



Chelsio Network Driver for macOS

Installation and User's Guide



This document and related products are distributed under licenses restricting their use, copying, distribution, and reverse-engineering.

No part of this document may be reproduced in any form or by any means without prior written permission by Chelsio Communications.

All third-party trademarks are copyright of their respective owners.

THIS DOCUMENTATION IS PROVIDED “AS IS” AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

THE USE OF THE SOFTWARE AND ANY ASSOCIATED MATERIALS (COLLECTIVELY THE “SOFTWARE”) IS SUBJECT TO THE SOFTWARE LICENSE TERMS OF CHELSIO COMMUNICATIONS, INC.



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

Copyright © 2018.Chelsio Communications. All Rights Reserved.

Chelsio® is a registered trademark of Chelsio Communications.

All other marks and names mentioned herein may be trademarks of their respective companies.

Document History

Version	Revision Date
1.0.0	10/26/2012
1.0.1	07/03/2013
1.0.2	04/03/2014
1.0.3	04/04/2014
1.0.4	04/23/2014
1.0.5	03/18/2016
1.0.6	11/02/2016
1.0.7	05/05/2017
1.0.8	06/08/2017
1.0.9	10/25/2017
1.1.0	12/29/2017

TABLE OF CONTENTS

1. Introduction	5
1.1. Features	5
1.2. Hardware Requirements	5
1.3. Software Requirements	7
1.4. Package Contents	7
2. Hardware Installation	8
3. Software/Driver Installation	11
3.1. GUI	11
3.2. CLI	15
4. Software/Driver Loading	16
5. Software/Driver Configuration and Fine-tuning	17
5.1. Important Configurable Parameters	17
5.2. Kernel Tuning	19
5.3. Network Device Configuration	19
5.4. cxgbtool	19
5.5. Firmware Update	20
6. Software/Driver Unloading	21
7. Software/Driver Uninstallation	22
8. Software/Driver Update	23
9. Appendix	24
9.1. Chelsio End-User License Agreement (EULA)	24

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 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 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 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 Terminator adapters bring a new level of performance metrics and functional capabilities to the computer networking industry.

1.1. Features

Chelsio's installer package installs T6, T5, T4 and T3 network drivers for macOS operating system. The network driver provides support for PCI Express Ethernet adapters based on the Chelsio Terminator (T6, T5, T4 and T3) ASIC.

The driver also supports Jumbo Frames, Transmit/Receive checksum offload, TCP segmentation offload (TSO/LSO), MSI Interrupts, Gatekeeper and Large Receive Offload (LRO).

The installer package contains T6/T5/T4/T3 kernel extension installation feature, please refer section [Software/Driver Installation](#) for details.

1.2. Hardware Requirements

1.2.1. Supported Adapters

The following are the currently shipping Chelsio adapters that are compatible with Chelsio macOS Network driver:

- **T6 Adapters**
 - T6225-CR
 - T6225-LL-CR
 - T6225-SO-CR

- T62100-CR
- T62100-LP-CR
- T62100-SO-CR

- **T5 Adapters**

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

- **T4 Adapters**

- T420-CR
- T440-CR
- T404-BT
- T422-CR
- T420-SO-CR
- T420-LL-CR
- T440-LP-CR
- T420-CX

- **T3 Adapters**

- N310E
- N310E-CXA
- N320E-GEN2
- S310E-SR
- S310E-SR+
- S310E-CXA
- S310E-CR
- N320E-CXA*
- S320E-CR*
- S320E-LP-CR*
- S302E*
- S320E-CXA*

*Only port 0 (first port) supported.

 **Note** *Spider cables not supported.*

1.3. Software Requirements

The Chelsio network driver has been developed to run on Intel based platforms in NIC mode. Currently the driver is available for following version(s):

- macOS 10.13 (High Sierra 64-bit)
- macOS 10.12.x (Sierra 64-bit)
- Macintosh OS X 10.11.x (El Capitan 64-bit)

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

1.4. Package Contents

The Chelsio network driver package for macOS consists of the following:

- **cxgtool.rtf**: *cxgbtool* help file
- **cxgb.pkg**: driver package
- **firmware**: firmware binary files

2. Hardware Installation

Follow these steps to install Chelsio adapter in your system:

- 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 according to 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.
- 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. Verify if the adapter was installed successfully by using the *system_profiler* command. You should see a similar output:
 - a. For T6 adapters

```
ethernet:

    Type: Ethernet Controller
    Bus: PCI
    Slot: Slot-1
    Vendor ID: 0x1425
    Device ID: 0x6002
    Subsystem Vendor ID: 0x1425
    Subsystem ID: 0x0000
    Revision ID: 0x0000
    Link Width: x8
    BSD name: cxgb7
    Kext name: cxgb.kext
    Location: /Library/Extensions/cxgb.kext
    Version: 1.16.43b2
```


b. For T5 adapters

```
ethernet:

Type: Ethernet Controller
Bus: PCI
Slot: Slot-1
Vendor ID: 0x1425
Device ID: 0x5001
Subsystem Vendor ID: 0x1425
Subsystem ID: 0x0000
Revision ID: 0x0000
Link Width: x8
BSD name: cxgb15
Kext name: cxgb.kext
Location: /Library/Extensions/cxgb.kext
Version: 1.16.43b2
```

c. For T4 adapters

```
ethernet:

Type: Ethernet Controller
Bus: PCI
Slot: Slot-1
Vendor ID: 0x1425
Device ID: 0x4003
Subsystem Vendor ID: 0x1425
Subsystem ID: 0x0000
Revision ID: 0x0000
Link Width: x8
BSD name: cxgb17
Kext name: cxgb.kext
Location: /Library/Extensions/cxgb.kext
Version: 1.16.43b2
```

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

- For T6 adapters:

```
cxgb: isMaster is true for PF0
cxgb:could not parse the configuration file on Master PF 0
cxgb[5:0]: legacy intr index = 0, MSI vectors reported = 1
cxgb: IOInterruptEventSource check passed
cxgb: Chelsio T6225-S0 rev 0 1000/10GBASE-SFP NIC PCIe 2.5 GT/s x8 MSI
cxgb:Chelsio T6225-S0 rev 0
cxgb:S/N: PT51160276, P/N: 11012146002
cxgb:Firmware version: 1.16.43.0
cxgb:Bootstrap version: 255.255.255.255
cxgb:TP Microcode version: 0.1.23.2
cxgb:No Expansion ROM loaded
cxgb:Serial Configuration version: 0x2001000
cxgb:VPD version: 0x53
cxgb[5:1]: legacy intr index = 0, MSI vectors reported = 1
cxgb7: attached with 5 suspended link-layer multicast membership(s)
cxgb: IOInterruptEventSource check passed
cxgb8: attached with 5 suspended link-layer multicast membership(s)
cxgb7: successfully restored 0 suspended link-layer multicast membership(s) (er
cxgb7: passive DA port module inserted
cxgb8: passive DA port module inserted
in6_unlink_ifa: IPv6 address 0xfa78d50d6605628b has no prefix
in6_unlink_ifa: IPv6 address 0xfa78d50d660563db has no prefix
cxgb7: link up, 10Gbps, full-duplex, Tx/Rx PAUSE
cxgb8: link up, 10Gbps, full-duplex, Tx/Rx PAUSE
```

- For T5 adapters:

```
cxgb: isMaster is true for PF0
cxgb[5:0]: legacy intr index = 0, MSI vectors reported = 1
cxgb: IOInterruptEventSource check passed
cxgb: Chelsio T520-CR rev 0 1000/10GBASE-SFP NIC PCIe 2.5 GT/s x8 MSI
cxgb:Chelsio T520-CR rev 0
cxgb:S/N: PT40131094, P/N: 110116050D0
cxgb:Firmware version: 1.16.43.0
cxgb:Bootstrap version: 1.1.0.0
cxgb:TP Microcode version: 0.1.4.9
cxgb:No Expansion ROM loaded
cxgb:Serial Configuration version: 0x1009000
cxgb:VPD version: 0x2
cxgb[5:1]: legacy intr index = 0, MSI vectors reported = 1
cxgb15: attached with 4 suspended link-layer multicast membership(s)
cxgb: IOInterruptEventSource check passed
cxgb16: attached with 4 suspended link-layer multicast membership(s)
cxgb15: passive DA port module inserted
cxgb16: passive DA port module inserted
in6_unlink_ifa: IPv6 address 0x4594aba2f4de0277 has no prefix
in6_unlink_ifa: IPv6 address 0x4594aba2f4de03c7 has no prefix
cxgb15: link up, 10Gbps, full-duplex, Tx/Rx PAUSE
cxgb16: link up, 10Gbps, full-duplex, Tx/Rx PAUSE
```

- For T4 adapters:

```
cxgb: isMaster is true for PF0
cxgb:could not parse the configuration file on Master PF 0
cxgb[5:0]: legacy intr index = 0, MSI vectors reported = 1
cxgb: IOInterruptEventSource check passed
cxgb: Chelsio T440-CR rev 2 1000/10GBASE-SFP NIC PCIe 5.0 GT/s x8 MSI
cxgb:Chelsio T440-CR rev 2
cxgb:S/N: PT27111183, P/N: 110112140D0
cxgb:Firmware version: 1.16.43.0
cxgb:Bootstrap version: 255.255.255.255
cxgb:TP Microcode version: 0.1.9.4
cxgb:No Expansion ROM loaded
cxgb:Serial Configuration version: 0x7071102
cxgb:VPD version: 0x1
cxgb[5:3]: legacy intr index = 0, MSI vectors reported = 1
cxgb[5:1]: legacy intr index = 0, MSI vectors reported = 1
cxgb[5:2]: legacy intr index = 0, MSI vectors reported = 1
cxgb17: attached with 4 suspended link-layer multicast membership(s)
cxgb: IOInterruptEventSource check passed
cxgb: IOInterruptEventSource check passed
cxgb: IOInterruptEventSource check passed
```

The above outputs indicate the hardware configuration and serial number of the adapter. As observed by the x8, the card is properly installed in an x8 slot on the machine and the card is using MSI 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 network interface. However, for T5 40G adapters, the association of physical Ethernet ports and their corresponding network device names is opposite. For these adapters, the port nearest to the motherboard will appear as the first network interface.

3. Software/Driver Installation

3.1. GUI

The driver must be installed by the administrator. Any attempt in installing the driver as a regular user will fail.

- i. If you haven't done already, download the installer package (*dmg file*) from [Chelsio Download Center](#).
- ii. Mount the disk image *cxgb-x.y.z.dmg* file by double-clicking on it. The disk image should mount as a new device and place you in the base directory of the *cxgb* device. If the disk image is downloaded using Safari browser, it will mount automatically.
- iii. Locate the *cxgb.pkg* installer package inside the mounted device and double-click on it to start the installer.
- iv. A Welcome screen will be displayed. Click "Continue" to proceed.

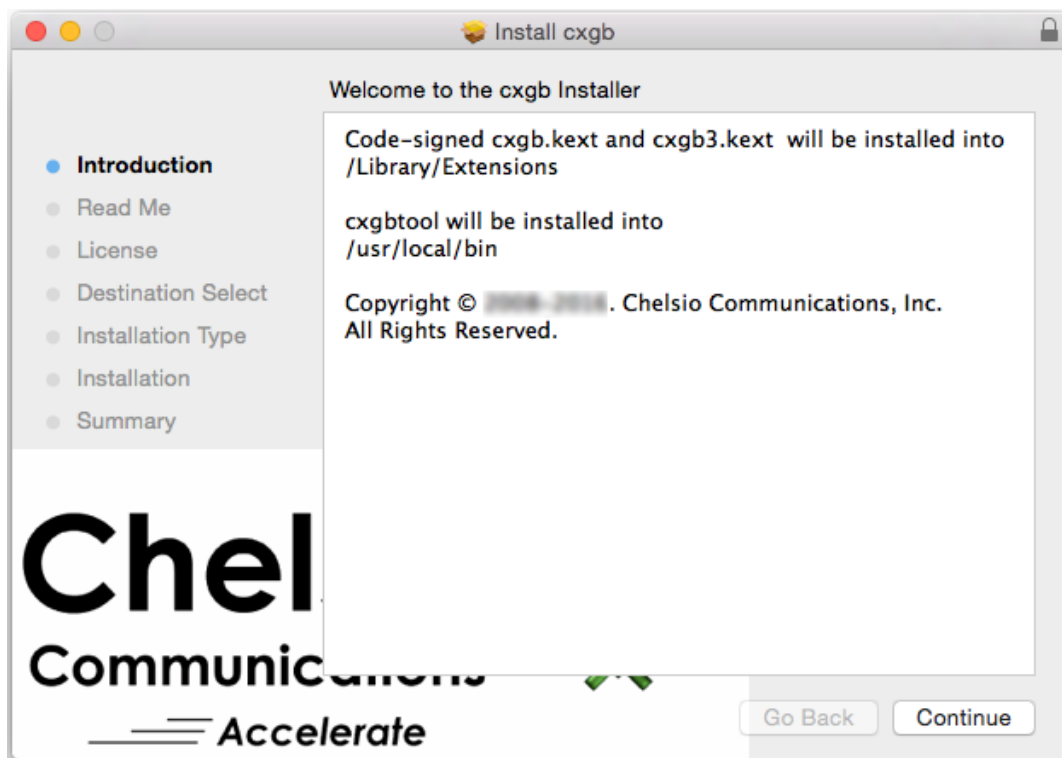


Figure 1 - Installer welcome window

- v. The next screen displays important information regarding the drivers for Chelsio adapters. Please read carefully and click “Continue” to proceed.



Figure 2 - Readme window

- vi. Click “Continue” and then click “Read License” to read Chelsio’s End User License Agreement or “Agree” to proceed.

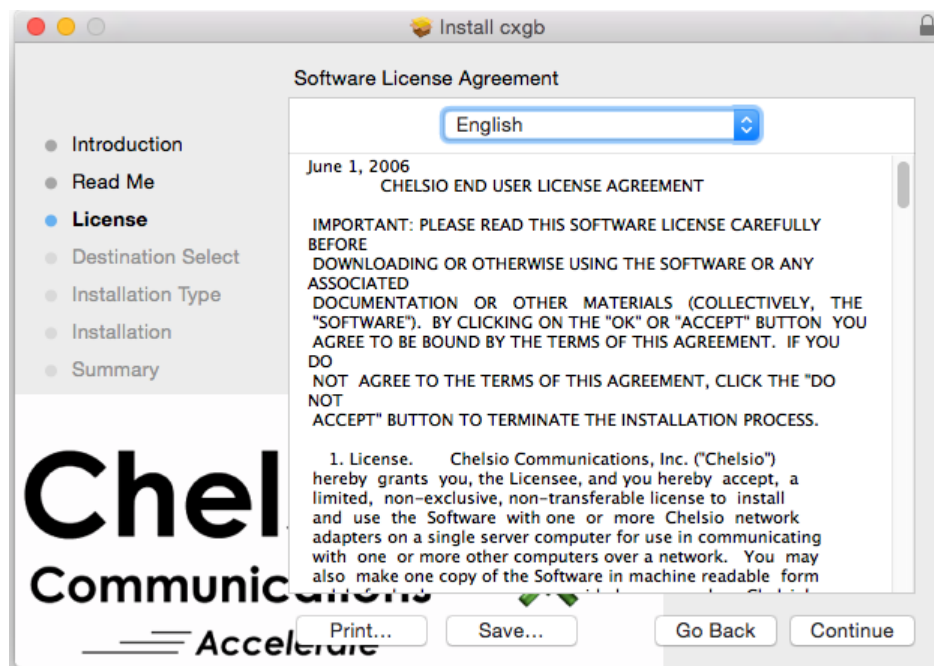


Figure 3 - Chelsio EULA window

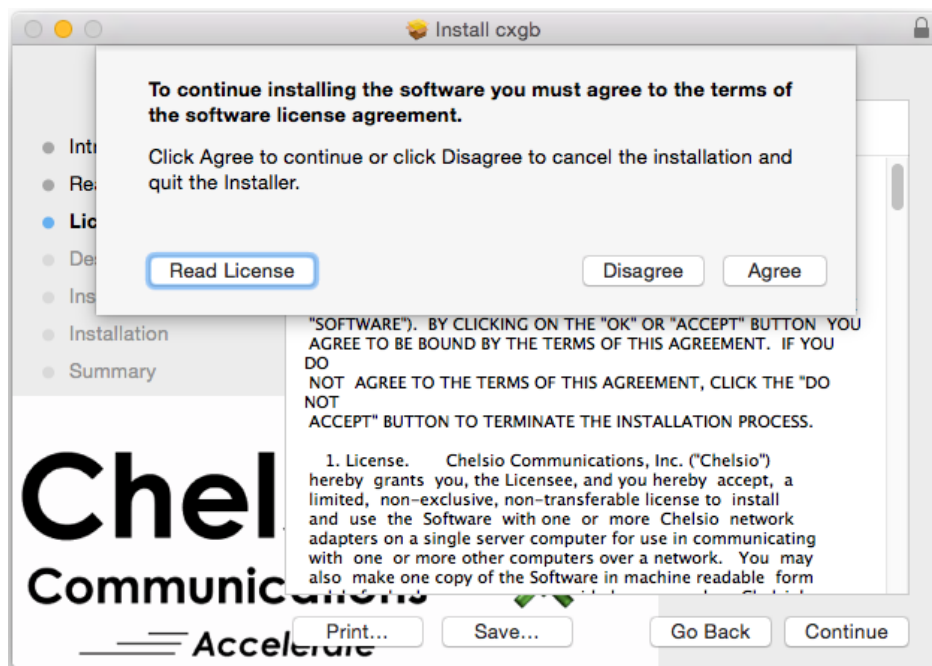


Figure 4 - EULA acceptance prompt

- vii. Now, either click “Install” to proceed with complete package installation or “Customize” to select the components to be installed.

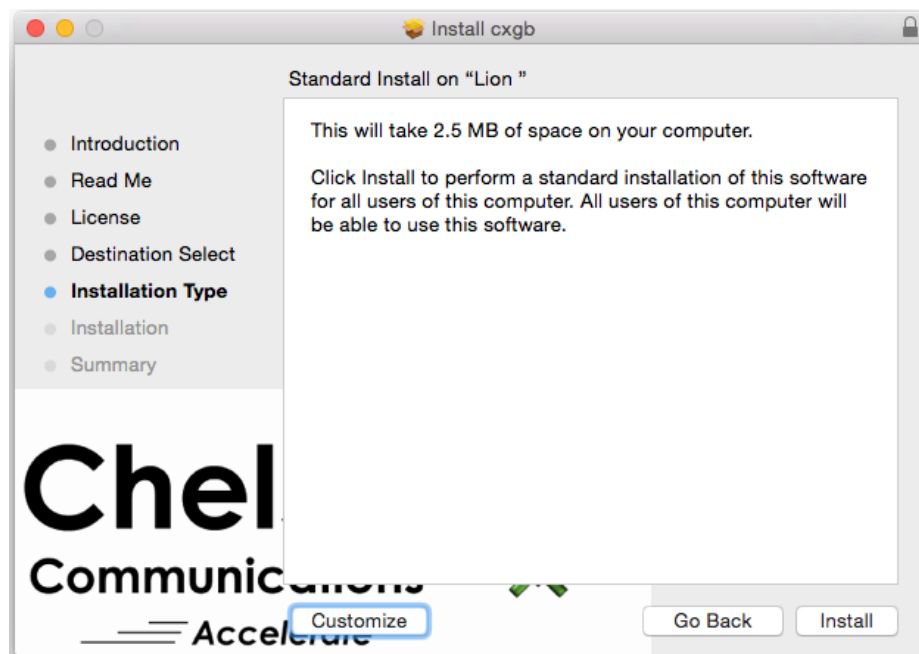


Figure 5 - Customize installation

Note In custom installation, user can choose between *cxgb* (T6/T5/T4 kernel extension), *cxgb3* (T3 kernel extension) or *cxgbtool* (command line utility). In standard installation, all three components will be selected & installed.

viii. The selected components will now be installed.

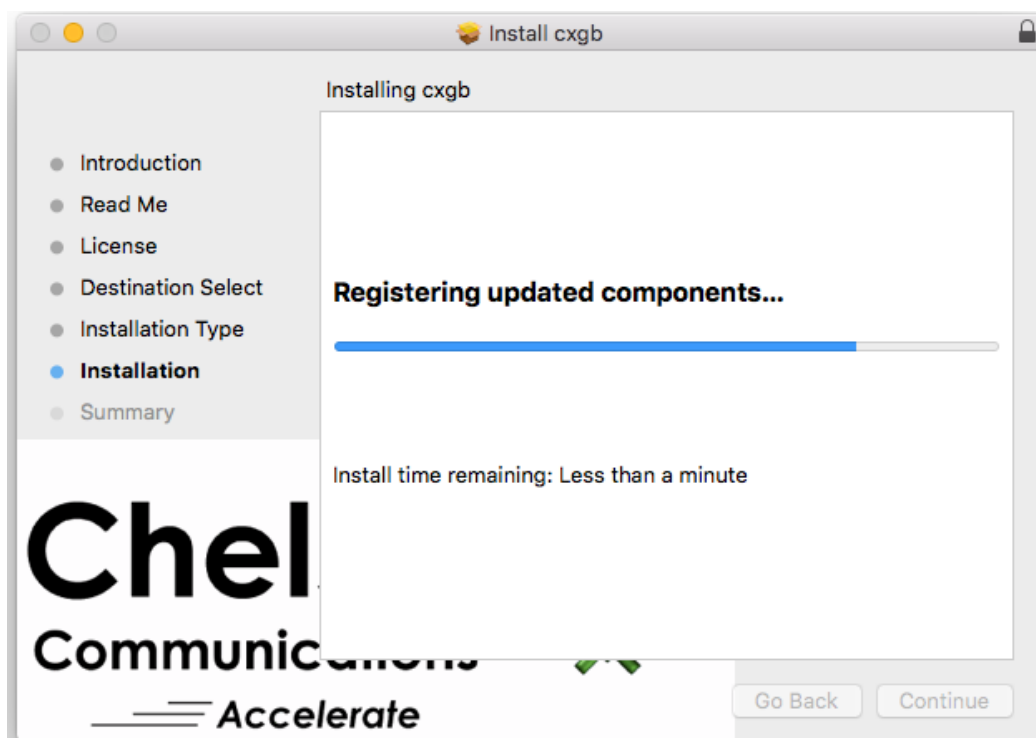


Figure 6 - Installation in progress

ix. Click "Close" to exit the installer.

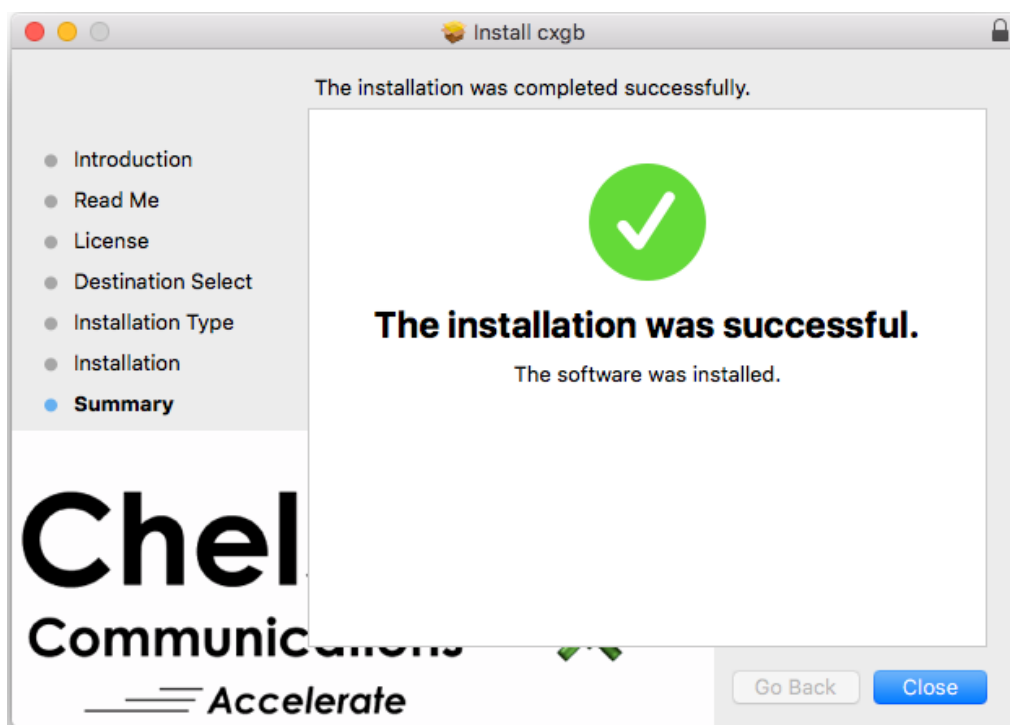


Figure 7 - Installation complete

3.2. CLI

- i. Mount the disk image *cxgb-x.y.z.dmg*

```
host:root# hdiutil mount cxgb-x.y.z.dmg
```

The disk image will be mounted to */Volumes* directory.

- ii. Install the driver:

```
host:root# installer -pkg /Volumes/cxgb-x.y.z/cxgb.pkg -target /
```

Example:

```
devikumar@Mac-Pro: ~ root# hdiutil mount Desktop/cxgb-1.16.45b0_T6_Sierra.dmg
/dev/disk2          GUID_partition_scheme
/dev/disk2s1        Apple_HFS                /Volumes/cxgb-1.16.45T6
devikumar@Mac-Pro: ~ root# installer -pkg /Volumes/cxgb-1.16.45T6/cxgb.pkg -target /
installer: Package name is cxgb
installer: Upgrading at base path /
installer: The upgrade was successful.
```

4. Software/Driver Loading

The installer will copy the signed KEXT into `/Library/Extensions/` directory.

- To load the T6/T5/T4 network driver run the following command:

```
host:root# sudo kextload /Library/Extensions/cxgb.kext
```

- To load the T3 network driver run the following command:

```
host:root# sudo kextload /Library/Extensions/cxgb3.kext
```


5. Software/Driver Configuration and Fine-tuning

5.1. Important Configurable Parameters

5.1.1. FEC

Chelsio T6 Unified Wire adapters support changing Forward Error Correction (FEC). The existing FEC settings can be viewed using:

```
host:root# sudo cxgbtool <cxgbX> fec
```

Below is a sample output on T6 25G port:

```
agile: ~ admin$ cxgbtool cxgb11 fec
supported:      auto (IEEE 802.3) Base-R/Reed-Solomon Reed-Solomon
IEEE 802.3 'auto': auto (IEEE 802.3) Base-R/Reed-Solomon Reed-Solomon
requested:      auto (IEEE 802.3)
actual:         Base-R/Reed-Solomon
```

To set FEC:

```
host:root# sudo cxgbtool <cxgbX> fec <value>
```

Here *value* can be:

rs: Reed-Solomon FEC

baser: Base-R/Reed-Solomon FEC

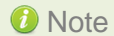
auto: Use standard FEC settings as specified by IEEE 802.3 interpretations of Cable Transceiver Module parameters.

off: Turn off FEC.

Example

Changing FEC from Reed-Solomon to Base-R/Reed-Solomon:

```
agile: ~ admin$ sudo cxgbtool cxgb11 fec
Password:
supported:      auto (IEEE 802.3) Base-R/Reed-Solomon Reed-Solomon
IEEE 802.3 'auto': auto (IEEE 802.3) Base-R/Reed-Solomon Reed-Solomon
requested:      Reed-Solomon
actual:         Reed-Solomon
agile:~ admin$ sudo cxgbtool cxgb11 fec baser
agile:~ admin$ sudo cxgbtool cxgb11 fec
supported:      auto (IEEE 802.3) Base-R/Reed-Solomon Reed-Solomon
IEEE 802.3 'auto': auto (IEEE 802.3) Base-R/Reed-Solomon Reed-Solomon
requested:      Base-R/Reed-Solomon
actual:         Base-R/Reed-Solomon
```



Note

- *FEC auto-negotiation is not supported on optic link.*
- *If auto-negotiation is disabled, ensure that the same FEC is set on both sides of the link, for the link to come up.*

5.1.2. LRO

• Enabling/Disabling

Large Receive Offload (LRO) support is enabled by default. It can be disabled using *cxgbtool*:

```
host:root# sudo cxgbtool cxgbX lro 0
```

```
~ root# sudo cxgbtool cxgb9 lro 0
Disabled LRO for all Queues on cxgb9
```

• Displaying status

To verify if LRO is enabled or disabled use:

```
host:root# sudo cxgbtool cxgbX qset
```

In the output, the LRO field should display 0 if disabled and 1 if enabled.

```
mac2:~ root# sudo cxgbtool cxgb9 qset
Qset  TxQ0  TxQ1  TxQ2  RspQ  RxQ0  RxQ1  Lat  LRO  WC
      0   1024   0    0   2047  1024   0   50   0   0
```

5.1.3. TCP Segmentation Offload Support

TCP Segmentation Offload has been supported since Snow Leopard and enabled by default. It can be disabled globally by using:

```
host:root# sysctl net.inet.tcp.tso=0
```

5.2. Kernel Tuning

5.2.1. Increasing default parameter values

To increase default parameter values on the client, edit the `/etc/sysctl.conf` configuration file. For example, if the default value for `kern.ipc.maxsockbuf < 2097152` then set it in `/etc/sysctl.conf` to be 2097152.


5.2.2. Increasing mbuf cluster


If `dmesg` output contains *outputPacket() zero segments*, it means in order to support the workload, the number of mbuf clusters available should be increased as packet drops are occurring. This can be achieved by increasing the number of mbuf clusters using `boot-args` parameter `ncl`.

See <http://support.apple.com/kb/HT3512> for more information.

5.3. Network Device Configuration

Please refer to the operating system documentation for administration and configuration of network devices.

 **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 the operating system documentation for manually configuring the network device.*

 **Note** *Network preferences panel should be used for changing interface properties such as active/inactive or MTU size.*

5.4. cxgbtool

The app `cxgbtool` is used to display or change Chelsio network card settings.

Loading firmware and setting hardware registers can only be done using the master physical function which restricts the BSD interface name that can be used as a parameter to `cxgbtool` for those commands. By default, the master physical function is associated with Port 0. The `cxgbtool` command with no parameters will list the master physical function BSD interface name.

For more information, use `cxgbtool help`:

```
host:root# cxgbtool -h
```

 **Note** *cxgbtool supports filtering settings on the Chelsio T3 based adapters only.*

5.5. Firmware Update

The minimum firmware version matching the driver must be loaded before the new driver installed can load, and the loading is initiated by the post-install phase of the installer.

The current driver can load the new firmware using the *loadfw* command of *cxgbtool* that came with the currently installed driver. Follow the steps mentioned below:

- i. If not done already, mount the new disk image *cxgb-x.y.z* file by double-clicking on it. The *cxgb* disk image should mount as a new device and place you in the base directory of the *cxgb* device.
- ii. Browse to the *firmware* directory. For example, if the disk image was mounted to */Volumes*, run the following commands to load the appropriate firmware based on Chelsio adapter family:

```
host:root# cd /Volumes/cxgb-x.y.z/firmware
host:root# cxgbtool cxgbX loadfw <firmware-file>.bin
```


6. Software/Driver Unloading

- To unload the T6/T5/T4 Network driver run the following command:

```
host:root# sudo kextunload /Library/Extensions/cxgb.kext
```

- To unload the T3 Network driver run the following command:

```
host:root# sudo kextunload /Library/Extensions/cxgb3.kext
```

 **Note** *Unloading the driver while traffic is running is not recommended.*

7. Software/Driver Uninstallation

Before proceeding, refer [Software/Driver Unloading](#) chapter and unload the driver depending on the driver type.

- To uninstall the T6/T5/T4 driver run the following command:

```
host:root# rm -rf /Library/Extensions/cxgb.kext
```

- To uninstall the T3 driver run the following command:

```
host:root# rm -rf /Library/Extensions/cxgb3.kext
```

8. Software/Driver Update

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

Please visit [Chelsio Download Center](#) for regular updates on various software/drivers. You can also subscribe to our newsletter for the latest software updates.

9. Appendix

9.1. Chelsio End-User License Agreement (EULA)

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

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