

PXE Boot User Guide For use with Chelsio T3 Based Hardware

PXE Boot Release Version 1.0

Chelsio Communications, Inc. www.chelsio.com

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1 INTRODUCTION

Thank you for choosing Chelsio Communications as the provider of your T3 based Ethernet adapter solution. This document describes the installation, use, and maintenance of the PXE boot solution designed for these adapters.

PXE is short for Preboot eXecution Environment and is used for booting computers over an Ethernet network using a network interface adapter including Chelsio's T3 based Network Interface Cards (NICs).

The Chelsio solution is a combination of hardware and software. The hardware consists of one of the wide range of Chelsio's T3 based NICs including various versions of the S302, S310, S320, S320e-CR, N302, N310, and the IBM & HP Mezzanine cards. These include 1g and 10G solutions, NIC only or TOE / iSCSI / iWARP solutions, PCI Express or PCI-X, and one or two port solutions.

The software consists of a PXE based BIOS option ROM client and the operating system (OS) device driver. There is also a utility that can be used in the installation and maintenance of the option ROM client and related components.

In combination, the solution is used to boot an OS from a remote PXE server over a network using the protocols in the PXE specifications. The BIOS option ROM resides on the flash memory of the T3 based NIC where it's accessed for use in the pre-boot environment as a PXE client. The client is used to connect to the PXE server where the remote storage resides which contains the booting OS.

Before booting an OS from a PXE server the OS must be installed. In most cases this can be accomplished using PXE. This document briefly describes this topic for both Windows and Linux.

The Chelsio PXE option ROM binaries are not limited for use with Windows and Linux but can be used for other operating systems including Solaris, FreeBSD, and Apple OS-X. This user guide however is limited to instructions for use with Windows and Linux. Please refer to the documentation that is available for these other operating systems for guidance and instructions.

FEATURES

Chelsio's PXE boot option ROM solution includes the following features:

Expanded T3 NIC Support

- TOE Adapters S Series (S310, S320, S320e-CR S302, IBM & HP Mezzanine cards)
- NIC (non-TOE) Adapters N Series (N302, N310, N320, N320-Gen2)

Compliances

- PXE version 2.1
- BIOS Boot Specification (BBS)
- POST Memory Management (PMM) specification

Flash Utilities

- Burns PXE option ROM binaries to Chelsio adapters
- Utility available for Windows, Linux, and DOS
- Also burns adapter firmware if necessary

HARDWARE REQUIREMENTS

The hardware requirements needed to use this solution are as follows:

- Chelsio T3 based Adapter This includes various versions of the S302, S310, S320, S320e-CR, S320-LP-CR, T3C10, N302, N310, N320, and the IBM & HP Mezzanine, N320E-Gen2 cards.
- A system with x86 or x64 based processors
- A system BIOS compliant with both the BIOS Boot Specification (BBS) and POST Memory Management (PMM). A vast majority of systems shipped today are compliant with these.

PXE BOOT PROCESS

PXE Boot involves 3 steps.

- 1. **DHCP** The option ROM based PXE code contacts a DHCP server for its IP address and TFTP settings. The DHCP server requires that the PXE options are enabled.
- 2. **Download of OS Bootloader via TFTP** The bootloader / bootstrap code is downloaded from the TFTP server specified in the DHCP server's response.
- 3. Boot of OS The bootloader interacts with the user to start an OS installer or boot to an OS.

Configuration of the DHCP and TFTP services are essential for the PXE boot process to succeed.

PACKAGE CONTENTS

The software supplied is in a .zip file. In it are the following:

- a. PXE option ROM based software binaries (pbootxx.rom file)
- b. DOS based Chelsio Flash Utility (cfu.exe ver 1.6)
- c. This document (PXE_userguide.pdf)
- d. The errata (errata.txt)
- e. Chelsio End User License Agreement (EULA.txt)

ABOUT THE EULA

Use of the option ROM PXE software implies acceptance of the terms in the Chelsio EULA.

2 FLASHING THE CHELSIO ADAPTER

The option ROM and firmware software binaries both must be on the T3 based Chelsio adapter before PXE boot can be used. These binaries are shipped pre-installed on the adapter but in case either need an upgrade this chapter describes the procedure. Please read both sections about choosing the correct binaries for flashing.

There are currently 3 ways of flashing the option ROM and/or the firmware binaries to the adapter:

- 1. From Windows
- 2. From Linux
- 3. From DOS

This list will expand for other operating systems as more drivers become available that incorporate flash utilities. If a driver for an OS being used is not Windows or Linux then it is recommended that the DOS utility be used.

The flash tools for each of the above three are described in detail further below.

Remember that for a particular adapter, it may not be necessary at all to flash either of the software binaries (option ROM or firmware). The sections below on choosing the correct versions will help determine if it's needed and if so, which version to use.

Choosing the PXE Option ROM Version

There are four option ROM files in the PXE software package but only one of the four is to be flashed onto a particular adapter model. The following table describes the file to be used during the flash process:

Chelsio Adapter Model	# of Ports	Link Speed	Option ROM Filename	PCI Dev ID
N310 & S310	1	10 GigE	Pboot30.rom	30h
(except the XFP+ version				
of the N310)				
N320, S320, S320E-SR+,	2	10 GigE	Pboot31.rom	31h
S320E-BT				
N302 & S302	2	1 GigE	Pboot32.rom	32h
N310	1	10 GigE	Pboot35.rom	35h
XFP+ version				
S320E-CR	2	10 GigE	Pboot36.rom	36h
(S320E-LP-CR)				
N320E-Gen2	2	10 GigE	Pboot37.rom	37h

If the wrong file is flashed to an adapter no harm is done. Simply re-flash the card with the correct file. Attempting to use PXE boot with a mis-matched option ROM file on the card will result in the option ROM not appearing in the BIOS.

Choosing the Firmware Version

The firmware version needed by the device driver for proper operation is dependent on the OS and the driver version used. Fortunately, for all device drivers that Chelsio supports there is a mechanism in place that automatically updates the firmware on the adapter if it doesn't match the required version needed by the driver. However, when PXE network booting is used there can be an issue for Linux users. There is a straight forward solution for this class of users.

Non-Linux Users: For non-Linux users, including Windows, Solaris, FreeBSD, and Apple OS-X, there are no firmware concerns. There is no need to manually update/flash the adapter to update the firmware.

Linux Users: For Linux users, the automatic mechanism that updates the firmware on the adapter from the device driver works well when booting from a local drive – but not when PXE network booting. For this reason the user must manually update/flash the adapter's firmware (if it's needed) to ensure it correctly matches what the driver needs. To do that one of the flash utility can be used to update the firmware. Once updated, the firmware on the adapter does not need to change.

Note that if a different non-Linux OS is booted that requires a different version of the firmware, that device driver will automatically update/flash the adapter with the new version. Then later if Linux is PXE network booted and the firmware required is mismatched, the boot will not succeed. In that case the firmware of the adapter will have to be updated again through one of the flash utilities.

Below are a set of tables that relates the firmware version requirement for each of the 21 supported Linux device drivers. There are 8 different versions of firmware that cover these.

Drivers with Commercial Distributions			
Operating System	Firmware Version Required		
RHEL 5 U1	4.0.0		
RHEL 5 U2	5.1.0		
RHEL 5 U3	7.0.0		
RHEL 5 U4	7.0.0		
Fedora Core 8	4.3.0		
SLES 10 SP2	5.0.0		
Open SuSE 11	5.0.0		

A common set of drivers come from Red Hat and Novell:

If the driver used for the T3 based Chelsio adapter is different from the above distribution versions then the driver may have been obtained either from the Chelsio download page or kernel.org. The following shows firmware for drivers from the Chelsio site:

Chelsio Downloadable Drivers			
Driver Name	Firmware Version Required		
Cxgb3toe-1.3.1.9	7.7.0		
cxgb3toe-1.1.022	6.1.0		
cxgb3toe-1.0.146	6.0.0		
cxgb3toe-1.0.142	6.0.0		
cxgb3toe-1.0.138b	5.0.0		
cxgb3toe-1.0.138a	5.0.0		
cxgb3toe-1.0.138	5.0.0		
cxgb3toe-1.0.133	5.0.0		
cxgb3toe-1.0.129a	5.0.0		
cxgb3toe-1.0.113	4.7.0		

The following shows firmware for drivers from kernel.org:

kernel.org Drivers

Release Version 1.0

Operating System	Firmware Version Required
2.6.27	7.0.0
2.6.26	6.0.0
2.6.25	5.0.0
2.6.24	4.6.0
2.6.23	4.3.0
2.6.22	4.0.0
2.6.21	3.3.0

Once the firmware version needed is determined from the above tables then one of the flash utilities can be used to update the adapter. That process is described in more detail further down in this user's guide.

To find the proper firmware file go to the Chelsio website, at www.chelsio.com and navigate to the Downloads section.

Flash Tool Parameters

The following parameter descriptions apply to the syntax in the flash tools described below for Windows, Linux, and DOS.

- <Adapter Number> 0 (zero) for the first Chelsio adapter in the system, 1 (one) for the second, 2 (two) for the third, etc. For the DOS flash tool only this parameter can be all which will affect all Chelsio T3 based adapters of the same type in the system.
- <Interface> (Linux only) What Linux assigns to the adapter such as eth0. If it's a two port adapter, use the first interface.
- **<Option ROM Image>** The option ROM image file that comes in the PXE download package. Use the PXE option ROM guide above for determining the correct file.
- **<FW Image>** The firmware image file that can be downloaded from the Chelsio download site. Use the firmware guide above for determining the correct file.

FLASH FROM WINDOWS

The Windows driver package has a utility called cxgen_tool.exe that can be used to flash both the PXE option ROM and firmware binary images to the adapter. To proceed, install the card in the Windows system and install the Chelsio drivers for the adapter. The Windows drivers can be downloaded from Chelsio's website at www.chelsio.com in the Downloads section.

Flashing the Option ROM

The command to flash the option ROM is:

```
> cxgen tool.exe -d <Adapter Number> -p <Option ROM Image>
```

Flashing the Firmware

In the Windows driver, the firmware is automatically updated on boot. If the adapter is intended to be transferred to a Linux (or other OS) based machine and Windows is used only to flash the adapter then the firmware can also be flashed with the same cxgen_tool utility. The command to flash the firmware is:

```
> cxgen tool.exe -d <Adapter Number> -p <FW Image>
```

FLASH FROM LINUX

The Linux driver package has a utility called cxgbtool that can be used to flash both the PXE option ROM and firmware binary images to the adapter. To proceed, install the card in the Linux system and install the Chelsio drivers for the adapter. The Linux drivers can be downloaded from Chelsio's website at www.chelsio.com in the Downloads section.

Flashing the Option ROM

The command to flash the option ROM is:

```
> cxgbtool <Interface> loadboot <Option ROM Image>
```

Flashing the Firmware

The firmware can be flashed with the same cxgbtool utility. The command is:

```
> cxgbtool <Interface> loadfw <FW Image>
```

FLASH FROM DOS

The Flash utility (cfu.exe) in the PXE download package can be used to flash both the PXE option ROM and the firmware to the adapter. The utility can only be used from a DOS prompt on a bootable DOS floppy disk and not from a Windows DOS command box.

Creating a Bootable DOS Diskette

A bootable floppy DOS diskette can be made from within the Windows OS or from within Linux by use of a free downloadable utility such as FreeDOS.

- Windows If you have a Windows system you can create a DOS bootable floppy. Right-click on the floppy drive in "My Computer" and select "Format". Now choose to create a DOS bootable disk.
- Linux For Linux users, a free open source DOS distribution is available from www.freedos.org. There are 2 options to obtain a DOS bootable OS. You can download the LiveCD ISO image, and burn it to a CDROM. A link for a floppy diskette image is also provided. The floppy diskette image can be written to a floppy with the 'dd' program with the following command:

```
> dd if=<floppy.img> of=/dev/fd0
```

/dev/fd0 is normally the first floppy drive in a Linux system but this may vary by system.

Note: Chelsio is not responsible for any consequences of downloading or using utilities that are available on the Internet, such as FreeDOS.

Copy the appropriate option ROM image file and the cfu.exe utility file to the floppy diskette. Also copy the appropriate firmware file to the floppy if needed. Then boot the system with the adapter using the bootable DOS diskette.

Flashing the Option ROM

The command to flash the option ROM is:

```
> cfu.exe -u <Option ROM Image> -d <Adapter Number>
```

The command to flash the option ROM for all cards of the same type in the system is:

```
> cfu.exe -u <Option ROM Image> -d all
```

Flashing the Firmware

The firmware can be flashed with the same cfu.exe utility. The command is:

```
> cfu.exe -f <FW Image> -d <Adapter Number>
```

The command to flash the firmware for all cards in the system is:

```
> cfu.exe -f <FW Image> -d all
```

3 OS SPECIFIC NOTES

The previous chapter describes the installation/upgrade instructions of the software binaries on the Chelsio adapter cards. This chapter briefly describes OS specific topics and PXE servers.

PXE SERVERS

Chelsio does not provide PXE servers but there are various ones on the market that are readily available. Popular open source servers are available such as RedHat's KickStart. There are also excellent servers available for purchase on the market. Whatever the choice, the requirement is that the server be compliant to the PXE standards per the requirements of the Chelsio solution.

MICROSOFT WINDOWS SERVER 2003 / 2008

For Windows, PXE is used for installations, not boot. For this purpose, Microsoft provides two mechanisms.

- **RIS Remote Installation Service**. This is an older installation method for Windows Server 2003 Service Pack 1 or earlier.
- WDS Windows Deployment Service. This is newer used on Windows Server 2003 or newer and on Windows Server 2008 and Vista.

Please use the documentation provided by Microsoft for instructions on the use of RIS and WDS.

Additional Tips

Follow these additional tips when using these services with Chelsio's solution. When installing, use the WHQL certified cxgn3 v1.1.3.3 or later driver for the Chelsio adapters, available on the download page at www.chelsio.com for the installation of Windows 2003 / 2008. For WDS deployments of Windows 2008 / Vista, please use the tools provided by Microsoft to copy the driver to the Boot Image used in the WDS setup.

Once the RIS / WDS installation is complete, DO NOT continue to use the cxgn3 driver. Please upgrade to the regular drivers provided for the adapter. The regular drivers are also available on the Chelsio website.

LINUX & OTHER OPERATING SYSTEMS

PXE booting or installing for Linux or other operating systems is relatively straight forward. However, the specifics are beyond the scope of this document. There are plentiful guides on the internet as well as documentation provided by the PXE server providers.

4 CUSTOMER SUPPORT

Please check the ERRATA file that is included in the distribution before contacting support as the answer to some questions can be found there. To contact Chelsio support for any issues regarding this product, email us at support@chelsio.com. Also check our website at www.chelsio.com for additional information.

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