



Chelsio NVMe-oF offload Initiator for VMware ESXi 6.7

Installation and User's Guide



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Version History

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I. Chelsio Unified Wire

1. Introduction

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

The **Terminator** series of adapters 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 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, Chelsio 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 datacenters, cloud service installations and high-performance computing environments, Chelsio adapters bring a new level of performance metrics and functional capabilities to the computer networking industry.

This document describes the installation, use and maintenance of NVMe-oF offload initiator software for VMware ESXi and its various components.

1.1. Features

The Chelsio NVMe-oF offload Initiator driver package installs various drivers and utilities for Chelsio's Unified Wire adapters.

 **Note** *Drivers are not VMware certified.*

1.2. Hardware Requirements

The Chelsio NVMe-oF offload Initiator software supports Chelsio Unified Wire adapters.

1.3. Software Requirements

The Chelsio NVMe-oF offload Initiator software has been developed to run on 64-bit ESXi based platforms and therefore it is a base requirement for running the driver.

1.4. Package Contents

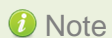
The Chelsio NVMe-oF offload Initiator driver package consists of the following files/directories:

- **cxl-*.vib**: Native Network driver VIB file.
- **cheiscsi-*.vib**: NVMe-oF Offload Initiator driver VIB file.
- **chelsio-esx-libcheiscsi-ima.so-*.vib**: IMA driver file.
- **docs**: This directory contains support documents - README, Release Notes and User's Guide (this document) for the software.
- **EULA**: Chelsio's End User License Agreement.

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.



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 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 `lspci` command

```
[root@ ~]# lspci | grep -i Chelsio
06:00.0 Ethernet controller: Chelsio Communications Inc T6225-CR Unified Wire Ethernet Controller
06:00.1 Ethernet controller: Chelsio Communications Inc T6225-CR Unified Wire Ethernet Controller
06:00.2 Ethernet controller: Chelsio Communications Inc T6225-CR Unified Wire Ethernet Controller
06:00.3 Ethernet controller: Chelsio Communications Inc T6225-CR Unified Wire Ethernet Controller
06:00.4 Ethernet controller: Chelsio Communications Inc T6225-CR Unified Wire Ethernet Controller
06:00.5 SCSI storage controller: Chelsio Communications Inc T6225-CR Unified Wire Storage Controller
06:00.6 Fibre Channel: Chelsio Communications Inc T6225-CR Unified Wire Storage Controller
```

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

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

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

The above outputs indicate the hardware configuration of the adapter as well as serial number.



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 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.

II. NVMe-oF Offload Initiator Driver

1. Introduction

NVMe over Fabrics specification extends the benefits of NVMe to large fabrics, beyond the reach and scalability of PCIe. NVMe enables deployments with hundreds or thousands of SSDs using a network interconnect, such as RDMA over Ethernet. Thanks to an optimized protocol stack, an end-to-end NVMe solution is expected to reduce access latency and improve performance, particularly when paired with a low latency, high efficiency transport such as RDMA. This allows applications to achieve fast storage response times, irrespective of whether the NVMe SSDs are attached locally or accessed remotely across enterprise or datacenter networks. Chelsio Unified Wire adapters with iWARP RDMA offload provide the high bandwidth and low latency fabric needed for NVMe-oF.

1.1. Hardware Requirements

1.1.1. Supported Adapters

The following are the currently shipping Chelsio adapters that are supported:

- T62100-LP-CR
- T6225-CR

1.2. Software Requirements

1.2.1. ESXi Requirements

The following 64-bit ESXi platforms are supported:

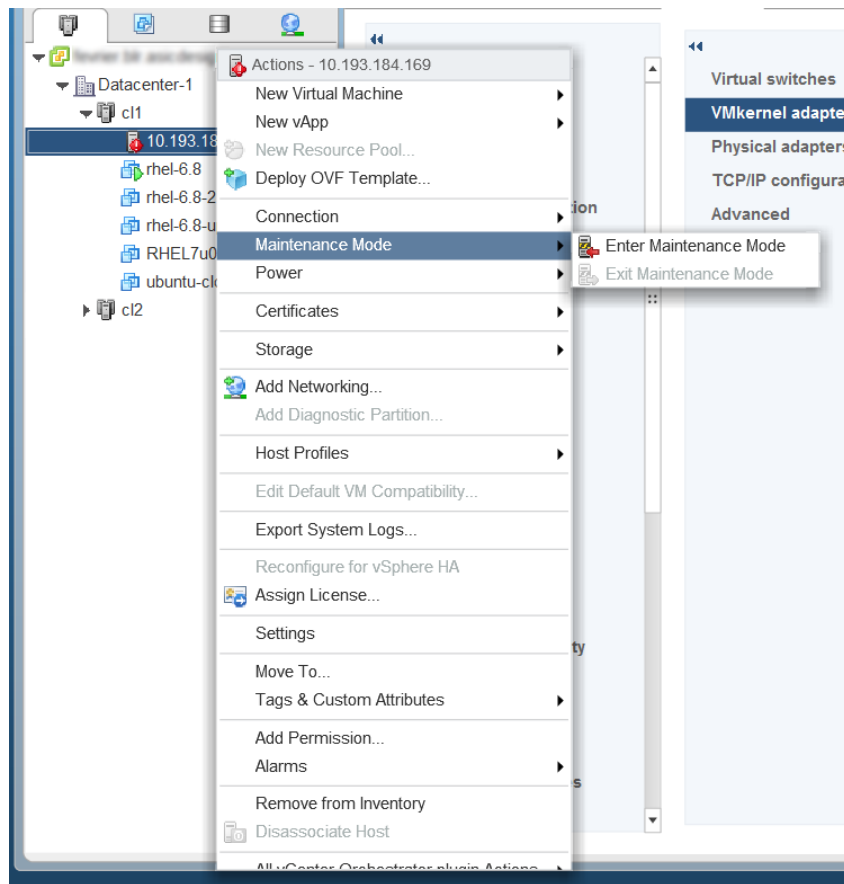
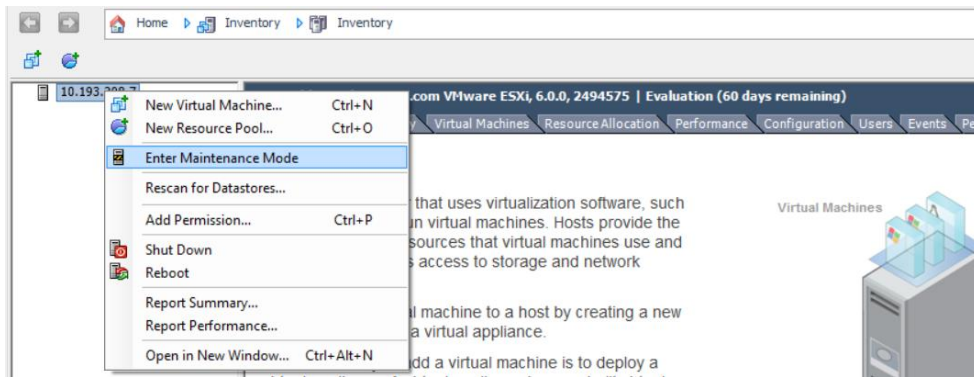
- ESXi 6.7
- ESXi 6.7 U1

2. Software/Driver Installation

- i. Download the driver package from [Chelsio Download Center](#).
- ii. Unzip the driver package:

```
[root@host:~] unzip <driver_package>.zip
```

- iii. Put the host in maintenance mode using the vSphere (desktop or web) Client.



iv. Install the drivers.

```
[root@host:~] cp *.vib /productLocker/  
[root@host:~] cp *.vib /var/log/vmware/  
[root@host:~] esxcli software vib install -v /productLocker/cxl-*.vib --no-  
sig-check  
[root@host:~] esxcli software vib install -v /productLocker/cheiscsi-*.vib -  
-no-sig-check  
[root@host:~] esxcli software vib install -v /productLocker/chelsio-esx-  
libcheiscsi-ima.so-*.vib --no-sig-check
```



Note *If there is an older version of the driver installed, use the below commands to update.*

```
[root@host:~] esxcli software vib update -v /productLocker/cxl-*.vib  
--no-sig-check  
[root@host:~] esxcli software vib update -v /productLocker/cheiscsi-  
*.vib --no-sig-check  
[root@host:~] esxcli software vib install -v /productLocker/chelsio-  
esx-libcheiscsi-ima.so-*.vib --no-sig-check  
[root@host:~] esxcli software vib remove -n chelsio-esx-  
libcheiscsi_ima.so
```

v. After installation/update completes successfully, exit from maintenance mode and reboot the host.

3. Software/Driver Loading

After rebooting the ESXi Host, the driver will load automatically. However, it is possible to manually load the driver by using the command below:

```
[root@host:~] vmkload_mod cheiscsi
```

Execute the below command so that device manager performs a rescan:

```
[root@host:~] kill -SIGHUP $(cat /var/run/vmware/vmkdevmgr.pid)
```

4. Software/Driver Configuration and Fine-tuning

4.1. cxgbtool

The `cxgbtool` command queries or sets various aspects of Chelsio network interface cards. It complements standard tools used to configure network settings and provides functionality not available through such tools. Some of the commands provided can be used to query running statistics to aid in debugging. The tool will be installed by default on installing the driver VIB.

- **Syntax & Usage**

To use `cxgbtool`, use the syntax:

```
[root@host:~] /opt/chelsio/bin/cxgbtool <options>
```

 **Note** *For information on available parameters and their usage, refer to `cxgbtool help` by running the `/opt/chelsio/bin/cxgbtool -h` command.*


4.2. Firmware Update

The Native Network driver (`cxl`) will auto-load the firmware if an update is required. The version can be verified using:

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c version
```

4.3. Connecting to NVMe target

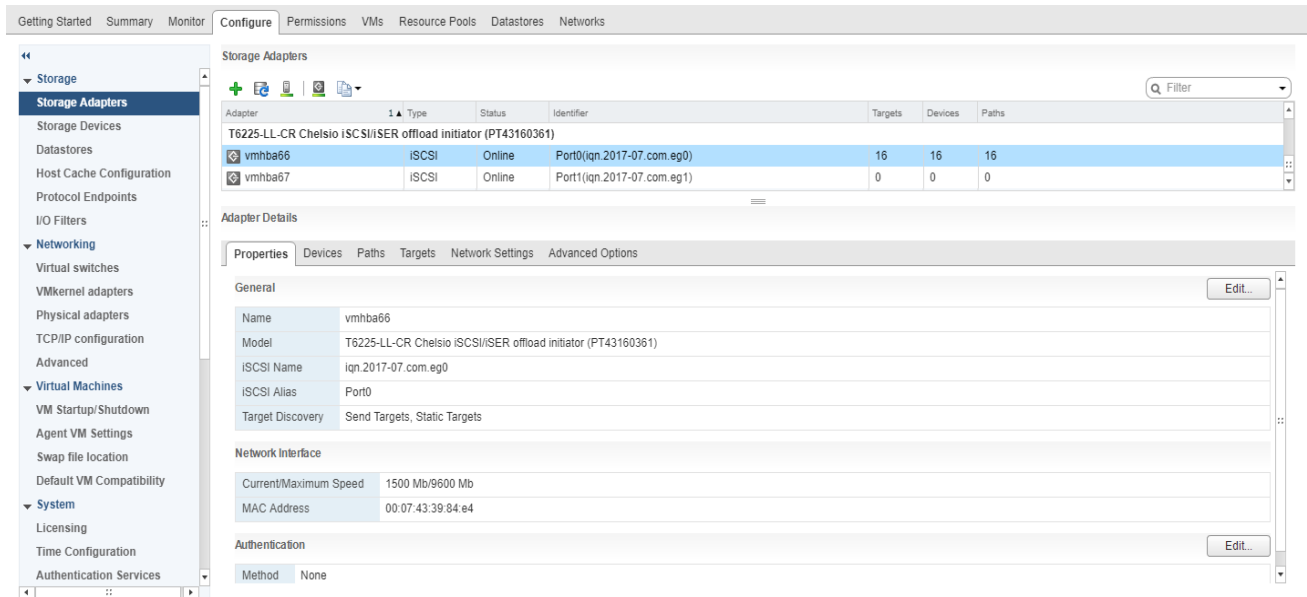
Configure the NVMe target machine with the IP Address, Target name, disks etc. For information on how to configure the NVMe Target, please refer Chelsio Unified Wire for Linux User's Guide.

 **Important** *Disable `iwpmc` service on the target machine. On RHEL7.X machines, use the below command.*

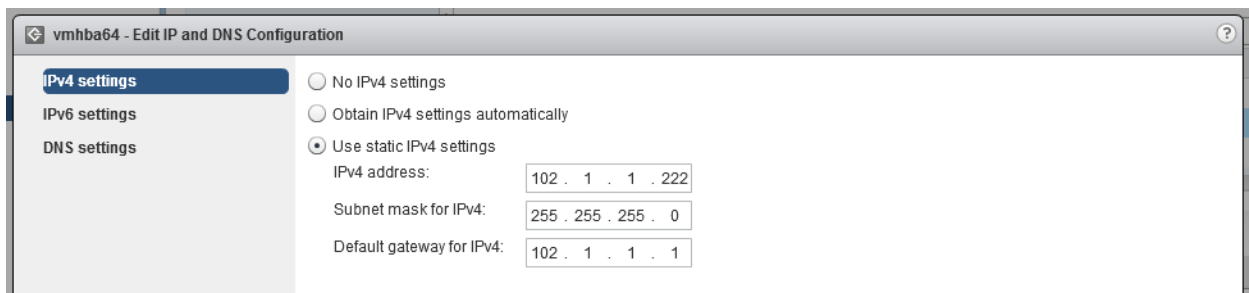
```
[root@host~]# systemctl stop iwpmc
```


Follow the below procedure on NVMe Initiator machine to connect to the target.

- i. Log in to vCenter Server through vSphere Web Client using a web browser.
- ii. If you have already created and configured the host intended to be used as initiator, skip to step (iii)
 - a. Under **Hosts and Clusters**, right-click and click **New Datacenter...** Provide a name and Click **OK**.
 - b. Right-click on the newly created datacenter and click **Add Host...** Follow onscreen instructions and provide information to add the host. Click **Finish**.
- iii. Select the host and under the **Configure** tab, select **Storage Adapters**. This will display the list of available Chelsio storage adapters.



- iv. In the **Adapter Details** section, click **Network Settings** tab and then **Edit**.
- v. Configure IP for the adapter and click **OK**. You can configure either IPv4 or IPv6 or both.



Adapter Details

Properties Devices Paths Targets **Network Settings** Advanced Options

IP Address and DNS Configuration Edit...

IPv4 address	102.1.1.222 (static)
Subnet mask for IPv4	255.255.255.0
Default gateway for IPv4	102.1.1.1
IPv6 settings	Not enabled
Preferred DNS server	Not supported
Alternate DNS server	Not supported

vi. Discover the target.

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport <target_port> -
ipaddr <target_ip_address> -p <Chelsio_Port #>
```

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport 4420 -ipaddr 102.1.1.146 -p 0
process_nvme_resp status 0x0 nrec 0x20
0) nvm subsystem nvme-ram0 ctrl id 0xffff addr 102.1.1.146
1) nvm subsystem nvme-ram1 ctrl id 0xffff addr 102.1.1.146
```

If `-p` is not specified, by default Port 0 will be used.

While using IPv6, specify the target IPv6 address within `[]`.

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport 4420 -ipaddr [1000::146] -p 0
process_nvme_resp status 0x0 nrec 0x5
0) nvm subsystem nvme-ram0 ctrl id 0xffff addr 1000::146%2
1) nvm subsystem nvme-ram1 ctrl id 0xffff addr 1000::146%2
```

Login to the target by specifying the target name.

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport <target_port> -
ipaddr <target_ip_address> -p <Chelsio_Port #> -L -subnqn <target_name>
```

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport 4420 -ipaddr 102.1.1.146 -p 0 -L -subnqn nvme-ram0
login status 0
target id 0
```

- vii. List the logged in targets.

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c nvmf -tlist -p <Chelsio_Port #>
```

If `-p` is not specified, by default Port 0 will be used.

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c nvmf -tlist
0) tgt_id: 0, state: 3, IP: 102.01.01.146, Port: 4420, sub_nqn: nvme-ram0
```

- viii. Rescan the storage adapter and the target LUNs will be visible.

```
[root@host:~] esxcfg-rescan -A
```

- ix. All the available LUNs will be displayed in the Devices tab. These LUNs can now be attached to VMs or can be used to store VMs.

Adapter Details

Properties **Devices** Paths Targets Network Settings Advanced Options

All Actions

Name	LUN	Type	Capacity	Operational...	Hardware Acceleration	Drive Type
NVMe iSCSI Disk (t10.NVMe____...)	0	disk	500.00 MB	Attached	Unknown	Flash

4.4. Disconnecting from NVMe target

To logout or disconnect from the NVMe target,

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport <target_port> --
ipaddr <target_ip_address> -p <Chelsio_Port #> -LT -tgtid <target_id>
```

If `-p` is not specified, by default Port 0 will be used.

5. Software/Driver Unloading

Logout of all the existing NVMe-oF sessions. Execute the command below to unload the driver:

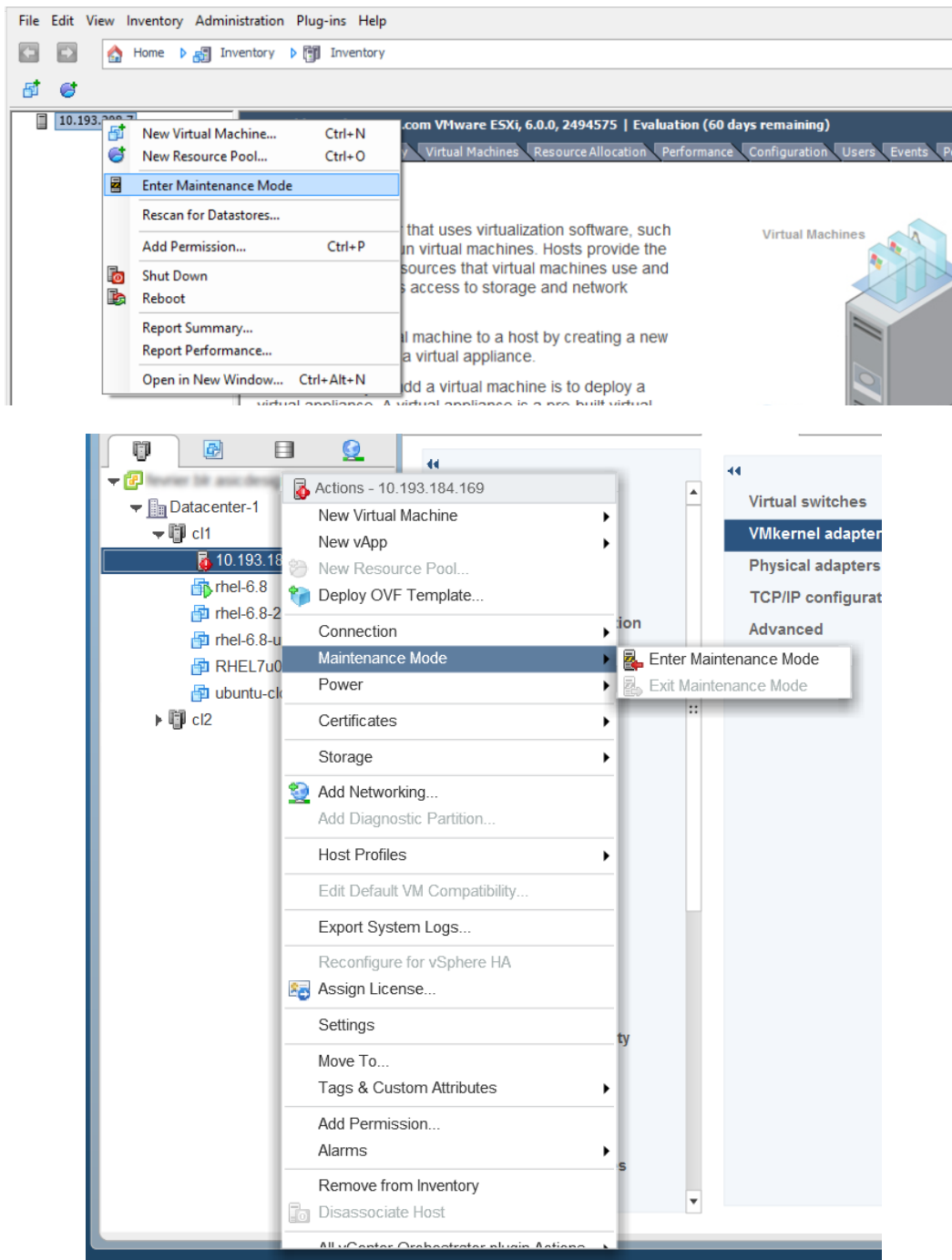
```
[root@host:~] vmkload_mod -u cheiscsi
```

6. Software/Driver Uninstallation

Note Before proceeding, please ensure that no NVMe-oF session or connection is active and running.

Follow the steps mentioned below to uninstall the driver:

- i. Put the host in maintenance mode using the vSphere (desktop or web) Client:



ii. Uninstall the drivers.

```
[root@host:~] esxcli software vib remove -n cheiscsi  
[root@host:~] esxcli software vib remove -n chelsio-esx-libcheiscsi-ima.so  
[root@host:~] esxcli software vib remove -n cxl
```

iii. Reboot the host.

```
[root@host:~] reboot
```

III. Appendix

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