Chelsio Communications

Accelerate

Chelsio Unified Wire for VMware ESXi 8.0

Installation and User Guide

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TABLE OF CONTENTS

I. CHELSIO UNIFIED WIRE 6

1. Introduction 7

1.1. Features 7

1.2. Hardware Requirements 7

1.3. Software Requirements 8

1.4. Package Contents 8

2. Hardware Installation 9

3. Software/Driver Installation 11

4. Software/Driver Uninstallation 12

5. Software/Driver Update 13

II. NATIVE NETWORK DRIVER WITH SR-IOV SUPPORT 14

1. Introduction 15

1.1. Hardware Requirements 15

1.2. Software Requirements 15

2. Software/Driver Loading 17

3. Software/Driver Configuration and Fine-tuning 18

3.1. Multiple Adapters 18

3.2. cxgbtool 18

3.3. Adapter Configuration 18

3.4. Firmware Update 19

3.5. Connecting a Virtual Machine 19

3.6. Virtual Functions (SR-IOV) 19

4. Software/Driver Unloading 26

III. ISCSI OFFLOAD INITIATOR DRIVER 27

1. Introduction 28

1.1. Hardware Requirements 28

2. Software/Driver Loading 29

3. Software/Driver Configuration and Fine-tuning 30

3.1. Configuring Initiator 30

3.2. Connecting to Target 32

3.3. Configurable Options 35

4. Software/Driver Unloading 37

IV. ISER OFFLOAD INITIATOR DRIVER 38

1. Introduction 39

1.1. Hardware Requirements 39

2. Software/Driver Loading 40

3. Software/Driver Configuration and Fine-tuning 41

3.1. Configuring Initiator 41

3.2. Connecting to Target 45

3.3. Configurable Options 48

4. Software/Driver Unloading 50

V. NVME-OF OFFLOAD INITIATOR DRIVER 51

1. Introduction 52

1.1. Hardware Requirements 52

2. Software/Driver Loading 53

3. Software/Driver Configuration and Fine-tuning 54

3.1. Connecting to NVMe target 54

3.2. Disconnecting from NVMe target 56

4. Software/Driver Unloading 57

VI. APPENDIX 58

1. Troubleshooting 59

2. Chelsio End-User License Agreement (EULA) 60

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 Unified Wire software for VMware ESXi and its various components.

1.1. Features

The Chelsio Unified Wire package installs various drivers and utilities and consists of the following software:

- **Native Network (NIC) driver with SR-IOV support**
- **iSCSI Offload Initiator Driver**
- **iSER Offload Initiator Driver**
- **NVMe-oF Offload Initiator Driver**

Note *Drivers are not VMware certified.*

For detailed instructions on loading, unloading, and configuring the drivers/tools, refer to their respective sections.

1.2. Hardware Requirements

The Chelsio Unified Wire software supports the Chelsio Terminator series of Unified Wire adapters. To know more about the list of adapters supported by each driver, refer to their respective sections.

1.3. Software Requirements

The Chelsio Unified Wire software has been developed to run on 64-bit ESXi based platforms.

- ESXi 8.0

1.4. Package Contents

The Chelsio Unified Wire driver package consists of the following files/directories:

- **cxl-*.vib**: Native Network driver VIB file.
- **cheiscsi-*.vib**: iSCSI, NVMe-oF Offload Initiator driver VIB file.
- **cheiwarp-*.vib**: iSER Offload Initiator driver VIB file.

2. Hardware Installation

Follow these steps to install the 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
```

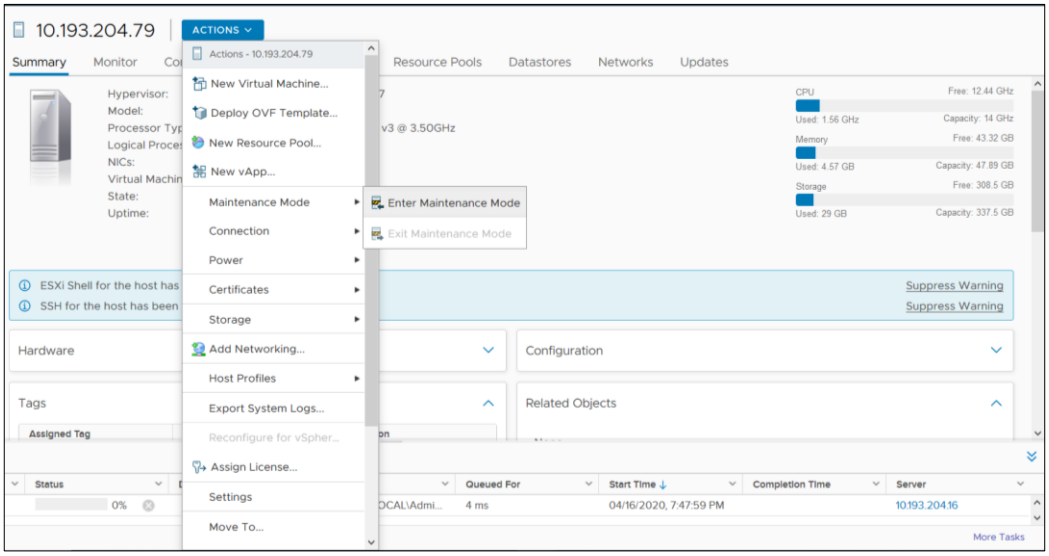
The above outputs indicate the hardware configuration of the adapter as well as serial number.

Note

Network device names for Chelsio's physical ports are assigned using the following convention: the port farthest from the motherboard appears 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 appears as the first network interface.

3. Software/Driver Installation

i. Download the driver package from Chelsio Download Center.
ii. Put the host in maintenance mode using the vSphere (desktop or web) Client.



iii. Install the drivers.

```
[root@host:~] cp *.zip  /productLocker/
[root@host:~] cp *.zip /var/log/vmware/
[root@host:~] esxcli software component apply --depot=/productLocker/CHL-
esx-8.0.0-Chelsio-Drivers-5.3.0.33-1OEM.800.1.0.20613240.zip --no-sig-check
```

```
[root@KGF2:~] esxcli software component apply --depot=/productLocker/CHL-esx-8.0.0-Chelsio-Drivers-5.3.0.33-1OEM.800.1.0.20613240.zip --no-sig-check
Installation Result
   Components Installed: Chelsio-Drivers_5.3.0.33-1OEM.800.1.0.20613240
   Components Removed:
   Components Skipped:
   Message: The update completed successfully, but the system needs to be rebooted for the changes to be effective.
   Reboot Required: true
```

iv. Once the installation or update is successfully completed, exit from maintenance mode and reboot the host.
v. Verify that the drivers are installed successfully.

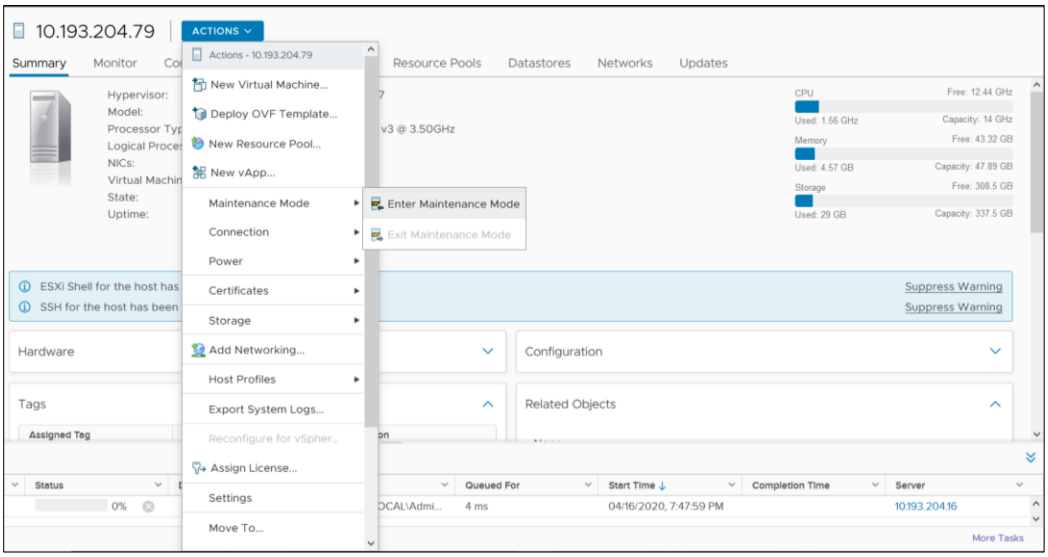
```
[root@host:~] esxcli software component vib list --component=Chelsio-Drivers
```

```
[root@KGF2:~] esxcli software component vib list --component=Chelsio-Drivers
Name      Version                             Vendor  Acceptance Level  Install Date  Platforms
--------  ----------------------------------  ------  ----------------  ------------  ---------
cheiscsi  5.3.0.33-1OEM.800.1.0.20613240      CHL     VMwareCertified   2025-02-25    host
cheiwarp  5.3.0.33-1OEM.800.1.0.20613240      CHL     VMwareCertified   2025-02-25    host
cxl       5.3.0.33-1OEM.800.1.0.20613240      CHL     VMwareCertified   2025-02-25    host
```

4. Software/Driver Uninstallation

Note *Before proceeding with the uninstallation, ensure that no iSCSI, iSER or NVMe-oF session or connection is active and running.*

i. Use the **vSphere Client (desktop or web)** to place the host in maintenance mode:



ii. Uninstall the drivers.

```
[root@host:~] esxcli software component remove --component=Chelsio-Drivers
```

```
[root@KGF2:~] esxcli software component remove --component=Chelsio-Drivers

Removal Result
   Components Installed:
   Components Removed: Chelsio-Drivers_5.3.0.33-10EM.800.1.0.20613240
   Components Skipped:
   Message: The update completed successfully, but the system needs to be rebooted for the changes to be effective.
   Reboot Required: true
```

iii. Reboot the host.

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

5. Software/Driver Update

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

For regular updates on various software/drivers, visit Chelsio Download Center. You can also subscribe to our newsletter for the latest software updates.

II. Native Network Driver with SR-IOV Support

1. Introduction

Chelsio's Unified Wire adapters provide extensive support for NIC operation. A high performance fully offloaded and fully featured TCP/IP stack meets or exceeds software implementations in RFC compliance. Chelsio's Terminator engine provides unparalleled performance through a specialized data flow processor implementation and a host of features designed for high throughput and low latency in demanding conditions and networking environments.

1.1. Hardware Requirements

1.1.1. Supported Adapters

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

- T62100-CR
- T62100-LP-CR
- T62100-SO-CR
- T6425-CR
- T6225-CR
- T6225-LL-CR
- T6225-SO-CR
- T580-CR
- T580-LP-CR
- T580-SO-CR
- T540-CR
- T540-LP-CR
- T540-SO-CR
- T540-BT
- T520-CR
- T520-LL-CR
- T520-SO-CR
- T520-BT

1.2. Software Requirements

1.2.1. ESXi Requirements

The native network driver has been developed to run on the following 64-bit ESXi platforms:

- **Host:**
  - ESXi 8.0

- **Virtual Machine (with VFs):**
  - RHEL/Rocky Linux 9.5, 5.14.0-503.11.1.el9_5.x86_64
  - RHEL/Rocky Linux 9.4, 5.14.0-427.14.1.el9_4.x86_64
  - RHEL/Rocky Linux 8.10, 4.18.0-553.el8_10.x86_64
  - RHEL/Rocky Linux 8.9, 4.18.0-513.5.1.el8_9.x86_64
  - Kernel.org 6.12.16
  - Kernel.org 6.6.79
  - Windows Server 2025
  - Windows Server 2022

1.2.2. SR-IOV Requirements

- SR-IOV should be enabled in the BIOS.
- Intel Virtualization Technology for Directed I/O (VT-d) should be enabled in the BIOS.
- PCI Express Slot should be ARI capable.

2. 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 cxl
```

Execute the following command, so that the device manager performs a rescan:

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

3. Software/Driver Configuration and Fine-tuning

3.1. Multiple Adapters

By default, the cxl driver will initialize eight Chelsio ports. In case of using multiple adapters, set the *max_ports* module parameter and reboot the machine.

```
[root@host:~] esxcfg-module -s max_ports=N cxl
[root@host:~] reboot
```

Note *This setting is persistent across reboots and need not be applied every time.*

Example: To use three numbers of T540-CR (4-port) adapters, with a total of 12 Chelsio ports:

```
[root@host:~] esxcfg-module -s max_ports=12 cxl
[root@host:~] reboot
```

3.2. 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.

Syntax and 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.*

3.3. Adapter Configuration

The adapter's configuration should be updated for optimal performance in ESXi environment.

Note *This configuration is not required for T6 adapters.*

Run the following *cxgbtool* command and reboot the machine.

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c esxcfg -set
[root@host:~] reboot
```

3.4. Firmware Update

The driver will auto-load the firmware if an update is required. The version can be verified using:

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

3.5. Connecting a Virtual Machine

Follow the steps mentioned below to connect the Chelsio adapter to a virtual machine:

i. Create a new virtual switch.

```
[root@host:~] esxcfg-vswitch -a vSwitchN
```

ii. Link a Chelsio adapter to the newly created virtual switch.

```
[root@host:~] esxcfg-vswitch -L vmnicN vSwitchN
```

iii. Create a new port group on the vSwitch.

```
[root@host:~] esxcfg-vswitch -A <port group name> vSwitchN
```

iv. From the vSphere client, right-click on the virtual machine, select the virtual network adapter to be used, and attach the newly created port group.

3.6. Virtual Functions (SR-IOV)

3.6.1. Instantiate VFs

Follow the steps mentioned below to instantiate virtual functions:

i. *max_vfs* is a comma separated module parameter that specifies the maximum number of VFs per port. Load the Native Network driver (cxl) with *max_vfs* parameter and set it to a non-zero value. In case of multiple adapters, use ',,' to separate the number of VFs per adapter:

```
[root@host:~] esxcfg-module cxl -s max_vfs=W,X,,Y,Z
```

Where,

W: Number of VFs per port 0 of adapter 0.
X: Number of VFs per port 1 of adapter 0.
Y: Number of VFs per port 0 of adapter 1.
Z: Number of VFs per port 1 of adapter 1.

Note *A maximum of 16 VFs can be instantiated per port*.

Example: To instantiate 3 VFs for port 1 of adapter 0 & 4 VFs for port 0 of adapter 1:

```
[root@host:~] esxcfg-module cxl -s max_vfs=0,3,,4,0
```

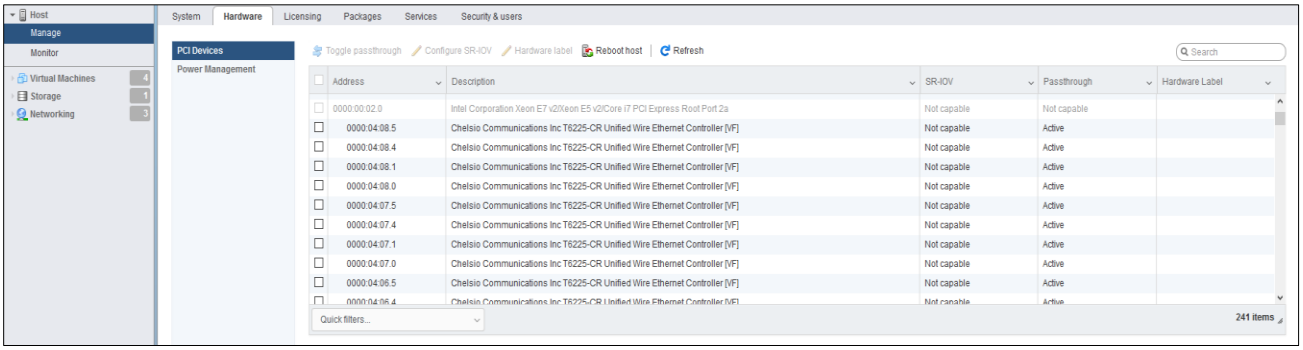
ii. Verify *max_vfs* setting using the *-g* option:

```
[root@host:~] esxcfg-module -g cxl
```

iii. Reboot the ESXi host to apply the changes.

iv. Check if VFs were instantiated successfully on the PCI bus by either using the shell prompt (using *lspci*) or GUI.

```
[root@          :~] lspci | grep Chelsio
0000:05:00.0 Network controller: Chelsio Communications Inc. T580-LP-CR Unified Wire Ethernet Controller [vmnic4]
0000:05:00.1 Network controller: Chelsio Communications Inc. T580-LP-CR Unified Wire Ethernet Controller [vmnic5]
0000:05:00.2 Network controller: Chelsio Communications Inc. T580-LP-CR Unified Wire Ethernet Controller [vmnic6]
0000:05:00.3 Network controller: Chelsio Communications Inc. T580-LP-CR Unified Wire Ethernet Controller [vmnic7]
0000:05:00.4 Network controller: Chelsio Communications Inc T580-LP-CR Unified Wire Ethernet Controller
0000:05:00.5 Mass storage controller: Chelsio Communications Inc T580-LP-CR Unified Wire Storage Controller
0000:05:00.6 Serial bus controller: Chelsio Communications Inc T580-LP-CR Unified Wire Storage Controller
0000:05:01.0 Network controller: Chelsio Communications Inc T580-LP-CR Unified Wire Ethernet Controller [PF_0.5.0_VF_0]
0000:05:01.1 Network controller: Chelsio Communications Inc T580-LP-CR Unified Wire Ethernet Controller [PF_0.5.1_VF_0]
0000:05:01.4 Network controller: Chelsio Communications Inc T580-LP-CR Unified Wire Ethernet Controller [PF_0.5.0_VF_1]
0000:05:01.5 Network controller: Chelsio Communications Inc T580-LP-CR Unified Wire Ethernet Controller [PF_0.5.1_VF_1]
```



3.6.2. Assigning VFs to VMs

Once the SR-IOV VFs are enabled/instantiated successfully on the host, they can be associated with Virtual Machines (VMs). The VFs can be assigned to VMs as:

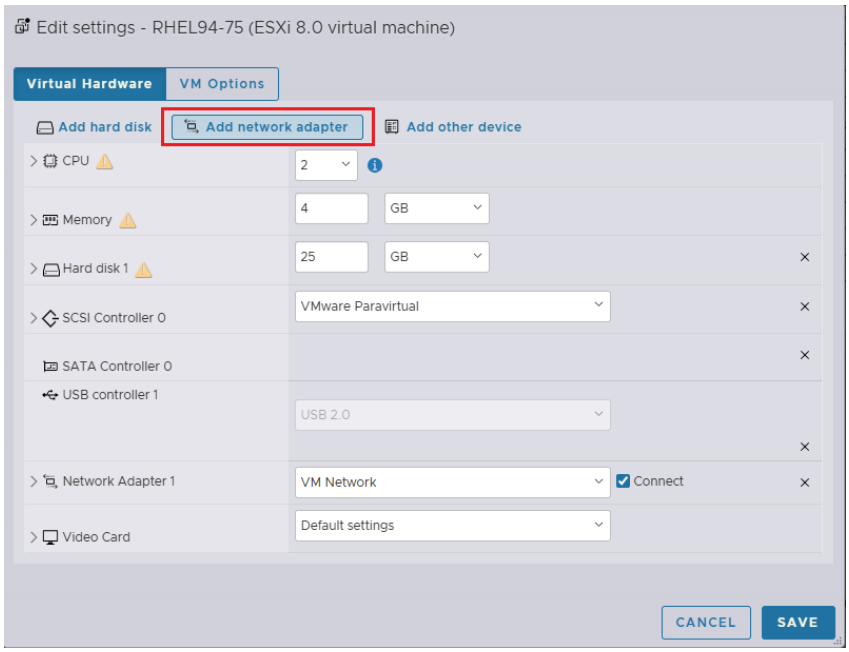
- SR-IOV passthrough network adapters
- PCI Devices

Note

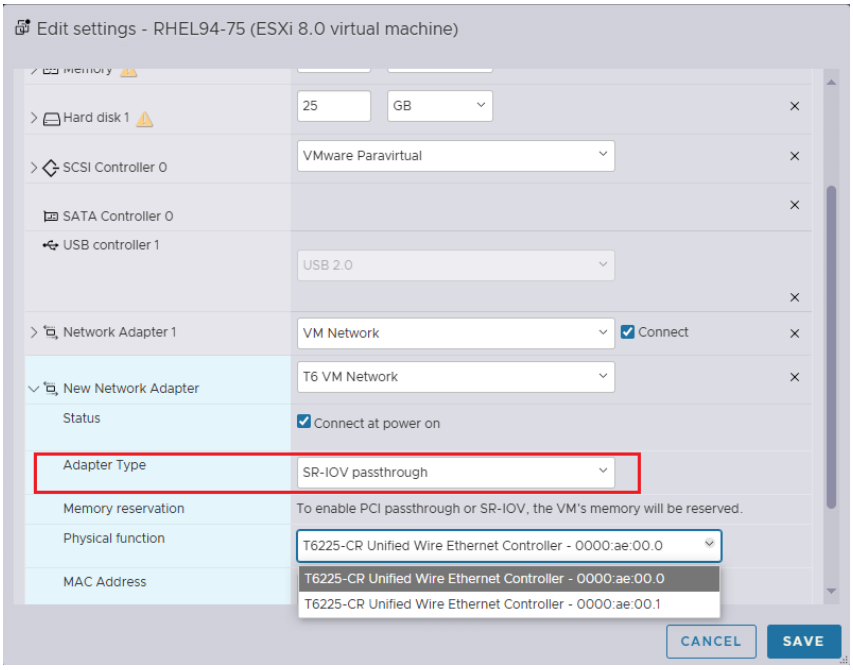
- *Unloading host network driver (cxl) when VFs are attached to VMs is not supported by VMware.*
- *T5 Adapters are not supported in Windows VMs with SR-IOV.*

SR-IOV passthrough network adapters

i. Right-click on the VM and select **Edit Settings**. Click **Add network adapter**.



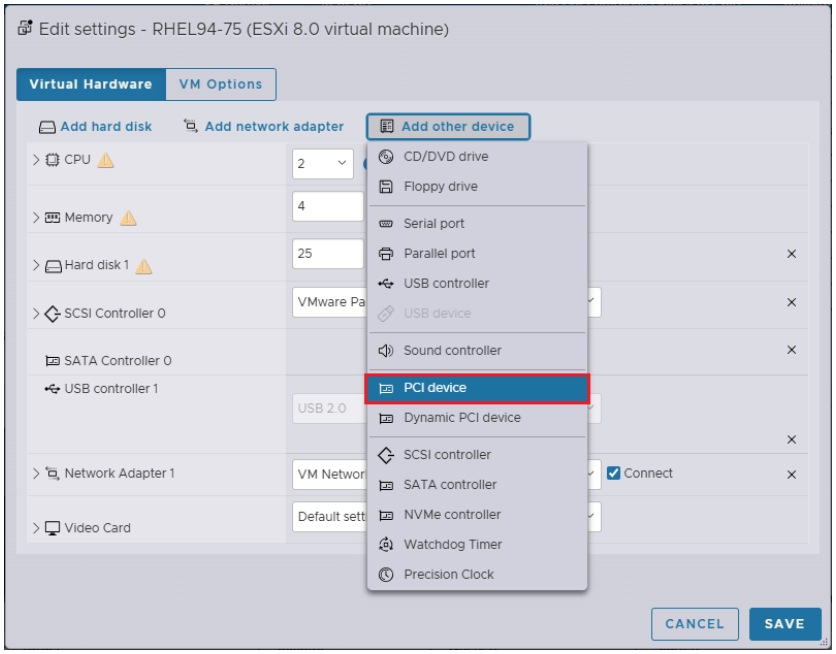
ii. Select the required Port Group and select **Adapter type** as **SR-IOV passthrough**.



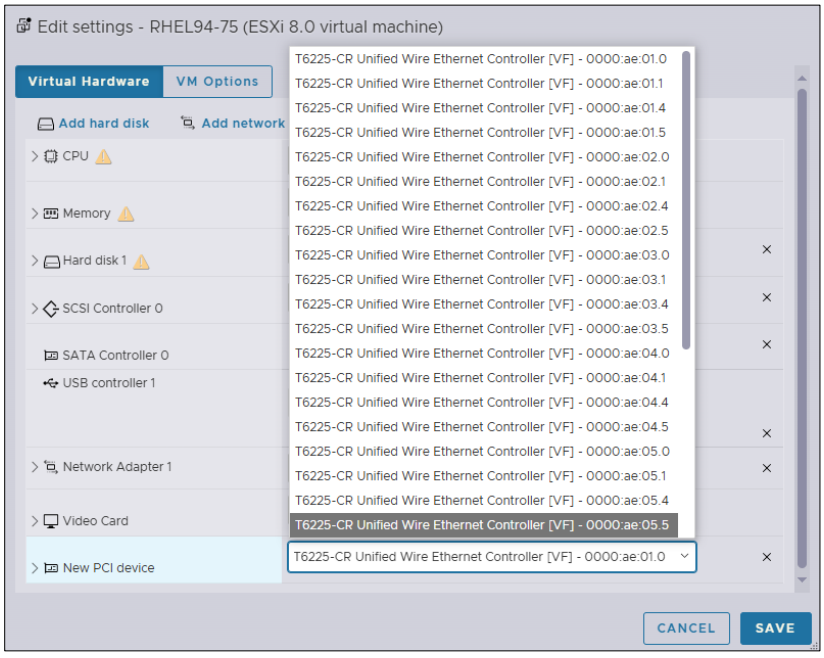
iii. Select the required Physical Function (Port) to use and click **Save**.

PCI Devices

i. Right-click on the VM and select **Edit Settings**. Click on **Virtual Hardware** tab. Click **ADD NEW DEVICE** and select **PCI Device**.



ii. Select the required Chelsio VF and click **Save**.



For more information on configuring SR-IOV, refer to VMware's official documentation.

3.6.3. Using VFs in Linux VM

To use the newly attached VFs in a virtual machine, follow the steps mentioned below:

i. Power-on the Virtual Machine with VF attached to it.
ii. Verify that the Chelsio VF shows up in the VM using the *lspci* command.

```
[root@host~]# lspci | grep Chelsio
00:08:0 Ethernet controller: Chelsio Communications Inc T580-LP-CR Unified
Wire Ethernet Controller [VF]
```

iii. Download the latest *Chelsio Unified Wire* driver package, from Chelsio Download Center.
iv. Untar the tarball using the following command.

```
[root@host~]# tar zxvf ChelsioUwire-x.xx.x.x.tar.gz
```

v. Change you current working directory to *ChelsioUwire-x.xx.x.x* directory and install the VF driver using the following command.

```
[root@host~]# make vnic_install
```

vi. Load the VF driver in the VM using the below command.

```
[root@host~]# modprobe cxgb4vf
```

Note *To know more about Chelsio Virtual Function driver, refer to the Chelsio Unified Wire for Linux User Guide.*

vii. Bring up the VF interface with the IP address and it will communicate with other VFs or hosts.

```
[root@host~]# ifconfig ethX <IPv4/IPv6 address> up
```

3.6.4. Using VFs in Windows VM

To use the newly attached VFs in a virtual machine, follow the steps mentioned below:

i. Power-on the Virtual Machine with VF attached to it.
ii. Download the latest *Chelsio Unified Wire* driver package, from Chelsio Download Center.
iii. Install the Chelsio Unified Wire using the installer or zip package.

Note *For detailed instructions, refer to the Chelsio Unified Wire for Windows User Guide.*

iv. Assign the required IP addresses for the VF in Network Connections.

Important *T5 Adapters are not supported in Windows VMs with SR-IOV.*

3.6.5. VF Link State

VF link state depends on the physical port link status by default. To override this and always enable the VF link, follow the below procedure. This will enable VF to VF communication irrespective of the physical port link status.

i. Update the *vfstate* using the following command on the host.

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c vfopt -idx <VF ID> -vfstate 2 -a
<adap> -p <port>
```

```
[root@zojila:~] /opt/chelsio/bin/cxgbtool -c vfopt -idx 2 -vfstate 2 -a 0 -p 1
Setting vf link status successful
```

ii. View the current *vfstate*.

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c vfopt -idx <VF ID> -a <adap> -p
<port>
```

```
[root@zojila:~] /opt/chelsio/bin/cxgbtool -c vfopt -idx 2 -a 0 -p 1
vf link state: 2
```

iii. Toggle the VF interface on the VM to apply the changes.

```
[root@host~]# ifconfig ethX down
[root@host~]# ifconfig ethX up
```

vfstate can be set to 1 for default behavior.

3.6.6. Example

i. In this example, 2 VFs are instantiated per port, hence a total of 4 VFs instantiated on the host. The host is then rebooted.

```
[root@host:~] esxcfg-module cxl -s max_vfs=2,2
[root@host:~] reboot
```

ii. 4 VMs are set up in the following combination:
- VF0 of PF0 (VF marked with the bus-id <PCIslot.01.0>) is assigned to VM1
- VF1 of PF0 (VF marked with the bus-id <PCIslot.01.4>) is assigned to VM2
- VF0 of PF1 (VF marked with the bus-id <PCIslot.01.1>) is assigned to VM3
- VF1 of PF1 (VF marked with the bus-id <PCIslot.01.5>) is assigned to VM4

iii. VMs are powered up one after another.
iv. VF driver (*cxgb4vf)* is installed and loaded in all the VMs.

The above configuration results in the following connectivity:

- VFs of the same port can communicate with each other. That is VM1 can communicate with VM2, and VM3 can communicate with VM4.
- VFs of port 0 (VM1 and VM2) will be able to communicate with any peer connected to port 0 of the network adapter.
- VFs of port 1 (VM3 and VM4) will be able to communicate with any peer connected to port 1 of the network adapter.

3.6.7. Configuring VLANs

If the VFs are attached as SR-IOV passthrough network adapters to the VMs, VLAN can be configured at the port group. After configuring the VLAN, the VF network driver should be reloaded on the VM to apply the changes.

```
[root@host~]# rmmod cxgb4vf
[root@host~]# modprobe cxgb4vf
```

For Windows VMs, disable and enable the **Chelsio Bus Enumerator [Virtual Function]** in System Devices of the Device Manager to apply the changes.

4. Software/Driver Unloading

Execute the following command to unload the Native Network driver:

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

Note *If iSCSI, iSER or NVMe-oF Offload Initiator Driver is loaded, unload it before unloading the native network driver.*

III. iSCSI Offload Initiator Driver

1. Introduction

The Chelsio Unified Wire series of adapters are Independent Hardware iSCSI adapters. They support iSCSI acceleration and iSCSI Direct Data Placement (DDP) where the hardware handles the expensive byte touching operations, such as CRC computation and verification, and direct DMA to the final host memory destination:

- **iSCSI PDU digest generation and verification**
  On transmit -side, Chelsio hardware computes and inserts the Header and Data digest into the PDUs. On receive-side, Chelsio hardware computes and verifies the Header and Data digest of the PDUs.
- **Direct Data Placement (DDP)**
  Chelsio hardware can directly place the iSCSI Data-In or Data-Out PDU's payload into pre-posted destination host-memory buffers based on the Initiator Task Tag (ITT) in Data-In or Target Task Tag (TTT) in Data-Out PDUs.
- **PDU Transmit and Recovery**
  On transmit-side, Chelsio hardware accepts the complete PDU (header + data) from the host driver, computes and inserts the digests, decomposes the PDU into multiple TCP segments if necessary, and transmit all the TCP segments onto the wire. It handles TCP retransmission if needed. On receive-side, Chelsio hardware recovers the iSCSI PDU by reassembling TCP segments, separating the header and data, calculating and verifying the digests, then forwarding the header to the host. The payload data, if possible, will be directly placed into the pre-posted host DDP buffer. Otherwise, the data will be sent to the host too.

1.1. Hardware Requirements

1.1.1. Supported Adapters

The following are the adapters that are compatible with Chelsio iSCSI Offload Initiator driver:

- T62100-CR
- T62100-LP-CR
- T6425-CR
- T6225-CR
- T6225-LL-CR
- T6225-SO-CR (*Memory Free; 256 IPv4/128 IPv6 offload connections supported*)
- T580-CR
- T580-LP-CR
- T540-CR
- T540-LP-CR
- T540-BT
- T520-CR
- T520-LL-CR
- T520-BT

2. Software/Driver Loading

After rebooting the ESXi Host, the driver will load automatically. However, it is possible to manually load the driver.

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

Execute the following command, so that device manager performs a rescan:

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

Note

Execute the following command to restore the Advanced Options of storage adapter after cheiscsi reload:

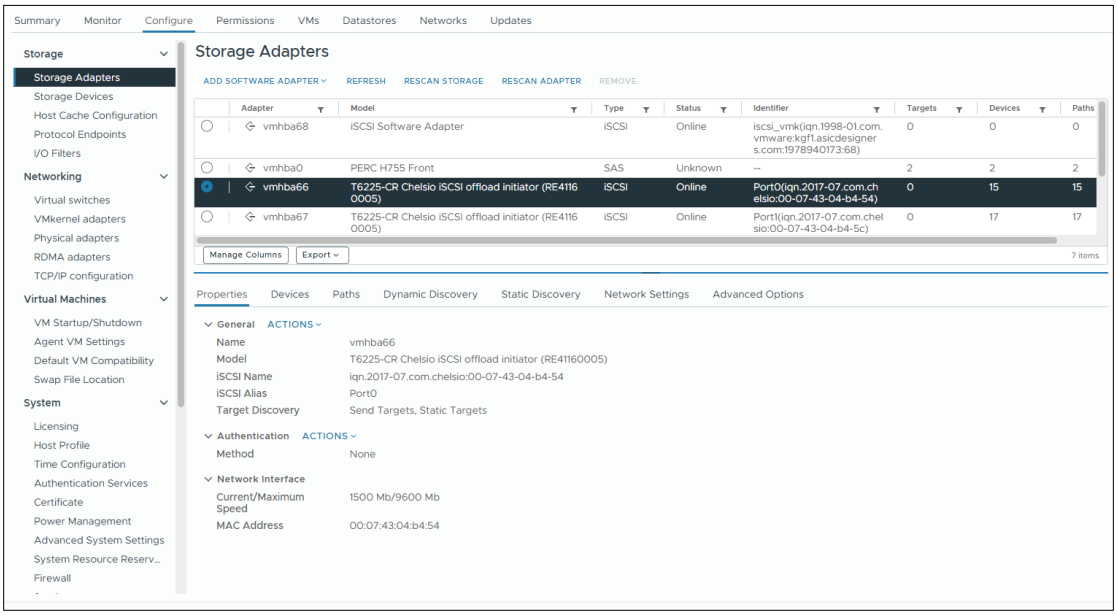
```
[root@host:~] esxcfg-rescan -A
```

3. Software/Driver Configuration and Fine-tuning

The following sections describe the method to configure Chelsio iSCSI Offload Initiator and connect to target.

3.1. Configuring Initiator

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 the onscreen instructions and provide information to add the host. Click **Finish**.
iii. Select the host and under the **Configure** tab, select **Storage Adapters**. This displays the list of available Chelsio iSCSI adapters.



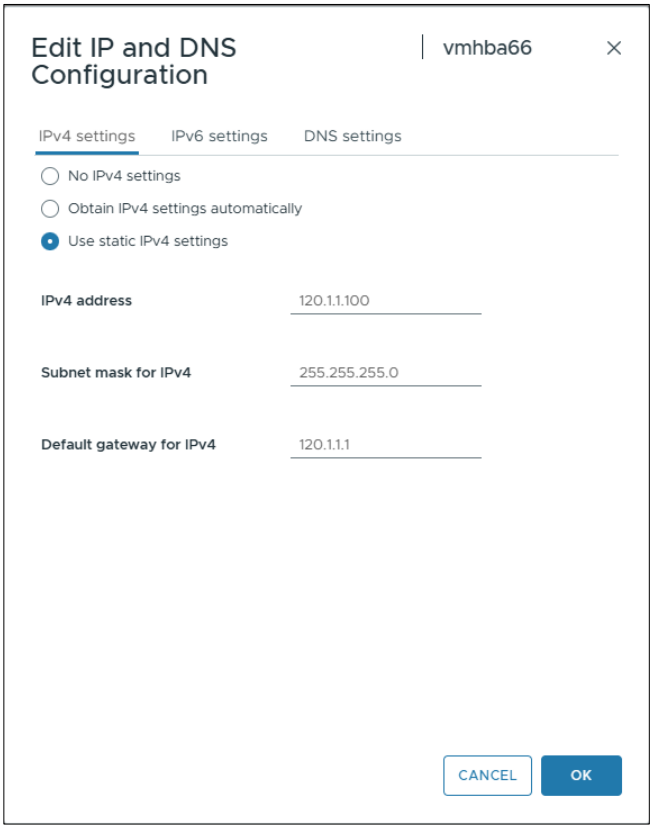
You can also view the list in CLI using:

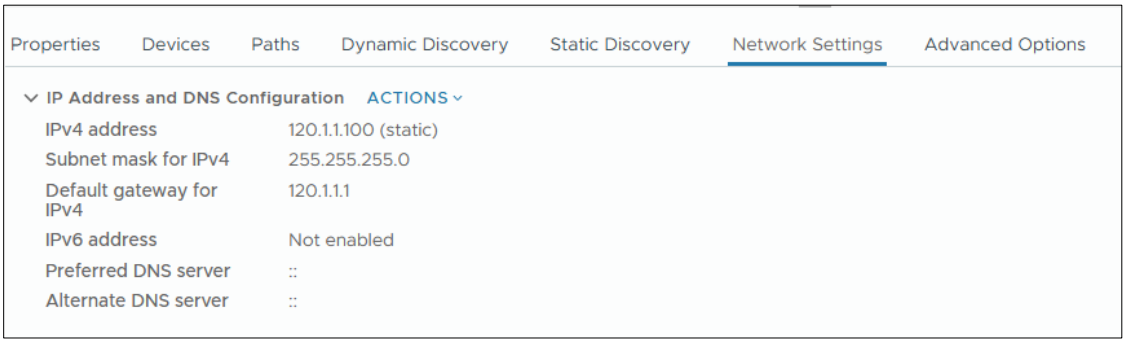
```
[root@host:~] esxcli iscsi adapter list
```

```
[root@KGF1:~] esxcli iscsi adapter list
Adapter  Driver     State   UID           Description
-------  ---------  ------  ------------  -----------
vmhba66  cheiscsi   online  iscsi.vmhba66  T6225-CR Chelsio iSCSI offload initiator (RE41160005)
vmhba67  cheiscsi   online  iscsi.vmhba67  T6225-CR Chelsio iSCSI offload initiator (RE41160005)
```

iv. In the **Adapter Details** section, click **Network Settings** tab and then **Edit**.

v. Configure IPv4 address for the adapter and click **OK**.



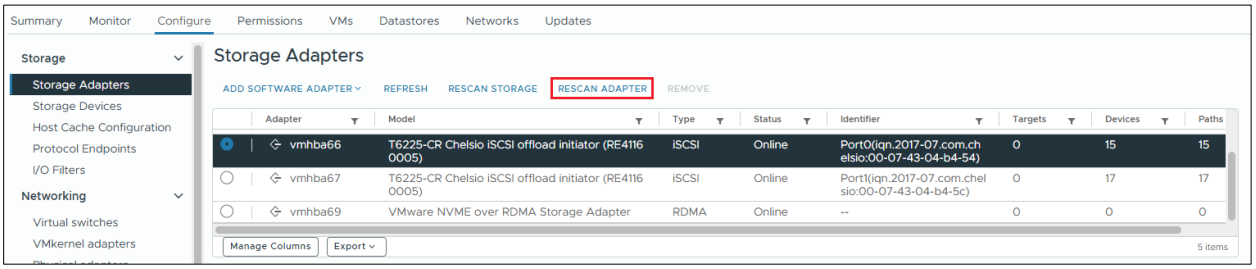


vi. To use IPv6 address, use the following command:

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c chnet -set -6 -ipaddr <IPv6
address> -gw <IPv6 gateway> -plen <subnet mask> -p <port>
```

```
[root@localhost:~] /opt/chelsio/bin/cxgbtool -c chnet -set -6 -ipaddr 2000::79 -gw 2000::1 -plen 64 -p 0
Setting chnet Configuration:
        Adapter name : vmhba64
        Node id      : 0
        Operation    : Setting Ipv6
        IP           : 2000::79
        prefix len   : 64
        Gateway      : 2000::1
        Status       : Success
```

vii. To apply the changes, click **RESCAN ADAPTER**.



3.2. Connecting to Target

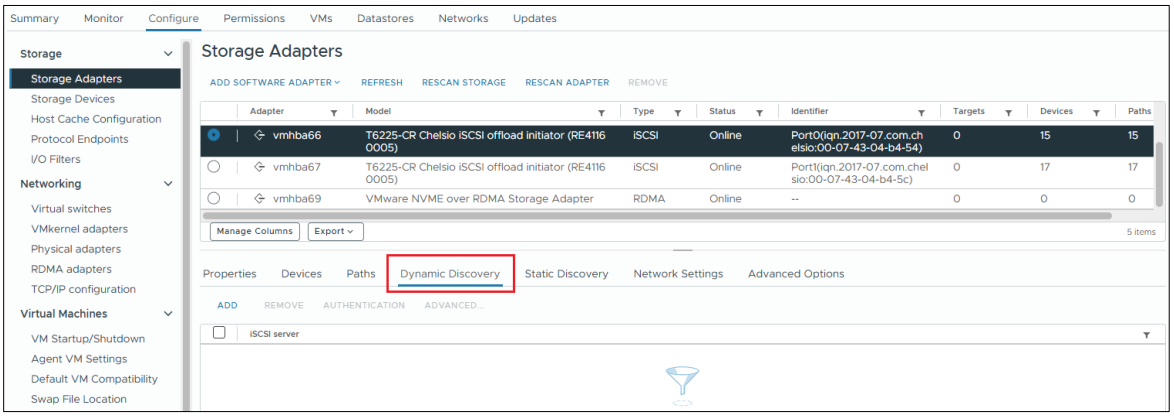
There are two methods to discover and connect to targets:

- **Dynamic Discovery:** Discovers all the available targets for a given target server.
- **Static Discovery:** Discovers a specific target by manually entering target information.

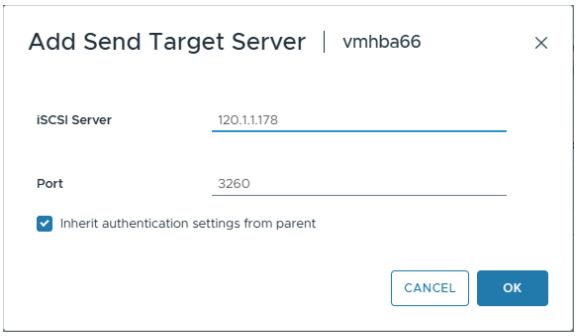
3.2.1. Dynamic Discovery

- **Adding Target Server**

i. Select the iSCSI adapter to connect to the target and select **Dynamic Discovery.**

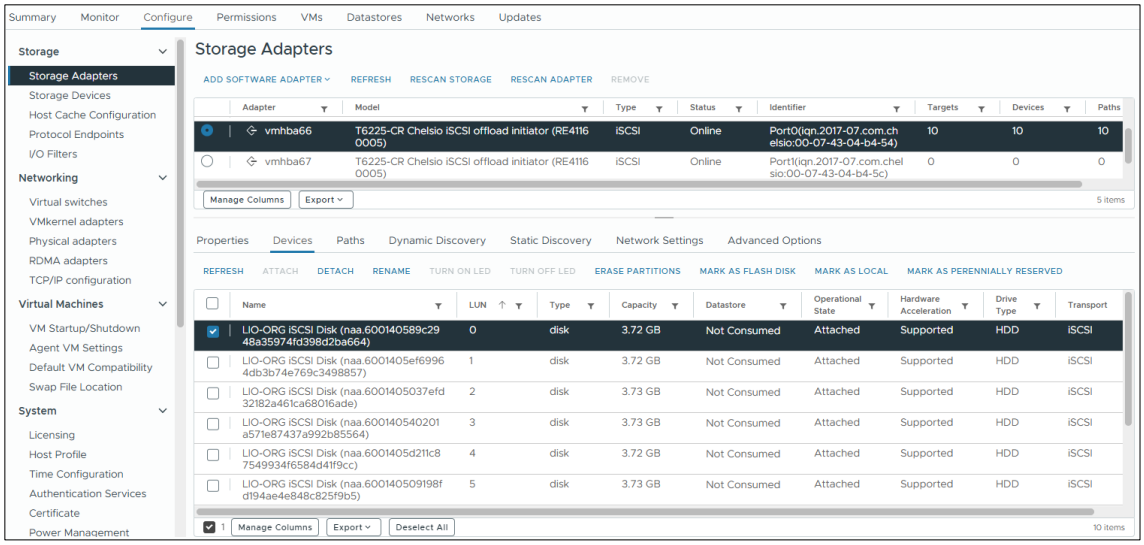


ii. Click **Add** and provide the target server IP. Click **OK**.



iii. To apply the changes, rescan the iSCSI adapter.

iv. All the available LUNs discovered on the given target server will be displayed in the **Devices** tab. You can perform various tasks like detach, rename, erase partitions, etc.



The **Paths** tab displays LUN status and allows you to enable or disable them.

These LUNs can now be attached to VMs or can be used to store VMs.

- **Removing Target Server**

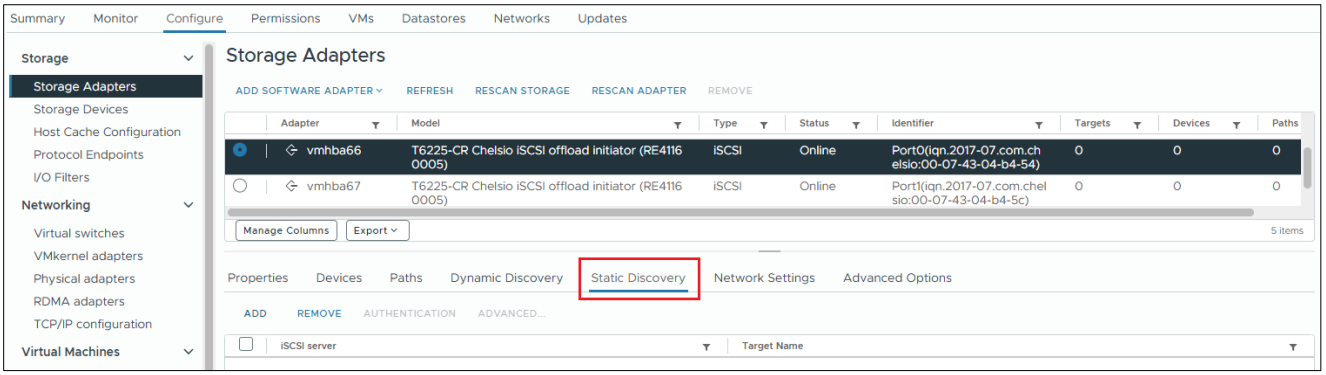
i. Under **Dynamic Discovery** tab, select target server, click **Remove** and then **OK** to confirm.

ii. To apply the changes, rescan the iSCSI adapter.

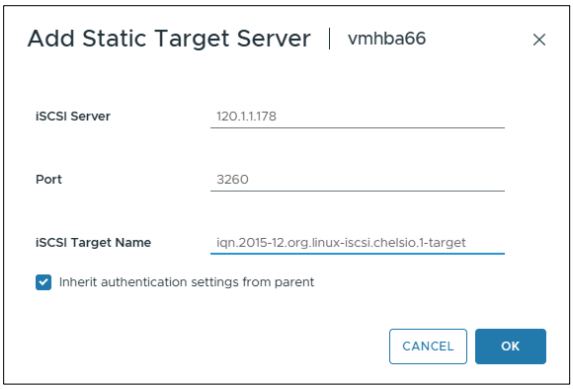
3.2.2. Static Discoverys

- **Adding Target Server**

i. Select the iSCSI interface to connect to the target and select **Static Discovery** tab**.**

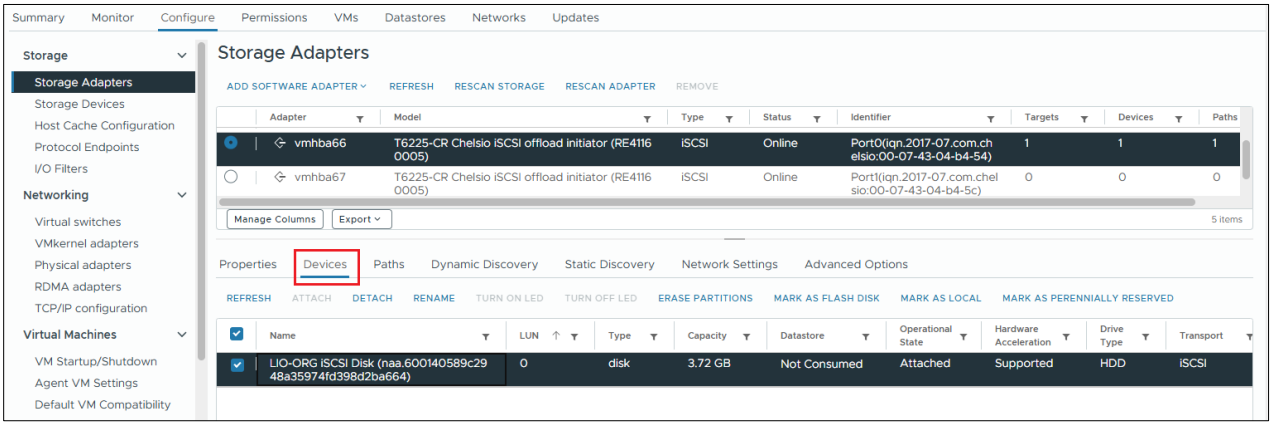


ii. Click **Add** and provide the target server IP and target IQN. Click **OK**.

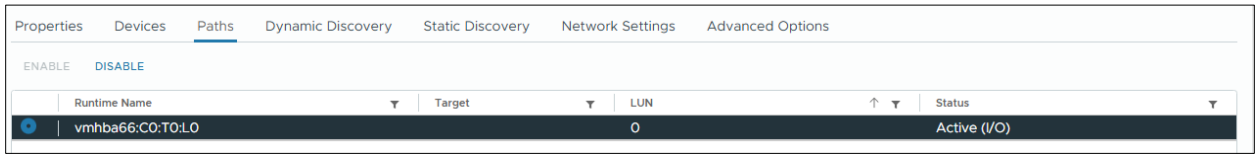


iii. To apply the changes, rescan the iSCSI adapter.

iv. All the available LUNs discovered on the given target server will be displayed in the **Devices** tab. You can perform various tasks like detach, rename, erase partitions, etc.



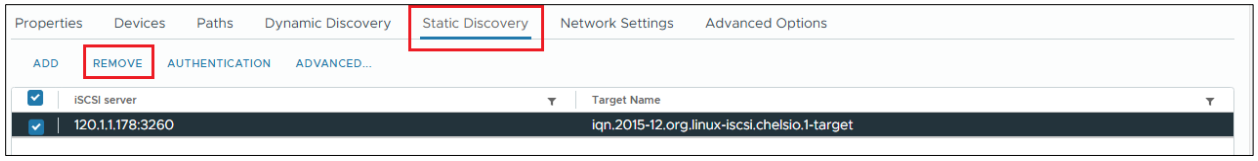
The **Paths** tab displays LUN status and allows you to enable or disable them.



These LUNs can now be attached to VMs or can be used to store VMs.

- **Removing Target Server**

i. Under **Static Discovery** tab, select the target server, click **Remove** and then **OK** to confirm.

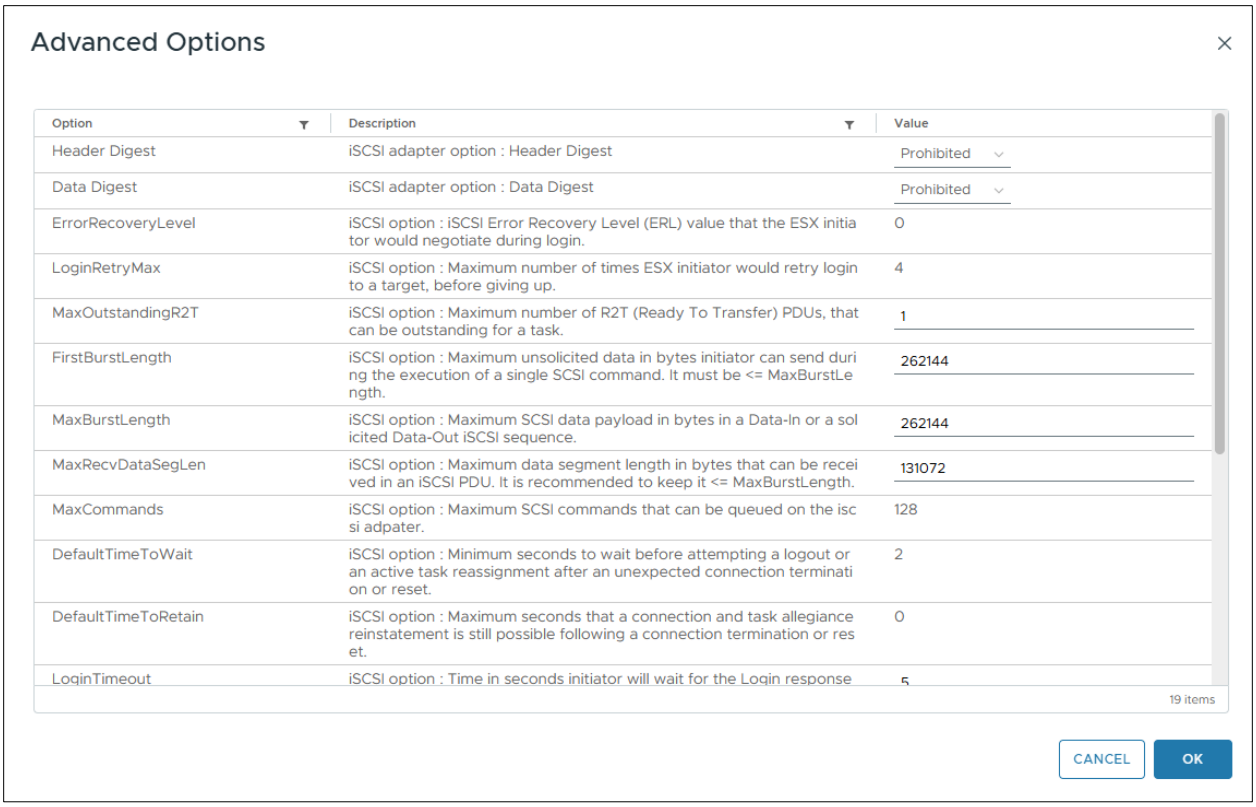


ii. To apply the changes, rescan the iSCSI adapter.

3.3. Configurable Options

The option to edit general initiator properties like alias and name is available under the **Properties** tab.

Advanced parameters like Digest, MTU, etc., can be changed in the **Advanced Options** tab.


Advanced Options
Option
Description
Value
Header Digest
iSCSI adapter option : Header Digest
Prohibited
Data Digest
iSCSI adapter option : Data Digest
Prohibited
ErrorRecoveryLevel
iSCSI option : iSCSI Error Recovery Level (ERL) value that the ESX initiator would negotiate during login.
0
LoginRetryMax
iSCSI option : Maximum number of times ESX initiator would retry login to a target, before giving up.
4
MaxOutstandingR2T
iSCSI option : Maximum number of R2T (Ready To Transfer) PDUs, that can be outstanding for a task.
1
FirstBurstLength
iSCSI option : Maximum unsolicited data in bytes initiator can send during the execution of a single SCSI command. It must be <= MaxBurstLength.
262144
MaxBurstLength
iSCSI option : Maximum SCSI data payload in bytes in a Data-In or a solicited Data-Out iSCSI sequence.
262144
MaxRecvDataSegLen
iSCSI option : Maximum data segment length in bytes that can be received in an iSCSI PDU. It is recommended to keep it <= MaxBurstLength.
131072
MaxCommands
iSCSI option : Maximum SCSI commands that can be queued on the iscsi adpater.
128
DefaultTimeToWait
iSCSI option : Minimum seconds to wait before attempting a logout or an active task reassignment after an unexpected connection termination or reset.
2
DefaultTimeToRetain
iSCSI option : Maximum seconds that a connection and task allegiance reinstatement is still possible following a connection termination or reset.
0
LoginTimeout
iSCSI option : Time in seconds initiator will wait for the Login response
5
19 items
CANCEL
OK

4. Software/Driver Unloading

Logout all the existing iSCSI sessions. Execute the command below to unload the iSCSI Offload Initiator driver:

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

```
[root@KGF2:~] vmkload_mod -u cheiscsi
Module cheiscsi successfully unloaded
```

IV. iSER Offload Initiator Driver

1. Introduction

The iSCSI Extensions for RDMA (iSER) protocol is a translation layer for operating iSCSI over RDMA transports, such as iWARP RDMA. Chelsio Unified Wire adapters supporting iWARP provide the higher bandwidth and lower latency required for block storage transfers. iSER is stable and provides benefits of the iSCSI protocol like security and high availability.

1.1. Hardware Requirements

1.1.1. Supported Adapters

The following are the adapters that are compatible with Chelsio iSER Offload Initiator driver:

- T62100-CR
- T62100-LP-CR
- T6425-CR
- T6225-CR
- T6225-LL-CR
- T6225-SO-CR (*Memory Free; 256 IPv4/128 IPv6 offload connections supported*)
- T580-CR
- T580-LP-CR
- T540-CR
- T540-LP-CR
- T540-BT
- T520-CR
- T520-LL-CR
- T520-BT

2. Software/Driver Loading

After rebooting the ESXi Host, the driver loads automatically. However, it is possible to manually load the driver.

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

Execute the following command, so that the device manager performs a rescan:

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

3. Software/Driver Configuration and Fine-tuning

The following sections describe the method to configure Chelsio iSER Offload Initiator and connect to target.

3.1. Configuring Initiator

i. Enable the iSER adapter.

```
[root@host:~] esxcli rdma iser add
```

Note *This is not persistent across reboots. To make it persistent, add the above command to /etc/rc.local.d/local.sh file.*

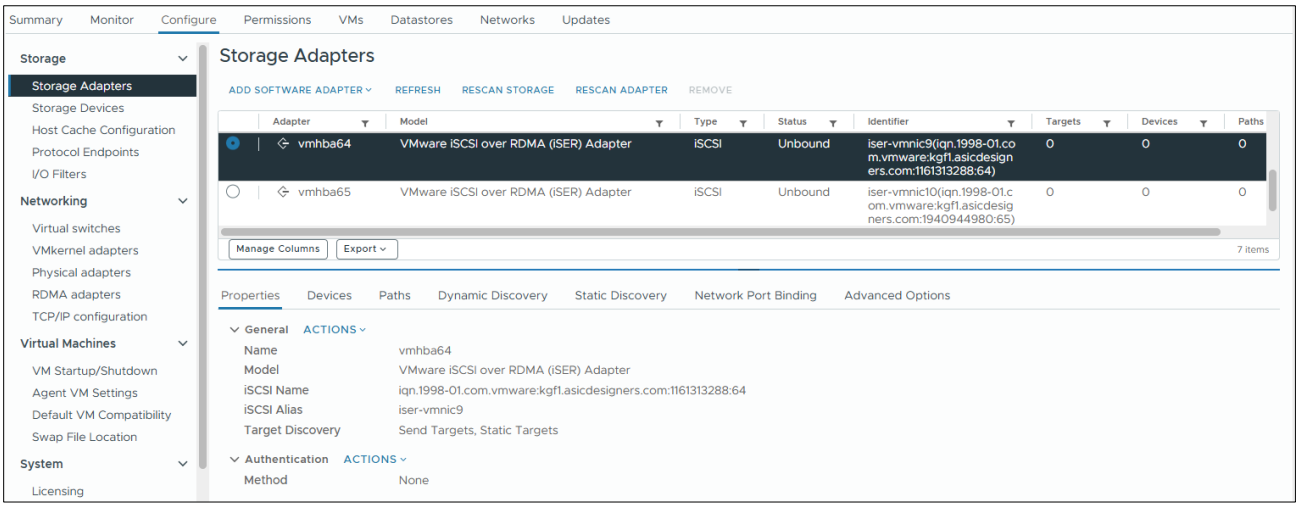
ii. Log in to vCenter Server through vSphere Web Client using a web browser.

iii. If you have already created and configured the host intended to be used as initiator, skip to step (iv).

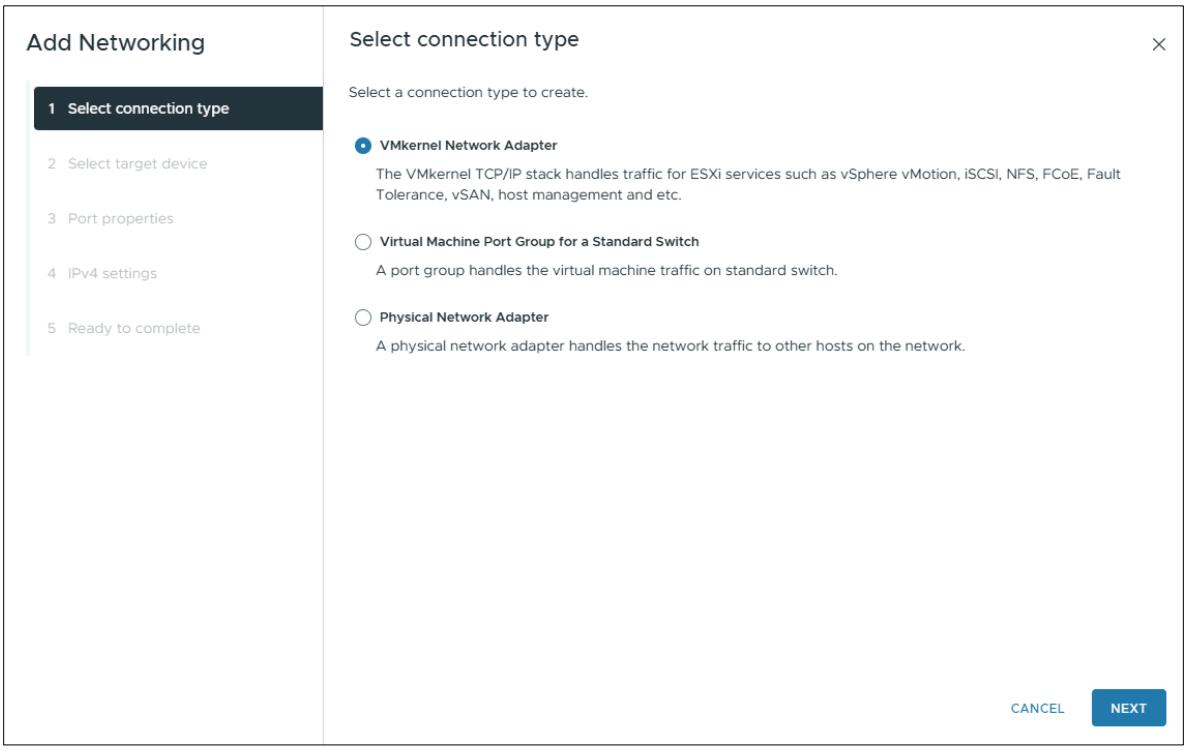
   a. Under **Hosts and Clusters**, right-click and click **New Datacenter…** Provide a name and Click **OK**.

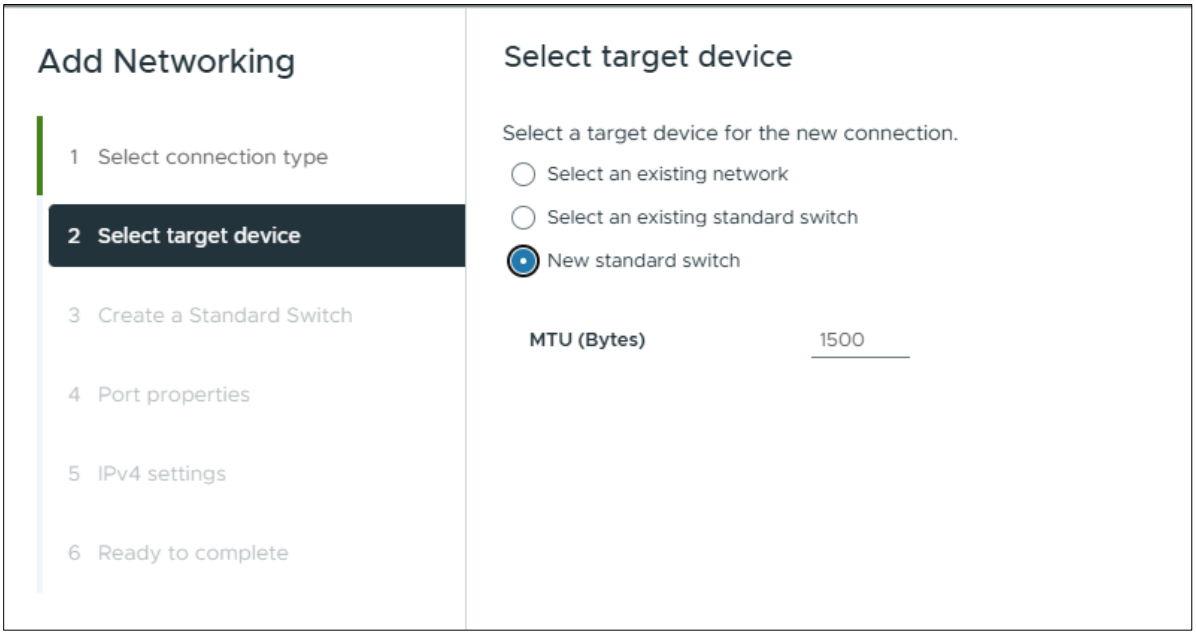
   b. Right-click on the newly created datacenter and click **Add Host...** Follow the onscreen instructions and provide information to add the host. Click **Finish**.

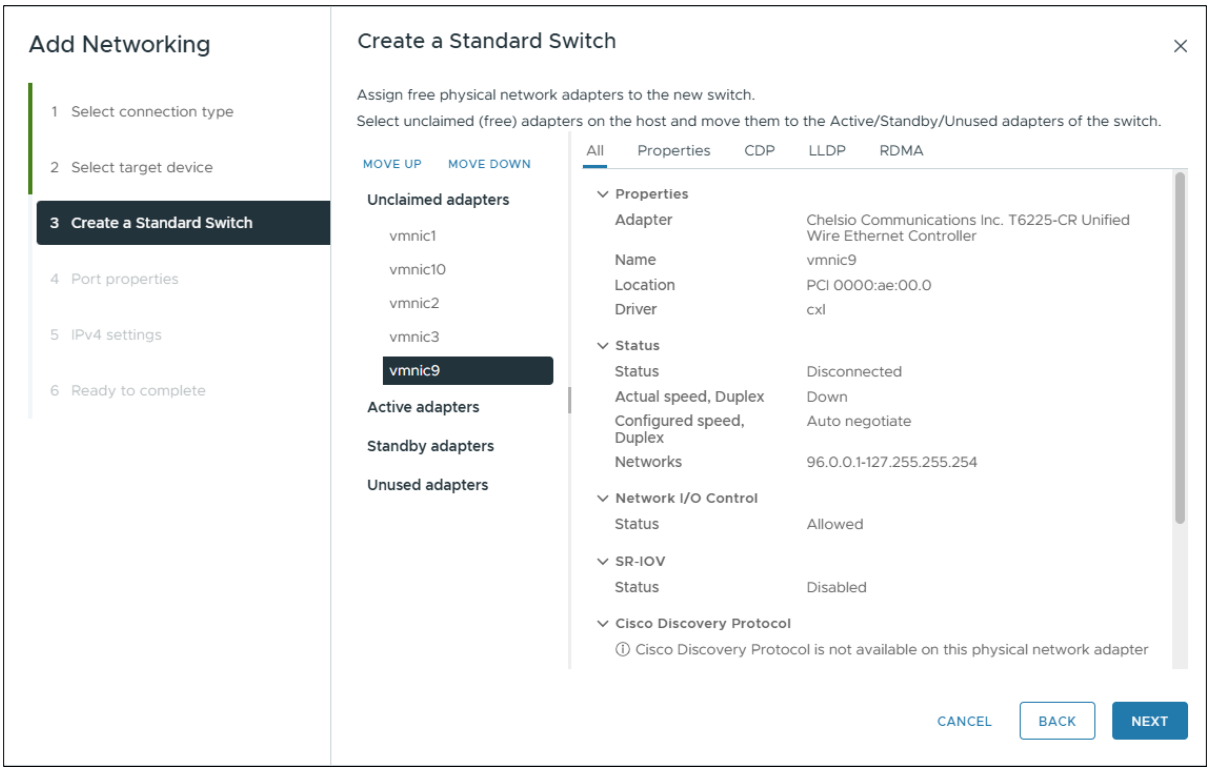
iv. Select the host and under the **Configure** tab, select **Storage Adapters**. This displays the list of available iSER adapters.



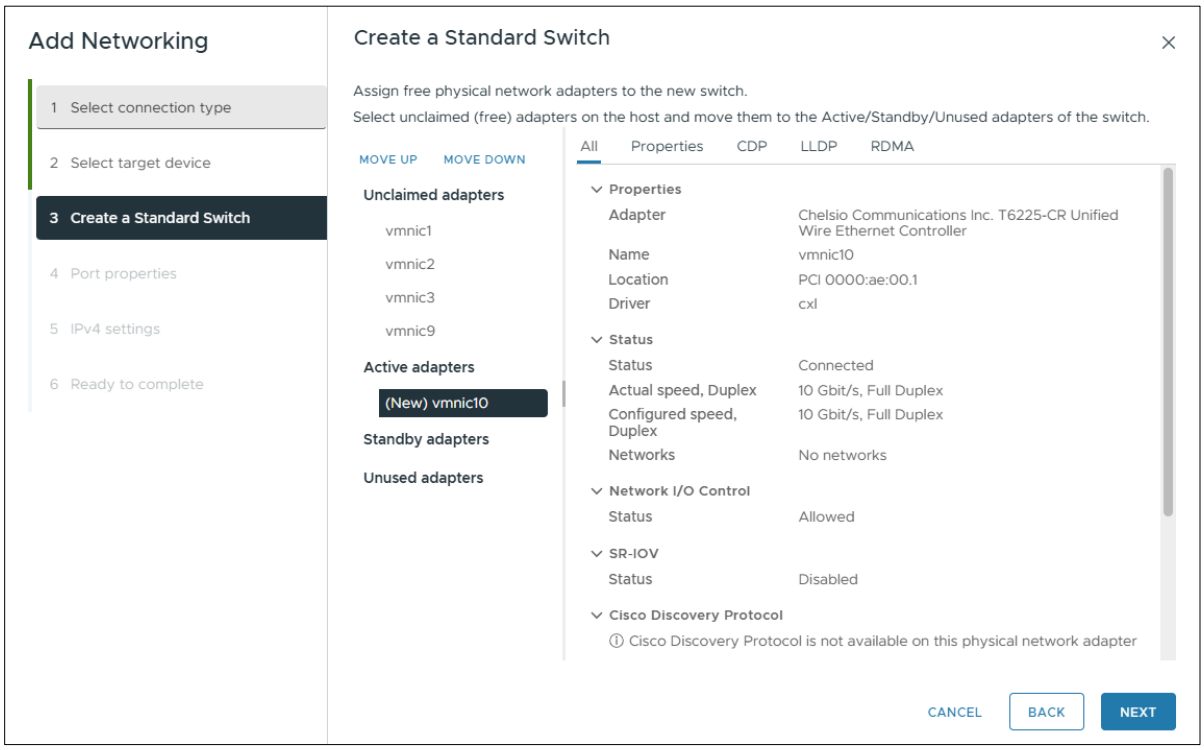
v. Create a VMkernel adapter connected to Chelsio uplink by following the screenshots below.



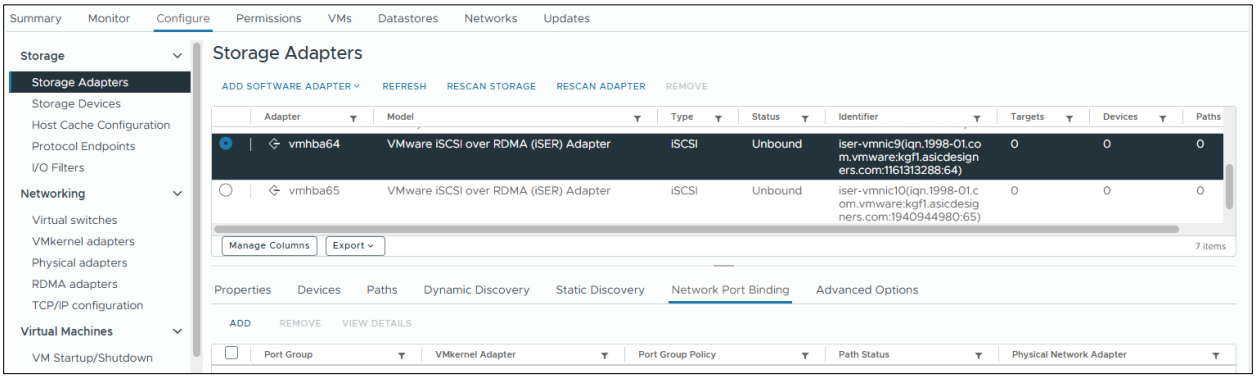


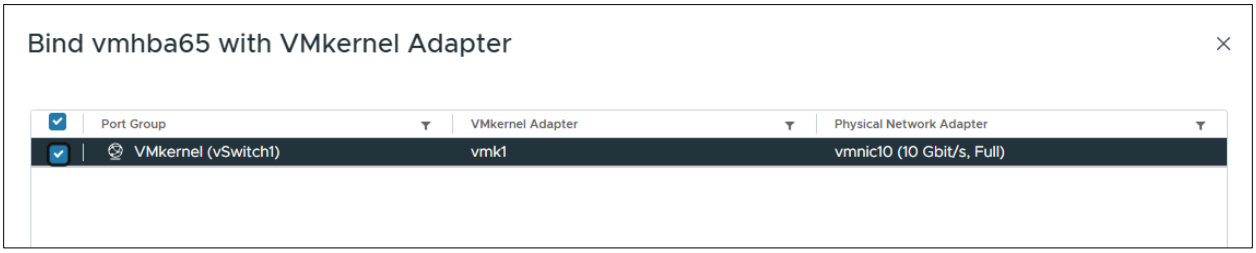


vi. Move the Chelsio ports to be used in the vSwitch to the **Active Adapters** section.

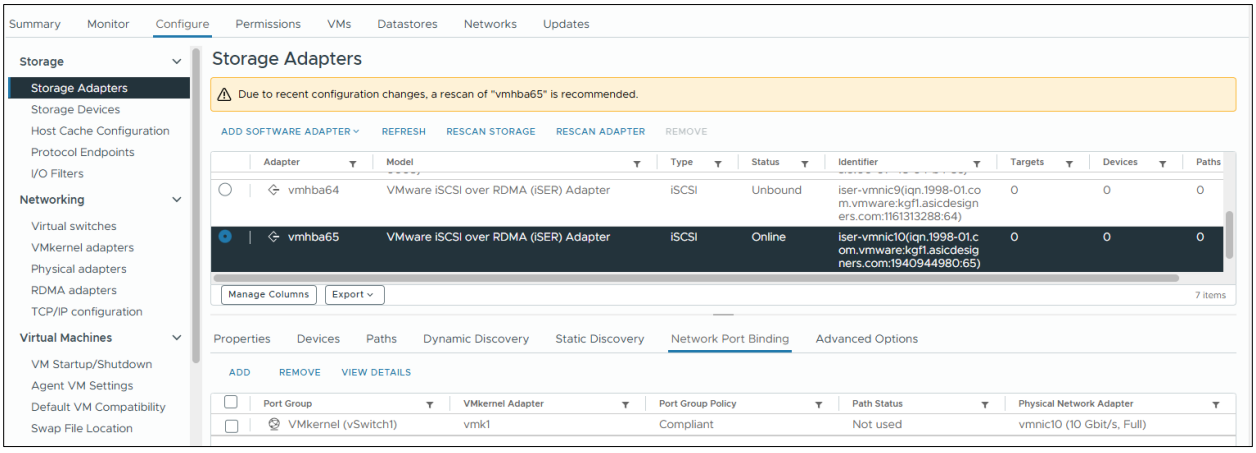


vii. Bind the VMkernel adapter to the VMware iSER Adapter.





viii. To apply the changes, click **RESCAN ADAPTER**. The status should show **Online**.



Note *Ensure that the VMkernel NIC is associated with a vSwitch containing only a single physical vmnic, as each physical vmnic maps to a distinct iSER vmhba adapter in ESXi.*

3.2. Connecting to Target

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

Important *Enable iwpmd service on the target machine. On RHEL7.X machines, use the following command:*

```
[root@host~]# systemctl start iwpmd
```

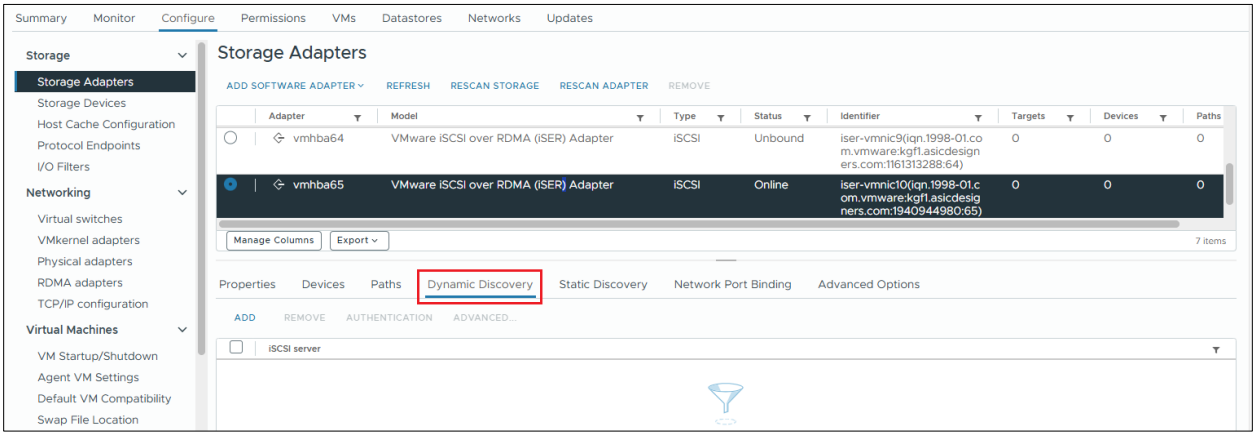
There are two methods to discover and connect to targets:

- **Dynamic Discovery:** Discovers all the available targets for a given target server.
- **Static Discovery:** Discovers a specific target by manually entering target information.

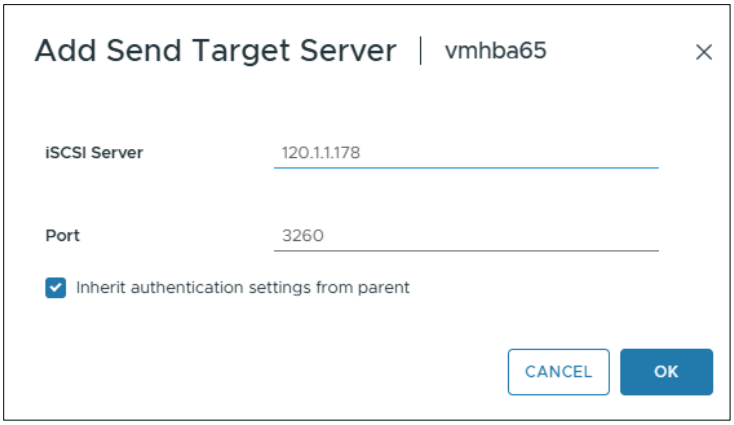
3.2.1. Dynamic Discovery

- **Adding Target Server**

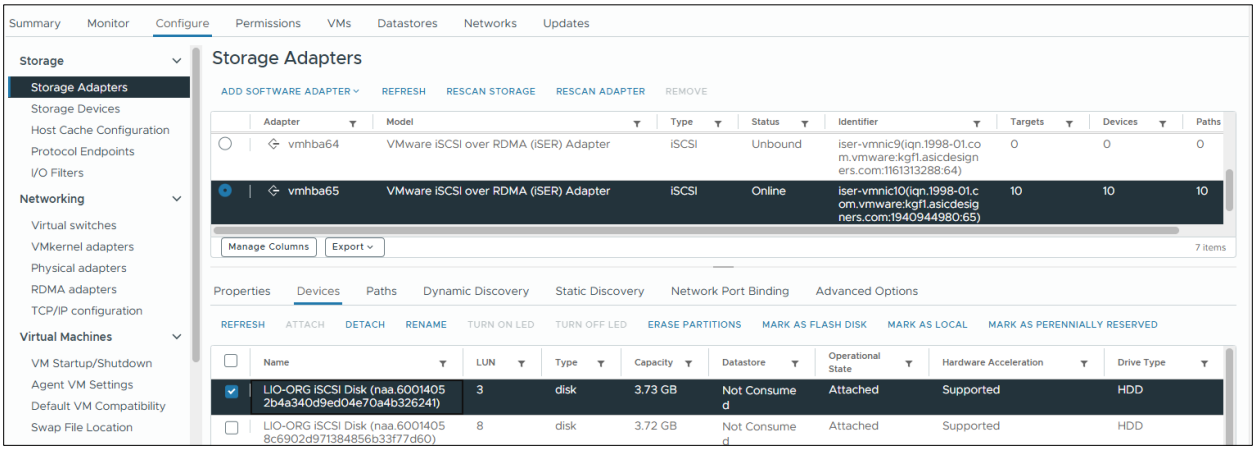
i. Select the iSER adapter to connect to the target and select **Dynamic Discovery.**



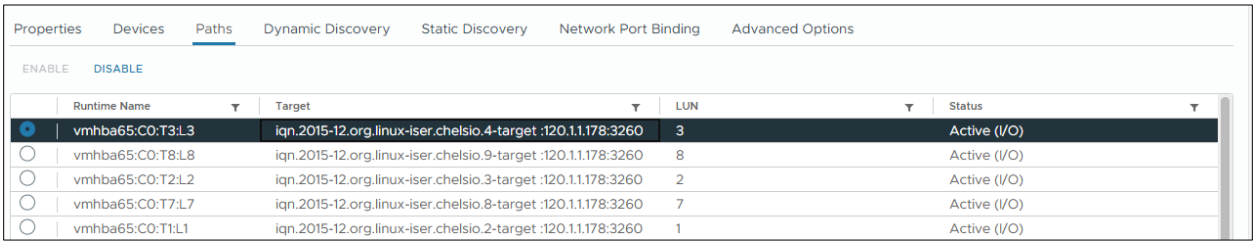
ii. Click **Add** and provide the target server IP. Click **OK**.



iii. To apply the changes, click **RESCAN ADAPTER**.
iv. All the available LUNs discovered on the given target server will be displayed in the **Devices** tab. You can perform various tasks like detach, rename, erase partitions, etc.



The **Paths** tab displays LUN status and allows you to enable or disable them.

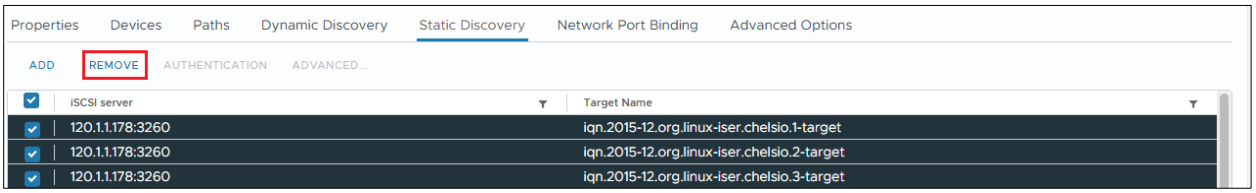


These LUNs can now be attached to VMs or can be used to store VMs.

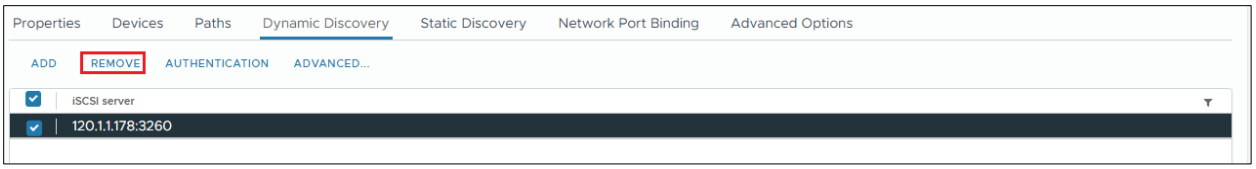
- **Removing Target Server**

During **Dynamic Discovery**, iSER targets also appear as static targets and need to be removed from the **Static** list.

i. Go to the **Static Discovery** tab, and select all the target iSCSI servers.
ii. Click **Remove** and then **OK** to confirm.



iii. Go to the **Dynamic Discovery** tab, and select all the target iSCSI servers.
iv. Click **Remove** and then **OK** to confirm.

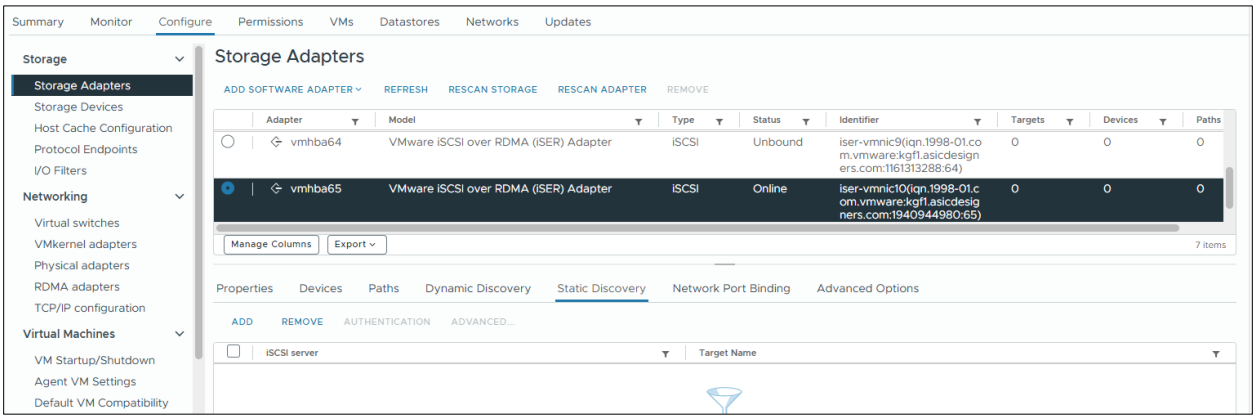


v. To apply the changes, rescan the iSER adapter.

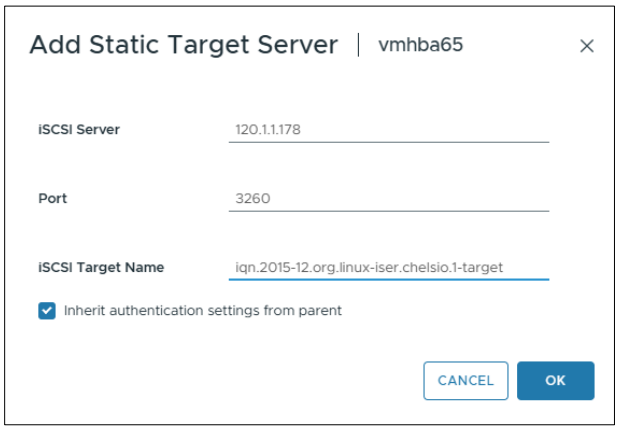
3.2.2. Static Discovery

- **Adding Target Server**

i. Select the iSER interface to connect to the target and select **Static Discovery** tab**.**

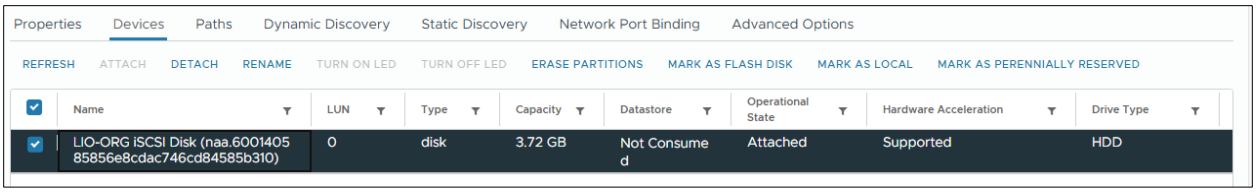


ii. Click **Add** and provide the target server IP and target IQN. Click **OK**.

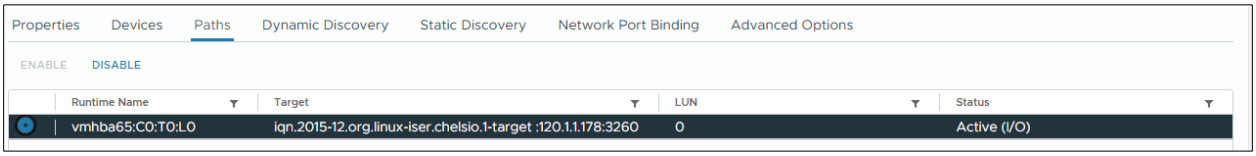


iii. To apply the changes, rescan the iSER adapter.

iv. All the available LUNs discovered on the given target server will be displayed in the **Devices** tab. You can perform various tasks like detach, rename, erase partitions, etc.



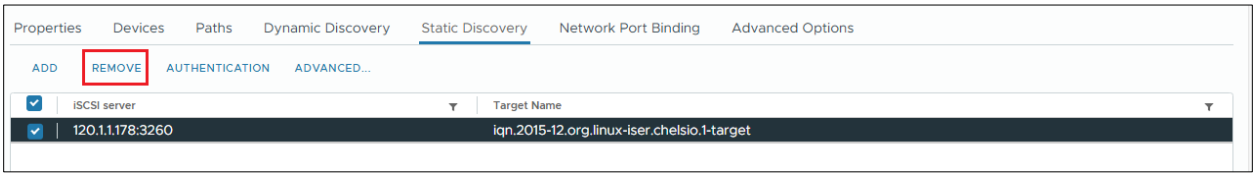
The **Paths** tab displays LUN status and allows you to enable or disable them.



These LUNs can now be attached to VMs or can be used to store VMs.

- **Removing Target Server**

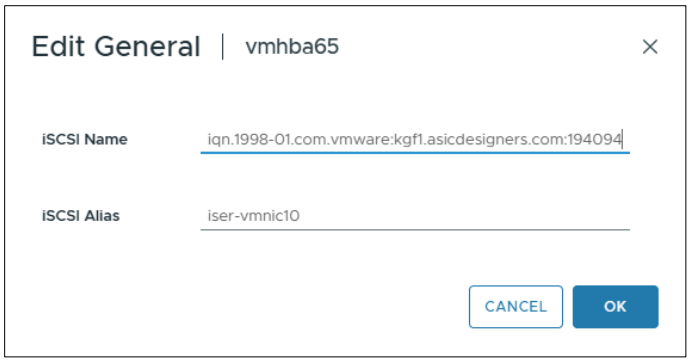
i. Select the target server in **Static Discovery** tab.
ii. Click **Remove** and then **Yes** to confirm.



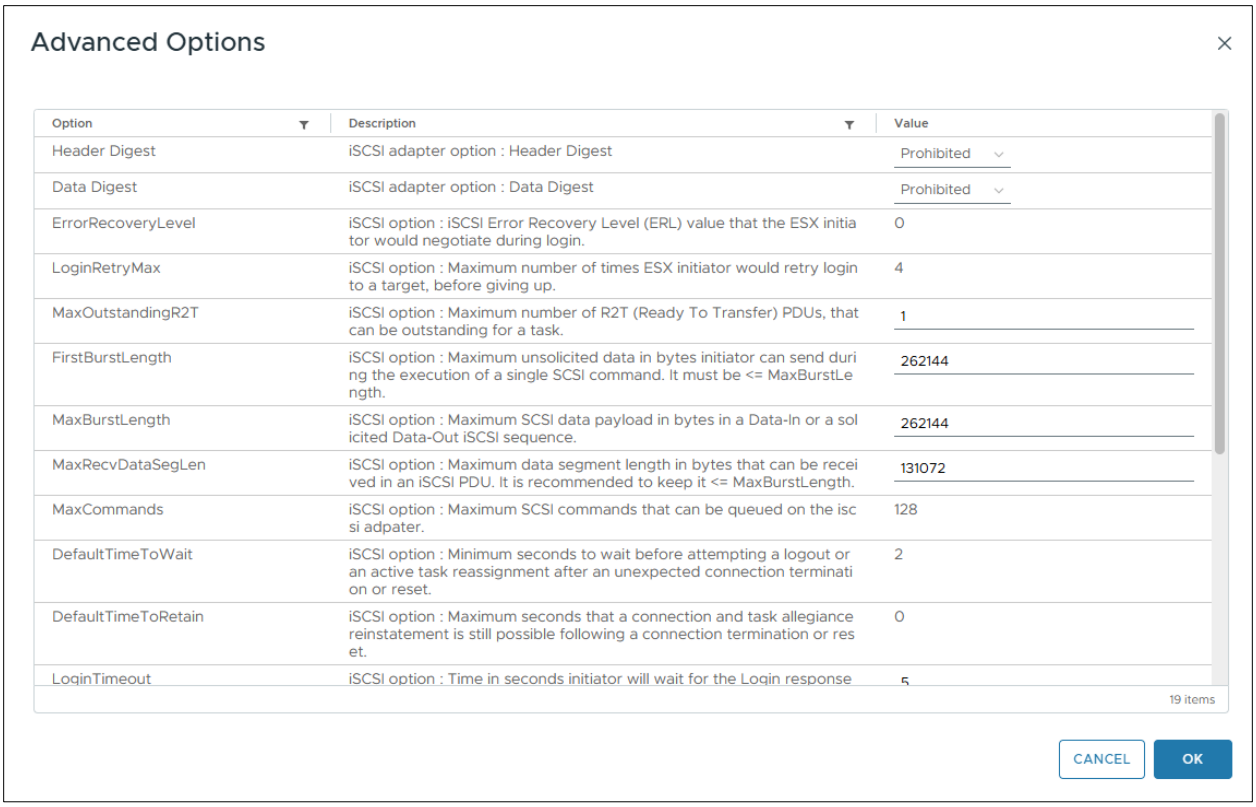
iii. To apply the changes, rescan the iSER adapter.

3.3. Configurable Options

The option to edit general initiator properties like alias and name is available under the **Properties** tab.



Advanced parameters like Digest, MTU, etc., can be changed in the **Advanced Options** tab.


Advanced Options
Option
Description
Value
Header Digest
iSCSI adapter option : Header Digest
Prohibited
Data Digest
iSCSI adapter option : Data Digest
Prohibited
ErrorRecoveryLevel
iSCSI option : iSCSI Error Recovery Level (ERL) value that the ESX initiator would negotiate during login.
0
LoginRetryMax
iSCSI option : Maximum number of times ESX initiator would retry login to a target, before giving up.
4
MaxOutstandingR2T
iSCSI option : Maximum number of R2T (Ready To Transfer) PDUs, that can be outstanding for a task.
1
FirstBurstLength
iSCSI option : Maximum unsolicited data in bytes initiator can send during the execution of a single SCSI command. It must be <= MaxBurstLength.
262144
MaxBurstLength
iSCSI option : Maximum SCSI data payload in bytes in a Data-In or a solicited Data-Out iSCSI sequence.
262144
MaxRecvDataSegLen
iSCSI option : Maximum data segment length in bytes that can be received in an iSCSI PDU. It is recommended to keep it <= MaxBurstLength.
131072
MaxCommands
iSCSI option : Maximum SCSI commands that can be queued on the iscsi adpater.
128
DefaultTimeToWait
iSCSI option : Minimum seconds to wait before attempting a logout or an active task reassignment after an unexpected connection termination or reset.
2
DefaultTimeToRetain
iSCSI option : Maximum seconds that a connection and task allegiance reinstatement is still possible following a connection termination or reset.
0
LoginTimeout
iSCSI option : Time in seconds initiator will wait for the Login response
5
19 items
CANCEL
OK

4. Software/Driver Unloading

Logout all the existing iSER sessions. Execute the following command to unload the iSER Offload Initiator driver:

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

V. 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-CR
- T62100-LP-CR
- T6425-CR
- T6225-CR
- T6225-LL-CR
- T6225-SO-CR (*Memory Free; 256 IPv4/128 IPv6 offload connections supported*)
- T580-CR
- T580-LP-CR
- T540-CR
- T540-LP-CR
- T540-BT
- T520-CR
- T520-LL-CR
- T520-BT

2. Software/Driver Loading

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

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

Execute the following command, so that the device manager performs a rescan:

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

3. Software/Driver Configuration and Fine-tuning

3.1. Connecting to NVMe target

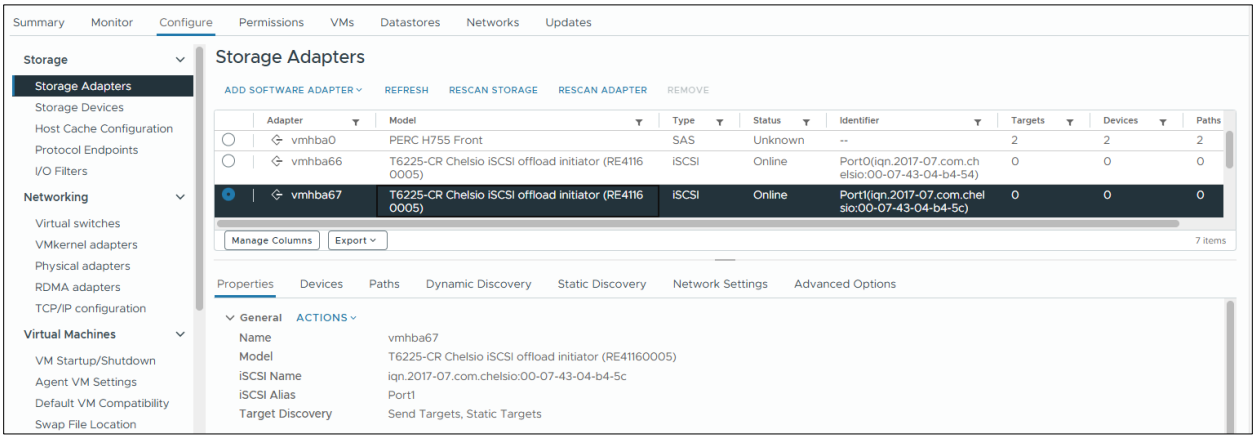
Configure the NVMe target machine with the IP Address, Target name, disks etc. For information on how to configure the NVMe Target, refer to the *Chelsio Unified Wire for Linux User Guide*.

Important *Disable iwpmd service on the target machine. On RHEL7.X machines, use the following command:*

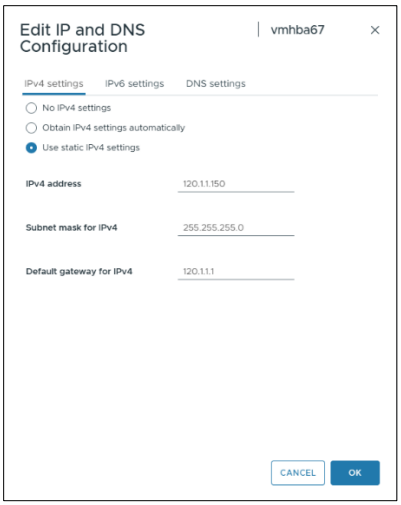
```
[root@host~]# systemctl stop iwpmd
```

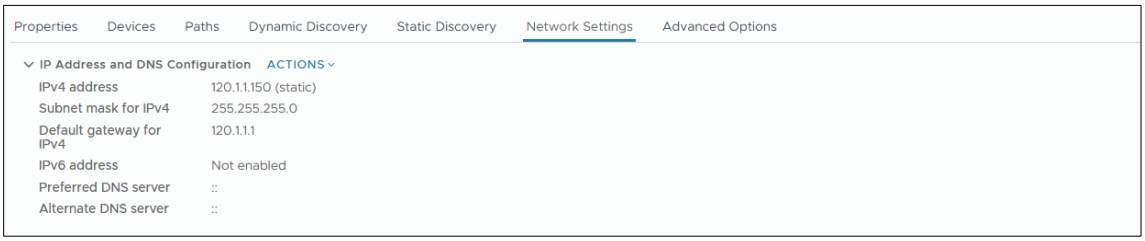
Follow the below procedure on NVMe Initiator machine to connect to the target:

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 displays the list of available Chelsio storage adapters.



iv. In the **Adapter Details** section, click **Network Settings** tab and then **Edit**.
v. Configure IPv4 address for the adapter and click **OK**.





vi. Use the following command to configure the IPv6 address:

```
[root@host:~] /opt/chelsio/bin/cxgbtool -c chnet -set -6 -ipaddr <IPv6
address> -gw <IPv6 gateway> -plen <subnet mask> -p <port>
```

```
[root@localhost:~] /opt/chelsio/bin/cxgbtool -c chnet -set -6 -ipaddr 2000::79 -gw 2000::1 -plen 64 -p 0
Setting chnet Configuration:
        Adapter name : vmhba64
        Node id      : 0
        Operation    : Setting Ipv6
        IP           : 2000::79
        prefix len   : 64
        Gateway      : 2000::1
        Status       : Success
```

vii. Discover the target.

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

```
[root@localhost:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport 4420 -ipaddr 10.200.200.5 -p 0 -D
process_nvmf_resp status 0x0 nrec 0x10
0) nvm subsys nvme-ram0 ctrl id 0xffff addr 10.200.200.5
1) nvm subsys nvme-ram1 ctrl id 0xffff addr 10.200.200.5
```

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

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

```
[root@localhost:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport 4420 -ipaddr [1000::146] -p 0 -D
```

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@localhost:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport 4420 -ipaddr 10.200.200.5 -p 0 -L -subnqn nvme-ram0
login status 0
target id 0
```

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

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

ix. List the logged in targets.

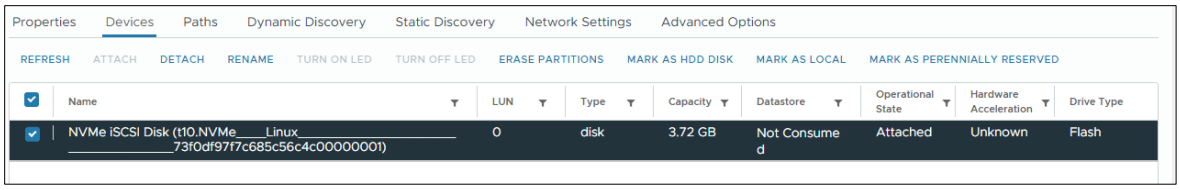
```
[root@host:~] /opt/chelsio/bin/cxgbtool -c nvmf -tlist -p <Chelsio_Port #>
```

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

```
[root@localhost:~] /opt/chelsio/bin/cxgbtool -c nvmf -tlist
0) tgt_id: 0, state: 5, IP: 10.200.200.5, Port: 4420, sub_nqn: nvme-ram0
```

s

x. 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.



3.2. 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 -all
```

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

```
[root@localhost:~] /opt/chelsio/bin/cxgbtool -c nvmf -tport 4420 -ipaddr 10.200.200.5 -p 0 -LT -all
Log out: tgt id 0
Logout status 0
```

4. Software/Driver Unloading

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

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

VI. Appendix

1. Troubleshooting

- ***Logs collection***

In case of any issues, collect the below logs:

- */var/log/vmkernel.log*
- Adapter logs (*dump_file*) using the below command:

```
[root@host:~]/opt/chelsio/bin/cxgbtool -c cudbg -d all -f <dump_file> -a
<adap>
```

```
[root@localhost:~] /opt/chelsio/bin/cxgbtool -c cudbg -d all -f /productLocker/cudbg.dmp -a 0
Writing 51347516 bytes to /productLocker/cudbg.dmp
```

In case of a PSOD, additionally provide the vmkernel zdump from */var/core/* directory.

Please contact Chelsio support at support@chelsio.com with all relevant logs for any issues.

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