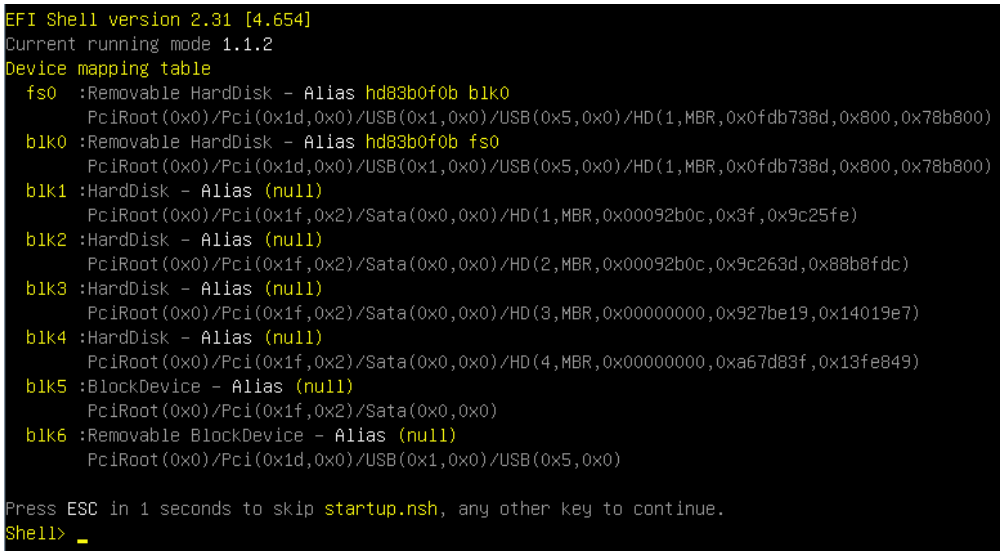
3.3.1. Loading uEFI driver

i. In BIOS, configure the system having Chelsio adapter to boot in uEFI mode.



Note *For Supermicro systems, enable **Network Stack*** as well before proceeding.

ii. Boot to EFI Shell.



```
EFI Shell version 2.31 [4.654]
Current running mode 1.1.2
Device mapping table
  fs0  :Removable HardDisk - Alias hd83b0f0b blk0
        PciRoot(0x0)/Pci(0x1d,0x0)/USB(0x1,0x0)/USB(0x5,0x0)/HD(1,MBR,0x0fdb738d,0x800,0x78b800)
  blk0 :Removable HardDisk - Alias hd83b0f0b fs0
        PciRoot(0x0)/Pci(0x1d,0x0)/USB(0x1,0x0)/USB(0x5,0x0)/HD(1,MBR,0x0fdb738d,0x800,0x78b800)
  blk1 :HardDisk - Alias (null)
        PciRoot(0x0)/Pci(0x1f,0x2)/Sata(0x0,0x0)/HD(1,MBR,0x00092b0c,0x3f,0x9c25fe)
  blk2 :HardDisk - Alias (null)
        PciRoot(0x0)/Pci(0x1f,0x2)/Sata(0x0,0x0)/HD(2,MBR,0x00092b0c,0x9c263d,0x88b8fdc)
  blk3 :HardDisk - Alias (null)
        PciRoot(0x0)/Pci(0x1f,0x2)/Sata(0x0,0x0)/HD(3,MBR,0x00000000,0x927be19,0x14019e7)
  blk4 :HardDisk - Alias (null)
        PciRoot(0x0)/Pci(0x1f,0x2)/Sata(0x0,0x0)/HD(4,MBR,0x00000000,0xa67d83f,0x13fe849)
  blk5 :BlockDevice - Alias (null)
        PciRoot(0x0)/Pci(0x1f,0x2)/Sata(0x0,0x0)
  blk6 :Removable BlockDevice - Alias (null)
        PciRoot(0x0)/Pci(0x1d,0x0)/USB(0x1,0x0)/USB(0x5,0x0)

Press ESC in 1 seconds to skip startup.nsh, any other key to continue.
Shell> _
```

iii. Issue command `drivers` to determine if Chelsio uEFI driver is already loaded. The below image shows that the driver is loaded.

```
A4 00000001 ? - -  -  - <UNKNOWN>                          SBDXE
A6 00000010 B - -  5  5 AMI Console Splitter Driver         ConSplitter
A9 00000010 D - -  1  - <UNKNOWN>                          GraphicsConsole
AA 0000000A D - -  4  - Generic Disk I/O Driver             DiskIoDxe
AB 0000000B B - -  1  3 Partition Driver(MBR/GPT/El Torito) PartitionDxe
AC 00000010 D - -  2  - PCH Serial ATA Controller Initializ SataController
AE 00000010 B - -  1  2 AMI Generic LPC Super I/O Driver    GenericSio
B0 00000001 ? - -  -  - AMI IDE BUS Driver                  IdeBusSrc
B2 00000010 ? - -  -  - AMI PS/2 Driver                     PS2Main
B4 00A50105 B - -  2 72 <UNKNOWN>                           PciBus
B6 00000010 B - -  2  2 <UNKNOWN>                           TerminalSrc
B7 00000010 B - -  1  1 <UNKNOWN>                           TerminalSrc
B8 0000000A D - -  2  - Simple Network Protocol Driver      SnpDxe
B9 0000000A B - -  2  8 MNP Network Service Driver          MnpDxe
BA 0000000A B - -  2  2 ARP Network Service Driver          ArpDxe
BB 0000000A B - -  2  2 DHCP Protocol Driver                Dhcp4Dxe
BC 0000000A D - -  2  - IP4 CONFIG Network Service Driver   Ip4ConfigDxe
BD 0000000A B - -  2 18 IP4 Network Service Driver          Ip4Dxe
BE 0000000A B - -  4  4 MTFTP4 Network Service              Mtftp4Dxe
BF 0000000A B - - 12 20 UDP Network Service Driver          Udp4Dxe
C0 0000000A D - -  1  - FAT File System Driver              Fat
C1 0000000A D - -  2  - iSCSI Driver                        IScsiDxe
C2 0000000A D - -  2  - iSCSI Driver                        IScsiDxe
C4 0000000A ? - -  -  - SCSI Bus Driver                     ScsiBus
C5 0000000A ? - -  -  - Scsi Disk Driver                    ScsiDisk
FA 00000010 ? - -  -  - AMI CSM Block I/O Driver            CsmBlockIo
FB 00000024 B - -  1  1 BIOS[INT10] Video Driver            CsmVideo
FC 00000010 ? - -  -  - <UNKNOWN>                           <UNKNOWN>
158 0100005E B X X  3  3 Chelsio Unified Driver              Offset(0x3834,0x1D
```

If the driver is not loaded, continue to step (v)

iv. Note the handle and unload the driver.

```
fs0:\CHELSIO\> unload -n <driver_handle>
```

Example:

```
FS1:\CHELSIO\> unload -n 1A1
Unload - Handle [72892A18] Result Success.
```

v. Load the uEFI driver (*ChelsioUD.efi*) present in the *CHELSIO* directory.

```
fs0:\CHELSIO> load ChelsioUD.efi
load: Image fs0:\CHELSIO\ChelsioUD.efi loaded at 7F2BA000 - Success
```

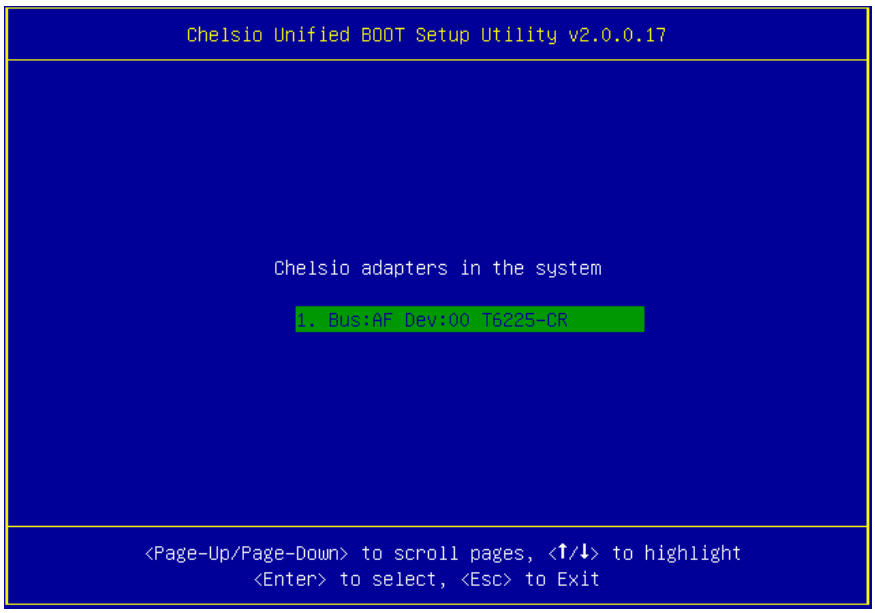
3.3.2. drvcfg

i. Please ensure that Chelsio uEFI driver is loaded correctly as mentioned in Loading uEFI driver section.

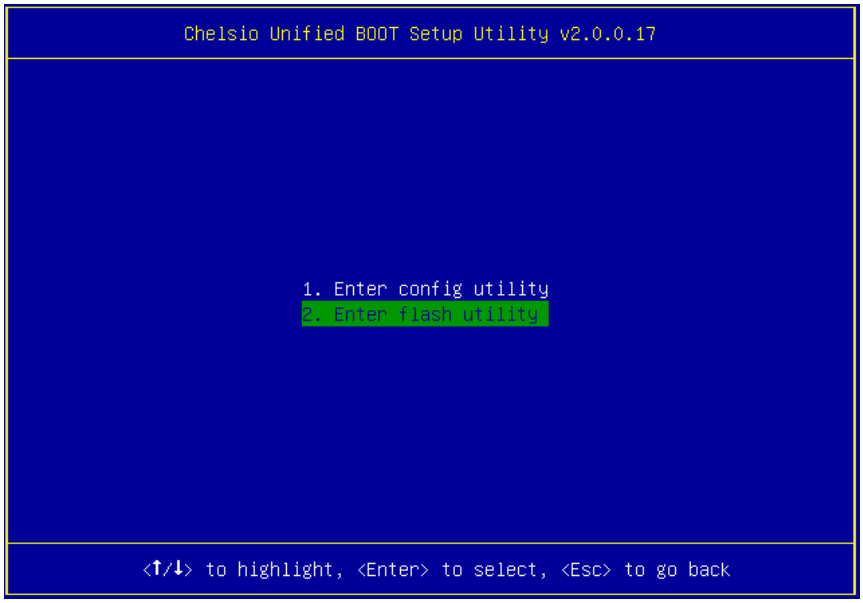
ii. Run the following command to launch the Unified Boot Setup utility.

```
fs0:\> drvcfg -s_
```

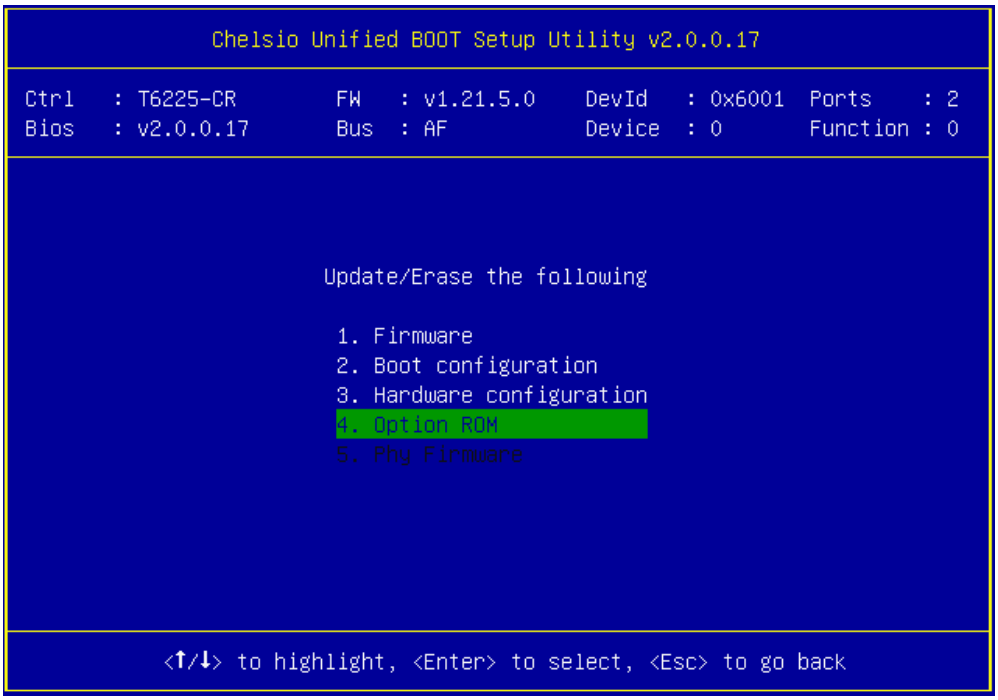
iii. Choose the Chelsio adapter which needs to be configured.



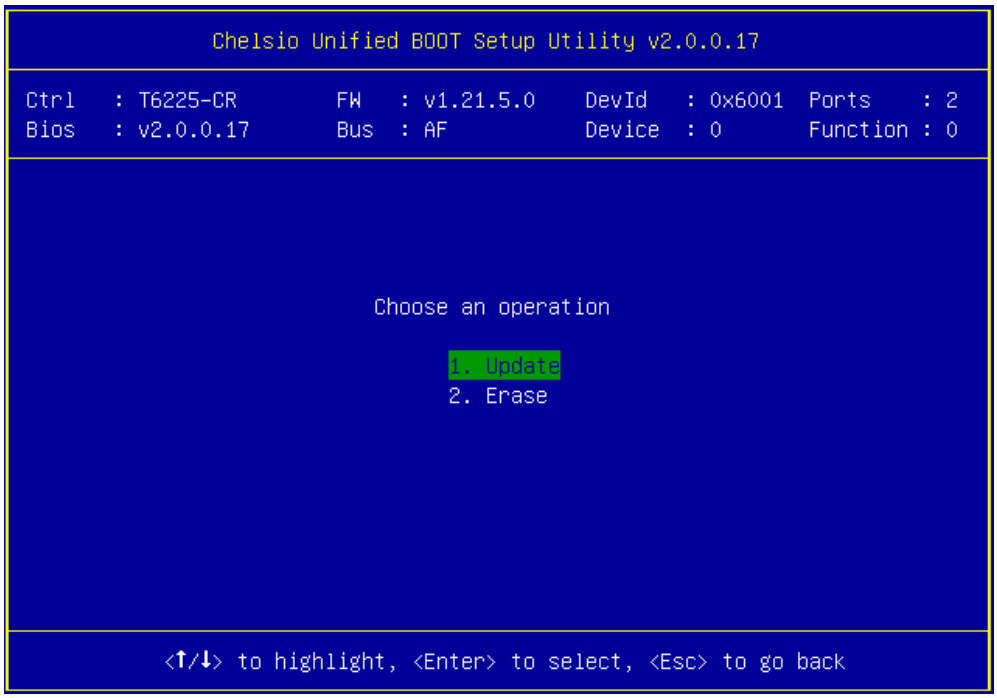
iv. Highlight **Enter flash utility** and press [Enter].



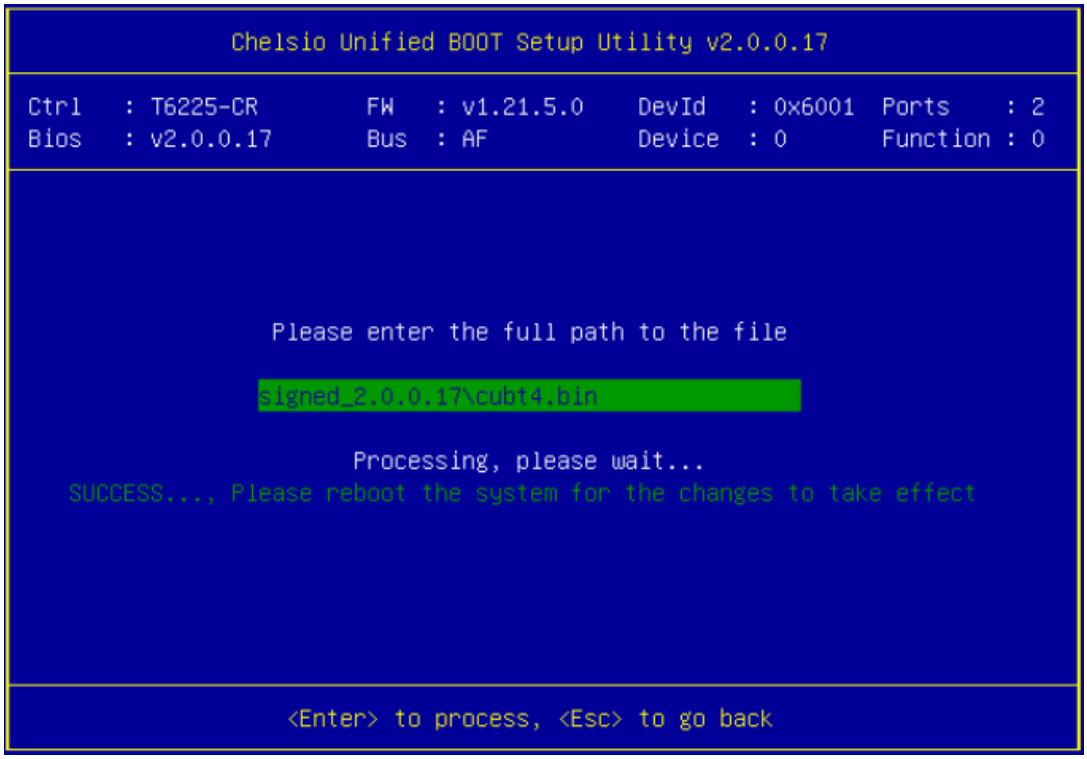
v. Highlight **Option ROM** and press [Enter].



vi. Highlight **Update** and press [Enter].



vii. Enter the path to the Option ROM file and press [Enter].



viii. Similarly, you can use the above method to update Firmware present in the *CHELSIO* directory.

ix. Reboot the machine for changes to take effect.

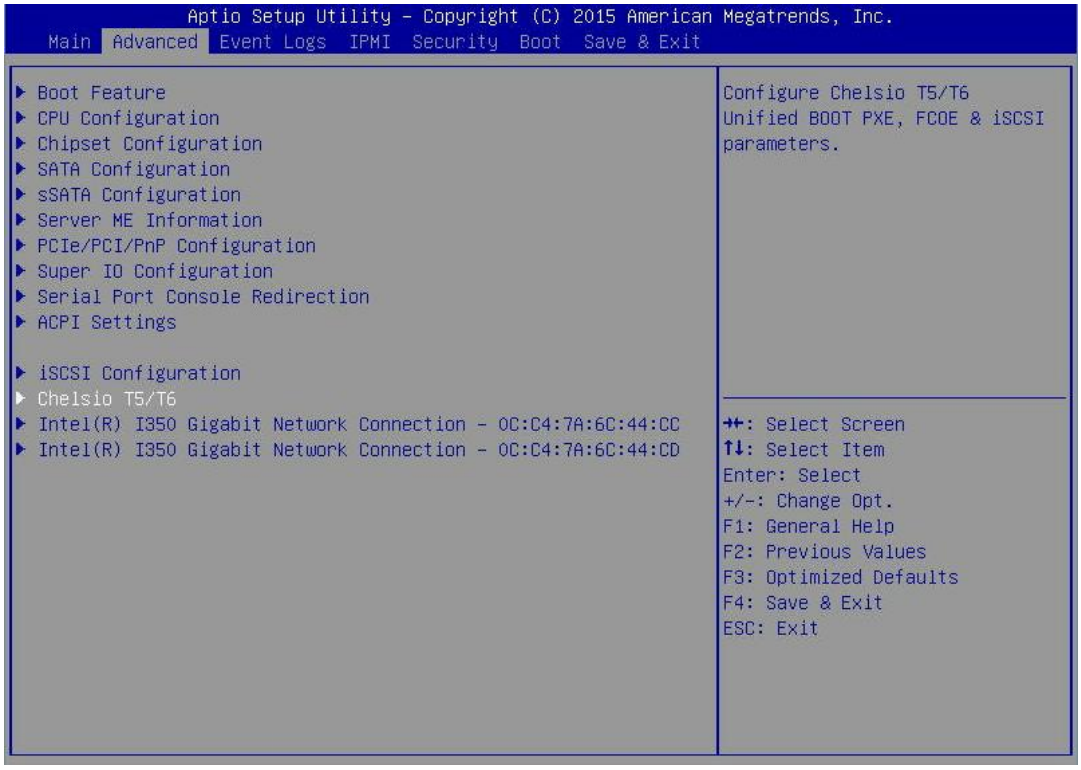
3.3.3. HII

i. Go into the BIOS setup.

ii. Chelsio HII should be listed as **Chelsio T5/T6** as shown below. Highlight it and press [Enter].

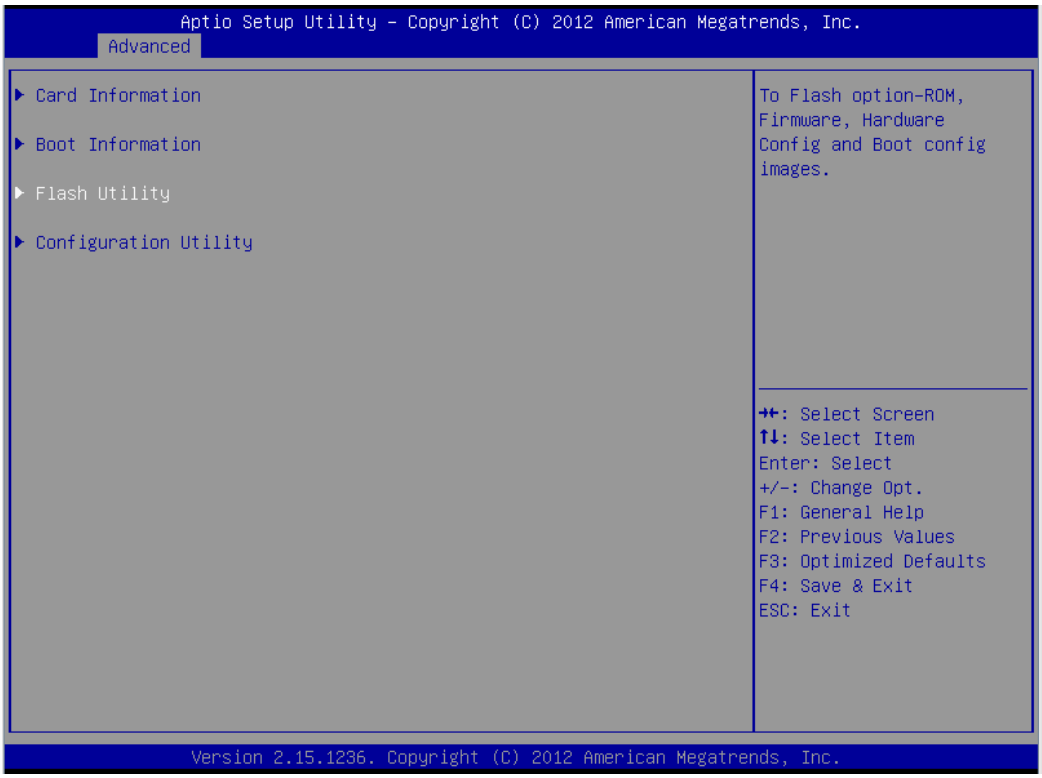
If Chelsio T5/T6 is not listed,

- Load the Chelsio uEFI driver as mentioned in Loading uEFI driver section.
- Flash the Option ROM and Firmware as mentioned in drvcfg section.



iii. Highlight the Chelsio adapter to be configured and press [Enter].

iv. Highlight **Flash Utility** and press [Enter].



v. Erase or update firmware using the methods explained below:

a. Erase existing firmware

i. Select [Erase] as Flash Operation
ii. Select [FW File] as Flash File Type
iii. Select Update/Erase
iv. Press [Y] to confirm

b. Update firmware

i. Select [Update] as Flash Operation
ii. Select [FW File] as Flash File Type
iii. Enter full path to the firmware file for Enter File Name, e.g., CHELSIO\t6fw-1.16.29.0.bin.
iv. Press [Enter]
v. Select Update/Erase
vi. Press [Y] to confirm

vi. Similarly, you can use the above method to update/erase Option ROM present in the *CHELSIO* directory.

vii. Reboot the machine for changes to take effect.

3.3.4. Firmware Management Protocol (FMP)

HP machines support Firmware Management Protocol (FMP) interface, in addition to HII. This can be used to update the Option ROM on Chelsio adapters.

Enabling FMP

i. Please ensure that Chelsio uEFI driver is loaded correctly as mentioned in Loading uEFI driver section

ii. Run the command `fwupdate -l` and Chelsio T6 adapter should be listed as shown below:

```
FS1:\CHELSIO\> fwupdate -l
* [BIOS] System ROM - U20 v2.20 (05/05/2016)
* [RAID.Slot.2.1]Slot 2 : Smart HBA H240 Controller - V2.52_B0
* [NIC.LOM.1.3]Embedded LOM 1 : HP Ethernet 1Gb 2-port 361i Adapter - NIC - 1.1067.0
* [NIC.Slot.3.1]Slot 3 : Chelsio T6 Controller - NIC - [illegible]
```

Upgrading Firmware

- **Using CLI**

i. Use the adapter's device name to update the firmware:

```
FS1:\CHELSIO\> fwupdate -d <device_name> -f cubt4.bin
```

Example:

```
FS1:\CHELSIO\> fwupdate -d NIC.Slot.3.1 -f cubt4.bin
Loading firmware file 'cubt4.bin'. It might take several minutes.
Current Firmware Version is [illegible].
Continue with firmware update? (y/n) :y
Firmware update completed successfully.
```

ii. Reboot machine for changes to take effect.

- **Using FMP**

i. Reboot system and press F9 to access **System Utilities**

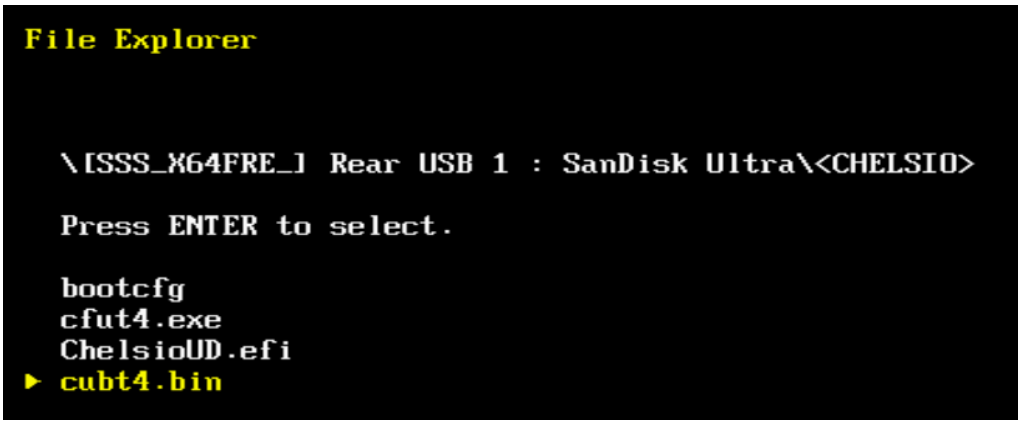
ii. Go to **Embedded Applications** → **Firmware Update** → **Chelsio T6 Controller**

```
System Utilities

Embedded Applications → Select a device to update → Firmware Update

  Slot 3 : Chelsio T6 Controller - NIC

▶ Select a firmware file
  Selected firmware file:
  Current Firmware Version:                    [illegible]
  Image Description                            [Chelsio Option ROM package]

  Start firmware update
```

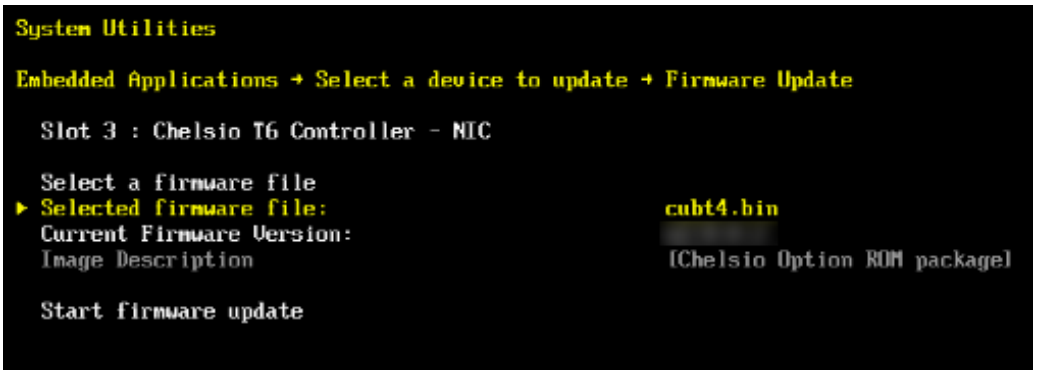
iii. Highlight **Select a firmware file** option and hit [Enter].

iv. Select the USB flash drive which contains the latest Option ROM and hit [Enter].

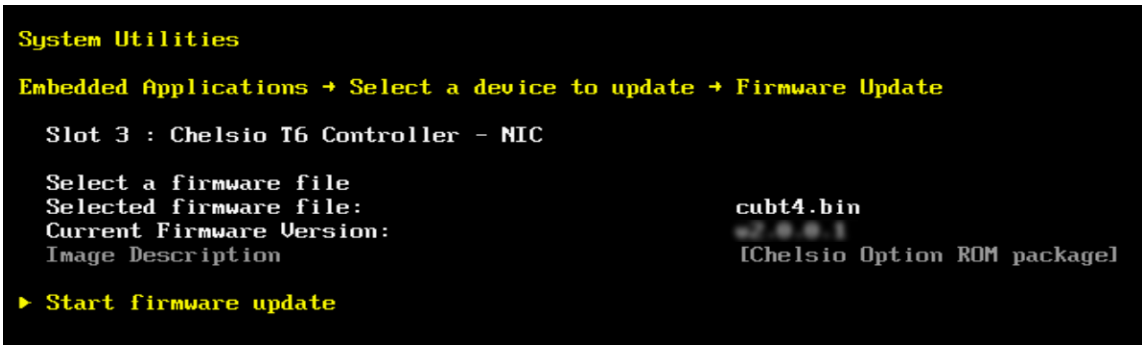
v. Select Option ROM file *cubt4.bin* and hit [Enter].



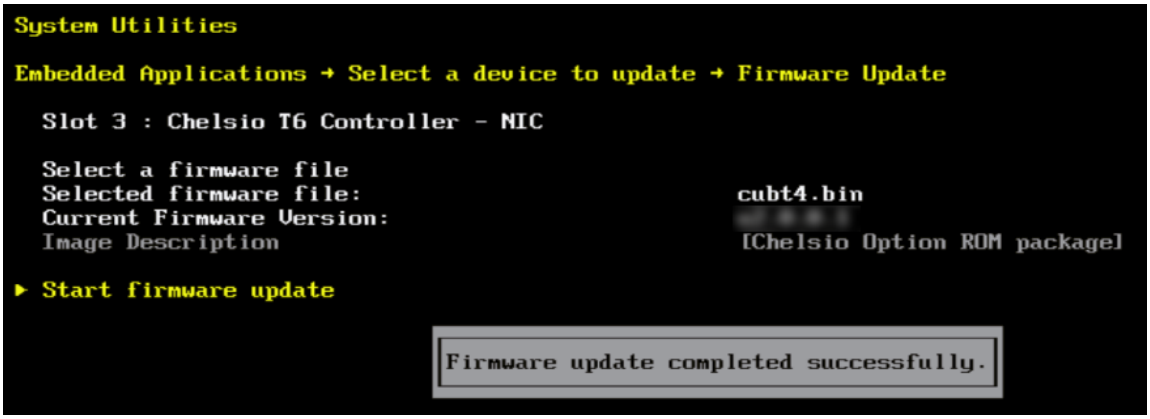
The file should show up in the **Selected firmware file** field.



vi. Select **Start firmware update** and hit [Enter].



vii. After **Firmware update completed successfully** prompt appears, reboot the machine for changes to take effect.



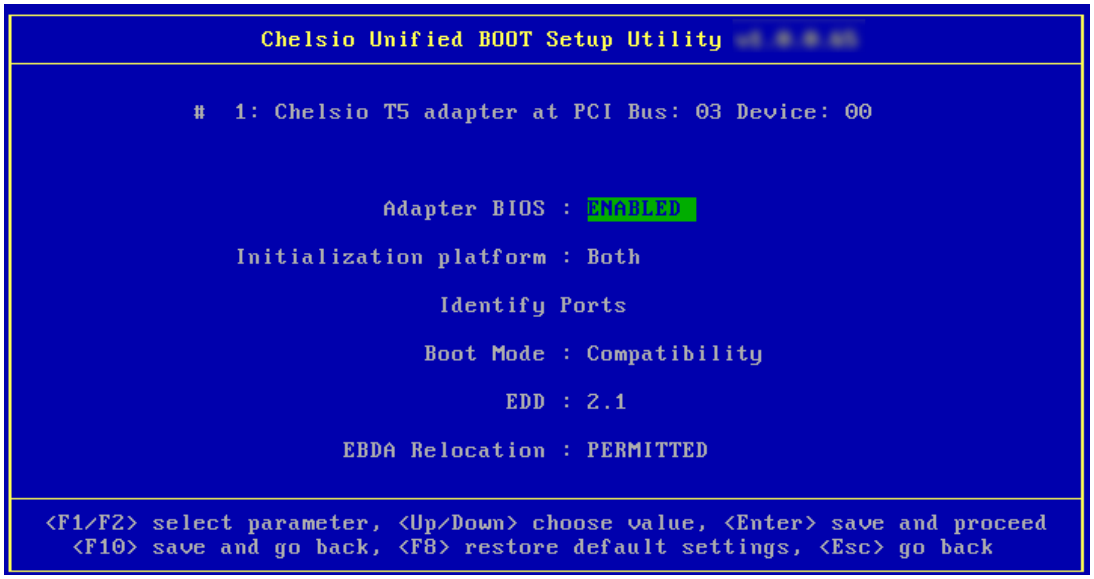
3.4. Default Option ROM Settings

If you wish to restore Option ROM settings to their default values, i.e., PXE enabled, iSCSI and FCoE disabled, use any of the methods mentioned below:

3.4.1. Using Option ROM (boot level)

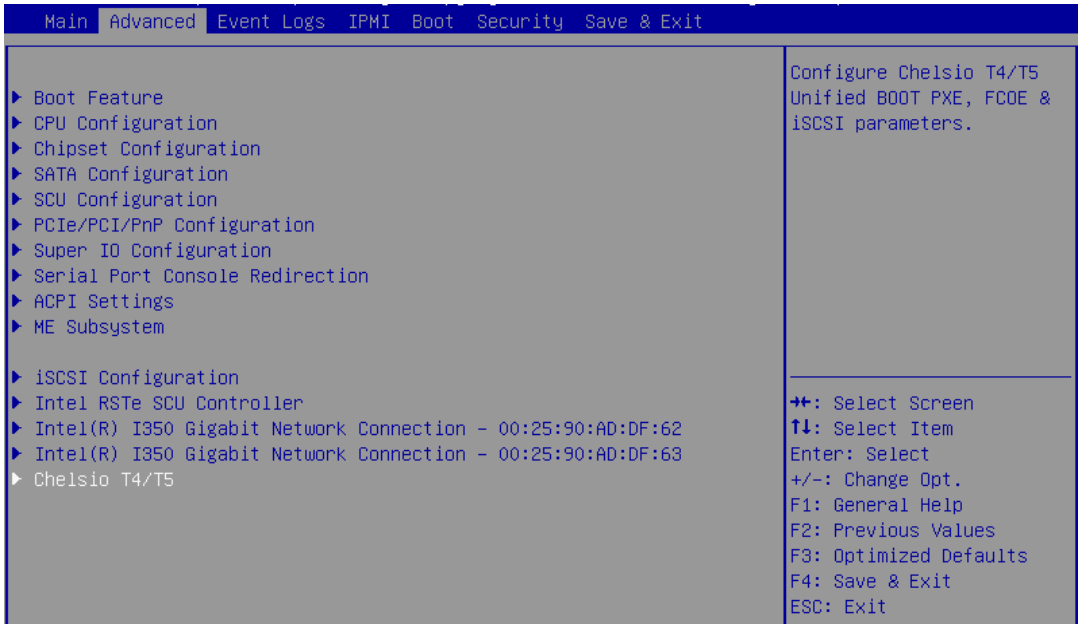
- **Legacy PXE**

Boot system into Chelsio's Unified Boot Setup utility and press F8.



- **uEFI PXE**

Boot system into uEFI mode and press F3.



4. Configuring PXE Server

The following components are required to configure a server as PXE Server:

- DHCP Server
- TFTP Server

PXE server configuration steps for different operating systems can be found in following links:

Note *Chelsio Communications does not take any responsibility regarding contents given in below mentioned links. They are given for example purposes only.*

- **Linux**
  - https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/7/html/installation_guide/chap-installation-server-setup
- **Windows**
  - http://technet.microsoft.com/en-us/library/cc771670%28WS.10%29.aspx
  - http://tftpd32.jounin.net/ (Use port # 67, set PXE option and provide bootable file name in settings)
  - http://unattended.sourceforge.net/pxe-win2k.html
- **VMware**
  - http://www.vstellar.com/2017/07/25/automating-esxi-deployment-using-pxe-boot-and-kickstart/
  - http://fdo-workspace.blogspot.in/2016/11/building-tftp-dhcp-for-pxe-esxi-65.html

5. PXE boot process

Before proceeding, please ensure that the Chelsio adapter has been flashed with the provided firmware and Option ROM (See Flashing Firmware and option ROM).

5.1. Legacy PXE boot

i. After configuring the PXE server, make sure the PXE server works. Then reboot the client machine.

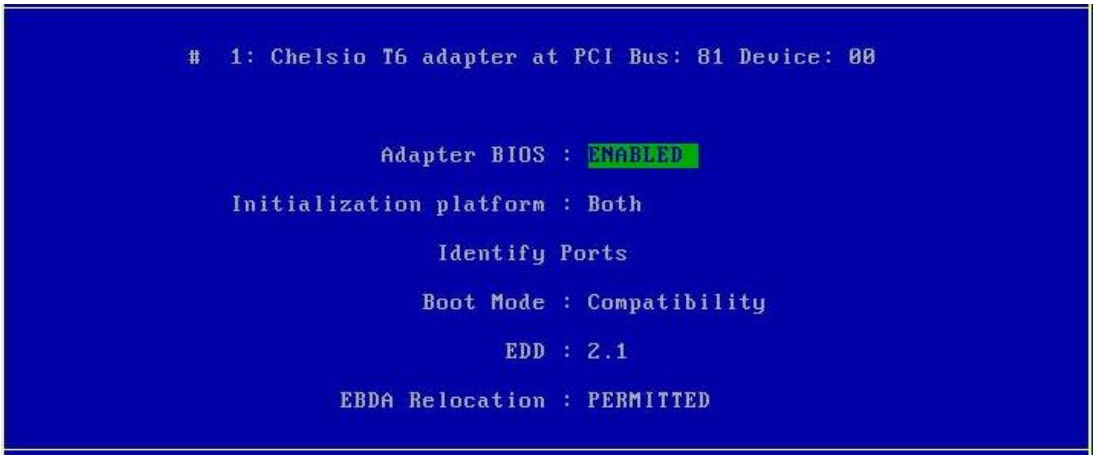
ii. Press [Alt+C] when the message to configure Chelsio adapters appears on the screen.

```
Chelsio Unified Boot BIOS [redacted]
Copyright (C) 2003-2016 Chelsio Communications
Press <Alt-C> to Configure T5/T6 Card(s). Press <Alt-S> to skip BIOS.
```

iii. The configuration utility will appear as below.

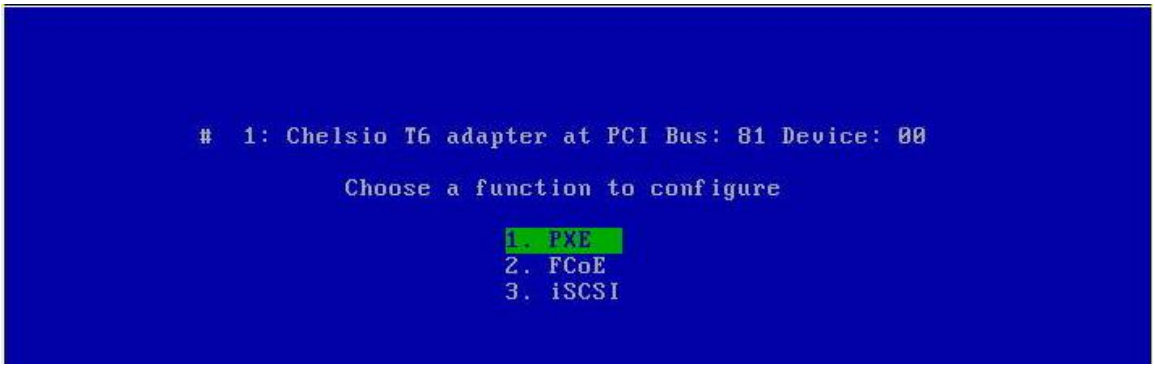
Choose the adapter on which you flashed the option ROM image. Hit [Enter].

iv. Enable the adapter BIOS using arrow keys if not already enabled. Hit [Enter].

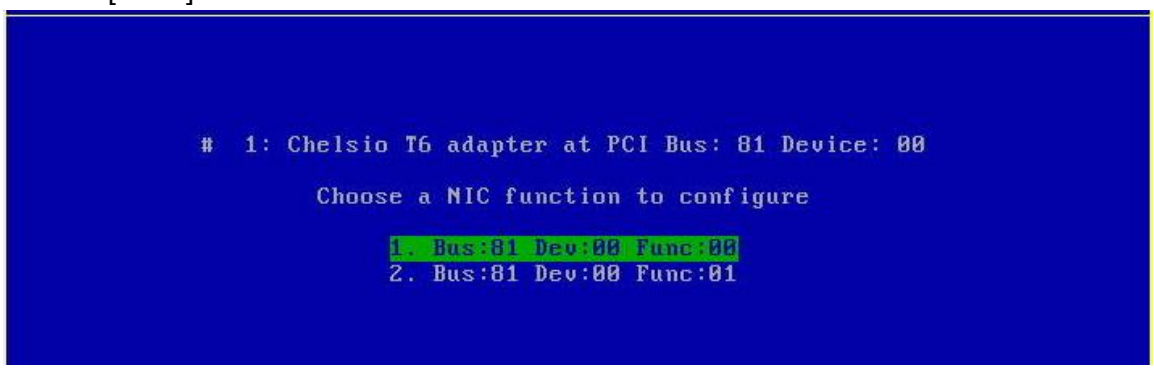


Note *Use the default values for Boot Mode, EDD and EBDA Relocation parameters, unless instructed otherwise.*

v. Choose **PXE** from the list to configure. Hit [Enter].



vi. Use the arrow keys to highlight the appropriate function among the supported NIC functions and hit [Enter] to select.



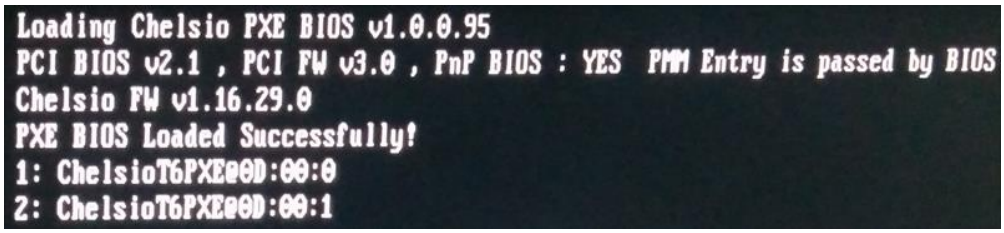
vii. Enable NIC function bios if not already enabled.

Choose the boot port to try the PXE boot. It is recommended to only enable functions and ports which are going to be used. Please note that enabling NIC Func 00 will enable port 0 for PXE, enabling NIC Func 01 will enable port 1 and so on for NIC function.

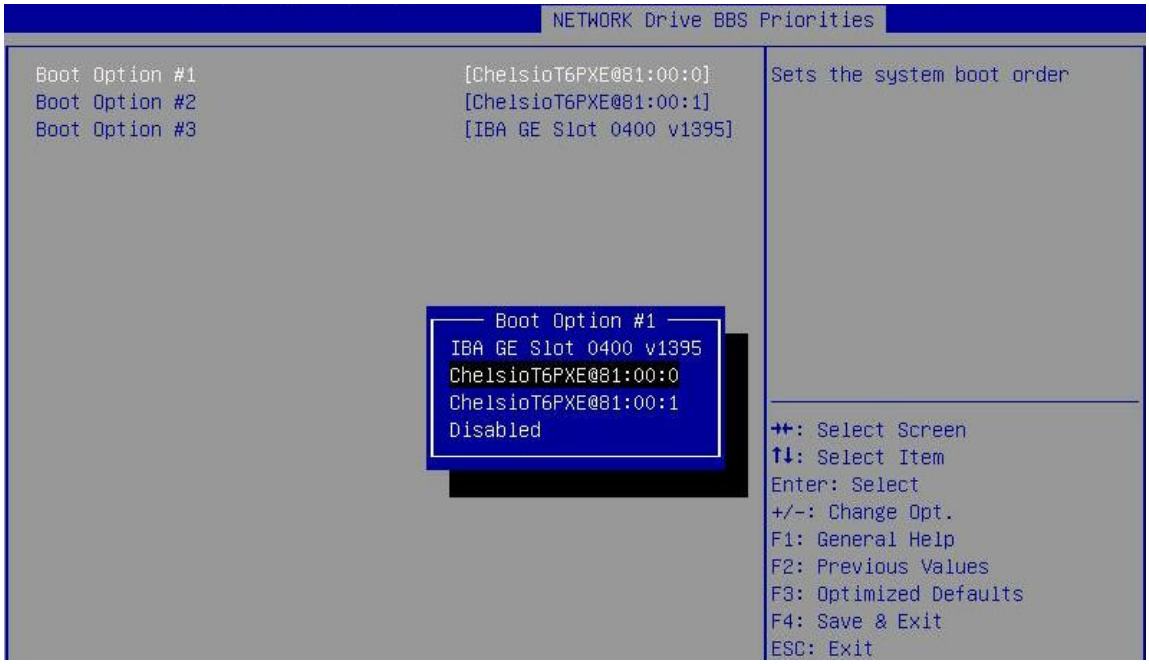
viii. Hit [F10] or [Esc] and then [Y] to save configuration changes.

ix. Reboot the system.

x. Allow the Chelsio option ROM to initialize and setup PXE devices. DO NOT PRESS ALT-S to skip Chelsio option ROM.



xi. In the system setup, choose any of the Chelsio PXE devices as the first boot device.



xii. Reboot. DO NOT PRESS ALT-S to skip Chelsio Option ROM, during POST.

xiii. Hit [F12] key when prompted to start PXE boot.

5.2. uEFI PXE Boot

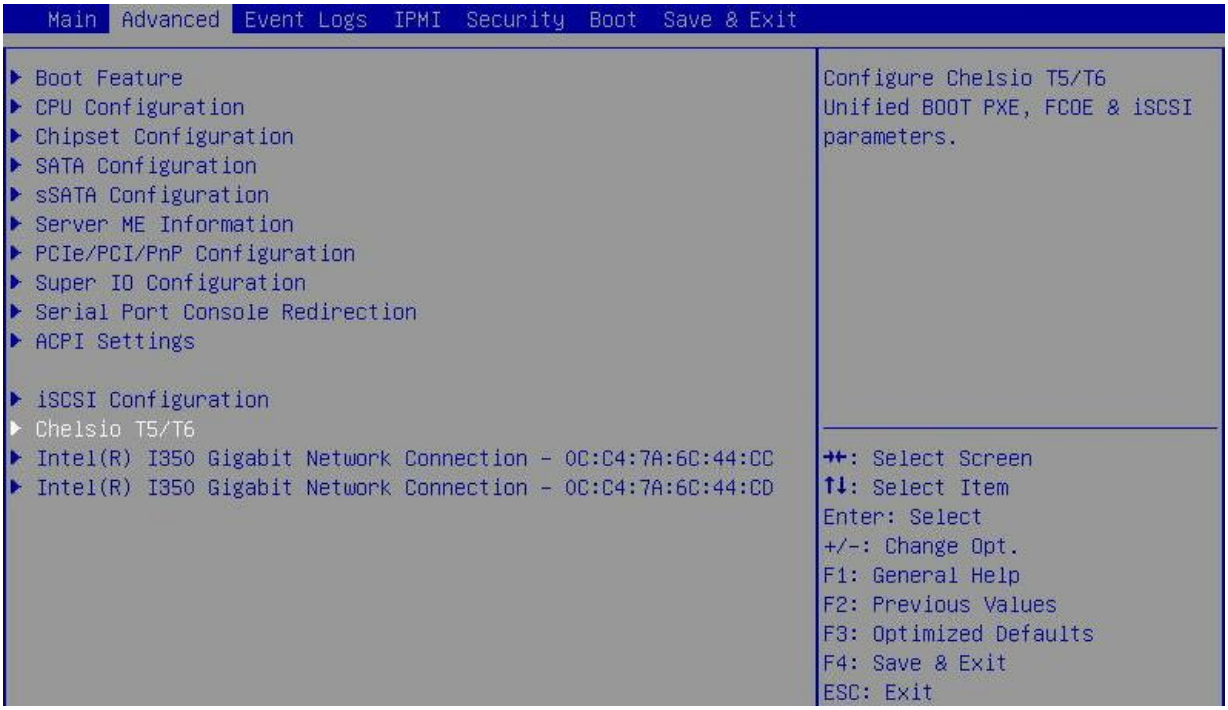
Important

- *Only uEFI v2.3.1, v2.4 and v2.5 supported.*
- *Any other uEFI version is NOT SUPPORTED and may render your system unusable.*

5.2.1. HII

This section describes the method to configure and use Chelsio uEFI PXE interfaces using HII.

i. Reboot the system and go into the BIOS setup.
ii. Chelsio HII should be listed as **Chelsio T5/T6**. Highlight it and press [Enter].

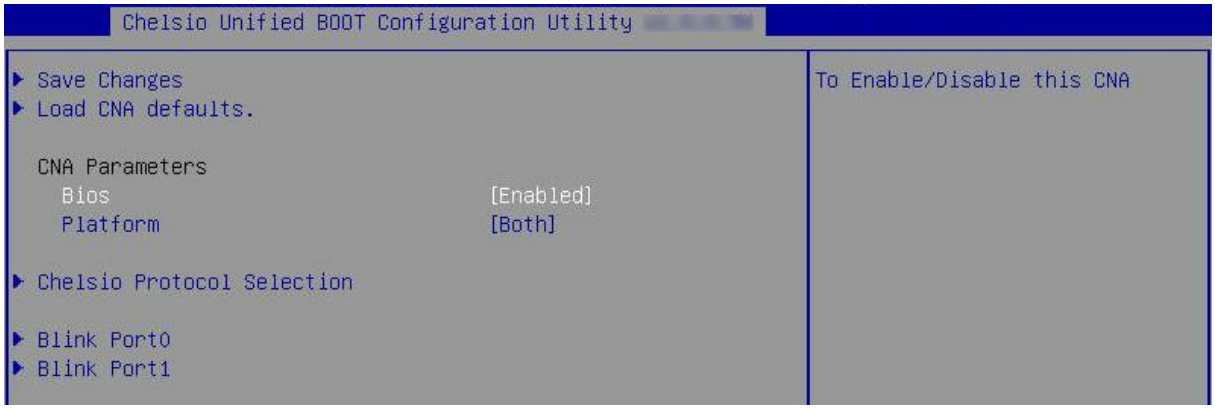


Note *Please ensure that Chelsio uEFI driver is loaded correctly as mentioned in Loading uEFI driver section.*

iii. Select the Chelsio adapter to be configured and press [Enter].

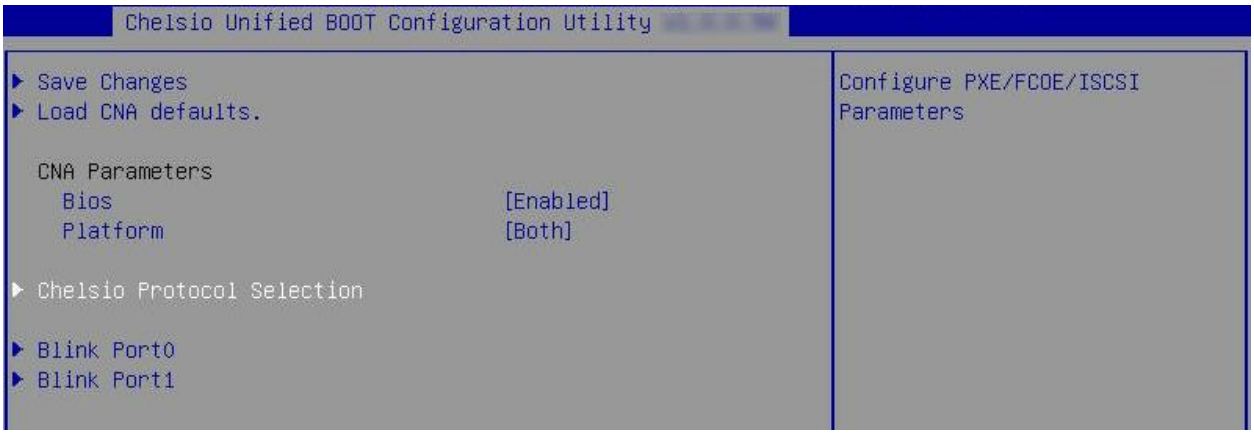
iv. Select **Configuration Utility** and press [Enter].

v. Enable adapter BIOS if not already enabled.

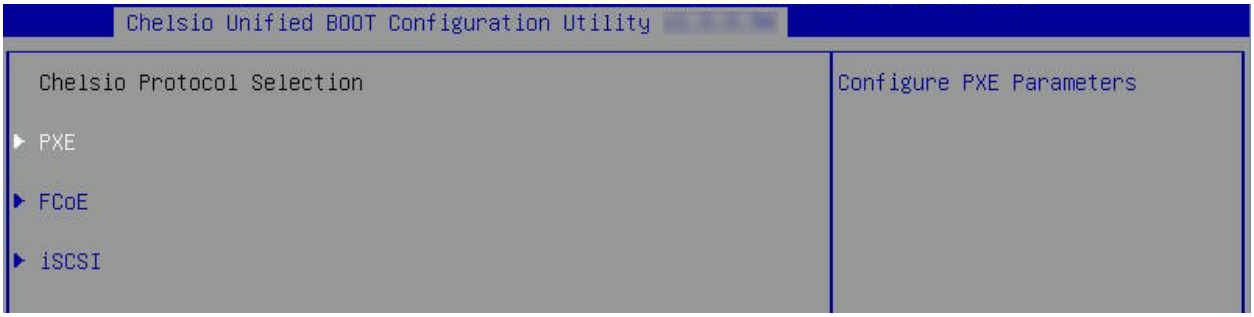


Note *It is highly recommended that you use the **Save Changes** option every time a parameter/option is changed.*

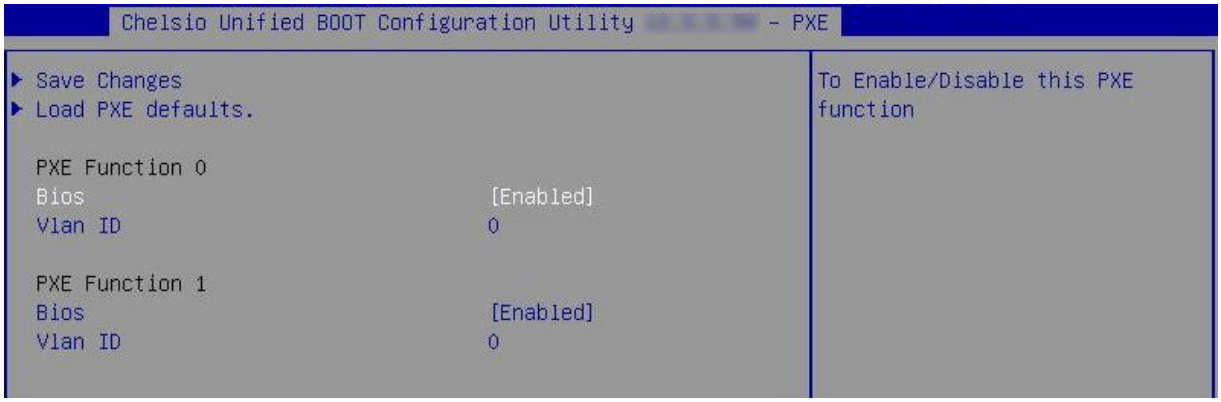
vi. Select **Chelsio Protocol Selection** and press [Enter].



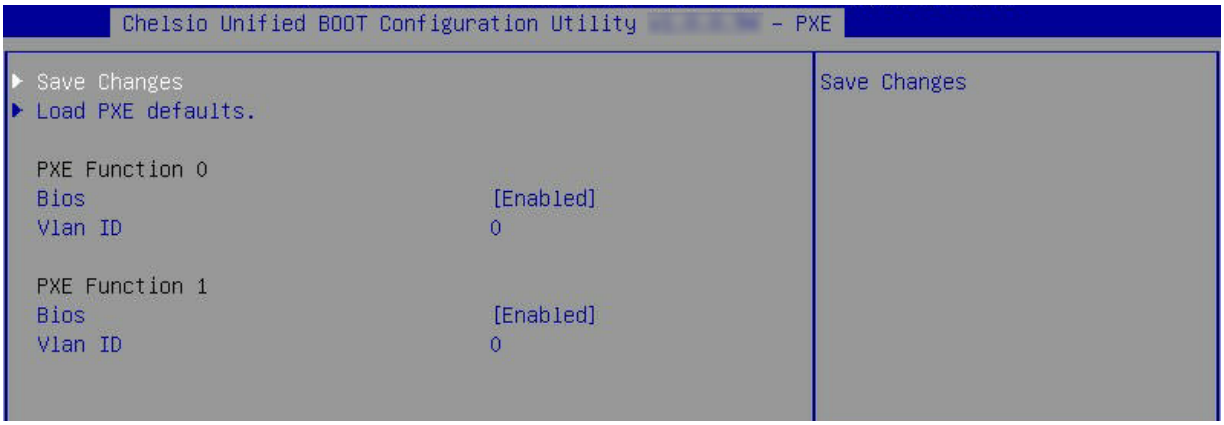
vii. Select **PXE** and press [Enter].



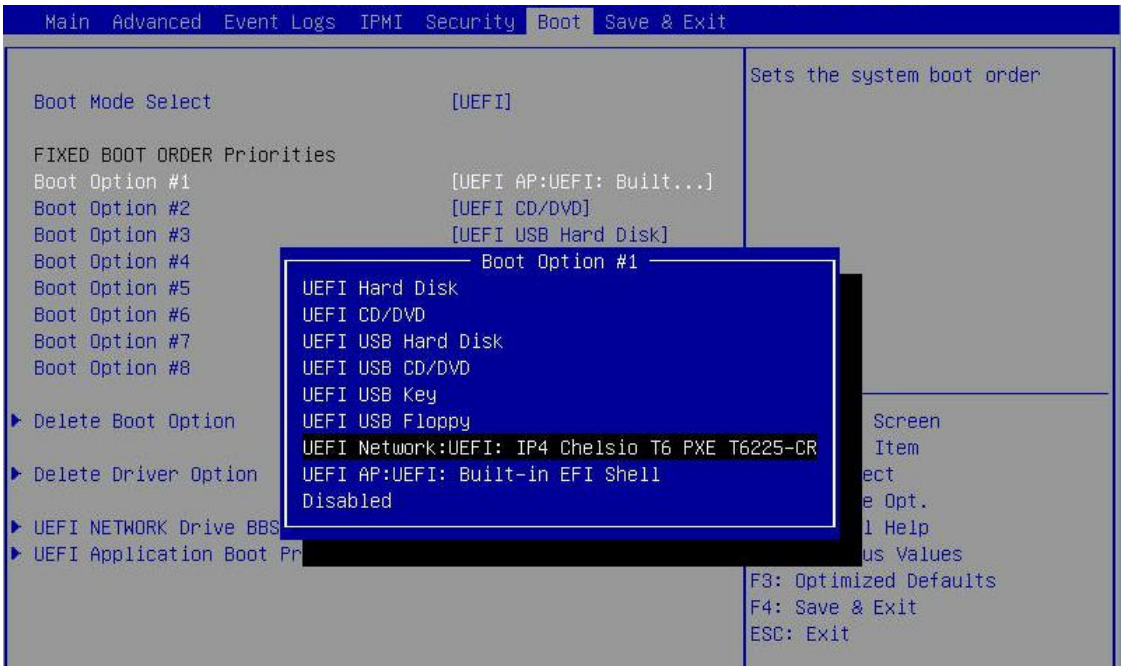
viii. Choose the boot port to try PXE boot. It is recommended to enable only those functions and ports which are going to be used. Please note that enabling PXE Function 0 will enable port 0 for PXE, enabling PXE Function 1 will enable port 1 and so on, for NIC function.



ix. Select **Save Changes** and press [Enter].



x. Reboot the system and in BIOS, choose any of the available Chelsio PXE devices.



xi. Reboot and hit [F12] key when prompted to start PXE boot.

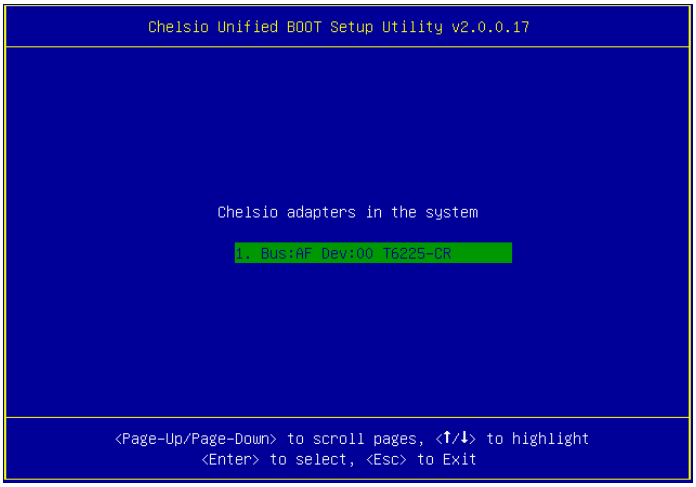
5.2.2. drvcfg

This section describes the method to configure and use Chelsio uEFI PXE interfaces using drvcfg.

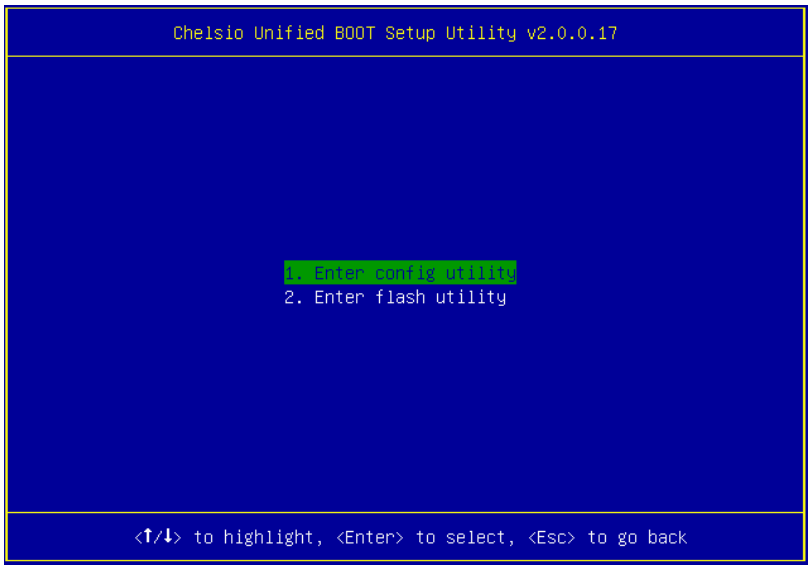
i. Boot the system into EFI shell.
ii. Run the following command to launch the Unified Boot Setup utility.

```
fs0:\> drvcfg -s_
```

iii. Choose the Chelsio adapter which needs to be configured.



iv. Highlight **Enter config utility** and press [Enter].



v. Further configuration steps are similar from step (iv) of Legacy PXE Boot section.

6. FCoE boot process

Before proceeding, please ensure that the Chelsio adapter has been flashed with the provided firmware and option ROM (See Flashing firmware and option ROM).

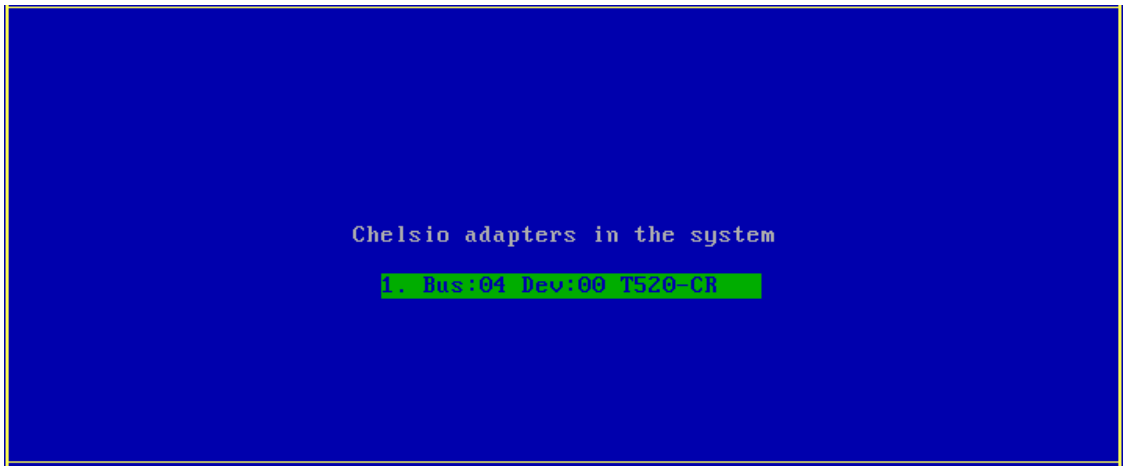
6.1. Legacy FCoE boot

i. Reboot the system.

ii. Press [Alt+C] when the message to configure Chelsio adapters appears on the screen.

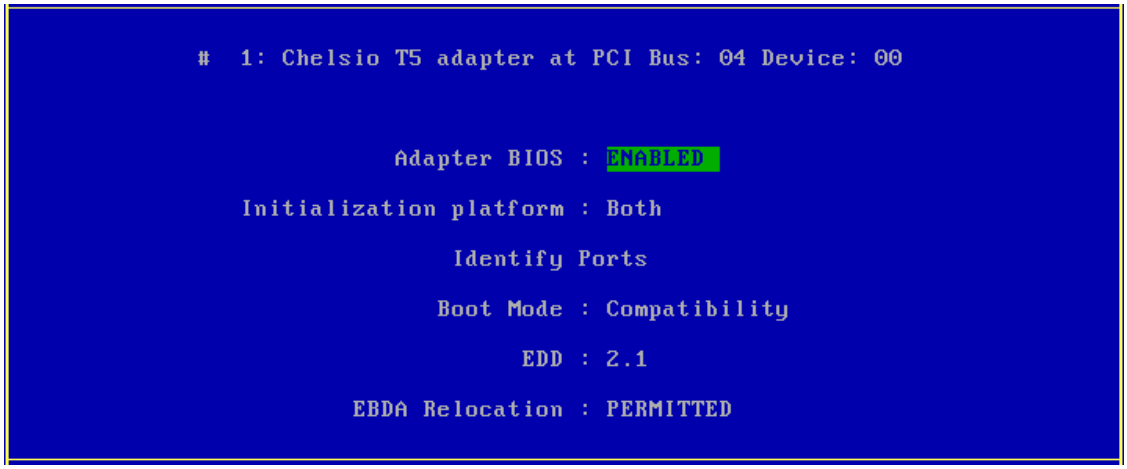
```
Chelsio Unified Boot BIOS
Copyright (C) 2003-2016 Chelsio Communications
Press <Alt-C> to Configure T5/T6 Card(s). Press <Alt-S> to skip BIOS.
```

iii. The configuration utility will appear as below.



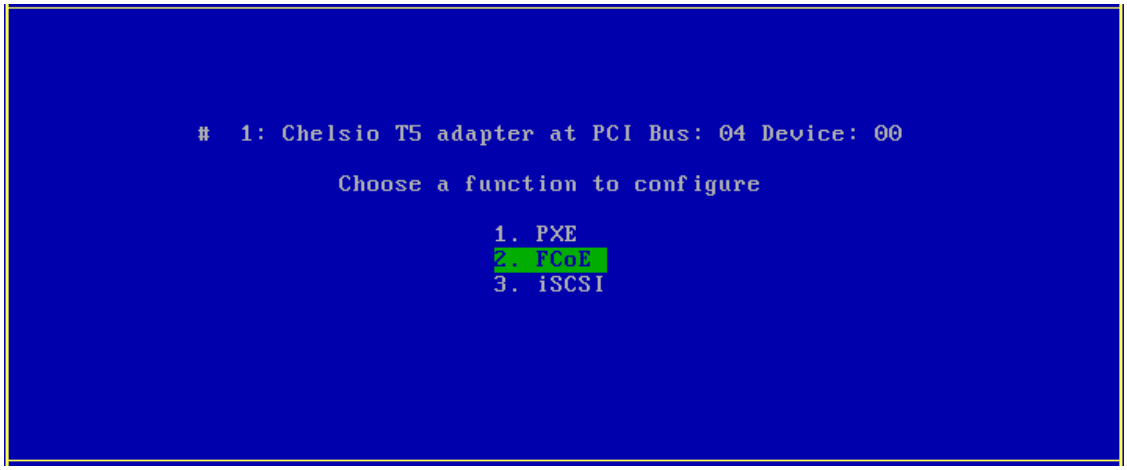
Choose the adapter on which you flashed the option ROM image. Hit [Enter].

iv. Enable the adapter BIOS if not already enabled. Hit [ENTER].

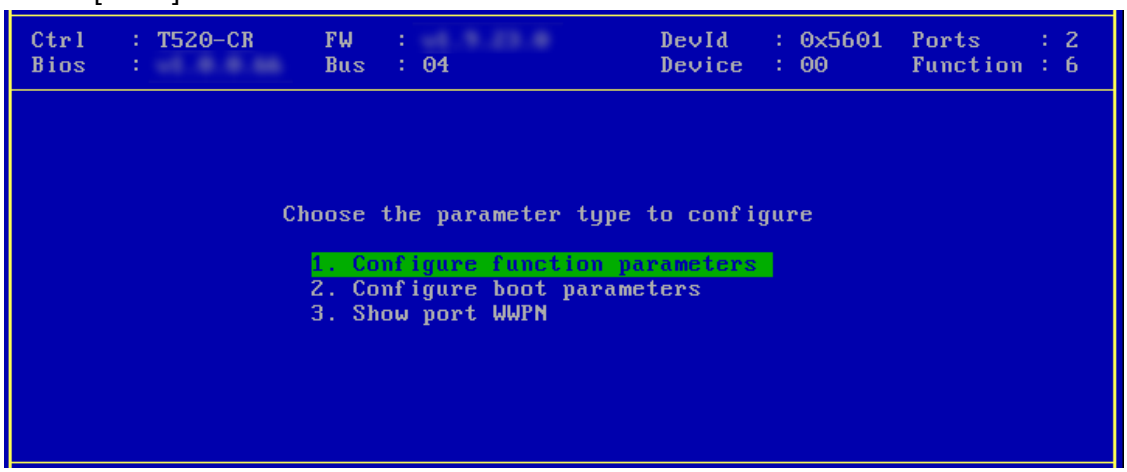


Note *Use the default values for Boot Mode, EDD and EBDA Relocation parameters, unless instructed otherwise.*

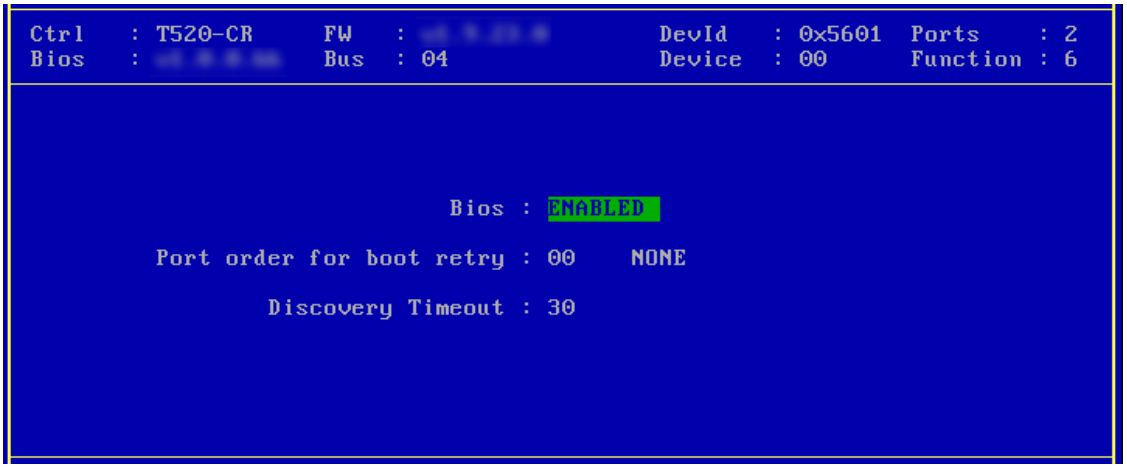
v. Choose **FCoE** from the list to configure and hit [Enter].



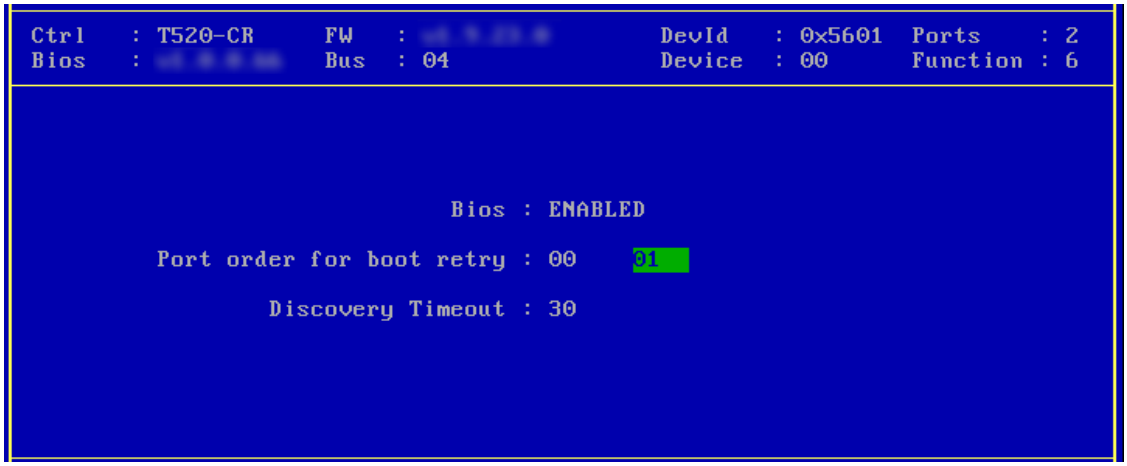
vi. Choose the first option, **Configure function parameters**, from the list of parameter type and hit [Enter].



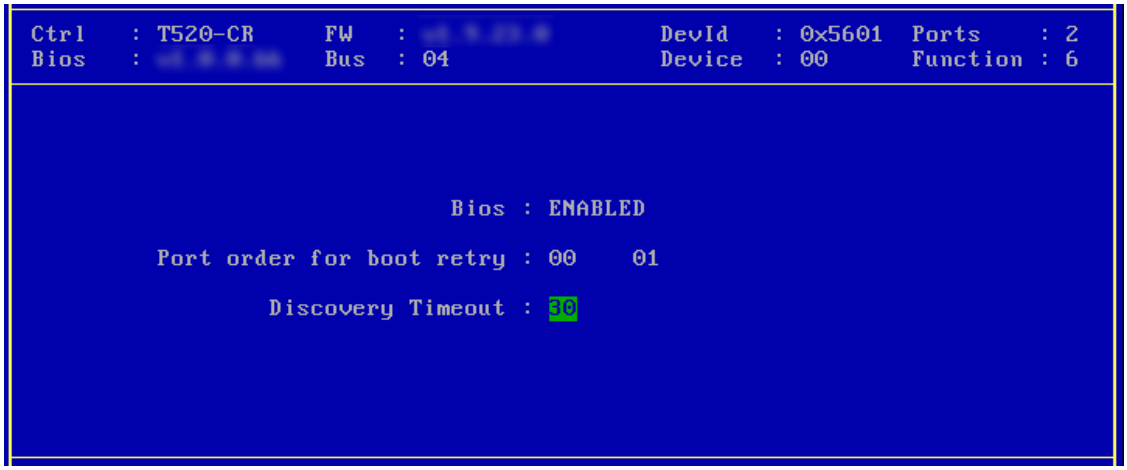
vii. Enable FCoE BIOS if not already enabled.



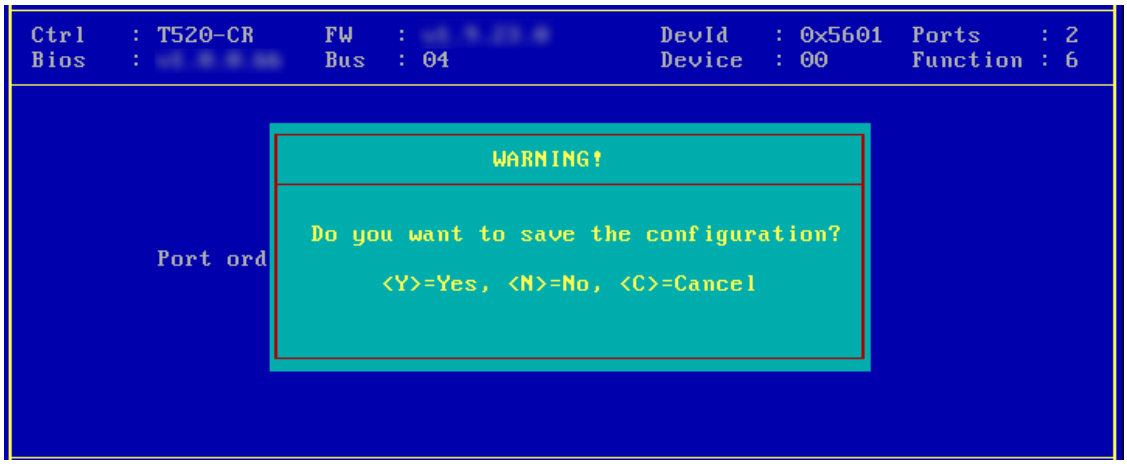
viii. Choose the order of the ports to discover FCoE targets.



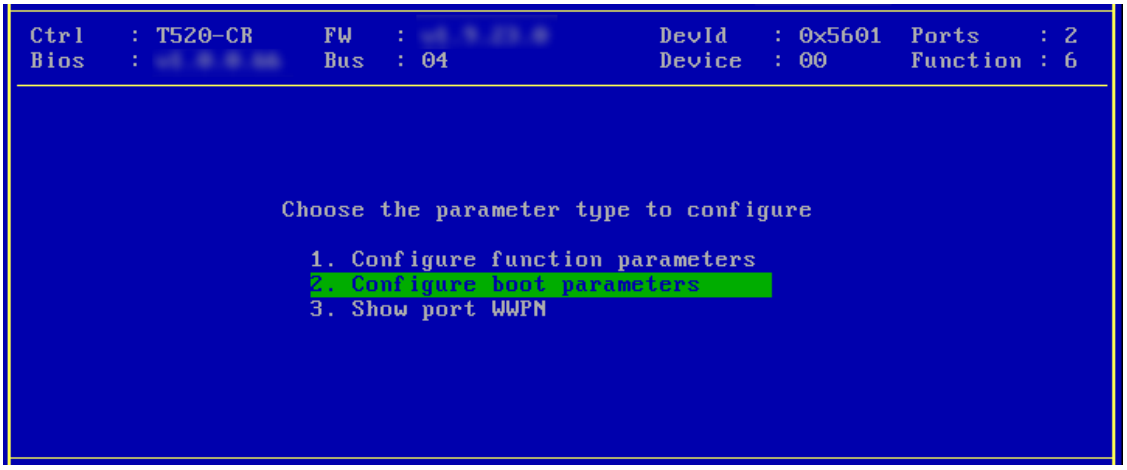
ix. Set discovery timeout to a suitable value. Recommended value is >= 30.



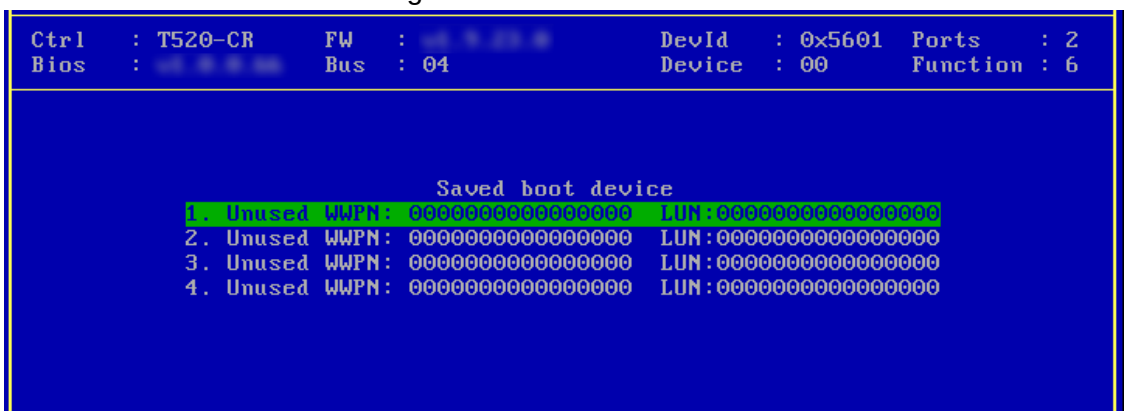
x. Hit [F10] or [Esc] and then [Y] to save the configuration.



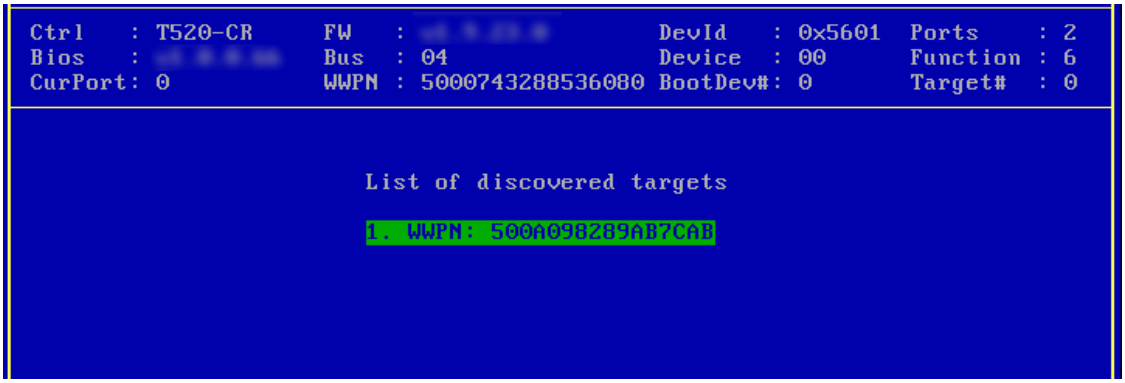
xi. Choose **Configure boot parameters**.



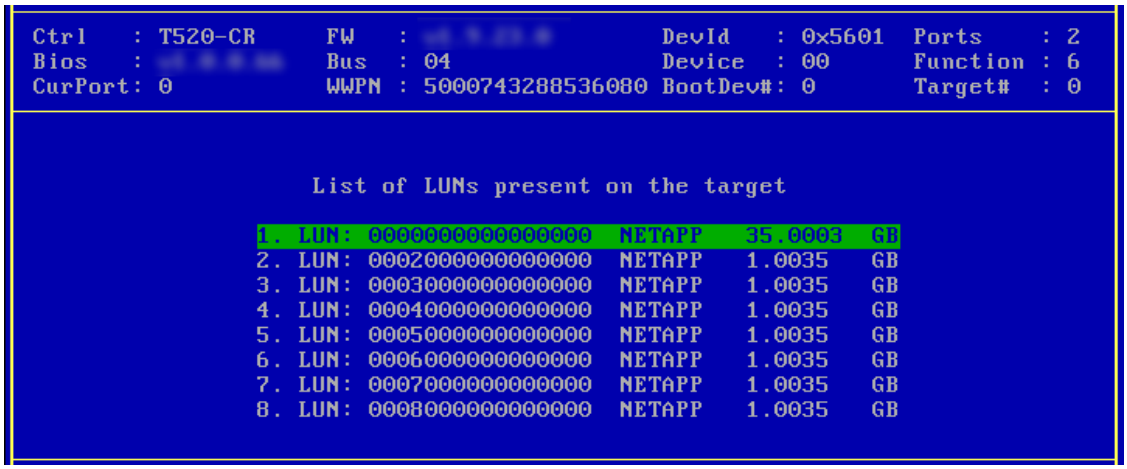
xii. Select the first boot device and hit [Enter] to discover FC/FCoE targets connected to the switch. Wait till all reachable targets are discovered.

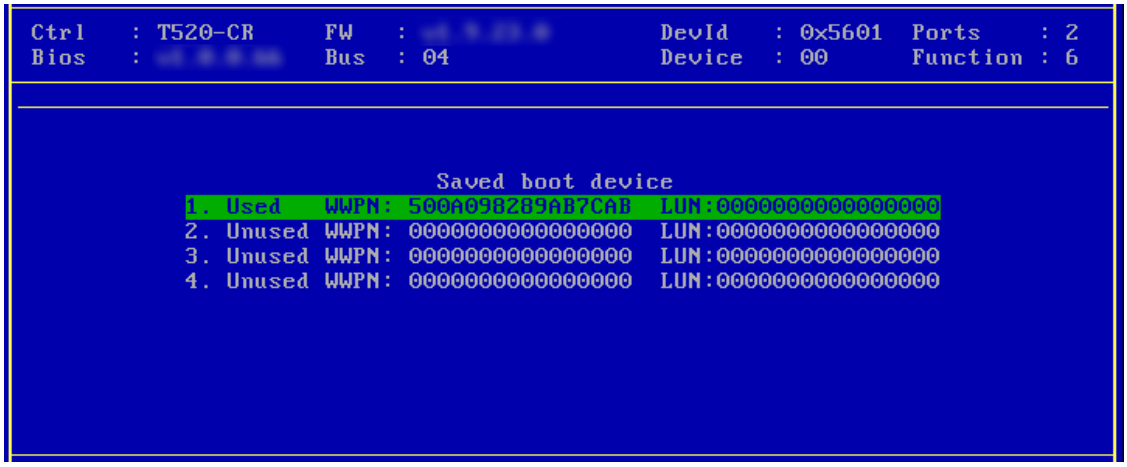


xiii. List of discovered targets will be displayed. Highlight a target using the arrow keys and hit [Enter] to select.

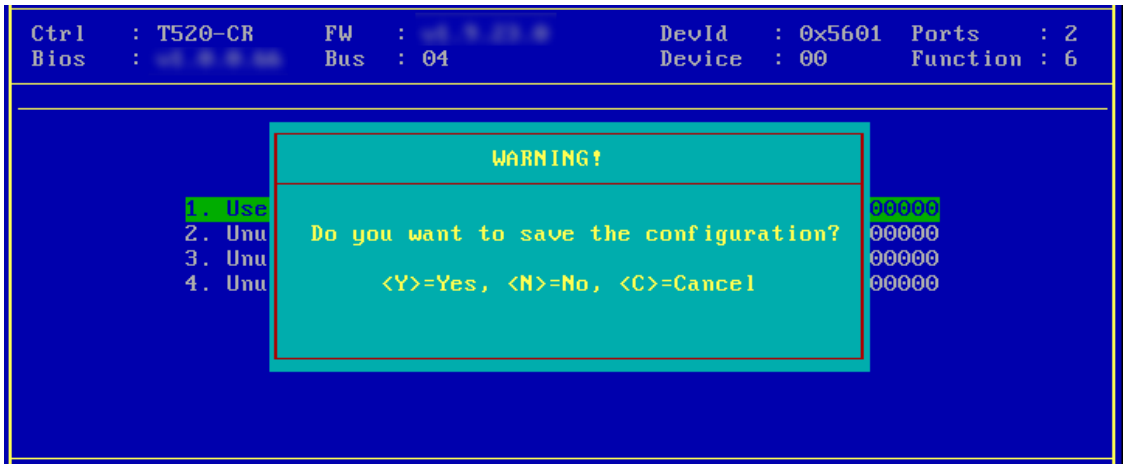


xiv. From the list of LUNs displayed for the selected target, choose one on which operating system has to be installed. Hit [Enter].





xv. Hit [F10] or [Esc] and then [Y] to save the configuration.

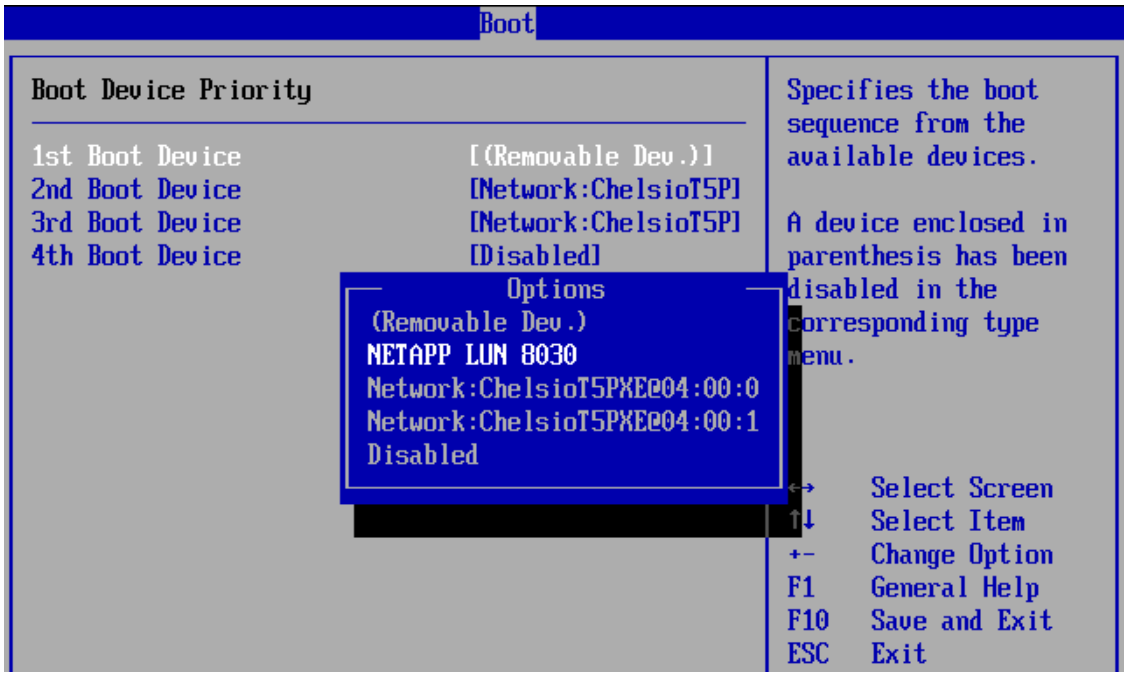


xvi. Reboot the machine.

xvii. During POST, allow the Chelsio Option ROM to discover FCoE targets.

```
Installing Chelsio T5 Storage FCoE BIOS
PCI BIOSv3.0 PCI FWv2.1 PnP BIOS: YES PMM Entry is passed by BIOS
Bringing up link on PCI:04:00:6 Port 0 ... Done
Discovering FCoE Target(s) on PCI:04:00:6 Port 0 ... Done
sd(1): T520-CR         PCI:04:00:6 P(0) WWPN:500A098289AB7CAB Lun(00)
       NETAPP  LUN              8030 35.0003 GB
Storage FCoE BIOS Installed Successfully!
```

xviii. Enter BIOS setup and choose FCoE disk discovered via Chelsio adapter as the first boot device.



xix. Reboot and boot from the FCoE disk or install the required OS using PXE.

6.2. uEFI FCoE Boot

Important

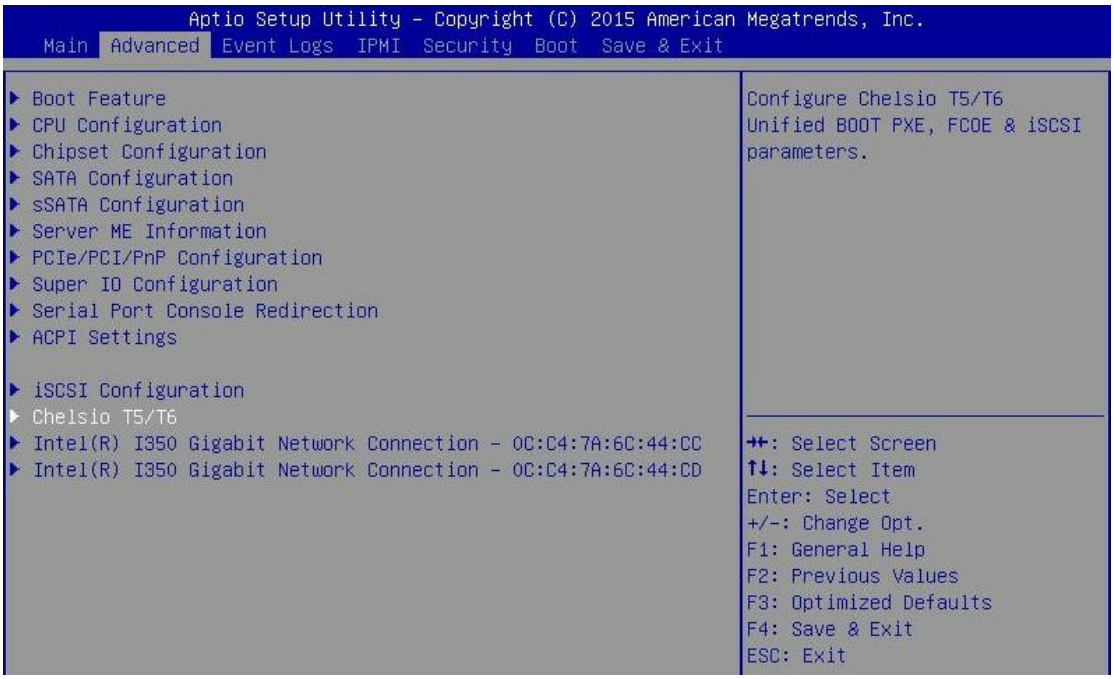
- *Only uEFI v2.3.1, v2.4 and v2.5 supported.*
- *Any other uEFI version is NOT SUPPORTED and may render your system unusable.*

6.2.1. HII

This section describes the method to configure and use Chelsio uEFI FCoE interfaces using HII.

i. Reboot the system and go into BIOS setup.

ii. Select **Chelsio T5/T6** and press [Enter]

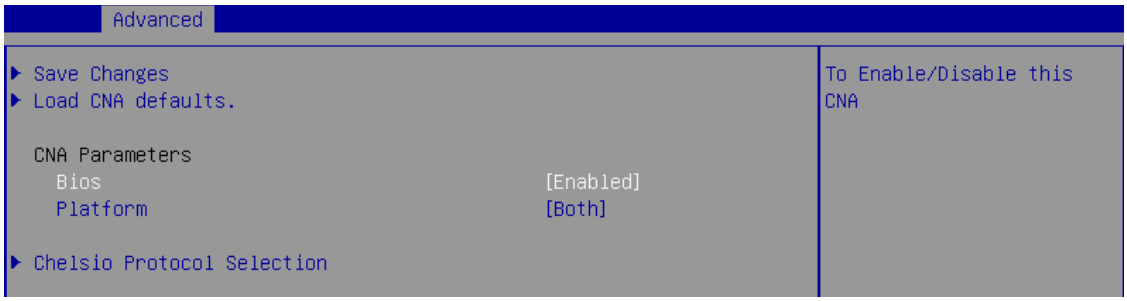


Note *Please ensure that Chelsio uEFI driver is loaded correctly as mentioned in Loading uEFI driver section.*

iii. Select the Chelsio adapter to be configured and press [Enter].

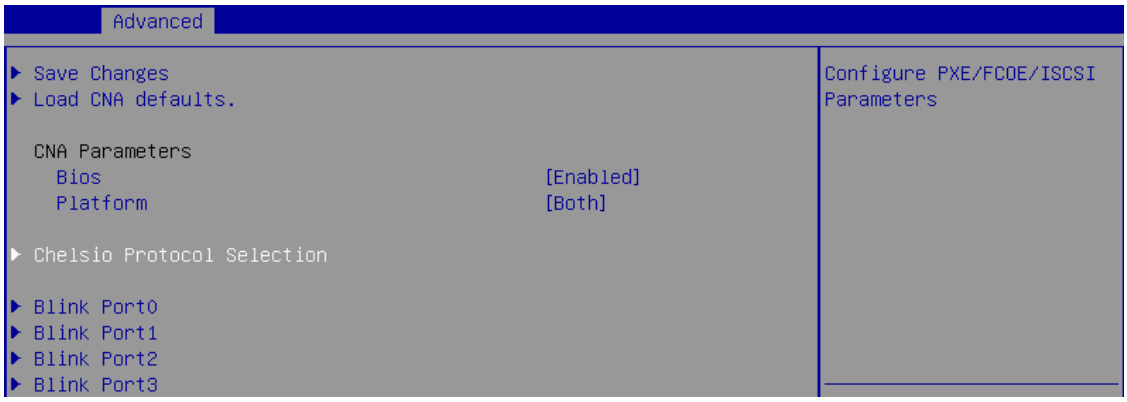
iv. Select **Configuration Utility** and press [Enter].

v. Enable adapter BIOS if not already enabled.



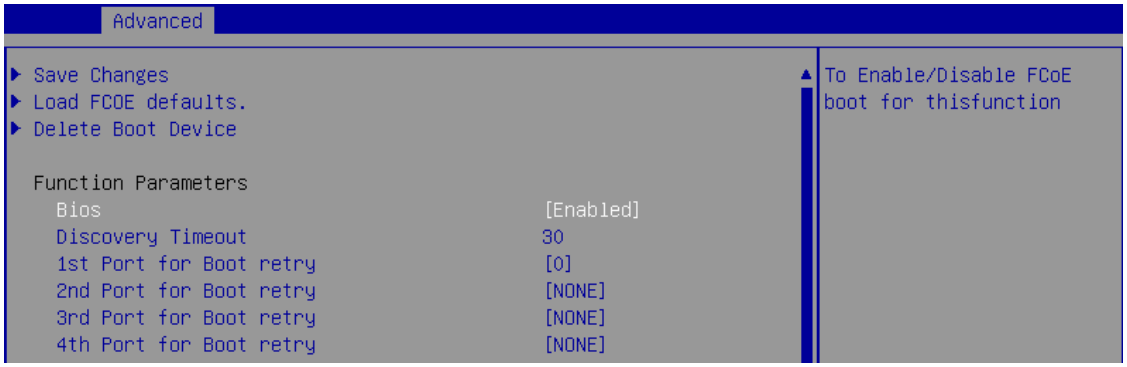
Note *It is highly recommended that you use the **Save Changes** option every time a parameter/option is changed.*

vi. Select **Chelsio Protocol Selection** and press [Enter].

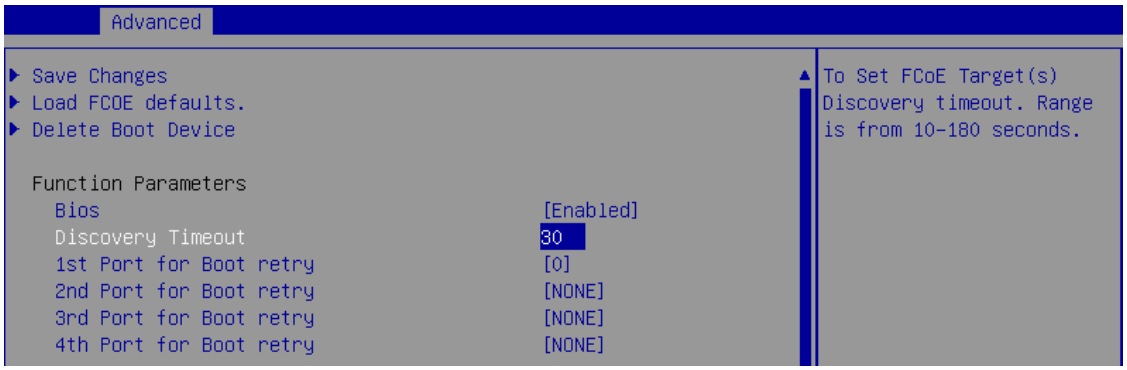


vii. Select **FCoE** and press [Enter].

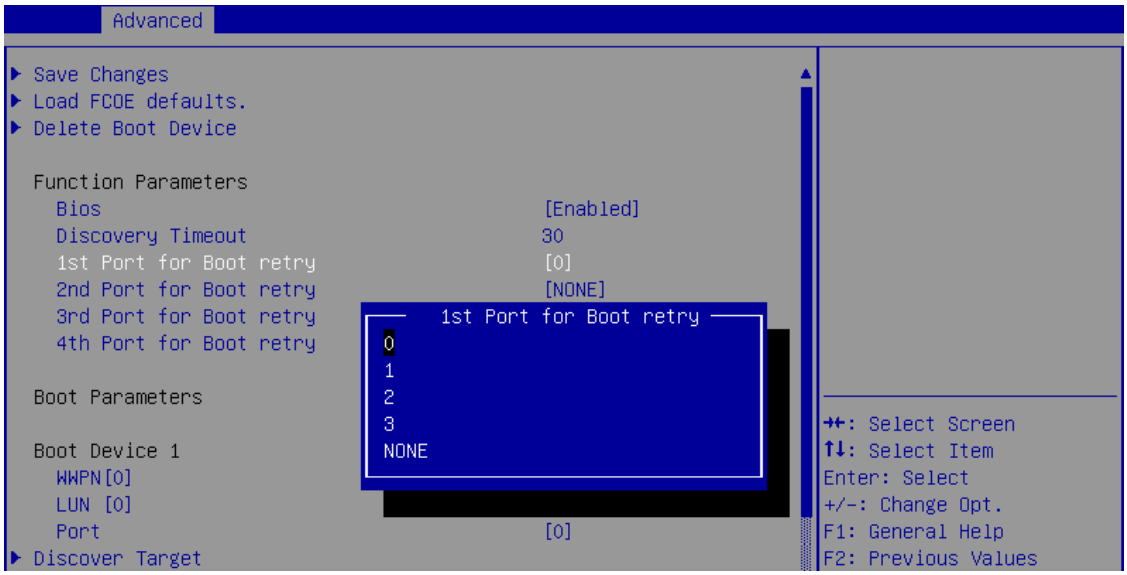
viii. Under **Function Parameters**, enable FCoE BIOS, if not already enabled.



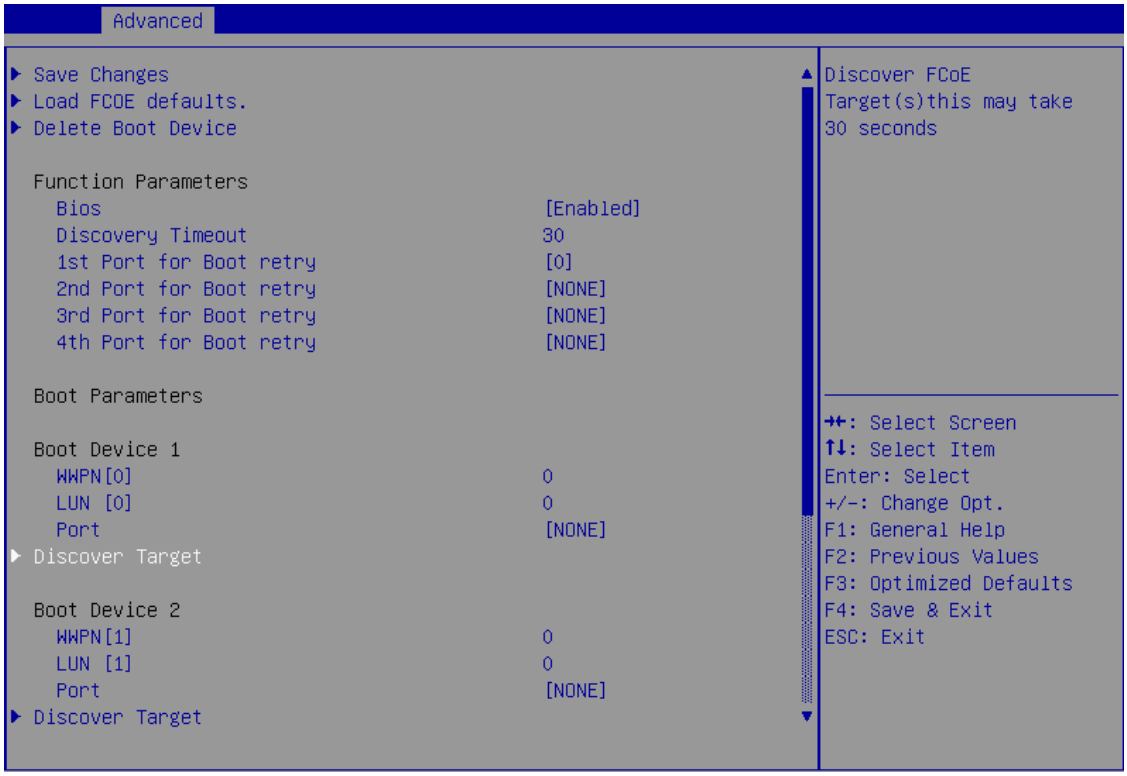
ix. Set discovery timeout to a suitable value. Recommended value is >= 30



x. Choose the order of the ports to discover FCoE targets.

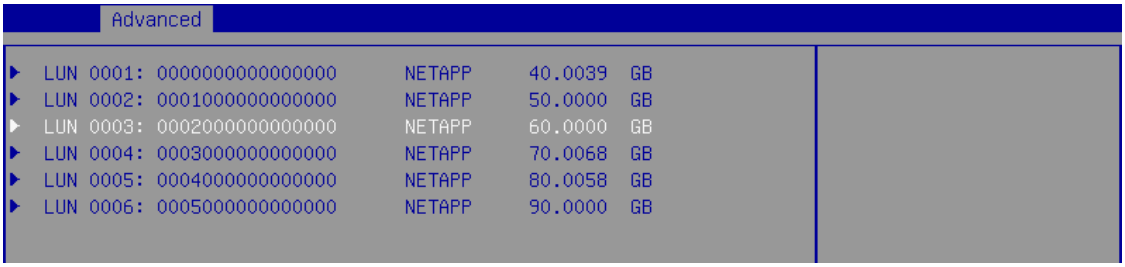


xi. Under the first boot device, select **Discover Target** and press [Enter] to discover FC/FCoE targets connected to the switch. Wait till all reachable targets are discovered.

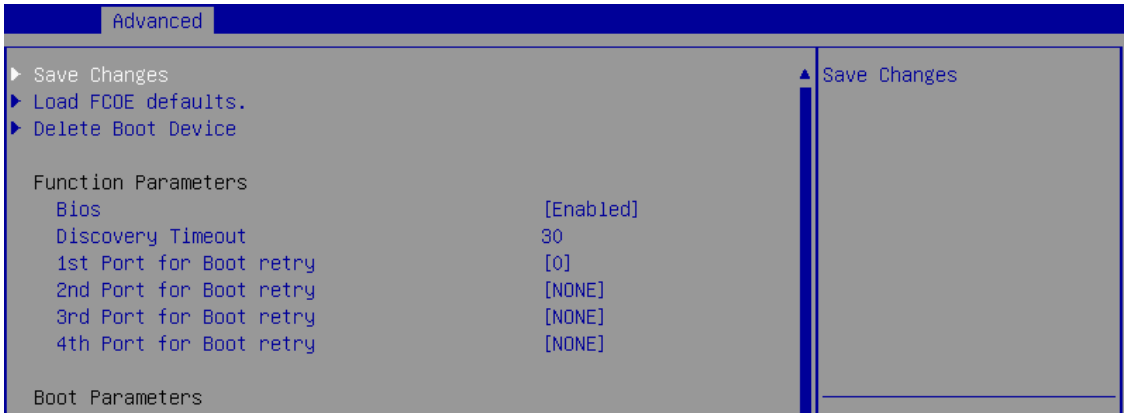


xii. List of discovered targets will be displayed. Highlight a target to select it and hit [Enter].

xiii. List of LUNs for the selected target will be displayed. Highlight a LUN to select it and hit [Enter].

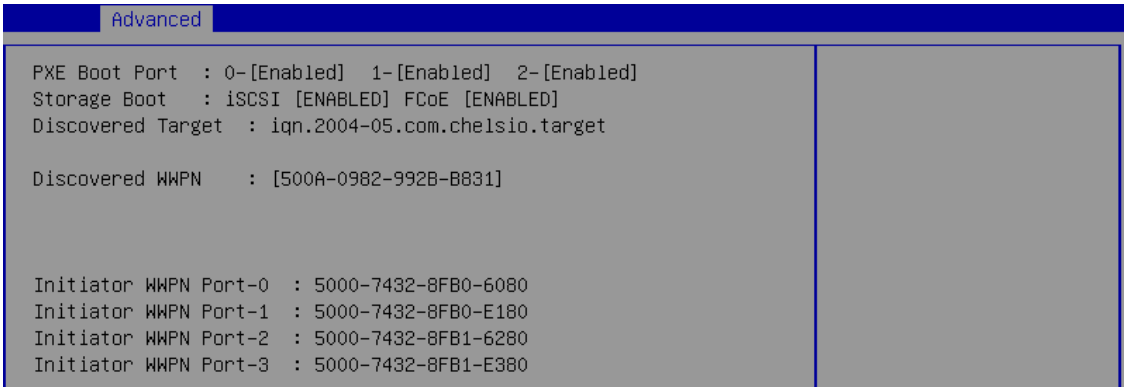


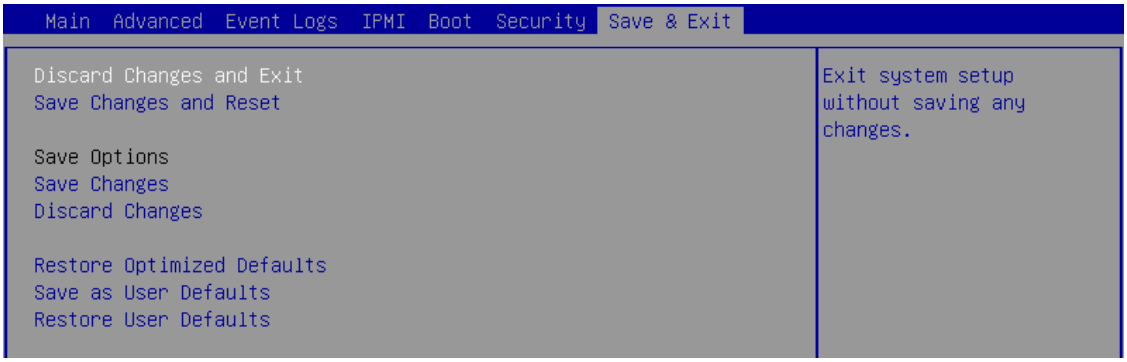
xiv. Select **Save Changes** and press [Enter].



xv. Reboot the system for changes to take effect.

xvi. The discovered LUN should appear in the **Boot Configuration** section and system BIOS section.





xvii. Select the LUN as the first boot device and exit from BIOS.

xviii. Either boot from the LUN or install the required OS.

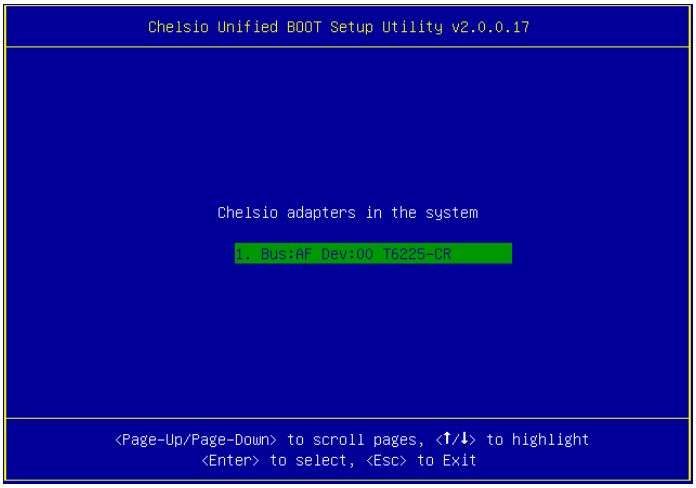
6.2.2. drvcfg

This section describes the method to configure and use Chelsio uEFI FCoE interfaces using drvcfg.

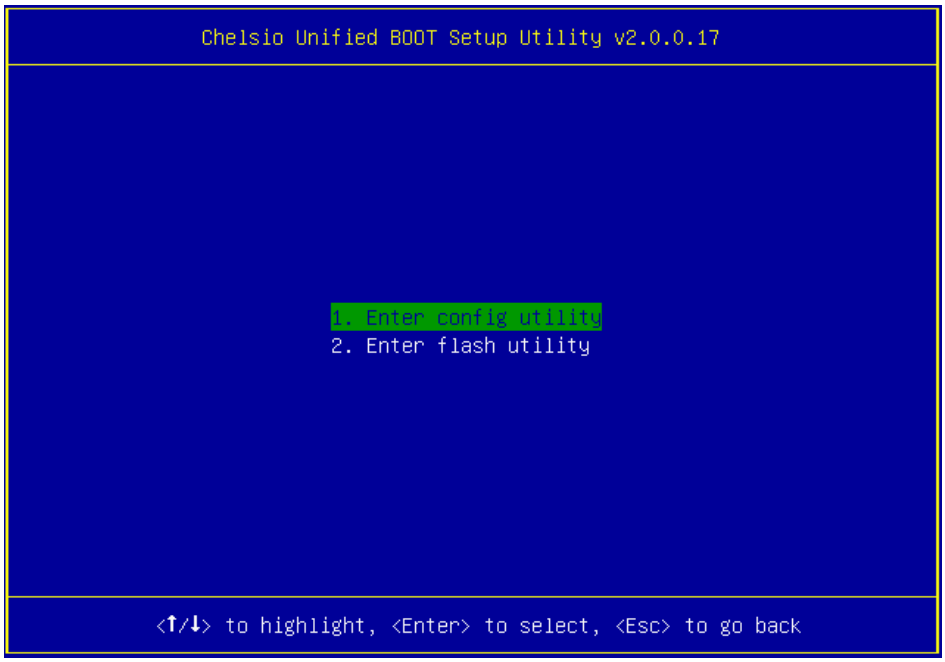
i. Boot the system into EFI shell.
ii. Run the following command to launch the configuration utility.

```
fs0:\> drvcfg -s_
```

iii. Choose the Chelsio adapter on which needs to be configured.



iv. Highlight **Enter config utility** and press [Enter].



v. Further configuration steps are similar from step (iv) of Legacy FCoE Boot section.

7. iSCSI boot process

Before proceeding, please ensure that the Chelsio adapter has been flashed with the provided firmware and option ROM (See Flashing Firmware and option ROM).

7.1. Legacy iSCSI boot

i. Reboot the system.

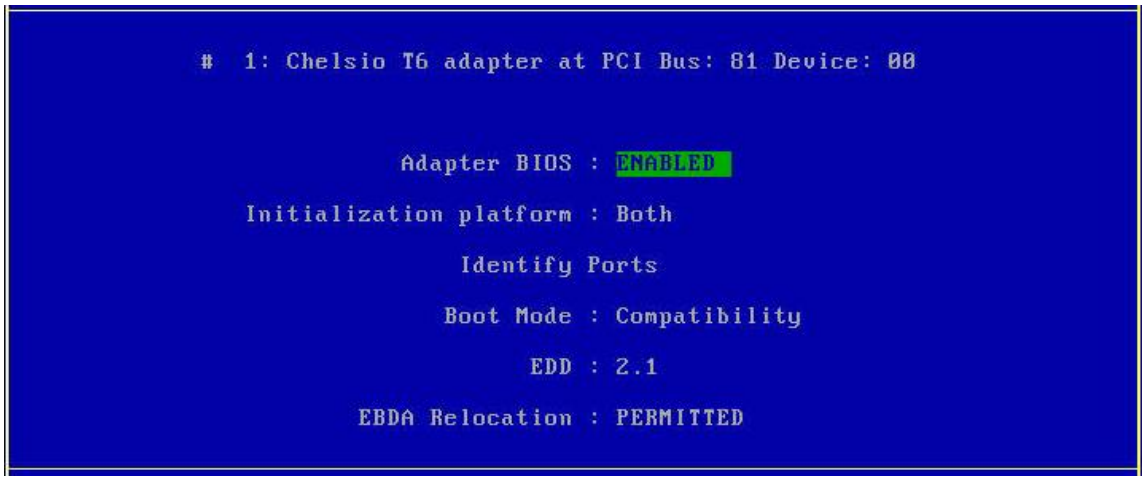
ii. Press [Alt+C] when the message to configure Chelsio adapters appears on the screen.

```
Chelsio Unified Boot BIOS
Copyright (C) 2003-2016 Chelsio Communications
Press <Alt-C> to Configure T5/T6 Card(s). Press <Alt-S> to skip BIOS.
```

iii. The configuration utility will appear as below:

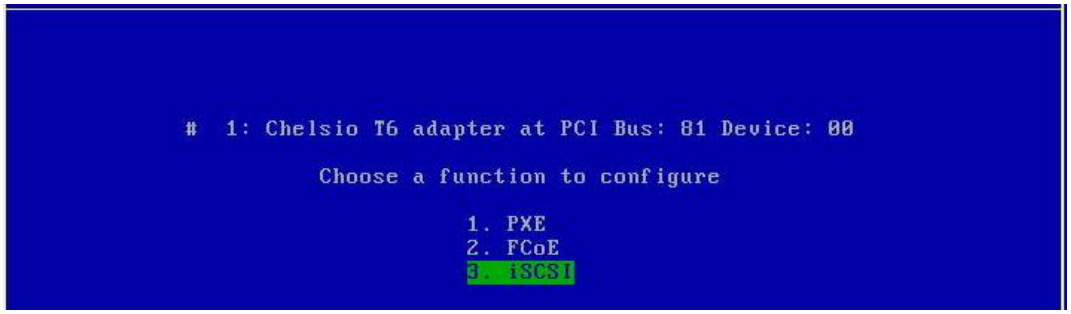
Choose the adapter on which you flashed the option ROM image. Hit [Enter].

iv. Enable the adapter BIOS if not already enabled. Hit [Enter].

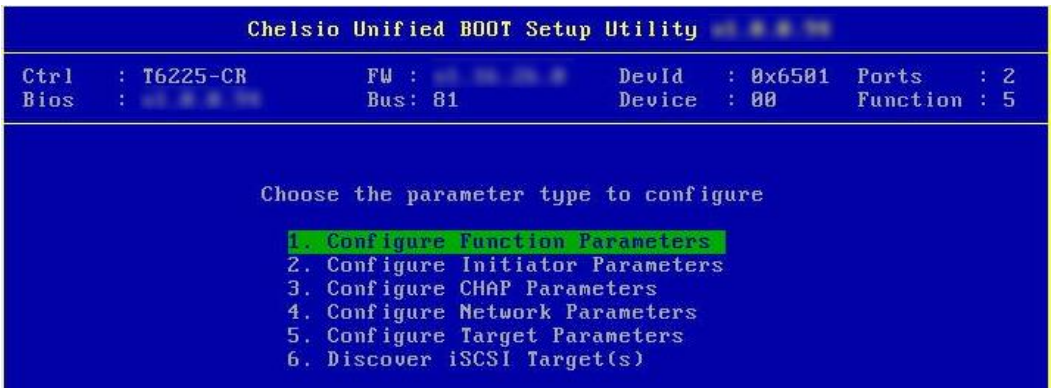


Note *Use the default values for Boot Mode, EDD and EBDA Relocation parameters, unless instructed otherwise.*

v. Choose **iSCSI** from the list to configure and hit [Enter].

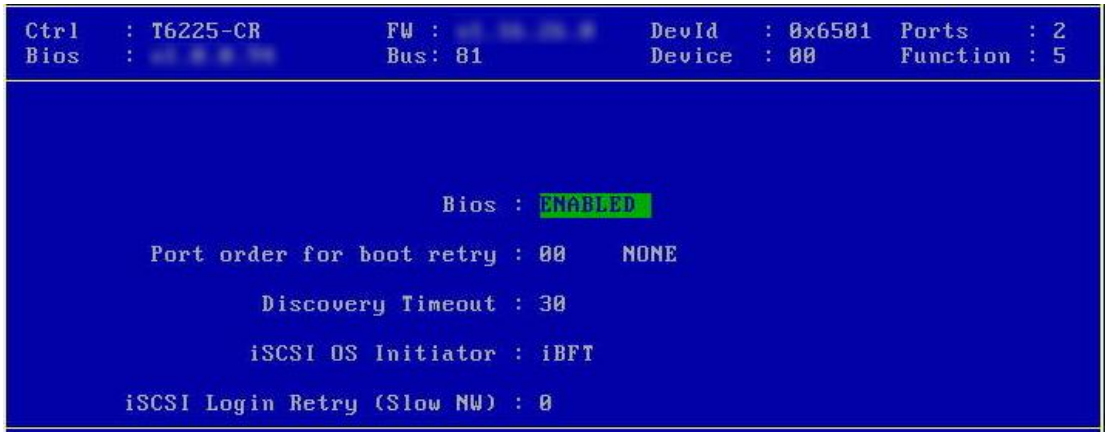


vi. Choose the first option, **Configure Function Parameters**, from the list of parameter type and hit [Enter].



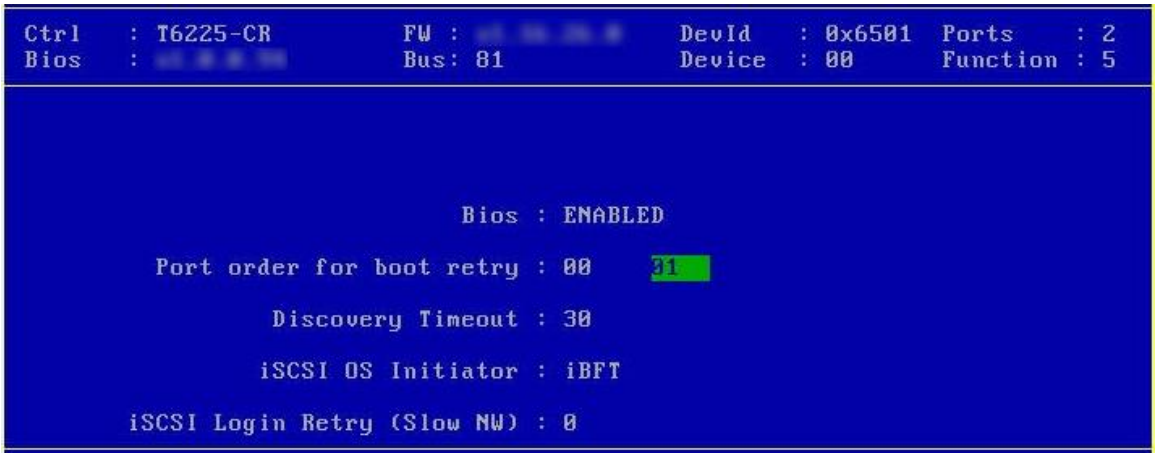
vii. Enable iSCSI BIOS if not already enabled. Select the iSCSI OS Initiator based on the OS you are installing. iBFT (iSCSI Boot Firmware Table) will be selected by default.

- Linux: Only iBFT is supported.
- Windows: Select CBFT to use Chelsio iSCSI Initiator, *cht4iscsi* during OS installation. If iBFT is selected, MS iSCSI Initiator will be used.
- ESX: Select CBFT to use Chelsio iSCSI Initiator, *cheiscsi* during OS installation. If iBFT is selected, ESXi iSCSI Initiator will be used.

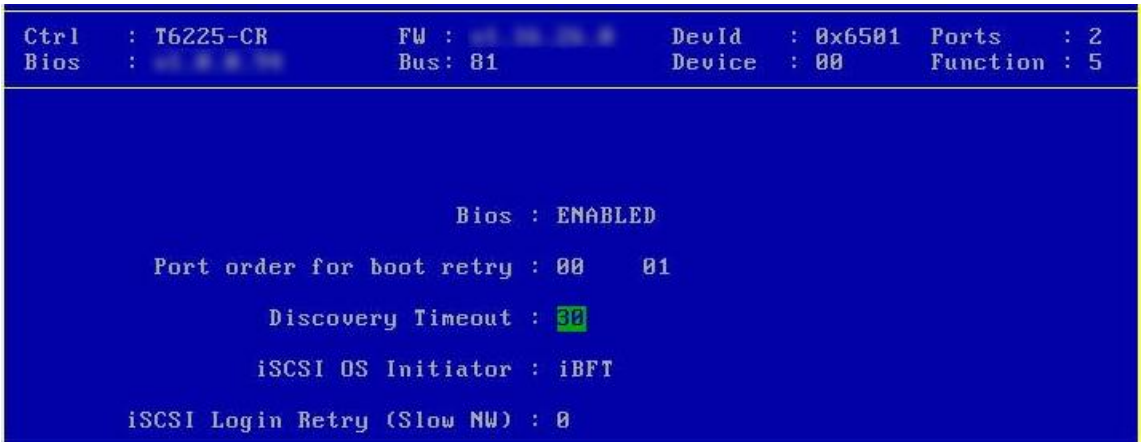


You can also configure the number of iSCSI login attempts (retries) in case the network is unreachable or slow.

viii. Choose the order of the ports to discover iSCSI targets.



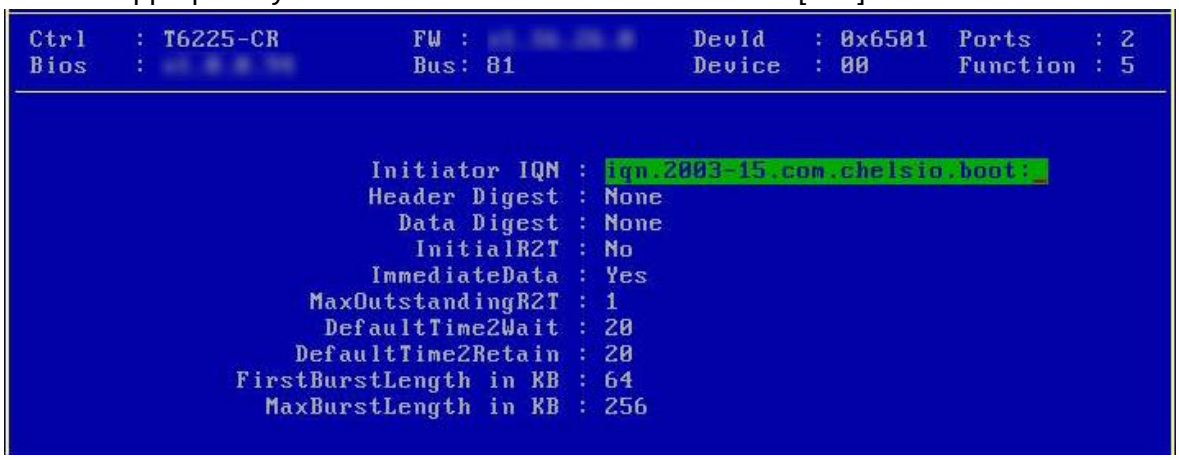
ix. Set discovery timeout to a suitable value. Recommended value is >= 30.



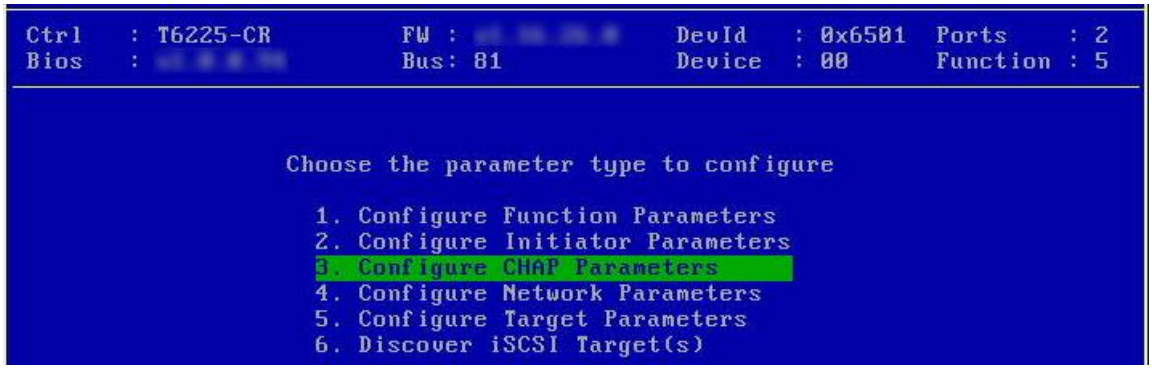
x. Hit [Esc] and then [Y] to save the configuration.

xi. Go back and choose **Configure Initiator Parameters** to configure initiator related properties.

xii. Initiator properties like IQN, Header Digest, Data Digest, etc. will be displayed. Change the values appropriately or continue with the default values. Hit [F10] to save.

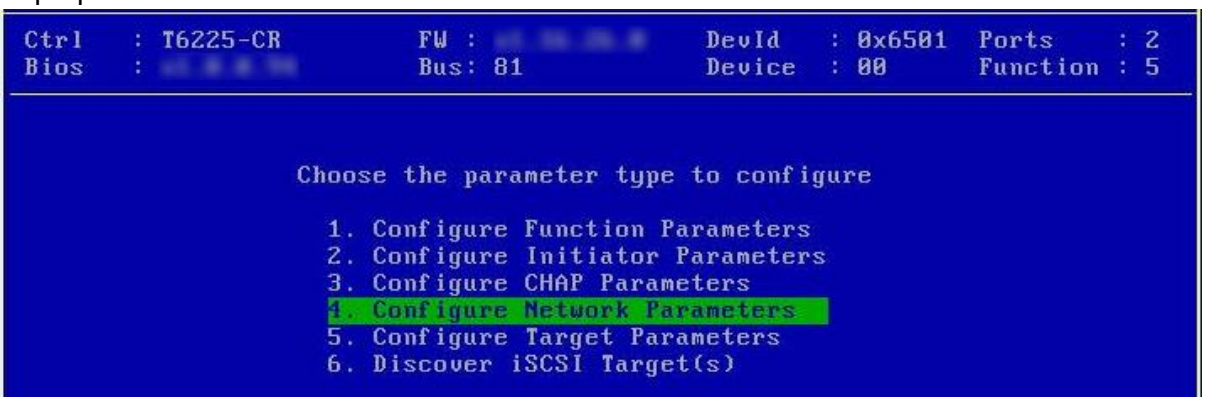


xiii. CHAP authentication is disabled by default. To enable and configure, go back and choose **Configure CHAP Parameters**

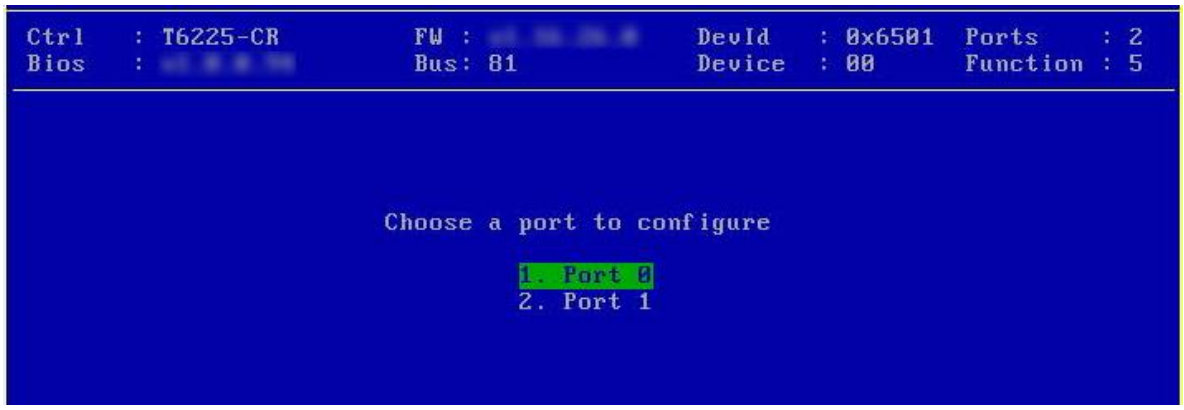


xiv. Enable CHAP authentication by selecting ONE-WAY or MUTUAL in the **CHAP Policy** field. Next, choose the CHAP method. Finally, provide Initiator and Target CHAP credentials as per the authentication method selected. Hit [F10] to save.

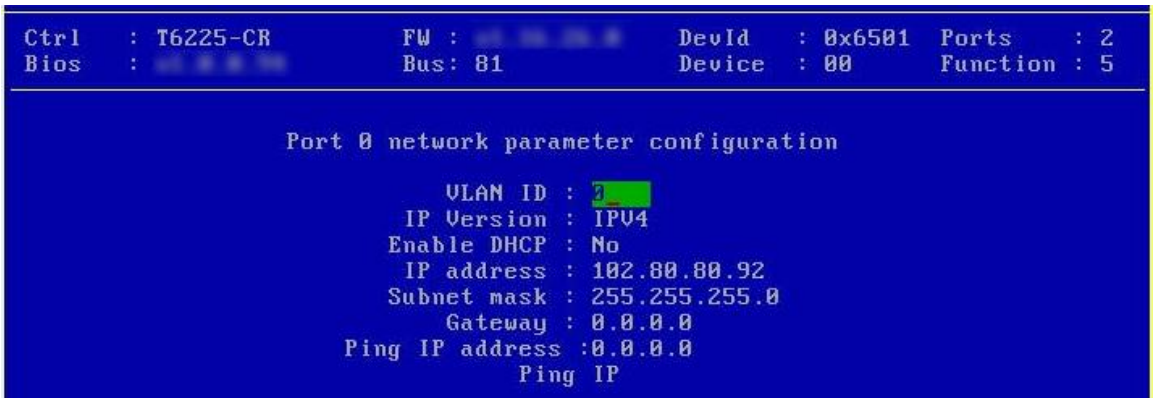
xv. Go back and choose **Configure Network Parameters** to configure iSCSI Network related properties.



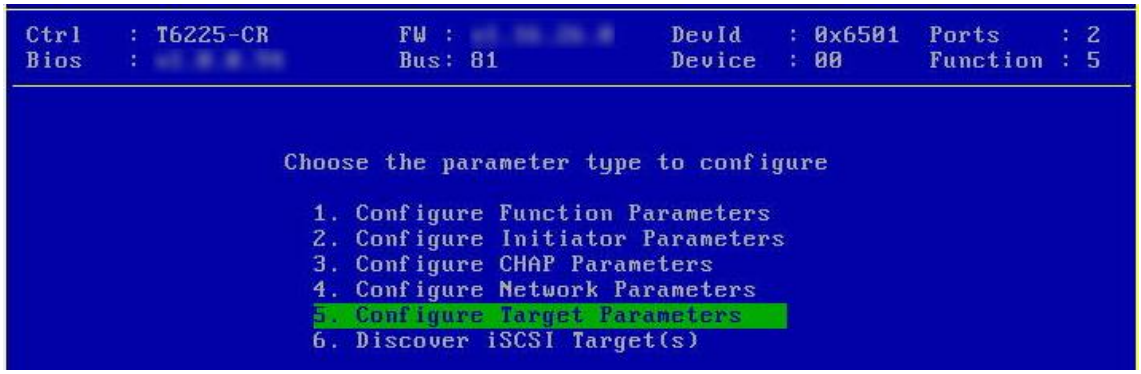
xvi. Select the port using which you want to connect to the target. Hit [Enter].



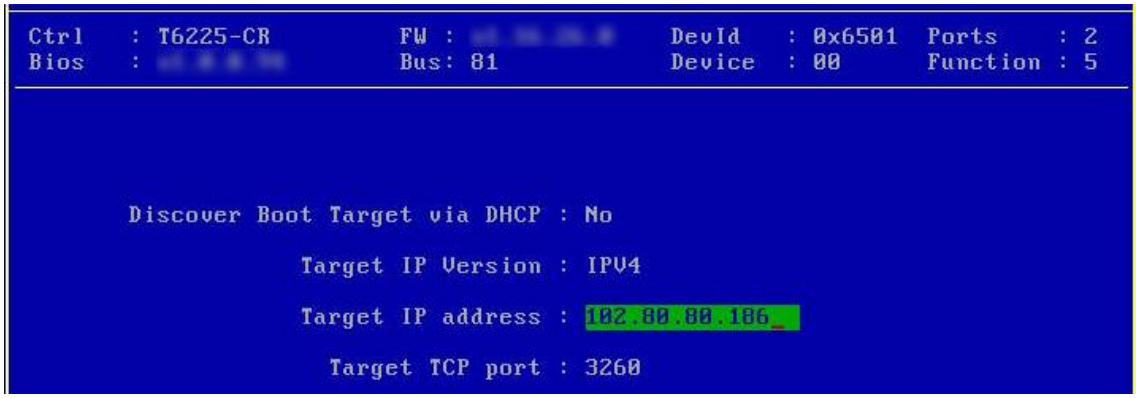
xvii. Select *Yes* in the **Enable DHCP** field to configure port using DHCP or *No* to manually configure the port. Hit [F10] to save.



xviii. Go back and choose **Configure Target Parameters** to configure iSCSI target related properties.



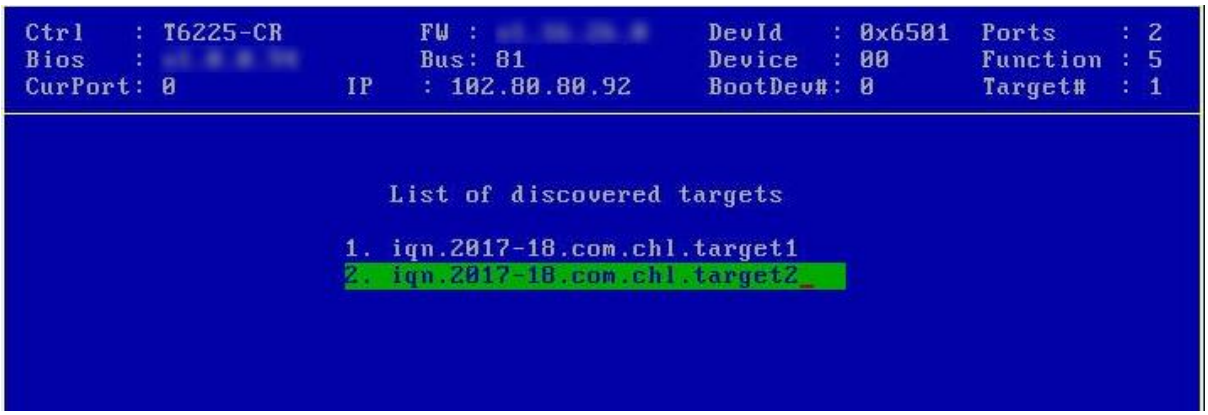
xix. If you want to discover target using DHCP, select *Yes* in the **Discover Boot Target via DHCP** field. To discover target via static IP, select *No* and provide the target IP and Hit [F10] to save. The default TCP port selected is 3260.



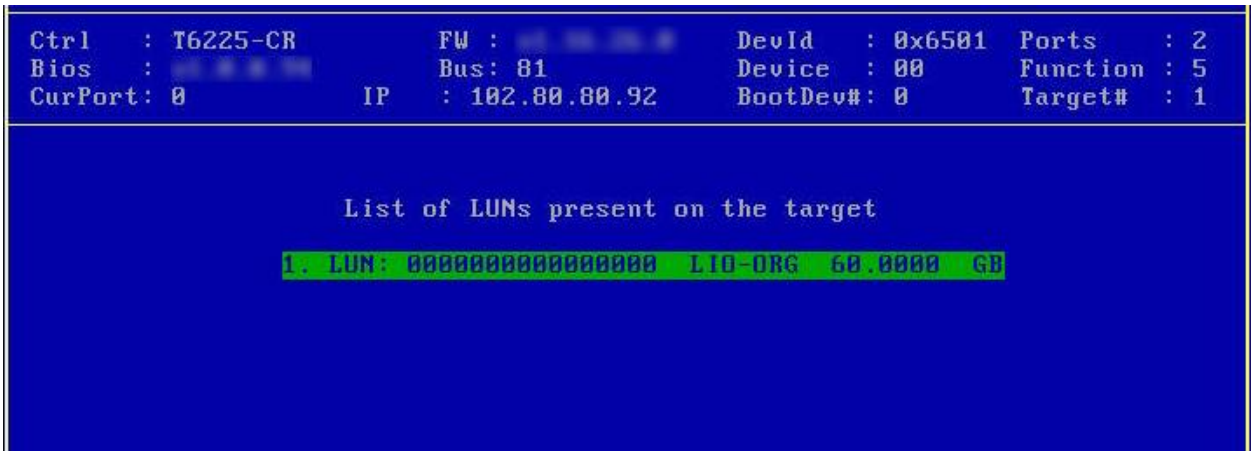
xx. Go back and choose **Discover iSCSI Target (s)** to connect to a target.

xxi. Select the portal group on which iSCSI service is provided by the target.

xxii. A list of available targets will be displayed. Select the target you wish to connect to and hit [Enter].



xxiii. A list of LUNs configured on the selected target will be displayed. Select the LUN you wish to connect to and hit [Enter].

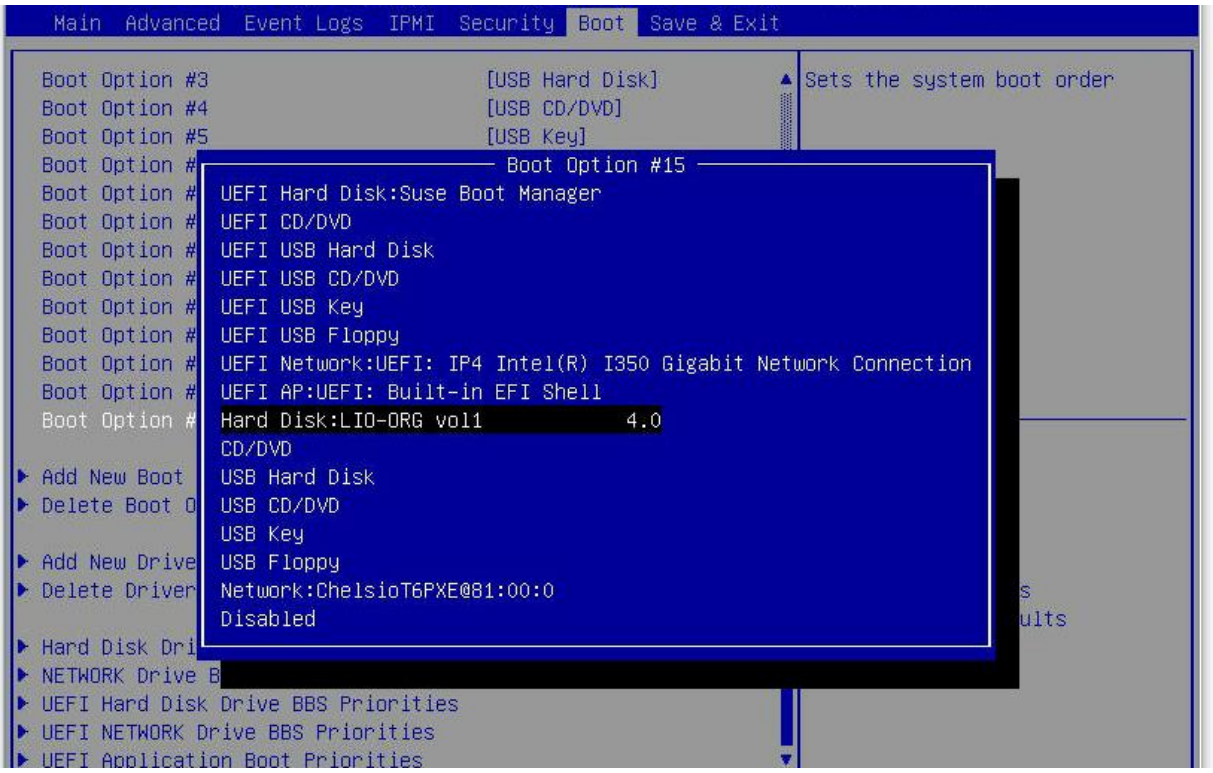


xxiv. Hit [Esc] and then [Y] to save the configuration.

xxv. Reboot the machine.

xxvi. During POST, allow the Chelsio Option ROM to discover iSCSI targets.

xxvii. Enter BIOS setup and choose iSCSI target LUN discovered via Chelsio adapter as the first boot device.



xxviii. Reboot and boot from the iSCSI Target LUN or install the required OS using PXE.

7.2. uEFI iSCSI Boot

Important

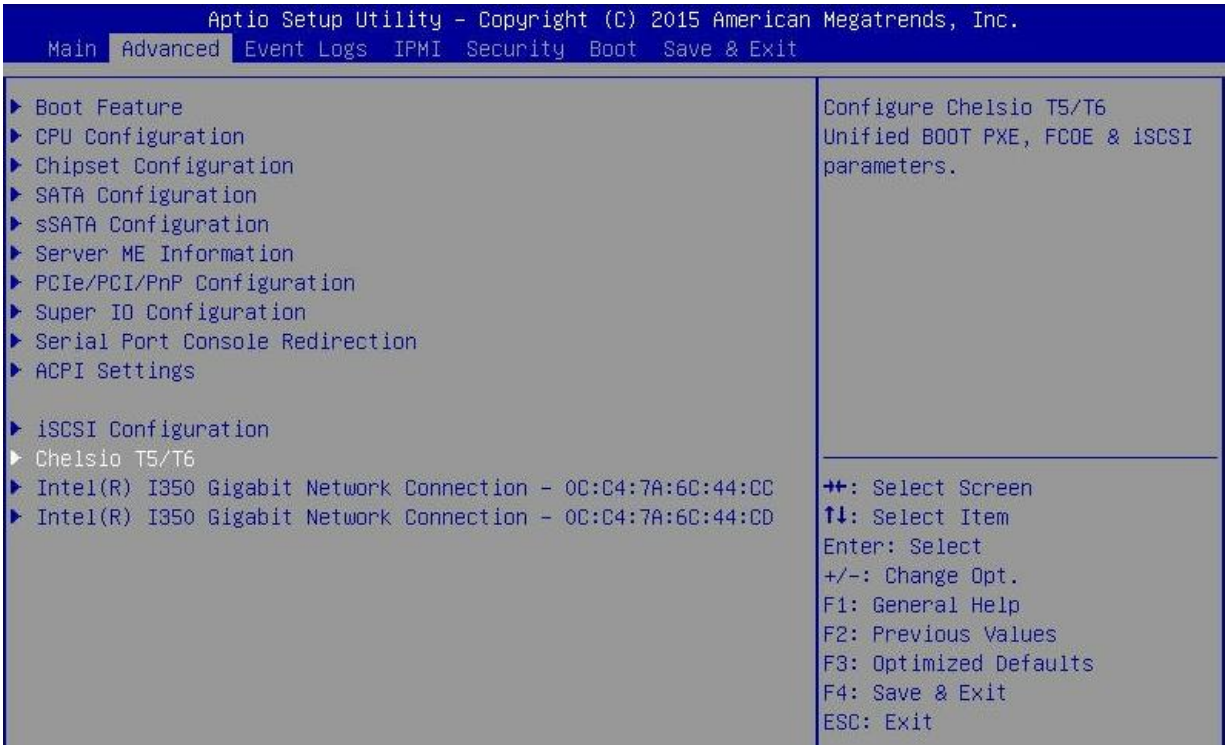
- *Only uEFI v2.3.1, v2.4 and v2.5 supported.*
- *Any other uEFI version is NOT SUPPORTED and may render your system unusable.*

7.2.1. HII

This section describes the method to configure and use Chelsio uEFI iSCSI interfaces using HII.

i. Reboot the system and go into BIOS setup.

ii. Select **Chelsio T5/T6** and press [Enter]

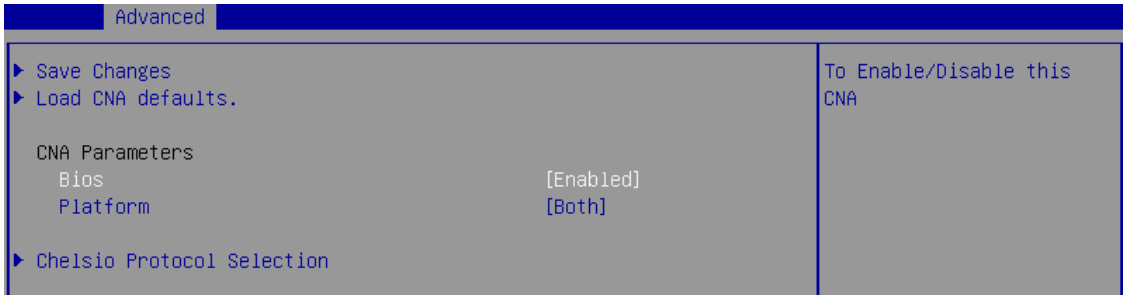


Note *Please ensure that Chelsio uEFI driver is loaded correctly as mentioned in Loading uEFI driver section.*

iii. Select the Chelsio adapter to be configured and press [Enter].

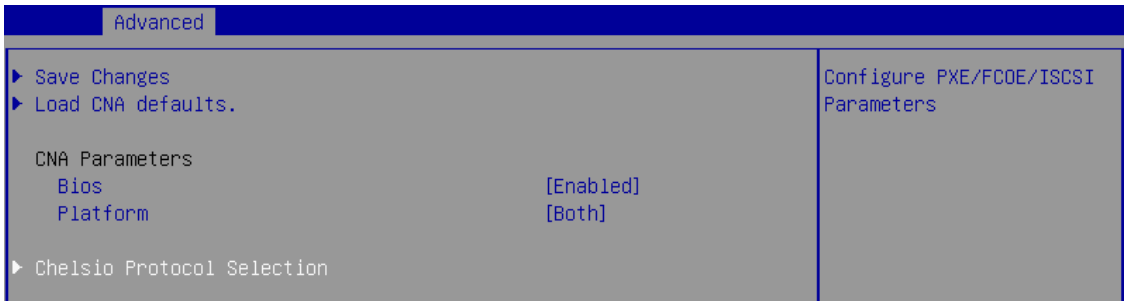
iv. Select **Configuration Utility** and press [Enter].

v. Enable adapter BIOS if not already enabled.

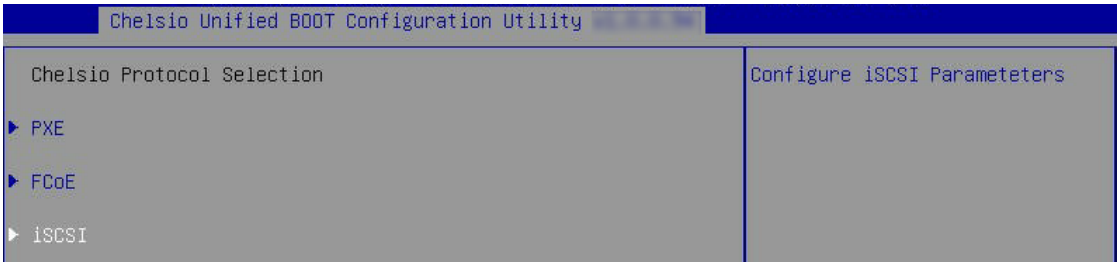


Note *It is highly recommended that you use the **Save Changes** option every time a parameter/option is changed.*

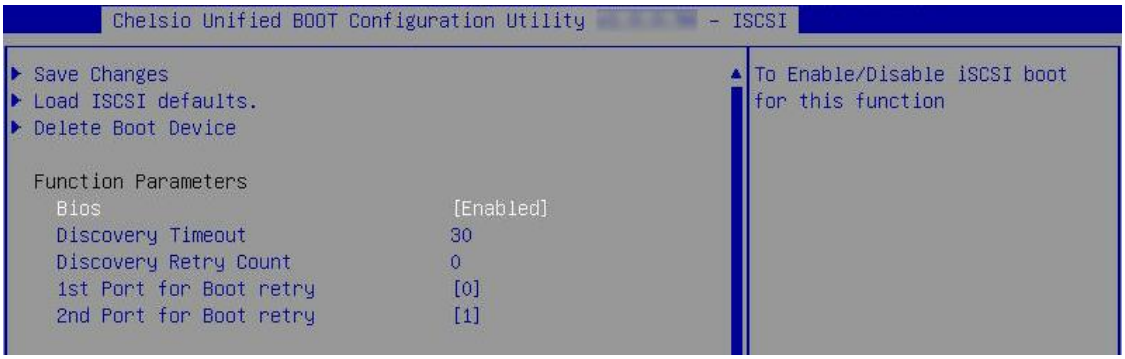
vi. Select **Chelsio Protocol Selection** and press [Enter].



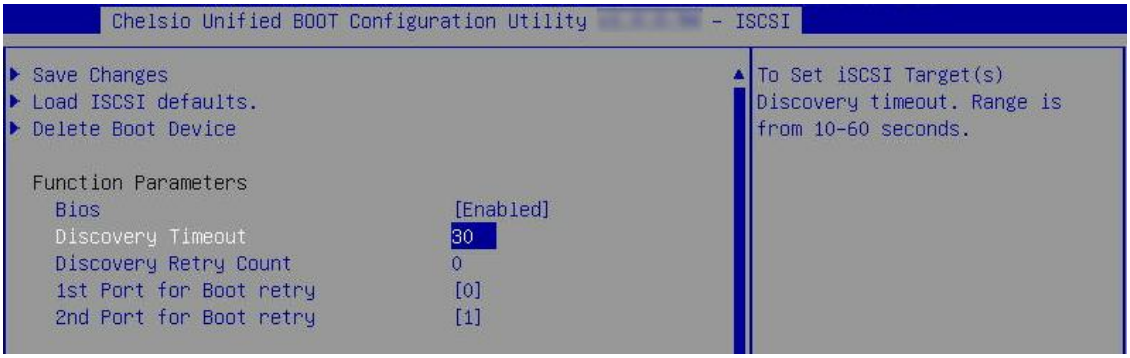
vii. Select **iSCSI** and press [Enter].



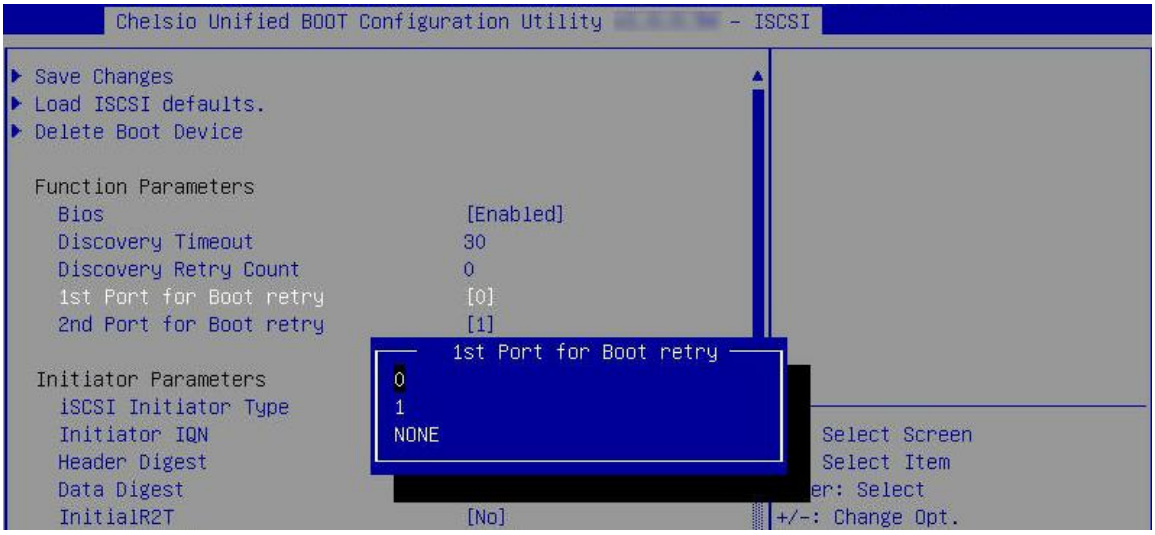
viii. Under **Function Parameters**, enable iSCSI BIOS, if not already enabled.



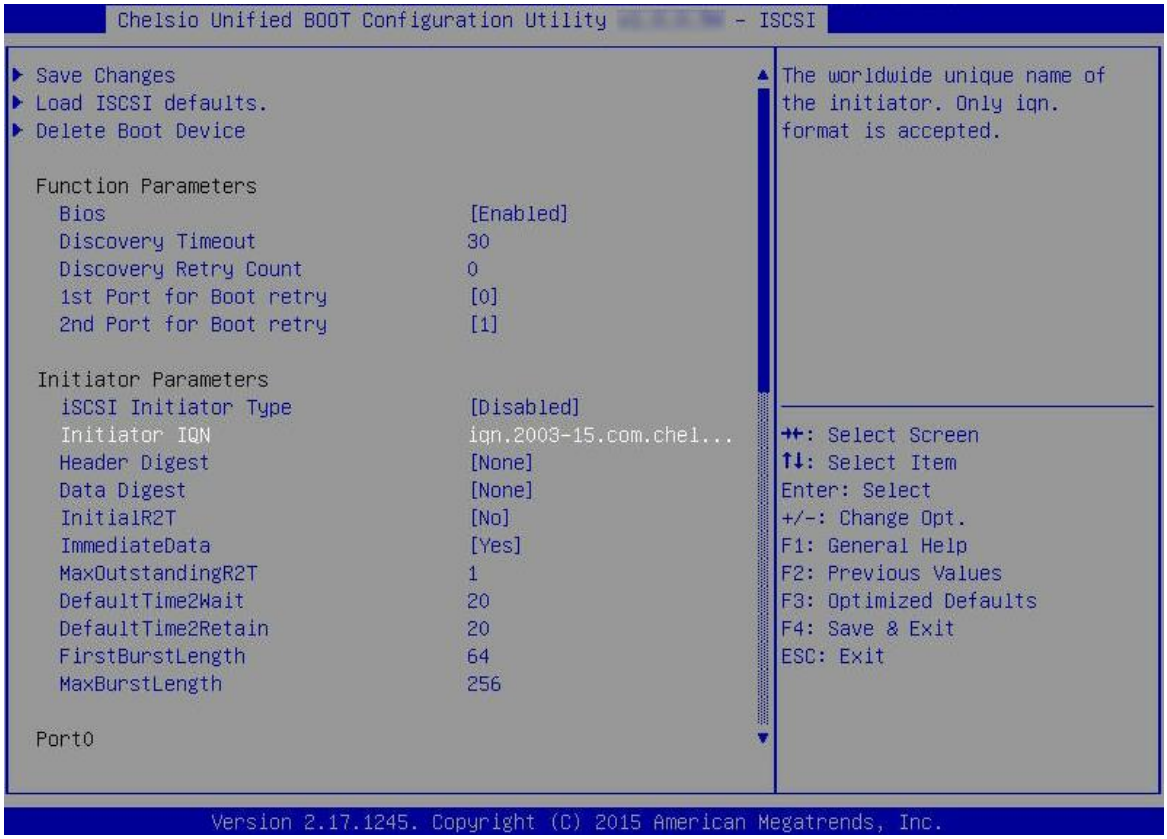
ix. Set discovery timeout to a suitable value. Recommended value is >= 30



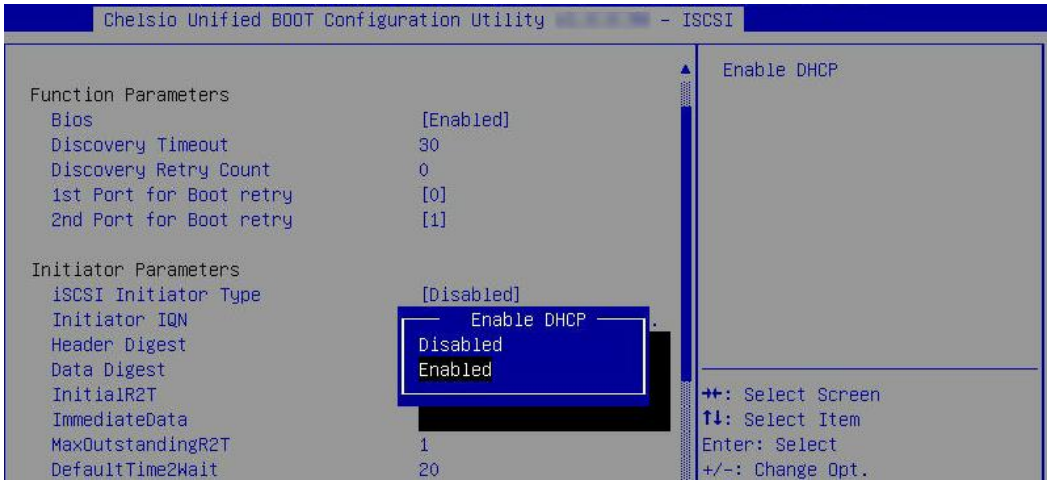
x. Choose the order of the ports to discover iSCSI targets.



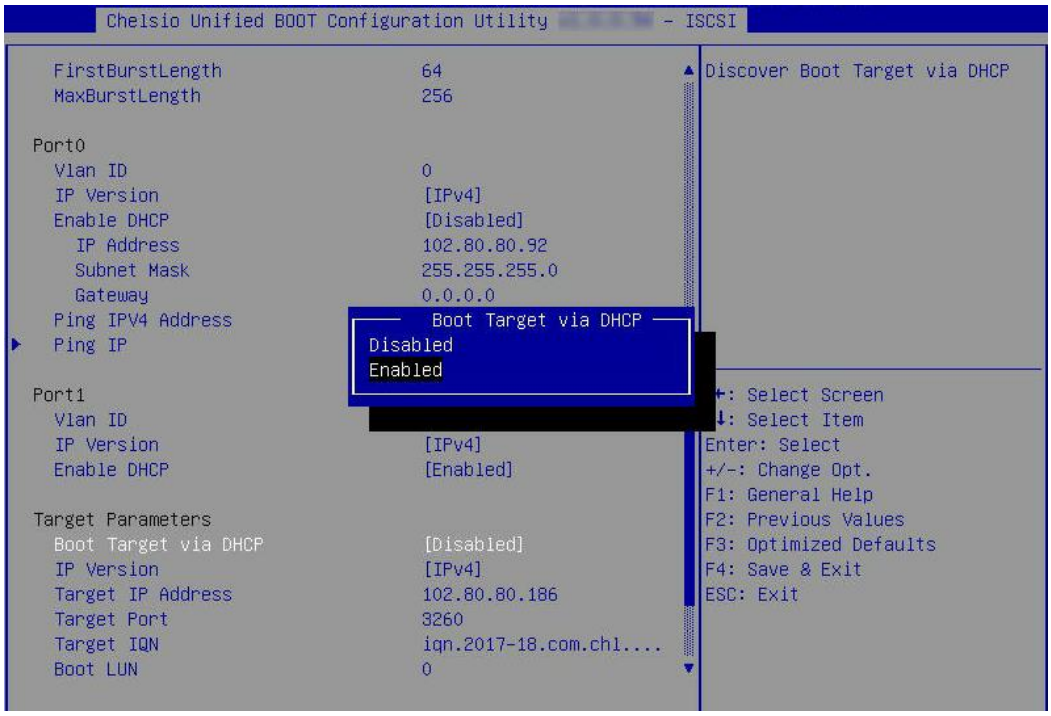
xi. Under **Initiator Parameters**, iSCSI Initiaitor properties like IQN, Header Digest, Data Digest, etc will be displayed. Change the values appropriately or continue with the default values.



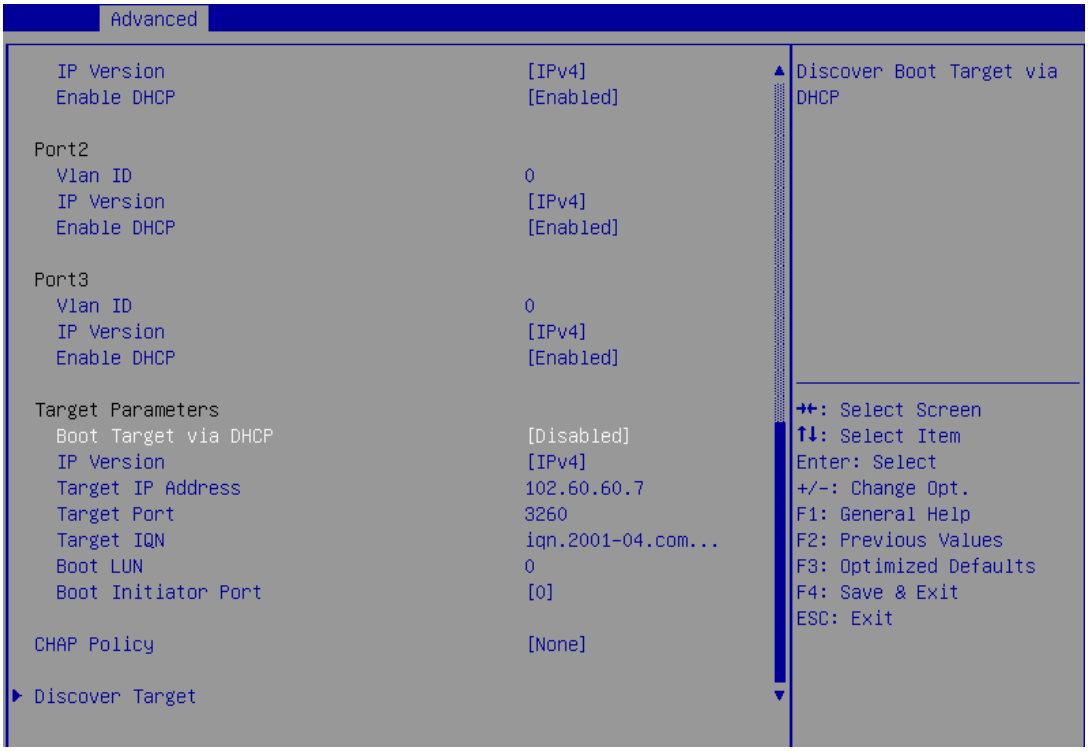
xii. Under the first port, select **Enable DHCP** field, hit [Enter] and select **Enabled**. This will configure port using DHCP. Select **Disabled** to manually configure the port.



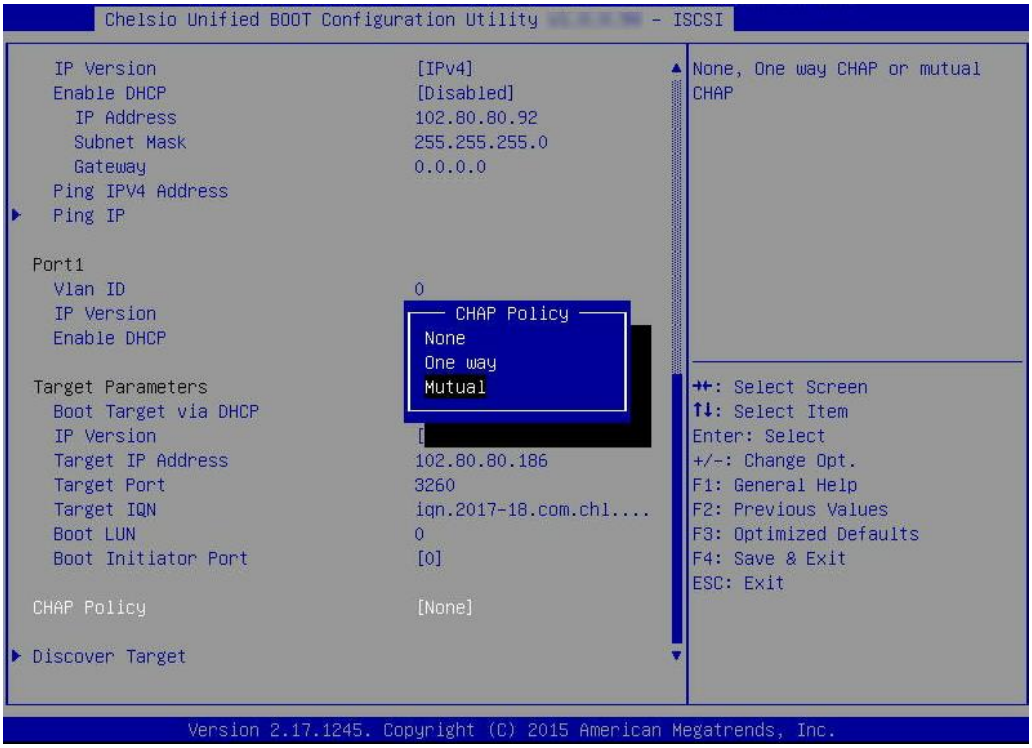
xiii. Under **Target Parameters**, select **Enabled** for the **Boot Target via DHCP** parameter to discover target using DHCP.



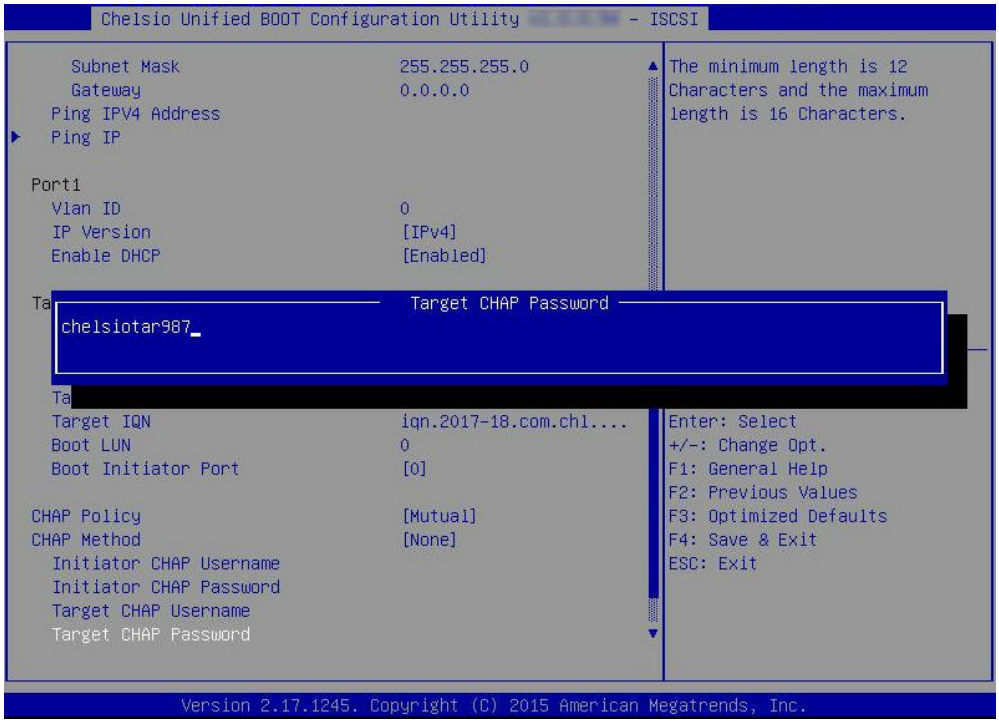
To discover target via static IP, select **Disabled** and provide the target IP.



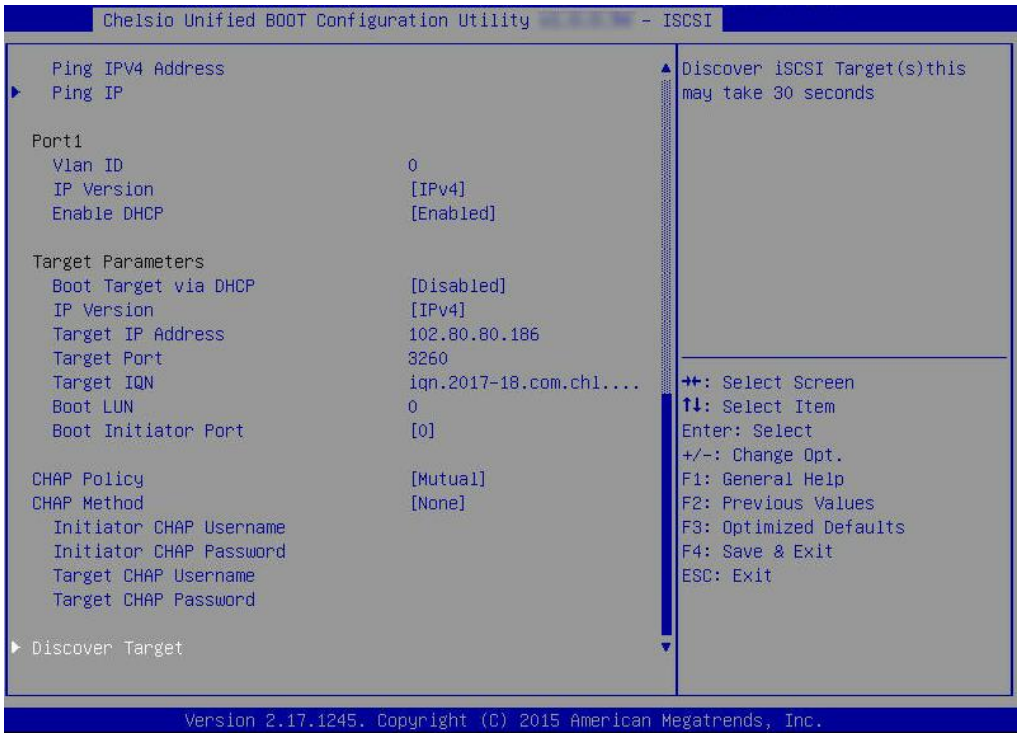
xiv. CHAP authentication is disabled by default. To enable and configure, highlight **CHAP Policy** and hit [Enter]. Select the policy type from the corresponding pop-up and hit [Enter] again.



xv. Provide Initiator and Target CHAP credentials as per the CHAP policy selected.

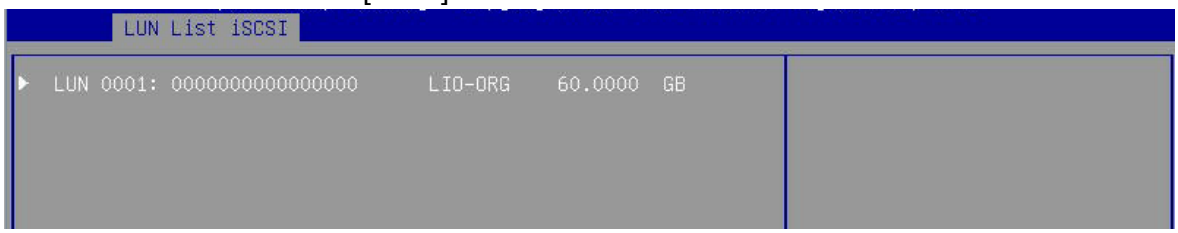


xvi. Select **Discover Target** and press [Enter] to discover iSCSI targets connected to the switch. Wait till all reachable targets are discovered.

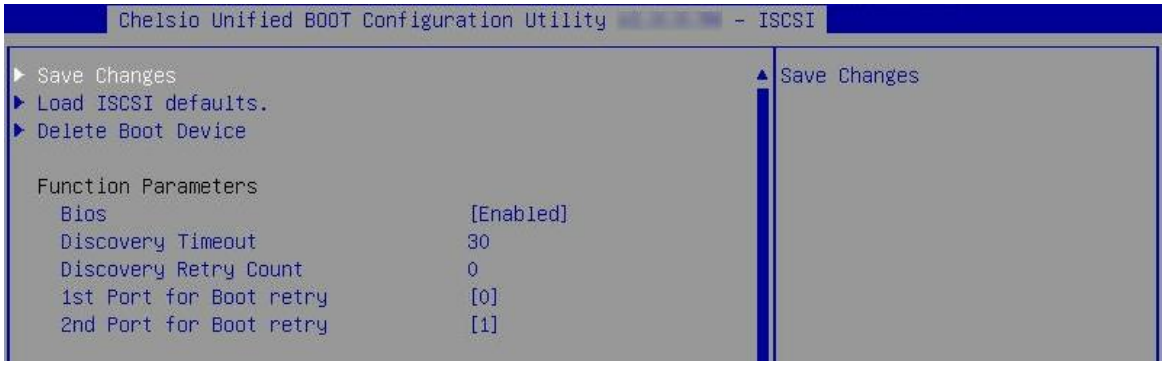


xvii. A list of available targets will be displayed. Select the target you wish to connect to and hit [Enter].

xviii. A list of LUNs configured on the selected target will be displayed. Select the LUN you wish to connect to and hit [Enter].

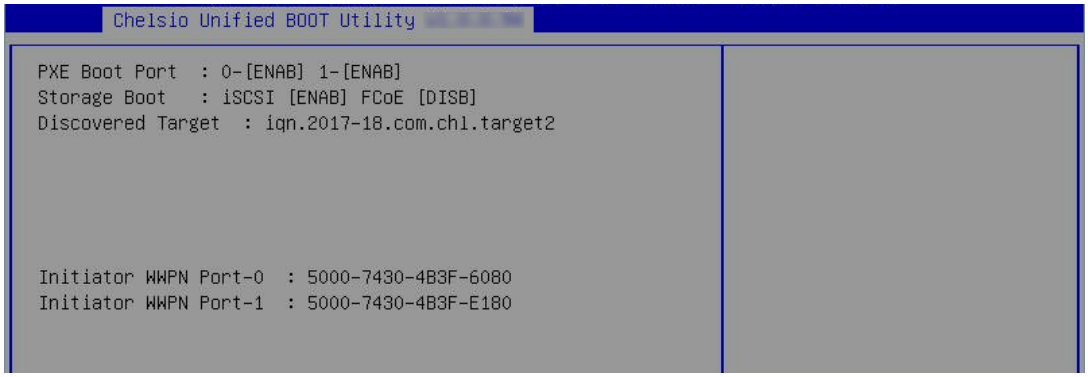


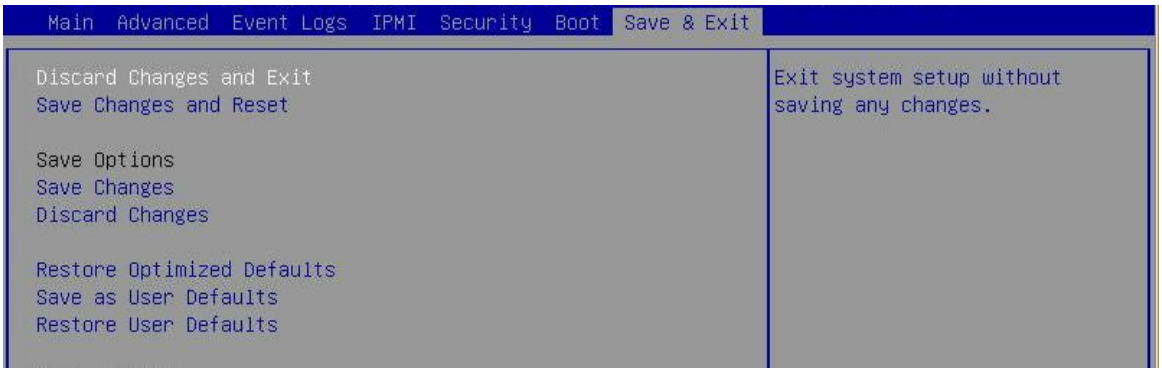
xix. Select **Save Changes** and press [Enter]



xx. Reboot the system for changes to take effect.

xxi. The discovered LUN should appear in the **Boot Configuration/ Boot Information** section and system BIOS.





xxii. Select the LUN as the first boot device and exit from BIOS.

xxiii. Either boot from the LUN or install the required OS.

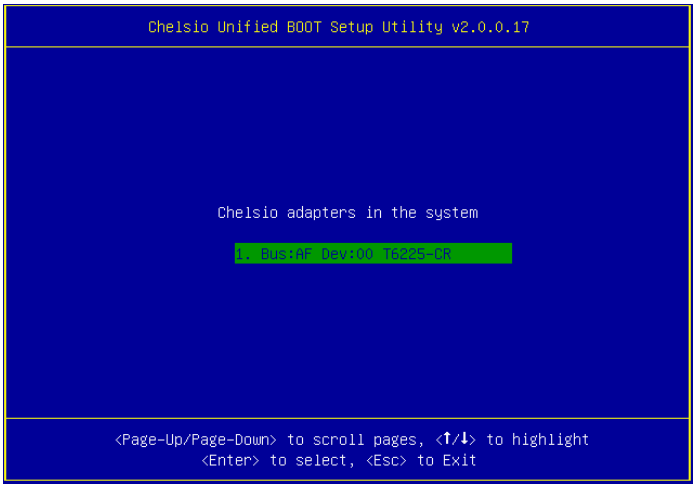
7.2.2. drvcfg

This section describes the method to configure and use Chelsio uEFI iSCSI interfaces using drvcfg.

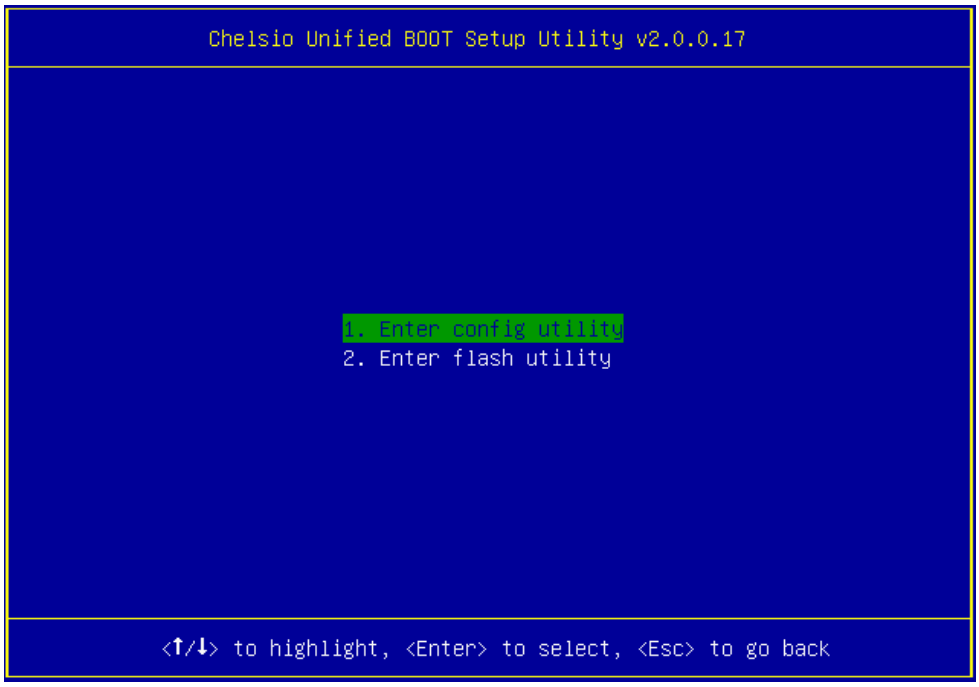
i. Boot the system into EFI shell.
ii. Run the following command to launch the configuration utility.

```
fs0:\> drvcfg -s_
```

iii. Choose the Chelsio adapter on which needs to be configured.



iv. Highlight **Enter config utility** and press [Enter].



v. Further configuration steps are similar from step (iv) of Legacy iSCSI Boot section.

II. Appendix

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).

IMPORTANT: PLEASE READ THIS SOFTWARE LICENSE CAREFULLY BEFORE DOWNLOADING OR OTHERWISE USING THE SOFTWARE OR ANY ASSOCIATED DOCUMENTATION OR OTHER MATERIALS (COLLECTIVELY, THE "SOFTWARE"). BY CLICKING ON THE "OK" OR "ACCEPT" BUTTON YOU AGREE TO BE BOUND BY THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, CLICK THE "DO NOT ACCEPT" BUTTON TO TERMINATE THE INSTALLATION PROCESS.

1. License. Chelsio Communications, Inc. ("Chelsio") hereby grants you, the Licensee, and you hereby accept, a limited, non-exclusive, non-transferable license to install and use the Software with one or more Chelsio network adapters on a single server computer for use in communicating with one or more other computers over a network. You may also make one copy of the Software in machine readable form solely for back-up purposes, provided you reproduce Chelsio's copyright notice and any proprietary legends included with the Software or as otherwise required by Chelsio.

2. Restrictions. This license granted hereunder does not constitute a sale of the Software or any copy thereof. Except as expressly permitted under this Agreement, you may not:

(i) reproduce, modify, adapt, translate, rent, lease, loan, resell, distribute, or create derivative works of or based upon, the Software or any part thereof; or

(ii) make available the Software, or any portion thereof, in any form, on the Internet. The Software contains trade secrets and, in order to protect them, you may not decompile, reverse engineer, disassemble, or otherwise reduce the Software to a human-perceivable form. You assume full responsibility for the use of the Software and agree to use the Software legally and responsibly.

3. Ownership of Software. As Licensee, you own only the media upon which the Software is recorded or fixed, but Chelsio retains all right, title and interest in and to the Software and all subsequent copies of the Software, regardless of the form or media in or on which the Software may be embedded.

4. Confidentiality. You agree to maintain the Software in confidence and not to disclose the Software, or any information or materials related thereto, to any third party without the express written consent of Chelsio. You further agree to take all reasonable precautions to limit access of the Software only to those of your employees who reasonably require such access to perform their employment obligations and who are bound by confidentiality agreements with you.

5. Term. This license is effective in perpetuity, unless terminated earlier. You may terminate the license at any time by destroying the Software (including the related documentation), together with all copies or modifications in any form. Chelsio may terminate this license, and this license shall be deemed to have automatically terminated, if you fail to comply with any term or condition of this Agreement. Upon any termination, including termination by you, you must destroy the Software (including the related documentation), together with all copies or modifications in any form.

6. Limited Warranty. If Chelsio furnishes the Software to you on media, Chelsio warrants only that the media upon which the Software is furnished will be free from

defects in material or workmanship under normal use and service for a period of thirty (30) days from the date of delivery to you.

CHELSIO DOES NOT AND CANNOT WARRANT THE PERFORMANCE OR RESULTS YOU MAY OBTAIN BY USING THE SOFTWARE OR ANY PART THEREOF. EXCEPT FOR THE FOREGOING LIMITED WARRANTY, CHELSIO MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, AND HEREBY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING, BUT NOT LIMITED TO, NON-INFRINGEMENT OF THIRD PARTY RIGHTS, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow the exclusion of implied warranties or limitations on how long an implied warranty may last, so the above limitations may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

7. Remedy for Breach of Warranty. The sole and exclusive liability of Chelsio and its distributors, and your sole and exclusive remedy, for a breach of the above warranty, shall be the replacement of any media furnished by Chelsio not meeting the above limited warranty and which is returned to Chelsio. If Chelsio or its distributor is unable to deliver replacement media which is free from defects in materials or workmanship, you may terminate this Agreement by returning the Software.

8. Limitation of Liability. IN NO EVENT SHALL CHELSIO HAVE ANY LIABILITY TO YOU OR ANY THIRD PARTY FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, HOWEVER CAUSED, AND ON ANY THEORY OF LIABILITY, ARISING OUT OF OR RELATED TO THE LICENSE OR USE OF THE SOFTWARE, INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR LOSS OF ANTICIPATED PROFITS, EVEN IF CHELSIO HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL CHELSIO'S LIABILITY ARISING OUT OF OR RELATED TO THE LICENSE OR USE OF THE SOFTWARE EXCEED THE AMOUNTS PAID BY YOU FOR THE LICENSE GRANTED HEREUNDER. THESE LIMITATIONS SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.

9. High Risk Activities. The Software is not fault-tolerant and is not designed, manufactured or intended for use or resale as online equipment control equipment in hazardous environments requiring fail-safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines, or weapons systems, in which the failure of the Software could lead directly to death, personal injury, or severe physical or environmental damage. Chelsio specifically disclaims any express or implied warranty of fitness for any high risk uses listed above.

10. Export. You acknowledge that the Software is of U.S. origin and subject to U.S. export jurisdiction. You acknowledge that the laws and regulations of the United States and other countries may restrict the export and re-export of the Software. You agree that you will not export or re-export the Software or documentation in any form in violation of applicable United States and foreign law. You agree to comply with all applicable international and national laws that apply to the Software, including the U.S.

Export Administration Regulations, as well as end-user, end-use, and destination restrictions issued by U.S. and other governments.

11. Government Restricted Rights. The Software is subject to restricted rights as follows. If the Software is acquired under the terms of a GSA contract: use, reproduction or disclosure is subject to the restrictions set forth in the applicable ADP Schedule contract. If the Software is acquired under the terms of a DoD or civilian agency contract, use, duplication or disclosure by the Government is subject to the restrictions of this Agreement in accordance with 48 C.F.R. 12.212 of the

Federal Acquisition Regulations and its successors and 49 C.F.R. 227.7202-1 of the DoD FAR Supplement and its successors.

12. General. You acknowledge that you have read this Agreement, understand it, and that by using the Software you agree to be bound by its terms and conditions. You further agree that it is the complete and exclusive statement of the agreement between Chelsio and you, and supersedes any proposal or prior agreement, oral or written, and any other communication between Chelsio and you relating to the subject matter of this Agreement. No additional or any different terms will be enforceable against Chelsio unless Chelsio gives its express consent, including an express waiver of the terms of this Agreement, in writing signed by an officer of Chelsio. This Agreement shall be governed by California law, except as to copyright matters, which are covered by Federal law. You hereby irrevocably submit to the personal jurisdiction of, and irrevocably waive objection to the laying of venue (including a waiver of any argument of forum non conveniens or other principles of like effect) in, the state and federal courts located in Santa Clara County, California, for the purposes of any litigation undertaken in connection with this Agreement. Should any provision of this Agreement be declared unenforceable in any jurisdiction, then such provision shall be deemed severable from this Agreement and shall not affect the remainder hereof. All rights in the Software not specifically granted in this Agreement are reserved by Chelsio. You may not assign or transfer this Agreement (by merger, operation of law or in any other manner) without the prior written consent of Chelsio and any attempt to do so without such consent shall be void and shall constitute a material breach of this Agreement.

Should you have any questions concerning this Agreement, you may contact Chelsio by writing to:

Chelsio Communications, Inc.
209 North Fair Oaks Avenue,
Sunnyvale, CA 94085
U.S.A