Chelsio Communications

Accelerate

Chelsio Unified Wire for Windows

Installation and User's Guide

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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 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 Unified Wire is an easy to use utility developed to provide installation of 64-bit Windows based drivers and tools for Chelsio's adapters. It consists of the following components:

- NDIS Function driver (NIC)
- NVGRE Offload
- VXLAN Task Offload
- Timestamps (Hardware and Software)
- PacketDirect (Kernel Mode and ARM Moderation)
- VMMQ/vRSS
- iWARP (ND)
- SMB Direct
- RDMA with Virtual Switch (Mode 2)
- Storage Spaces Direct (S2D)
- Storage Replica (SR)
- Mesh Topology
- NDIS SR-IOV
- Guest RDMA (Mode 3)
- iSCSI Storport Miniport
- iSER Storport Miniport
- NVMe Storport Miniport
- Data Center Bridging (DCB)

1.2. Hardware Requirements

The Chelsio Unified Wire supports all x64 architectures supporting PCIE (x4, x8, x16) slots.

- AMD CPUs, 64-bit (x86_64/amd64)
- Intel CPUs, 64-bit (x86_64)

Note *The Chelsio Unified Wire supports 3.3v PCI bus only. Running an adapter on a PCI x4 slot is not recommended as performance will be significantly reduced by the limitations of PCI.*

Note *T4 family of adapters are not supported.*

1.3. Software Requirements

The Chelsio Unified Wire software has been developed to run on Windows based platforms. To know more about the complete list of versions supported by each driver/software, please refer their respective sections.

Note *Drivers are WHQL and Azure Stack Certified.*

1.4. Package Contents

Unified Wire Installer

Chelsio Unified Wire comes with an interactive installer and support documentation. The documentation, consisting of README, Release Notes and User's Guide (this document), can be found in the *<system_drive>\ChelsioUwire\docs* directory after installing Chelsio Unified Wire.

Zip Package

The zip package contains driver files, firmware binaries, adapter configuration binaries and support documentation (*docs* folder).

2. Hardware Installation

i. Shutdown/power off your system.
ii. Power off all remaining peripherals attached to your system.
iii. Unpack the Chelsio adapter and place it on an anti-static surface.
iv. Remove the system case cover 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 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. To do so, open **Device Manager** in **Control Panel**.
xiii. Under **Other devices** section, Chelsio adapter should be listed as ***Ethernet Controller.*** If the adapter is not listed, right-click on the system name or click on the **Actions** menu and select ***Scan for hardware changes***

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

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

xiv. Once the Unified Wire package is installed, open **Device Manager** again. Expand **Network adapters** section and now Chelsio adapter should be listed.

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 Ethernet 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

Chelsio Unified Wire can be installed using the Installer or the zip package. Refer the relevant section below depending on the method of installation selected.

Important *If you are planning to install Unified Wire in a cluster, it should be done on all the members. Using different versions of Unified Wire is not supported.*

3.1. Prerequisites

Please make sure that the following requirements are met before installation:

- Latest Microsoft Visual C++ Redistributable packages for Visual Studio (x86 and x64) are required if you are planning to use installer.
- Windows update KB2685811 should be installed on Windows 7 Client and 2008 R2 Server. It will be installed if *Automatic Updates* is configured or can be installed manually from https://www.catalog.update.microsoft.com/Search.aspx?q=KB2685811

3.2. Unified Wire Installer

Chelsio Unified Wire Installer provides two methods of installation: **GUI** or **CLI** mode. GUI mode provides an interactive GUI installer with customizable options. Whereas, CLI mode enables unattended installation of Chelsio drivers and software thereby relieving the user from monitoring the installation process and providing input via dialog boxes.

3.2.1. Enabling Test Signing

In case the drivers in the package are not WHQL certified, follow the steps mentioned below to enable test signing on your system:

i. Goto Start->Run command option, enter "cmd" and press OK. This will open the command prompt utility.
ii. Run the following command:

```
C:\Users\Administrator> bcdedit /set testsigning on
```

iii. Reboot the machine for the changes to take effect.

3.2.2. GUI mode (Installer)

i. Run the **ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe** installer application.
ii. Click **Next** for the Chelsio End User License Agreement Window.

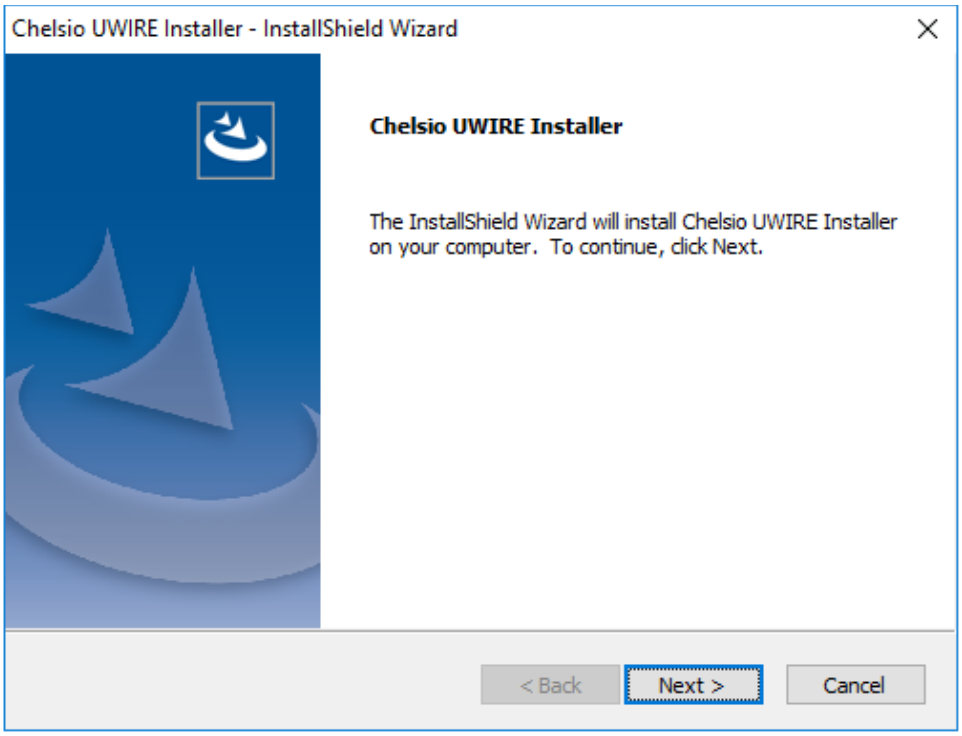

Figure 1 - Unified Wire installer welcome window

iii. Select the radio button **I accept the terms of the license agreement** and click **Next**

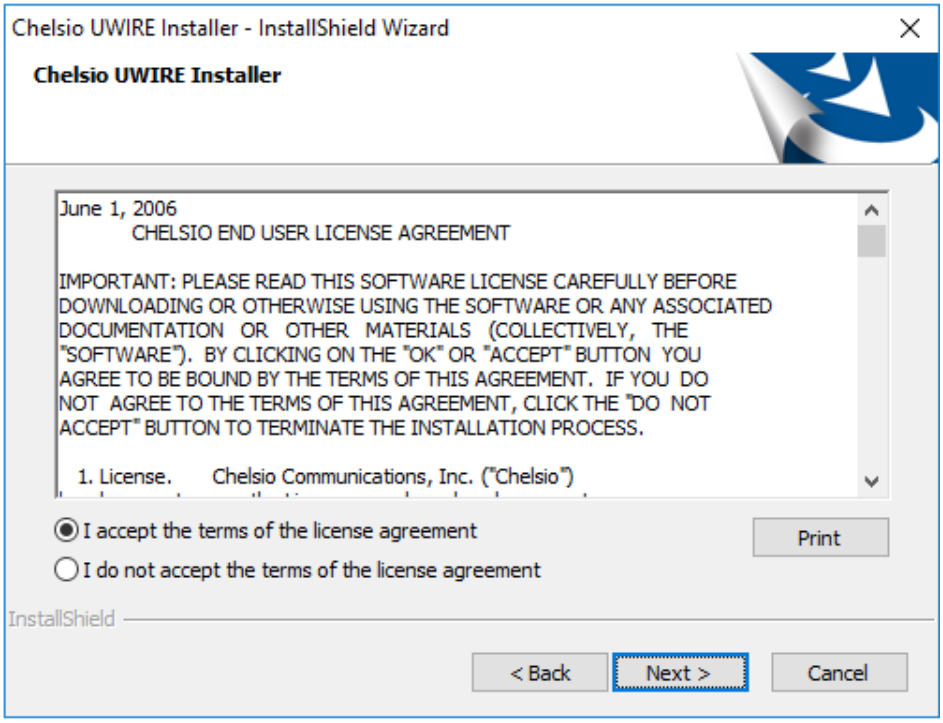

Figure 2 - Chelsio EULA window

iv. Now, either select **Complete** for complete package installation or else select **Custom** radio button to customize the installation.

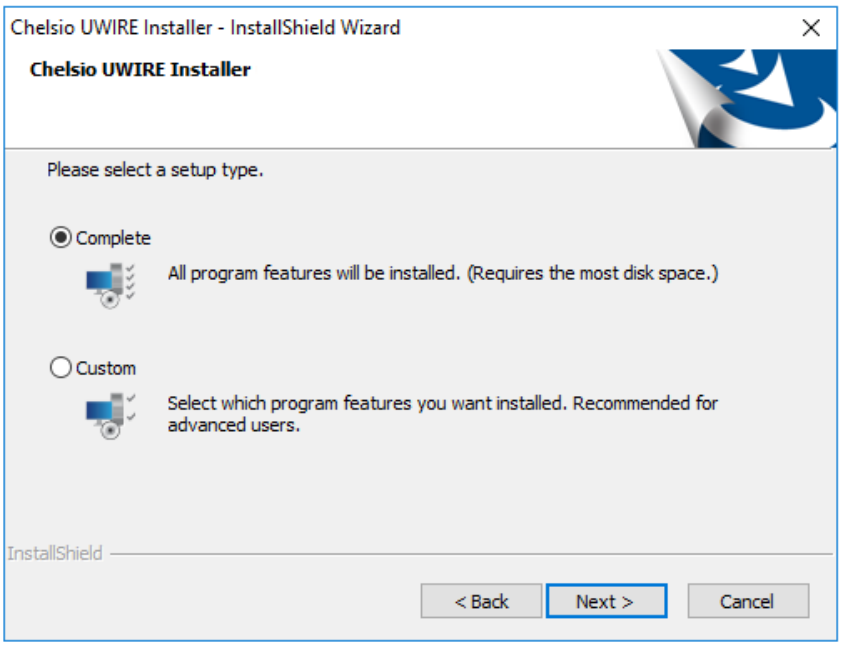

Figure 3 - Select setup (installation) type

Complete option will not install iSCSI, iSER and NVMe Storport Miniport drivers. Use the **Custom** option to install them. Virtual Bus Driver (VBD) and NDIS (NIC) drivers are required for iSER and NVMe Storport Miniport drivers to work, whereas iSCSI Storport Miniport needs VBD to function.

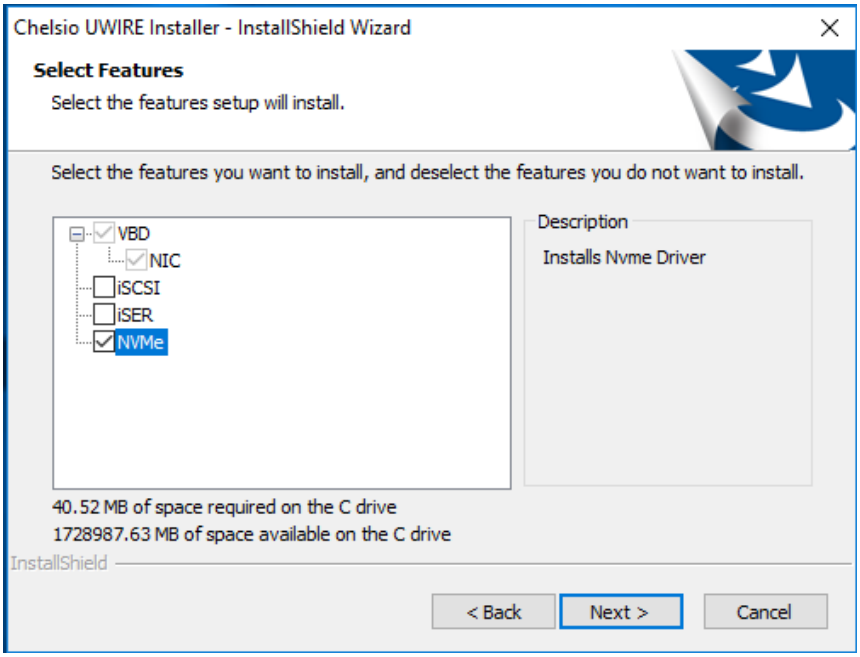

Figure 4 – Custom installation

v. **Set NIC parameters to default values** is auto selected during the installation. Click **Next**.

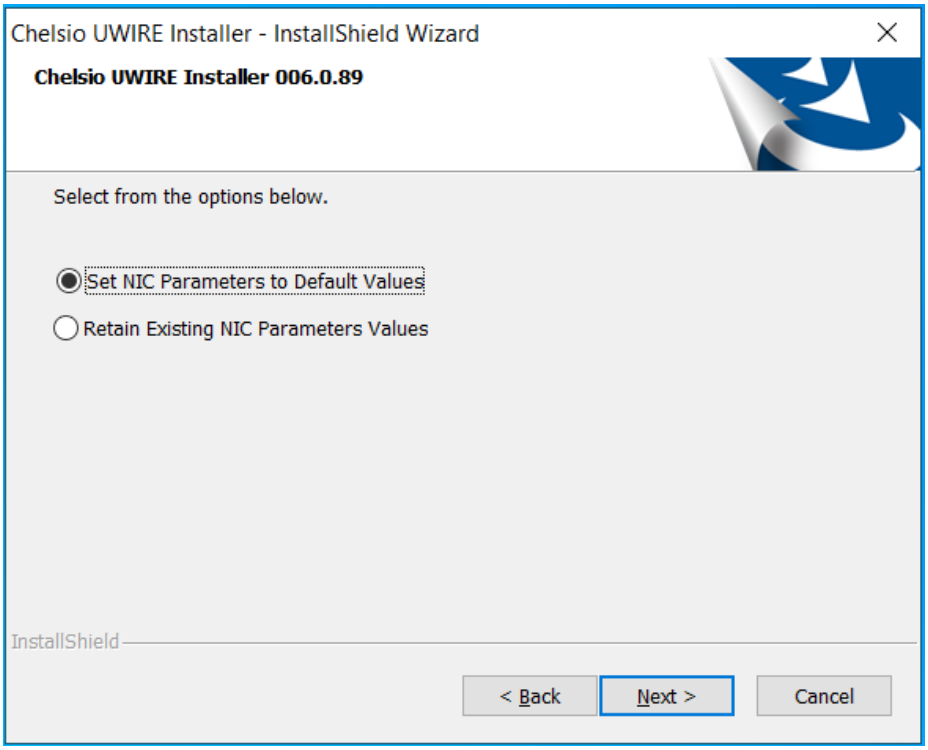

Figure 5 – Handling NIC parameters

vi. Click **Install** to start the installation.

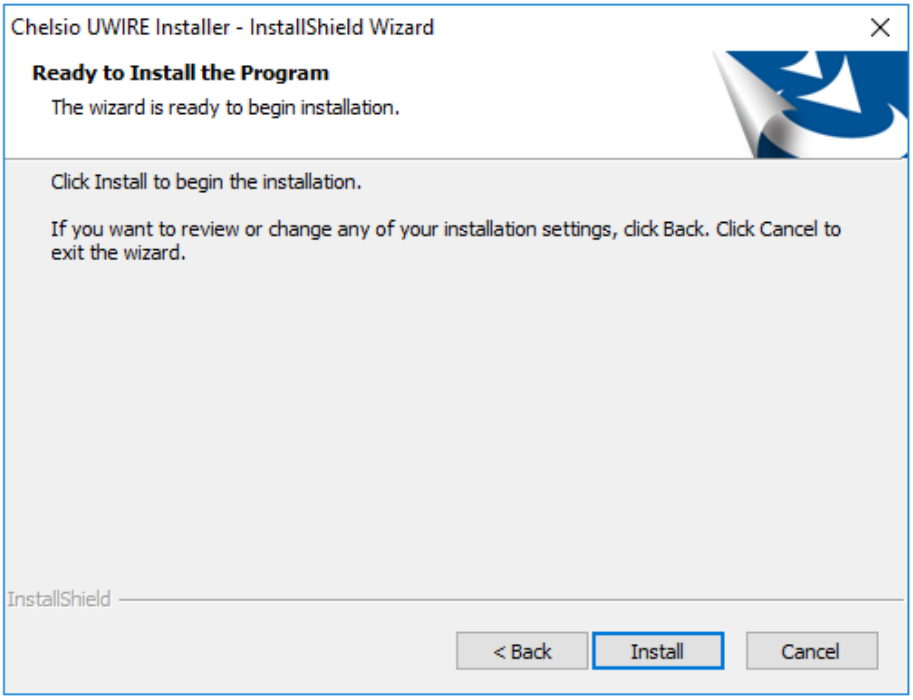

Figure 6 - Start installation

vii. Selected driver components will now be installed.

Figure 7 - Installation in progress

viii. Click **Finish** to exit from the Unified Wire Installer.

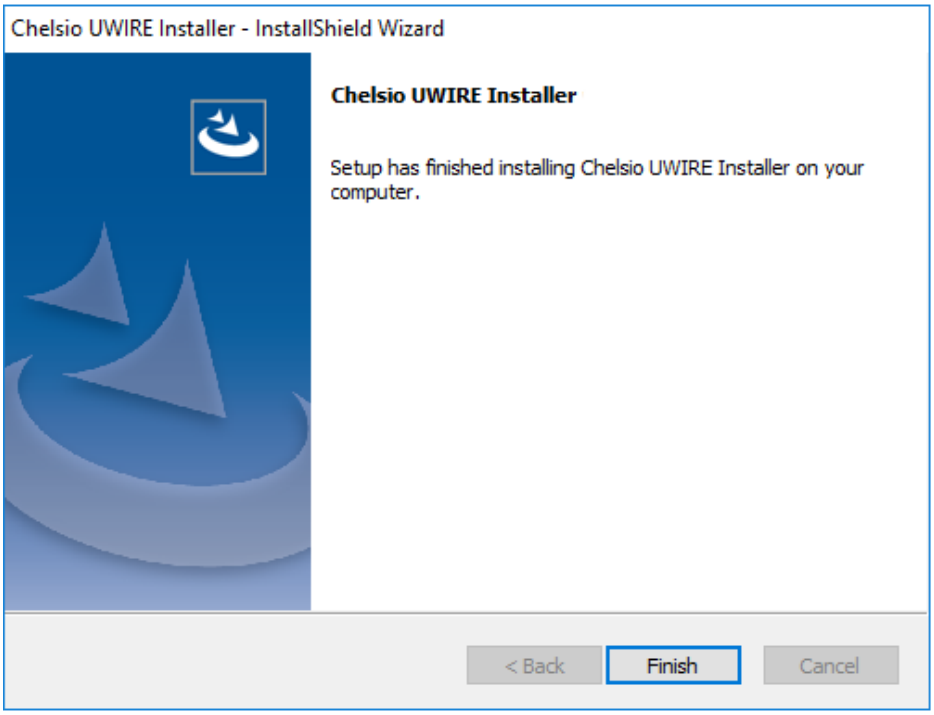

Figure 8 - Finishing Unified Wire installation

3.2.3. CLI mode (Silent Installation)

To install drivers/software using this feature, open **command prompt** and execute the following command:

```
C:\Users\Administrator>ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe –in <driver(s)>
```

E.g.:

```
C:\Users\Administrator>ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe –in all
```

The above command will install all drivers, except iSCSI, iSER and NVMe Storport Miniport drivers.

To install a particular driver (network driver in this case), execute the following command:

```
C:\Users\Administrator>ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe –in nic
```

The NIC parameters will be reset to default values during installation. Existing NIC parameters will be retained during update operation.

To add a driver to an existing list of already installed drivers, use the following command:

```
C:\Users\Administrator>ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe –add
<driver(s)>
```

E.g.: To add iSCSI Storport Miniport driver,

```
C:\Users\Administrator>ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe -add iSCSI
```

To know more about other parameters and options, execute the following command:

```
C:\Users\Administrator>ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe -help
```

The above command will create a help file, *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy_help.txt,* in the present working directory which contains the complete list of command line syntax required for performing all the necessary CLI operations.

Note *A log file, ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.log, is created in the same directory which keeps a record of all the commands executed and their results.*

3.3. Zip Package

Chelsio Unified Wire zip package provides two methods of installation: **Manual** and using **Offline Windows Image**. In Manual method, the driver components must be individually installed using the Device Manager. Using the second method, you can add Chelsio driver components to an offline OS image. The image can then be used to install Windows on your system.

3.3.1. Enabling Test Signing

In case the drivers in the package are not WHQL certified, please follow the steps mentioned below to enable test signing before installing Unified Wire:

i. Open command prompt and run the following command to enable test signing:

```
C:\Users\Administrator>bcdedit /set testsigning on
```

ii. Change your working directory to *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy/Selfsign/* and run the following commands:

```
C:\ChelsioUwire_x.x.x.x_WIN_yyy.y.yy\Selfsign> .\certmgr.exe -add
.\chelsiocert1.cer -s -r LocalMachine root -all
C:\ChelsioUwire_x.x.x.x_WIN_yyy.y.yy\Selfsign> .\certmgr.exe -add
.\chelsiocert1.cer -s -r LocalMachine trustedpublisher -all
```

iii. Reboot the machine for the changes to take effect.

3.3.2. Drivers location

The driver files should be manually picked from:

- *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy\drivers\Win19* for Server 2022, 2019 and 11 Client.
- *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy\drivers\Win10* for Server 2016 and 10 Client.

3.3.3. Manual Installation

Important

- *The driver components need to be installed strictly in the order described here. Using any other order is not supported.*
- *Before proceeding, open Device Manager and disable NDIS Miniport driver (Network adapters->Chelsio Network Adapter) followed by Virtual Bus Driver (System devices->Chelsio Bus Enumerator).*

Virtual Bus Driver

i. Open **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on **System Devices**, right click on **Chelsio Bus Enumerator** and select **Update Driver Software.**
ii. Select **Browse my computer for driver software**.
iii. Select **Let me pick from a list of device drivers on my computer** and click **Next.**

iv. Click on **Have Disk** Button and on the next screen browse for **chvbdx64.inf** file and click **Open** and then **OK.**
v. Click **Next** and driver installation will progress. Click **Close** once the installation is complete.

NDIS Miniport driver

i. Open **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on **Network Adapters**, right click on the **Chelsio network adapter** and select **Update Driver Software**.
ii. Select **Browse my computer for driver software.**
iii. Select **Let me pick from a list of device drivers on my computer.**
iv. Click on **Have Disk** Button and on the next screen browse for **chnetx64.inf** and click **Open** and then **OK.**
v. Click **Next** and driver installation will progress. Click **Close** once the installation is complete.

Repeat the above steps for the other adapters**.**

iSCSI Storport Miniport driver

i. Open **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on **System Devices**, right click on the **Chelsio Bus Enumerator** and select **Properties.**
ii. Under **Advanced** tab, select **iSCSI Instances** and set the *Value* to **default**. Click **OK**.
iii. Under **Other Devices**, select **Chelsio iScsi Function on Port#00**, right-click and select **Update Driver Software**.
iv. Select **Browse my computer for driver software.**
v. Select **Let me pick from a list of device drivers on my computer** and click **Next.**
vi. Click on **Have Disk** Button and on the next screen, browse for **cht4iscsi.inf** file and click **Open** and then **OK.**
vii. Click **Next** and driver installation will progress. Click **Close** once the installation is complete.

Repeat the same procedure for other ports.

iSER Storport Miniport driver

i. Open **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on **System Devices**, right click on the **Chelsio Bus Enumerator** and select **Properties.**
ii. Under **Advanced** tab, select **iSER Instances** and set the *Value* to **default**. Click **OK**.
iii. Under **Other Devices**, select **Chelsio iSer Function on Port#00**, right-click and select **Update Driver Software**.
iv. Select **Browse my computer for driver software.**
v. Select **Let me pick from a list of device drivers on my computer** and click **Next.**
vi. Click on **Have Disk** Button and on the next screen, browse for **chiserx64.inf** file and click **Open** and then **OK.**
vii. Click **Next** and driver installation will progress. Click **Close** once the installation is complete.

Repeat the same procedure for other ports.

- **NVMe Storport Miniport driver**

i. Open **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on **System Devices**, right click on the **Chelsio Bus Enumerator** and select **Properties.**
ii. Under **Advanced** tab, select **NVMeOF Instances** and set the *Value* to **default**. Click **OK**.
iii. Under **Other Devices**, select **Chelsio NVMeOF Function on Port#00**, right-click and select **Update Driver Software**.
iv. Select **Browse my computer for driver software.**
v. Select **Let me pick from a list of device drivers on my computer** and click **Next.**
vi. Click on **Have Disk** Button and on the next screen, browse for **chnvmfx64.inf** file and click **Open** and then **OK.**
vii. Click **Next** and driver installation will progress. Click **Close** once the installation is complete.

Repeat the same procedure for other ports.

- **Generic Function**

i. Open **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on **System Devices**, right click on **Chelsio Generic Function** and select **Update Driver Software**.
ii. Select **Browse my computer for driver software.**
iii. Select **Let me pick from a list of device drivers on my computer.**
iv. Click on **Have Disk** Button and on the next screen browse for **chnulx64.inf** file and click **Open** and then **OK.**
v. Click **Next** and driver installation will progress. Click **Close** once the installation is complete.

3.3.4. Offline Windows Image

You can use Windows Deployment Image Servicing and Management (DISM) tool to add Chelsio driver components (*.inf* files) to an offline Windows image. For more information, visit the following links:

- http://technet.microsoft.com/en-us/library/hh825070.aspx
- http://blogs.technet.com/b/heyscriptingguy/archive/2012/09/27/use-the-powershell-dism-cmdlets-to-manage-windows-8.aspx

4. Firmware Update

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

```
C:\Users\Administrator>cxgbtool vbd0 debug version
```

In case of installer, the firmware binaries will be copied to *<system_drive>**ChelsioUwire* *Firmware*\ folder during installation.

For zip package, the binaries will be present in *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy**firmware*\ folder.

5. Software/Driver Update

Chelsio Unified Wire can be updated using Installer or zip package. The update method for each is described below.

Important *If you are planning to upgrade Unified Wire in a cluster, it should be done on all the members. Using different versions of Unified Wire is not supported.*

5.1. Unified Wire Installer

i. Run the **ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe** installer application and click **Next**

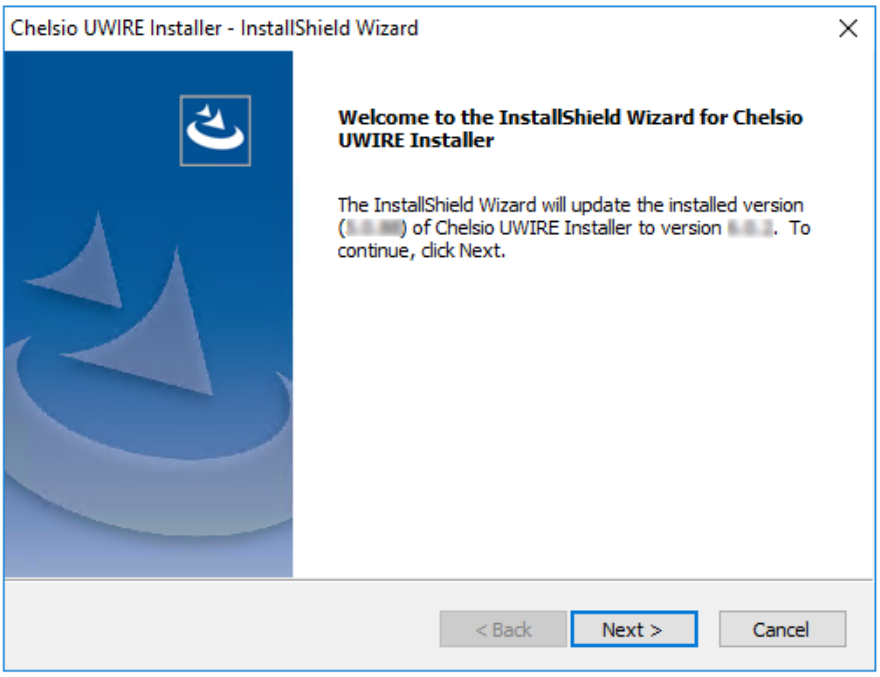

Figure 9 - Unified Wire installer welcome window

ii. **Retain Existing NIC Parameter Values** is selected by default during Update.

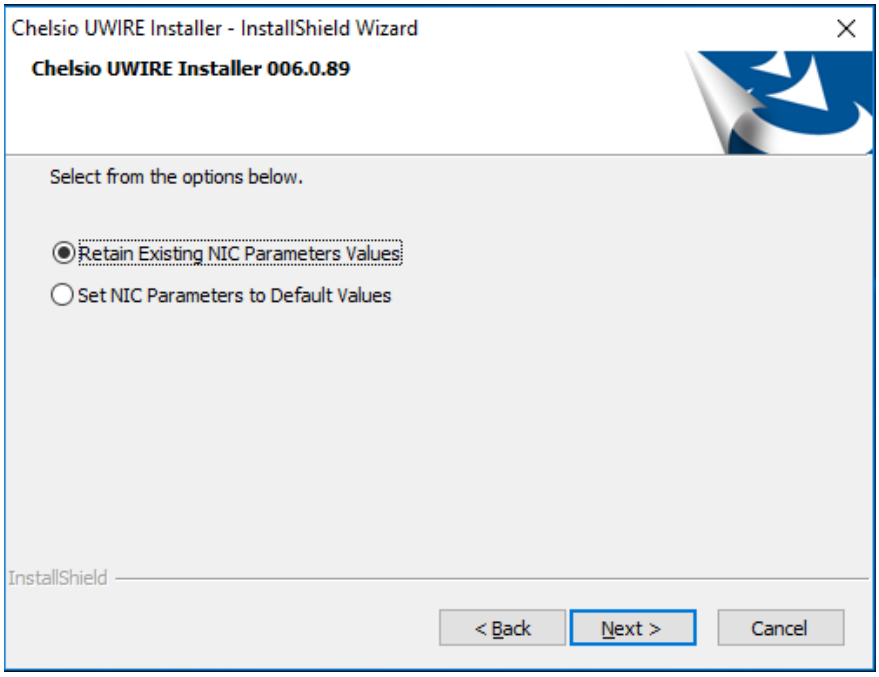

Figure 10 – Handling NIC Parameter Values

iii. Click **Next** to start the update.
iv. Click **Finish** to exit from the Unified Wire Installer.

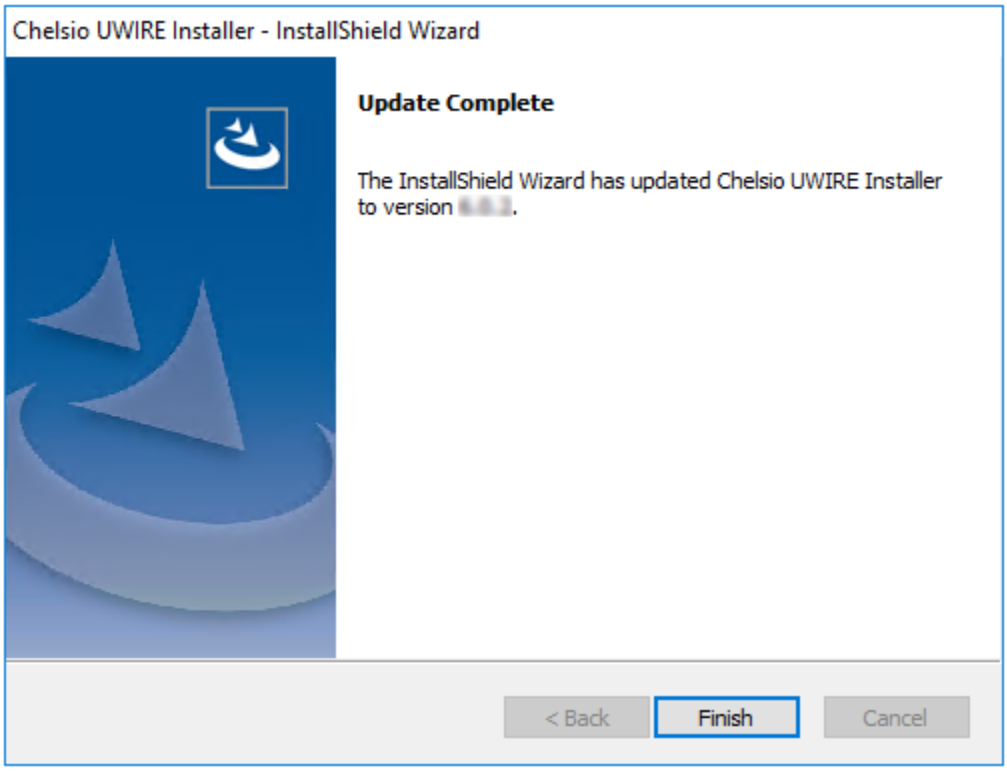

Figure 11 - Finishing Unified Wire update

5.2. Zip Package

The method to update Unified Wire using zip package is same as installation. Refer the installation section for more information.

5.3. Windows Update

Note *This is not supported in the current release.*

i. Make sure that you have an active internet connection.
ii. Open **Device Manager**, click on **System Devices**, right-click on the **Chelsio Bus Enumerator**, and then select **Update Driver Software..**

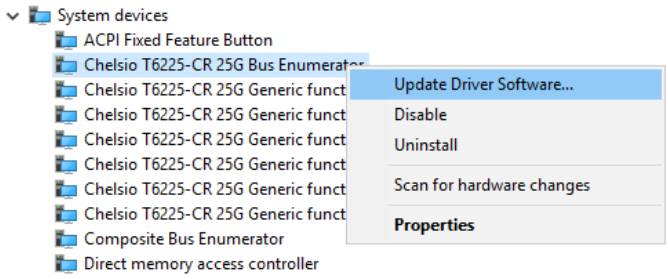

Figure 12 – Updating VBD driver

iii. Select **Search automatically for updated driver software**.

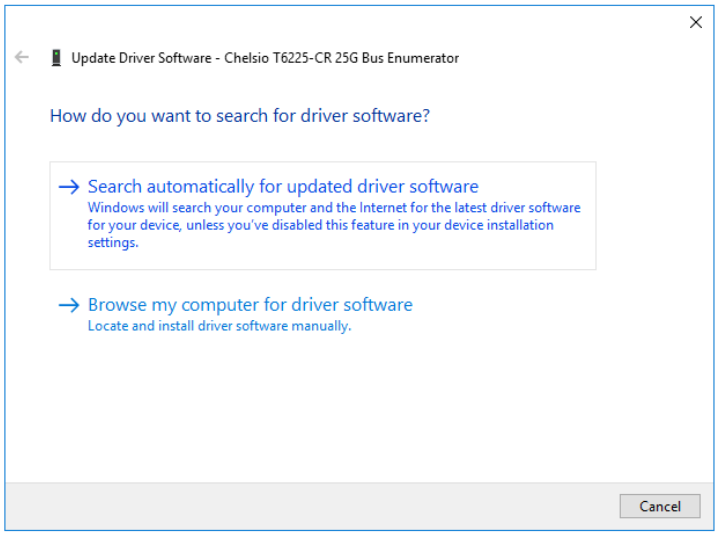

Figure 13 – Searching for driver using Windows update

iv. Windows will search and install the latest driver. Click **Close**.

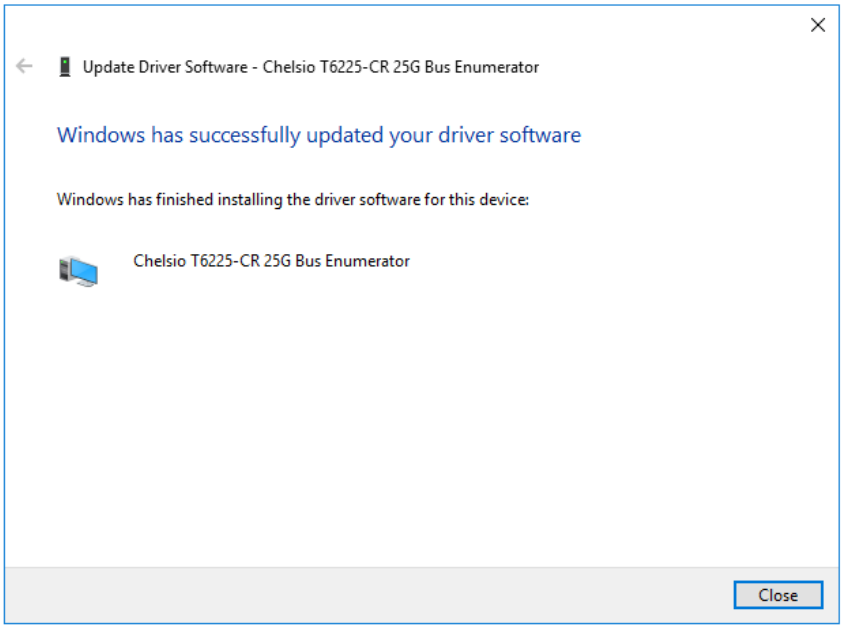

Figure 14 - Driver update successful

v. Click on **Network Adapters**, right-click on **Chelsio Network Adapter** and select **Update Driver Software..**

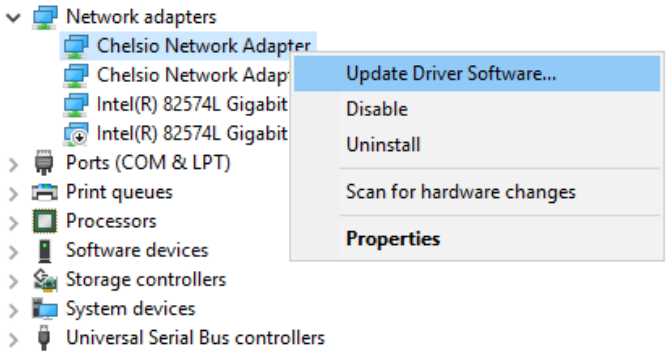

Figure 15 - Updating NDIS driver

vi. Select **Search automatically for updated driver software**

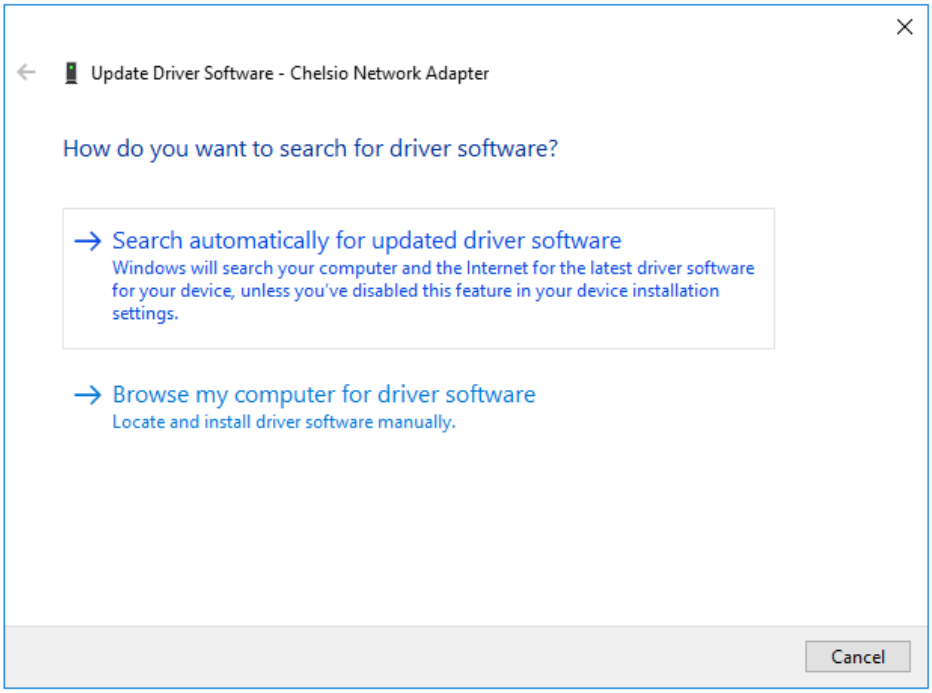

Figure 16- Searching for driver using Windows update

vii. Windows will search and install the latest driver. Click **Close**.

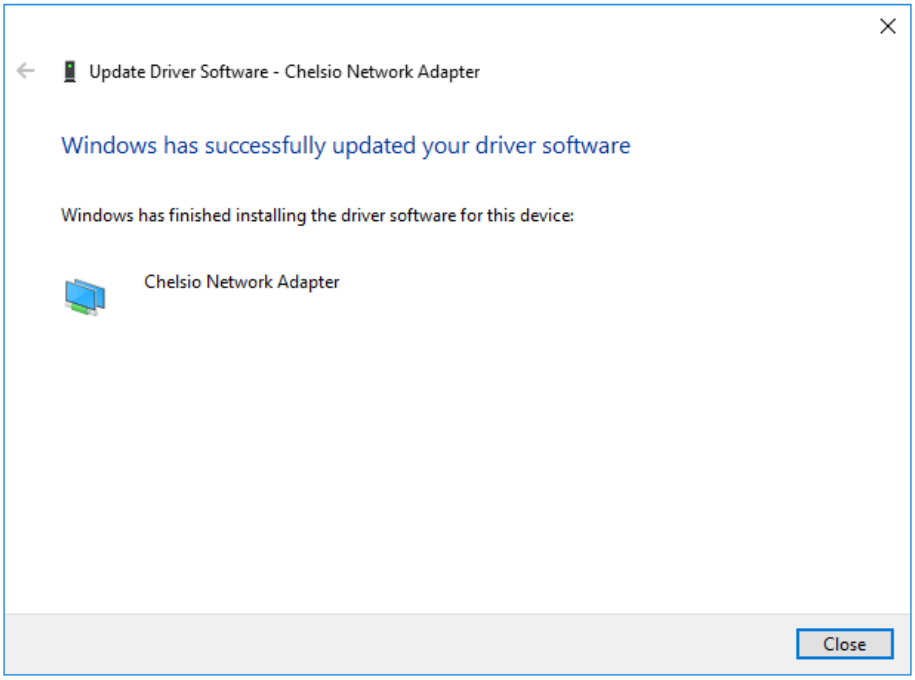

Figure 17 - Driver update successful

viii. Click on **Storage controllers**, right-click on **Chelsio T6 iSCSI Initiator** and select **Update Driver Software..**

Note *If Chelsio iSCSI interface is not listed, verify if you have specified the number of iSCSI instances in VBD parameters.*

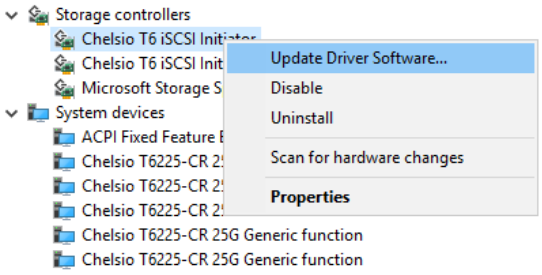

Figure 18 - Updating iSCSI Storport Miniport driver

ix. Windows will search and install the latest driver. Click **Close**.

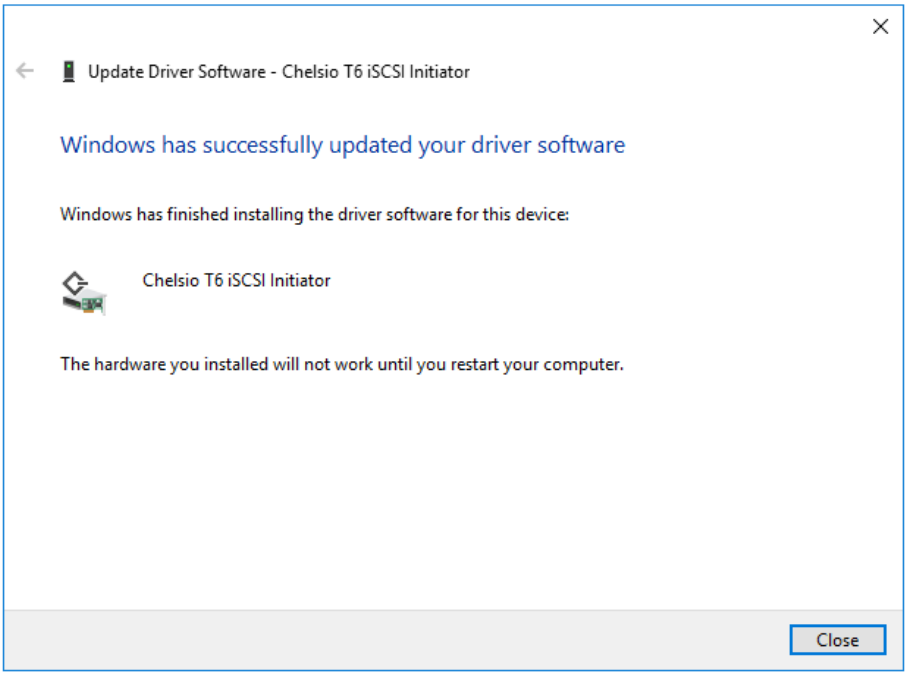

Figure 19 - Driver update successful

x. Click on **Storage controllers**, right-click on **Chelsio T6 iSER Initiator** and select **Update Driver Software..**

Note *If Chelsio iSER interface is not listed, verify if you have specified the number of iSER instances in VBD parameters.*

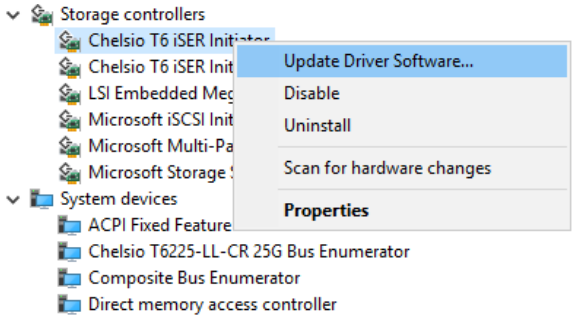

Figure 20 - Updating iSER Initiator driver

xi. Select **Search automatically for updated driver software**

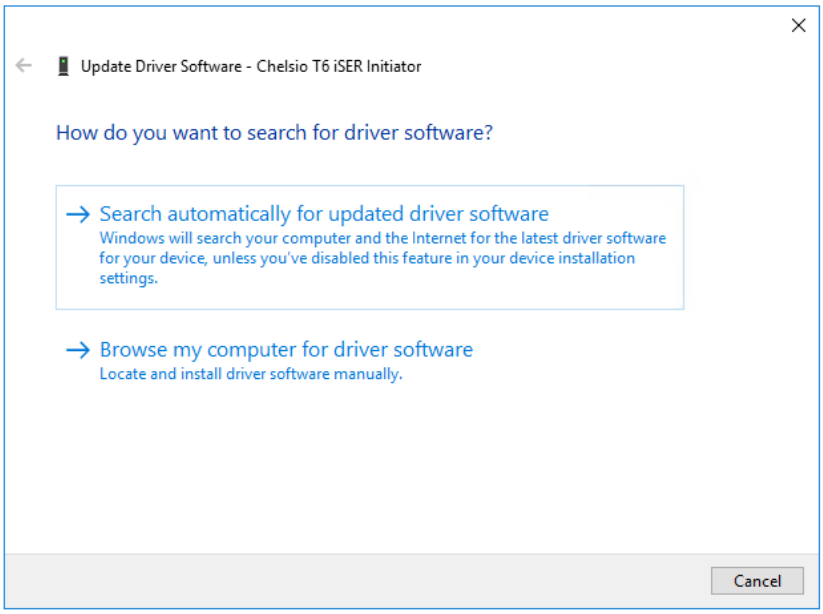

Figure 21- Searching for driver using Windows update

xii. Windows will search and install the latest driver. Click **Close**.

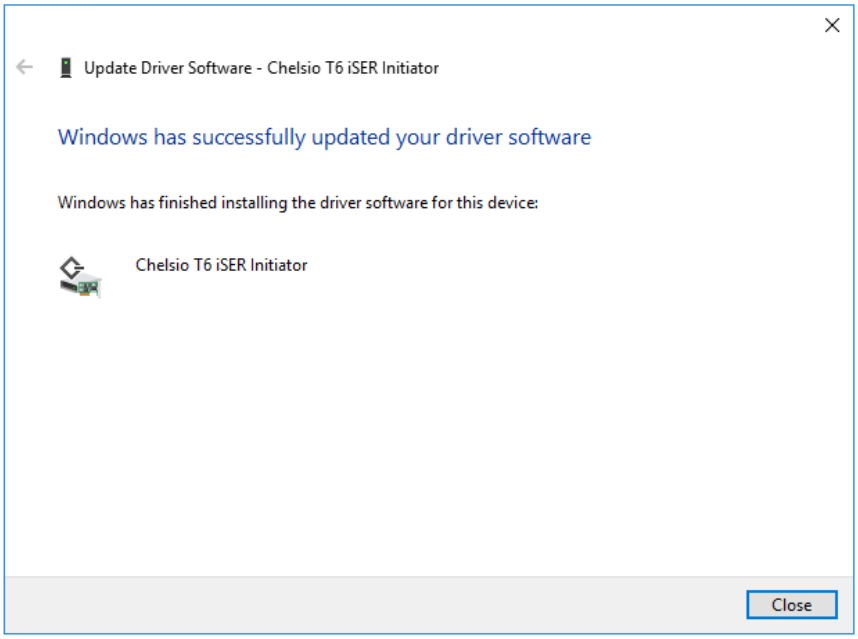

Figure 22 - Driver update successful

xiii. Open the **Device Manager,** click on **System devices**, right-click on **Chelsio Generic Function** and select **Update Driver Software..**

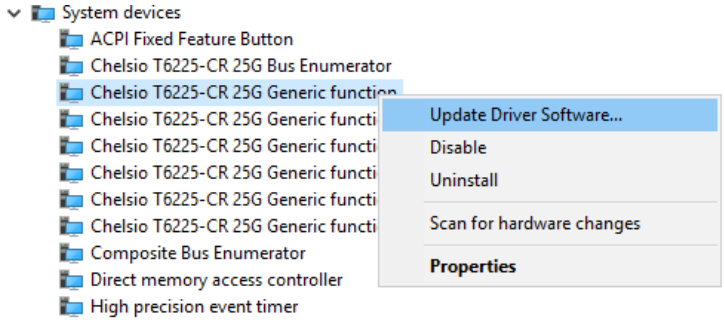

Figure 23 - Updating Generic function driver

xiv. Select **Search automatically for updated driver software**.

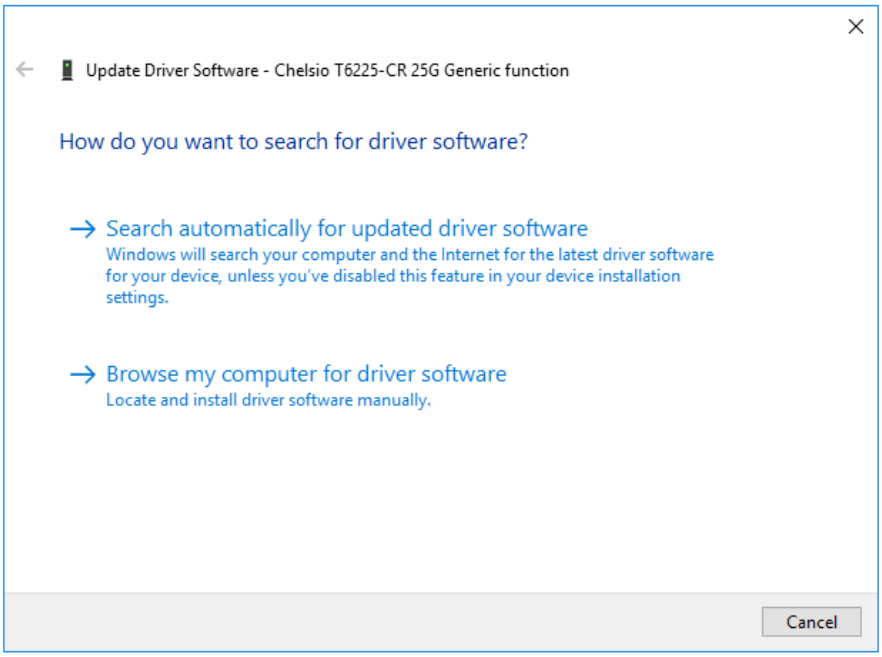

Figure 24 - Searching for driver using Windows update

xv. Windows will search and install the latest driver. Click **Close**.

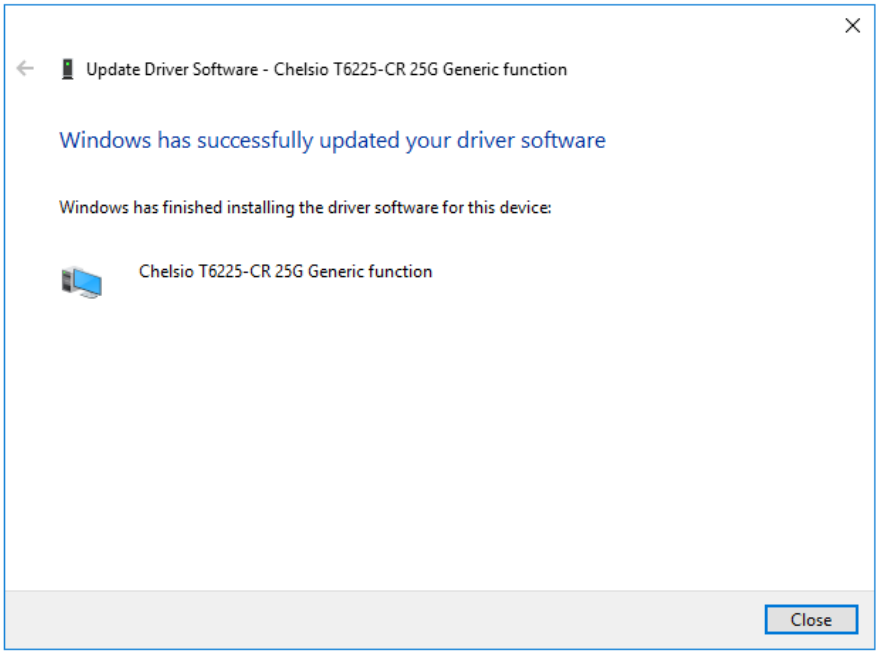

Figure 25 - Driver update successful

6. Configuring Chelsio Network Interfaces

In order to test Chelsio adapters' features, it is required to use at least two machines, each with Chelsio's network adapters. These machines can be connected directly (back-to-back) or with a switch.

6.1. Recommended Settings

It is highly recommended to configure NDIS Driver Parameters *Flow Control* as *Auto Negotiation* and *NDIS QoS* as *Disabled.* So, after the driver installation/update using any method (Installer/Zip Package/Windows Update), please check these driver parameters from the Device Manager, Advanced Tab for all Chelsio Network Adapters, and change them if needed.

6.2. Configuring 40G Adapters

You can use the **chelsio_adapter_config.ps1** script to configure Chelsio 40G adapters in any of the following three operational modes:

- **DEFAULT (2X40G)**: This is the default mode of operation where each port functions as 40Gbps link. The port nearest to the motherboard will appear as the first network interface (Port 0).
- **SPIDER (4X10G)**: In this mode, port 0 functions as 4 10Gbps links and port 1 is disabled.
- **QSA (2X10G)**: This mode adds support for QSA (QSFP to SFP+) modules, enabling smooth, cost-effective, connections between 40 Gigabit Ethernet adapters and 1 or 10 Gigabit Ethernet networks using existing SFP+ based cabling. The port farthest from the motherboard will appear as the first network interface (Port 0).

6.2.1. Windows GUI Machine (Installer & Zip Package)

i. In case of Installer, the configuration script and cxgbtool.exe will be copied to *<system_drive>\Windows\System32* folder during installation.

   If you are using the zip package, copy *cxgbtool.exe* from *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy* folder to *<system_drive>\Windows\System32* and change your working directory to *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy\Adapter Configuration*.

ii. Open PowerShell with administrative privileges.
iii. Run the adapter configuration script and enter the index of the 40G adapter for which the configuration needs to be updated. Hit [Enter].

Installer:

```
PS C:\Users\Administrator>chelsio_adapter_config.ps1
```

Zip Package:

```
PS D:\ChelsioUwire_x.x.x.x_WIN_yyy.y.yy\Adapter Configuration>
.\chelsio_adapter_config.ps1
```

```
Select the Adapter
        1.T580-SO-CR      S/N:PT39131112
Input : 1
```

Figure 26 - Selecting adapter

iv. Select *Port settings* (option 3) as the configuration type. Hit [Enter].

```
Choose the configuration type:
        1. NON-SRIOV (Default)
        2. SRIOV
        3. Port settings
Input : 3
```

Figure 27 - Port settings

v. Select the operation mode and then enter *y* to confirm.

```
Choose the type:
        1. DEFAULT (2 x 40G)
        2. SPIDER  (4 x 10G)
        3. QSA     (2 x 10G)
Input : 2
Do you want to continue (y/n): y
Successfully updated the selected configuration type.

Verification: Passed
```

Figure 28 - Operation mode

vi. Open **Device Manager**, click on **System Devices** and right-click on the 40G Chelsio adapter selected in step (iii).
vii. Select **Disable** and then **Enable** for changes to take effect.

6.3. Assigning IP Address

If your computer is connected to a network with a DHCP server, Chelsio network interfaces will acquire DHCP IPs automatically.

To assign static IPs, follow the steps mentioned below:

i. Double click on the Network Connections icon and choose the Chelsio card entry and double click it.
ii. Click on the Properties button from the Local Area Connection X Status.
iii. Select “Internet Protocol (TCP/IP)” from the list and click on Properties button below it.

iv. From the Internet Protocol (TCP/IP) Properties window, assign an IP Address (e.g. 192.169.1.10) and subnet mask (e.g. 255.255.255.0).
v. Click on Ok and close on the other window.
vi. Check to see if you can ping to some other address on this subnet.

6.4. Deadman Watchdog Timer

In some cases when a port is receiving traffic, if the host machine hits a BSOD or crashes, the port cleanup will not be complete, and the port will send indefinite pause frames. This might cause few switch ports to go into an error state. Using the Deadman Watchdog timer feature, the firmware will bring down the host machine ports after the specified time (user configurable). This feature is disabled by default. It can be configured using the **Set-DeadmanWatchdogTimer.ps1** script.

i. In case of Installer, the configuration script will be copied to *<system_drive>\Windows\System32* folder during installation.

   If you are using the zip package, change your working directory to *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy\DeadmanWatchdogTimer*.

ii. Open PowerShell with administrative privileges.
iii. Run the configuration script specifying the time (in milliseconds).

Installer:

```
PS C:\Users\Administrator>Set-DeadmanWatchdogTimer.ps1 -WatchdogTimer
30000
```

Zip Package:

```
PS D:\ChelsioUwire_x.x.x.x_WIN_yyy.y.yy\DeadmanWatchdogTimer> .\Set-
DeadmanWatchdogTimer.ps1 -WatchdogTimer 30000
```

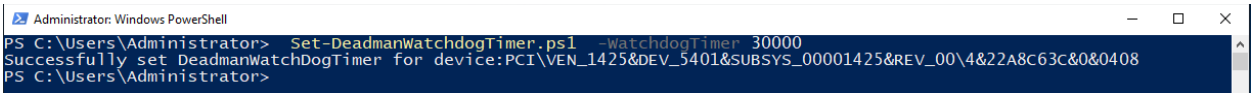

Figure 29- Setting Deadman Watchdog Timer

The command will set the Deadman Watchdog Timer value for all the adapters in the machine. To set only to a specific adapter, specify the Device Path using the **-DeviceId** option.

Note *For more help and detailed examples, execute the below command:*

PS C:\Users\Administrator>get-help Set-DeadmanWatchdogTimer.ps1 -full

iv. To disable the feature, set 0 as the timer value.

Figure 30 - Disabling Deadman Watchdog Timer

6.5. Chelsio Management

Chelsio Management Feature allows to update the following properties of Chelsio adapters and to collect Debug logs.

- FW Config file
- Serial Init
- Performance tuning

Open the **Device Manager**, click on the **System Devices**, double click on the **Chelsio Bus Enumerator**, and then click the **Chelsio Management** tab.

• FW Config file

Appropriate Firmware Configuration file will already be used by the VBD driver. To use a custom Firmware Configuration file, click **Browse** in **Change Firmware Config** section and select the new FW Configuration file.

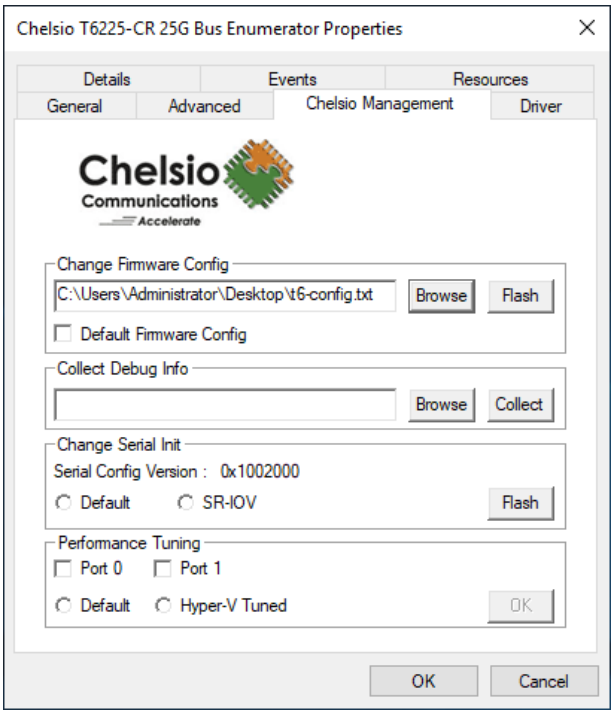

Figure 31 - Changing Firmware Config

Click **Flash** and then **OK** when asked for Confirmation.

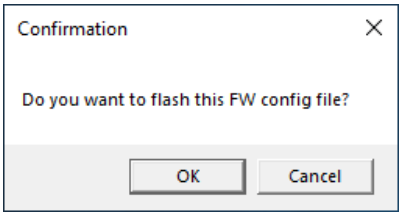

Figure 32 - Confirmation

Click **OK** on the Chelsio Management Window for the changes to take effect. The VBD driver will reload and use the newly flashed Firmware Configuration.

To revert to default FW Configuration (the one used by Driver), select **Default Firmware Config** and click **Flash.**

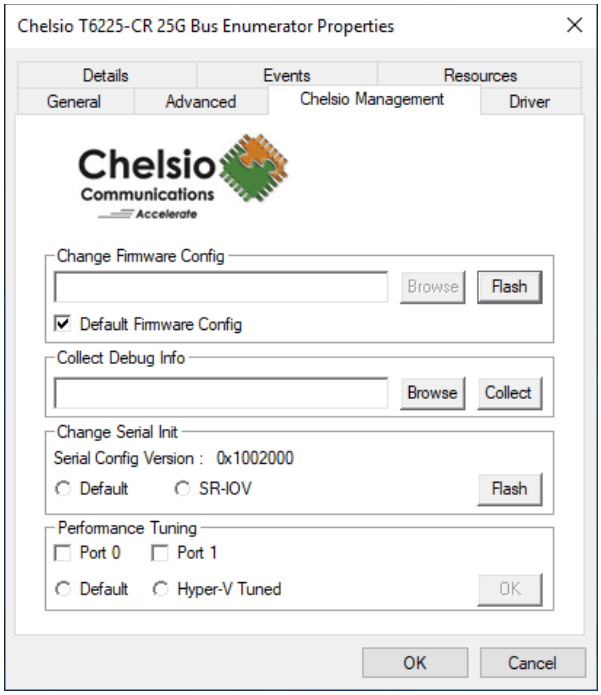

Figure 33 - Default Firmware Config

Click **OK** when asked for Confirmation.

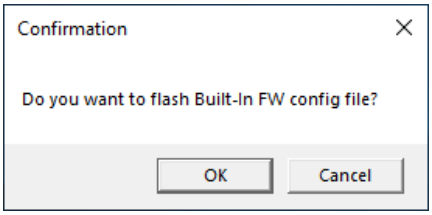

Figure 34 - Confirmation

Click **OK** on the Chelsio Management Window for the changes to take effect. The VBD driver will reload and use the default Firmware Configuration.

- ## Change Serial Init

The adapter configuration needs to be updated to use NDIS SR-IOV features. To update it, select **SR-IOV** in Change Serial Init section and click **Flash**.

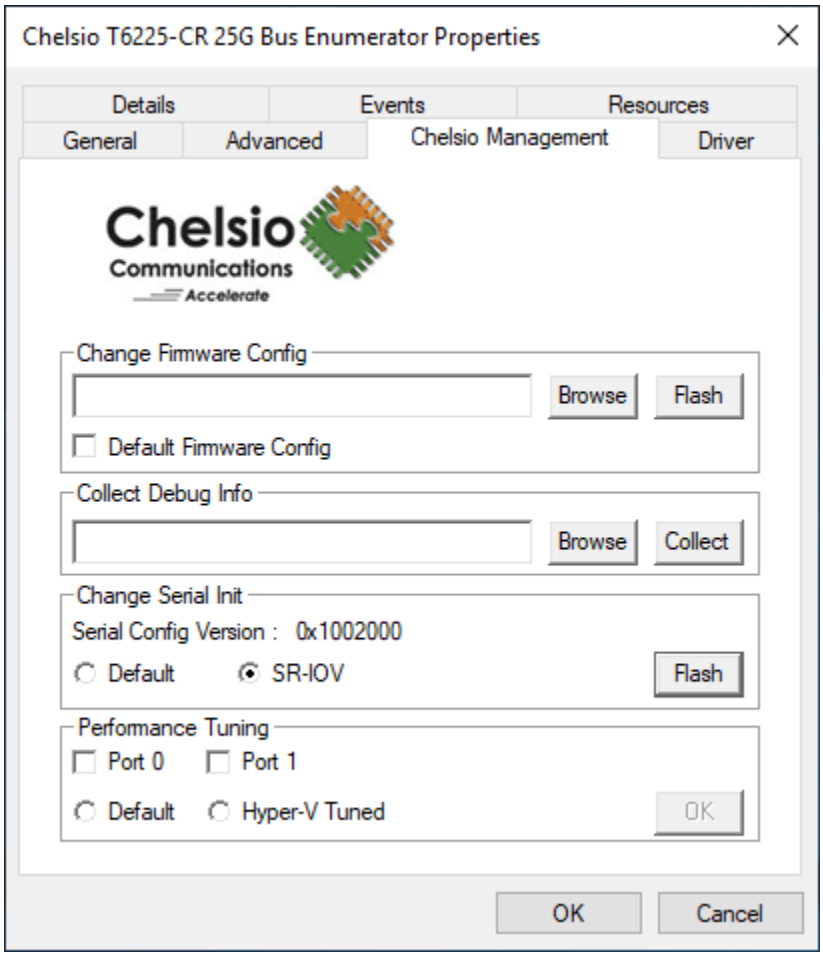

Figure 35 - Update Serial Init to SR-IOV

Click **OK** when asked for Confirmation.

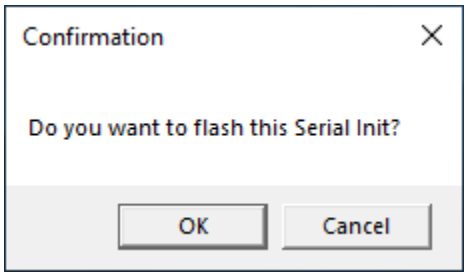

Figure 36 - Confirmation

Click **OK** on the Chelsio Management Window and reboot the machine for changes to take effect.

To revert to Default settings (non SR-IOV), select **Default** in Change Serial Init section and click **Flash**.

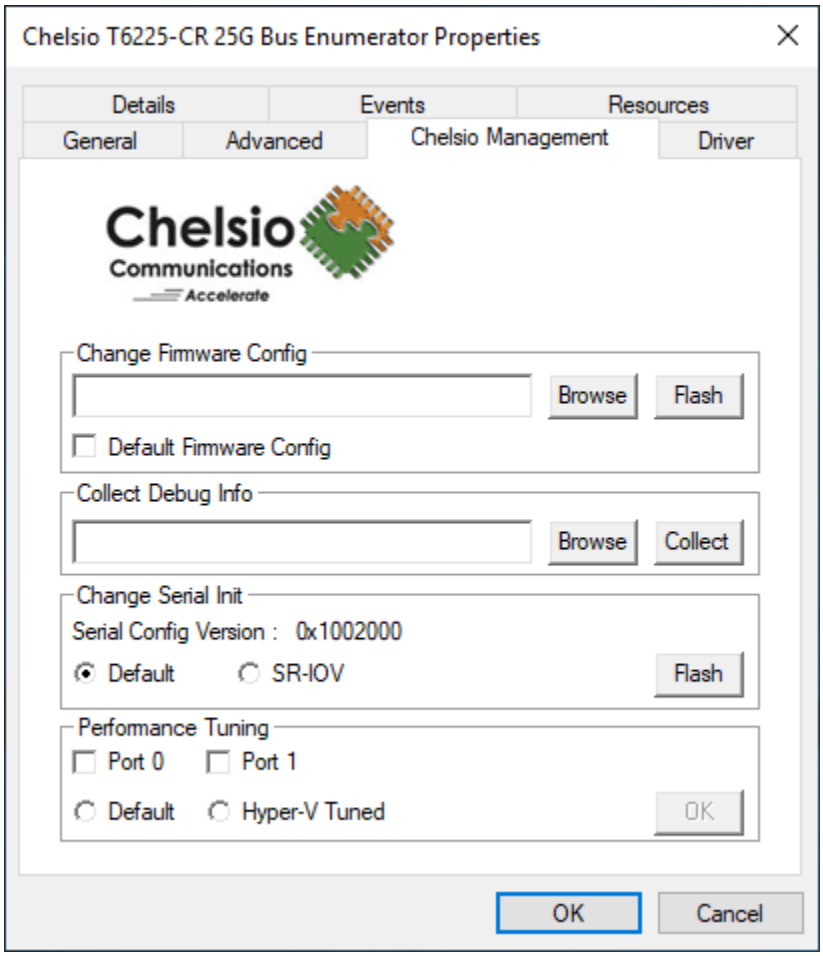

Figure 37 - Update to Default Serial Init

Click **OK** when asked for Confirmation.

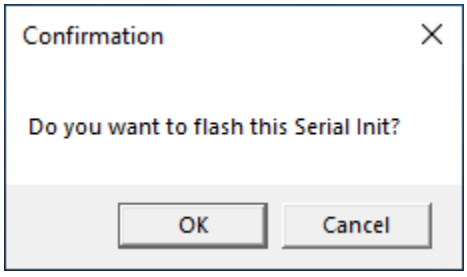

Figure 38 - Confirmation

Click **OK** on the Chelsio Management Window and reboot the machine for changes to take effect.

- ## Performance Tuning

To tune the adapter for best Performance, select the required Ports and select **Hyper-V Tuned** in Performance Tuning section. Click **OK**

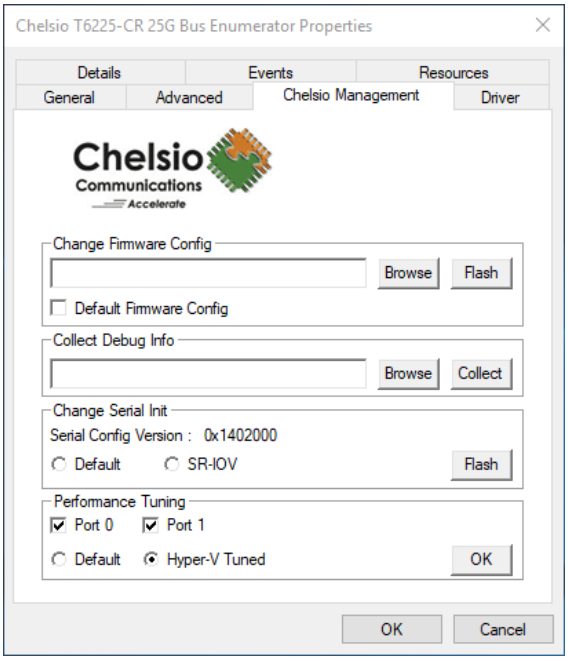

Figure 39 - Update Performance tuning

To revert the Performance tuning settings, select the required Ports and click **Default** in Performance Tuning section. Click **OK**

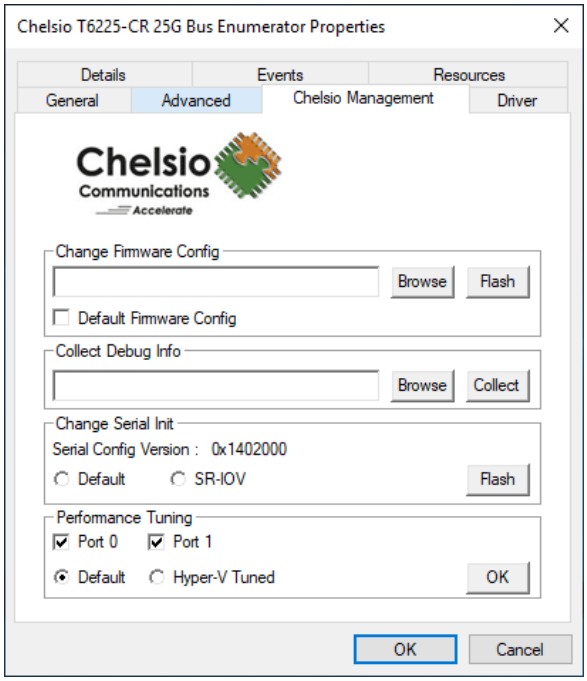

Figure 40 - Default Performance tuning

- ## Collect Debug Info

In case of any Driver/Firmware issue, Chelsio hardware debug information needs to be collected and the same should be provided to Chelsio for further analysis. To collect the required debug logs from the adapter, click **Browse** in Collect Debug Info section and select the destination folder.

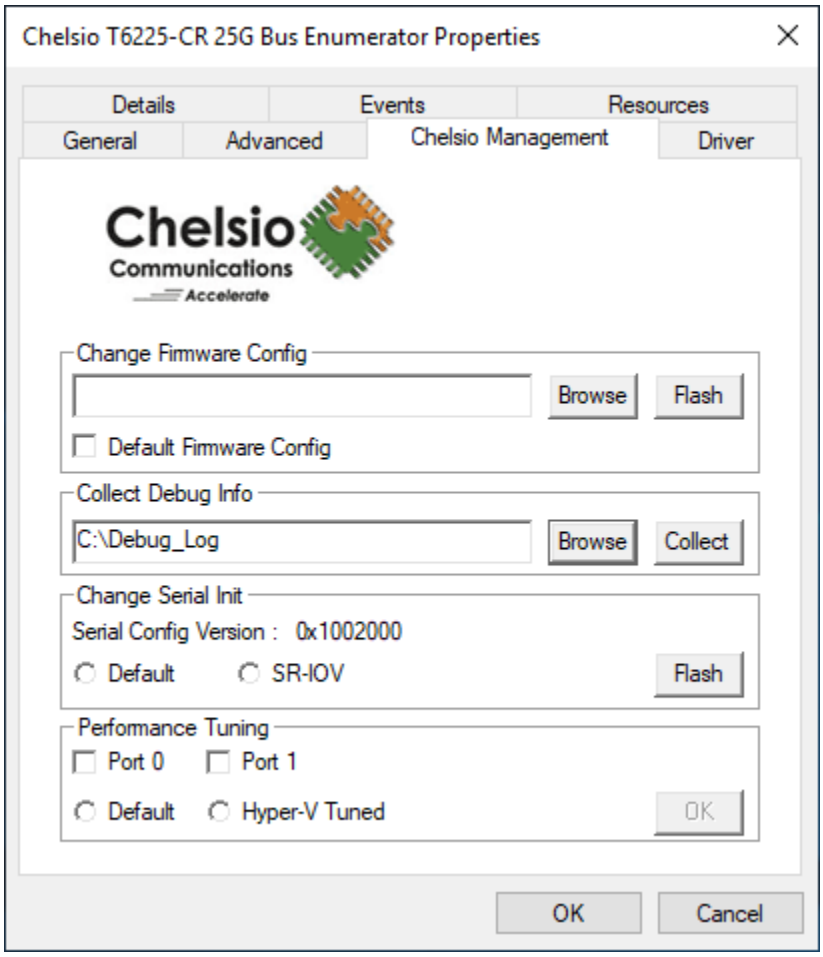

Figure 41 - Collecting Debug Information

Click **Collect**. The Logs will be collected in the selected folder with name *ChelsioDebug_<ddMMyyyHHmmss>.DMP*

7. Performance Tuning

The following section lists the various steps to tune the system for optimal performance:

- Install the adapter into a PCIe Gen3 x8/x16 slot. Ensure that T6 100G adapters are placed in x16 slots and not in x8_in_x16 slots.
- Disable virtualization, c-state technology, VT-d, Intel I/O AT and SR-IOV in the BIOS settings.

Note *NDIS SR-IOV will require* virtualization, VT-d and SR-IOV to be enabled in the BIOS.

- Set **Power Options** in Control Panel to *High Performance*.
- Tune the adapter for best performance using Chelsio Management feature as explained here.

8. *cxgbtool* help

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.

Syntax

```
cxgbtool <vbdIface|nicIface|iSCSIIface|rdma> <category> <command> <options>
```

Definitions

`nicIface` is the name of the network device to work on, given in the format `nic0`, `nic1`.

`vbdIface` is the name of the Chelsio Bus Enumerator instance to work on, given in the format `vbd0`, `vbd1`

`iscsIface` is the name of the Chelsio iSCSI interface to work on, given in the format `iSCSI0`, `iSCSI1`

`rdma` is the name of the Chelsio RDMA interface to work on.

`category` is one of the cxgbtool categories, i.e., debug, hardware, cudbg, firmware, boot

`command` is the action you wish to perform on the adapter or property you wish to view/change.

`option` is the optional parameter to be provided with *command*.

- **Help**
  - Displaying cxgbtool help: `cxgbtool`
  - Displaying list of available cxgbtool commands: `cxgbtool -h all`
  - Displaying category specific help:

    ```
    cxgbtool <vbdIface|nicIface|iSCSIIface> <category> -h
    ```

  - Displaying list of cudbg entities: `cxgbtool <vbdIface> cudbg dbg -h`
  - Displaying RDMA help: `cxgbtool rdma -h`

- **Debug**
  - **version**

Description: Display adapter information like part number, serial number, device ID, firmware version, TP, etc.

Syntax: `cxgbtool <vbdIface|nicIface|iscsiIface> debug version`

Example:

```
C:\Users\Administrator>cxgbtool nic0 debug version
P/N:            11012096004
S/N:            PT43160304
DeviceId:       6401 (T6225-CR)
FW Ver:         1.16.38.0
TP Ver:         0.1.23.2
Driver Ver:     6.5.4.10
Nic File Ver:   6.5.4.10
VBD File Ver:   6.5.4.10
Cudbg lib Ver:  1.14.0
SCFG Ver:       0x1402000
```

Figure 42 - Display adapter information

  - **inst**

Description: Install driver package specified in the setup information file (.inf).

Syntax: `cxgbtool debug inst <file>`

Example:

```
C:\Users\Administrator>cxgbtool debug inst Desktop\chvbdx64.inf
ENTER:  DriverPackageInstallA
ENTER:  DriverPackageInstallW
Installing INF file 'C:\Users\Administrator\Desktop\chvbdx64.inf' (Plug and Play).
Looking for Model Section [Chelsio.NTamd64]...
Installing devices with Id "PCI\VEN_1425&DEV_5410&SUBSYS_00001425&REV_00" using INF "C:\Windows\System32\DriverStore\FileRepository\chvbdx64.inf_amd64_db5d99a4eb080b3f\chvbdx64.
inf".
Installation did not occur because the hardware isn't currently present.
Installing devices with Id "PCI\VEN_1425&DEV_6401&SUBSYS_00001425&REV_00" using INF "C:\Windows\System32\DriverStore\FileRepository\chvbdx64.inf_amd64_db5d99a4eb080b3f\chvbdx64.
inf".
ENTER UpdateDriverForPlugAndPlayDevices...
RETURN UpdateDriverForPlugAndPlayDevices.
Installation was successful.
Marked Phantom Device with Hardware/Compatible Id 'PCI\VEN_1425&DEV_5410&SUBSYS_00001425&REV_00' for reinstall on next plug-in.
Install completed
RETURN: DriverPackageInstallW  (0x0)
RETURN: DriverPackageInstallA  (0x0)
```

Figure 43 - Install driver package

  - **update**

Description: Update driver package.

Syntax: `cxgbtool debug update <file>`

Example:

```
C:\Users\Administrator>cxgbtool debug update C:\Users\Administrator\Desktop\v6.5.8.0\bin\fre\x64\chvbdx64.inf
Driver for HwId:PCI\VEN_1425&DEV_6407&SUBSYS_00001425&REV_00 updated successfully!!!
```

Figure 44 - Update driver package

- **uninst**

Description: Uninstall driver package specified in the setup information file (.inf).

Syntax: `cxgbtool debug uninst <file>`

Example:

```
C:\Users\Administrator>cxgbtool debug uninst Desktop\chvbdx64.inf
Removing device instance PCI\VEN_1425&DEV_6401&SUBSYS_00001425&REV_00\4&2A43D483&0&0410
Removing device instance PCI\VEN_1425&DEV_5410&SUBSYS_00001425&REV_00\4&31024D2F&0&0418
ENTER:  DriverPackageGetPathA
RETURN: DriverPackageGetPathA  (0x7A)
ENTER:  DriverPackageGetPathA
RETURN: DriverPackageGetPathA  (0x0)
ENTER:  DriverPackageUninstallA
ENTER:  DriverPackageUninstallW
Uninstalling driver package C:\Windows\System32\DriverStore\FileRepository\chvbdx64.inf_amd64_db5d99a4eb080b3f\chvbdx64.inf...
Successfully uninstalled 'C:\Windows\INF\oem6.inf'.
No devices found for C:\Windows\System32\DriverStore\FileRepository\chvbdx64.inf_amd64_db5d99a4eb080b3f\chvbdx64.inf uninstall.
Successfully deleted properties for driver store entry 'C:\Windows\System32\DriverStore\FileRepository\chvbdx64.inf_amd64_db5d99a4eb080b3f\chvbdx64.inf'.
Uninstall completed.
RETURN: DriverPackageUninstallW  (0x0)
RETURN: DriverPackageUninstallA  (0x0)
```

Figure 45 - Uninstall driver package

- **rescan**

Description: Scan for hardware changes in the device manager.

Syntax: `cxgbtool debug rescan`

Example:

```
C:\Users\Administrator>cxgbtool debug rescan
```

Figure 46 - Rescan for hardware changes

- **qstats**

Description: Display statistics for each Tx & Rx queue.

Syntax: `cxgbtool <nicIface|iscsiIface> debug qstats <queueType|clr>`

`clr`: Clear queue statistics.

Queue Type	Description
txeth	Tx tunnel queue statistics.
rxeth	Rx tunnel queue statistics.
txvirt	Tx VM queue statistics.
rxvirt	Rx VM queue statistics.
txtoe	Tx Chimney queue statistics.
rxtoe	Rx Chimney queue statistics.
txrdma	Tx RDMA queue statistics.
rxrdma	Rx RDMA queue statistics.
txctrl	Chimney control queue statistics.
txfwd	Chimney forwarding queue statistics.
txnvgre *	Tx NVGRE statistics.
rxnvgre *	Rx NVGRE statistics.

txiscsi	Tx iSCSI queue statistics.
rxiscsi	Rx iSCSI queue statistics.
txpd	Tx PacketDirect queue statistics.
rxpd	Rx PacketDirect queue statistics.

** not supported on T6 adapters*

Qstats Parameter	Description
BcBytes	Broadcast packet size in bytes.
BcPkts	Number of broadcast packets.
CoalBytes	Coalesced packet size in bytes.
CoalPkts	Number of coalesced packets.
DropPkts	Number of dropped packets.
EncapBytes [#]	NVGRE/VXLAN packet size in bytes.
EncapPkts [#]	Number of NVGRE/VXLAN packets.
VlanMismatch	Number of packets with VLAN mismatch.
Fw4Ack	Number of SGE update requests.
LargeRxDropPkts	Dropped packets due to large size counter.
LSO	Number of large send offloaded packets.
McBytes	Multicast packet size in bytes.
McPkts	Number of multicast packets.
NblsRecv	Total Nbls received.
NblsSent	Total Nbls sent.
NoRxBufs	Packets couldn't process because of lack of memory.
NvPkts	Send NVGRE packets.
PeerAbort	Peer abort request.
CqComp	Number of CQ completions.
PktsDefrag	Number of defragged packets.
PktsDrop	Total packets dropped.
PktsQued	Total packets queued.
PktsSent	Total packets sent.
Quefull	Number of time queue full happened.
RecvNbls	Total Nbls received.
RssGroup	RSS group number allocated to queue.
VPortId	Vport ID of queue.
RssProc	RSS processor number allocated to queue.
RxCsumErr	Number of received packets with checksum error.
RxCsumErrIp	Number of received IP packets with checksum error.
RxCsumErrTcp	Number of received TCP packets with checksum error.
SysThreadEvts	Number of system thread events.
TxCsumOfld	Number of checksum offloaded Tx packets.
UcBytes	Unicast packets size in bytes.
UcPkts	Number of unicast packets.
VlanEx	Number of VLAN extracted packets.
VLANin	Number of VLAN inserted packets.

[#] supported only on T6 adapters

Example of rxeth qstats

```
C:\Users\Administrator>cxgbtool nic0 debug qstats rxeth

StatsType           RxEth#36            RxEth#37            RxEth#38            RxEth#39

UcPkts              21                  3                   3                   1
UcBytes             1324                260                 239                 93
McPkts              0                   2                   3                   0
McBytes             0                   180                 258                 0
BcPkts              6                   0                   45                  0
BcBytes             360                 0                   4572                0
CoalPkts            0                   0                   0                   0
CoalBytes           0                   0                   0                   0
DropPkts            0                   0                   0                   0
RecvNbls            27                  5                   51                  1
RxCsumErr           0                   0                   0                   0
RxCsumErrTcp        0                   0                   0                   0
RxCsumErrIp         0                   0                   0                   0
VLANex              0                   0                   0                   0
SysThreadEvts       0                   0                   0                   0
LargeRxDropPkts     0                   0                   0                   0
RssProc             0                   16                  24                  32
RssGroup            0                   0                   0                   0
```

Figure 47 - Queue Statistics

- **hardware**
  - **sensor**

Description: Display sensor data.

Syntax: `cxgbtool <nicIface> hardware sensor`

Example:

```
C:\Users\Administrator>cxgbtool nic0 hardware sensor
Temperature: 80C
Core VDD: 855mV
```

Figure 48 - Sensor data

- **fec**

Description: Set/Display Forward Error Correction (FEC) parameters.

Syntax:

`cxgbtool <nicIface> hardware fec [<config params>]`

Example:

- Displaying currently set FEC mode.

```
C:\Users\Administrator>cxgbtool nic0 hardware fec
supported:  : Base-R/Reed-Solomon Reed-Solomon
advertising:: no FEC
```

Figure 49 - Read FEC

- Setting FEC mode:

```
C:\Users\Administrator>cxgbtool nic0 hardware fec rs

C:\Users\Administrator>cxgbtool nic0 hardware fec
supported:  : Base-R/Reed-Solomon Reed-Solomon
advertising:: Reed-Solomon
```

Figure 50 - Set FEC

- **link_cfg**

Description: Set/Display link configuration parameters.

Syntax:

```
cxgbtool <nicIface> hardware link_cfg <options>
```

Example:

- Displaying link configuration information:

```
C:\Users\Administrator>cxgbtool nic0 hardware link_cfg
Link Configuration
 Supported ports                : [ FIBRE ]
 Supported link modes           : 1000baseT/Full
                                  10000baseT/Full
                                  25000baseCR/Full
 Supported auto-negotiation     : Yes

 Advertised link modes          : 1000baseT/Full
                                  10000baseT/Full
                                  25000baseCR/Full
 Advertised auto-negotiation    : Yes

 Speed                          : 25Gbps
 port                           : Other
 Auto-negotiation               : On
```

Figure 51 - Read Link Configuration

- Enabling/Disabling auto-negotiation:

Auto-negotiation is enabled by default. To disable it, use the *autoneg off* parameter on all connected machines of the link.

```
C:\Users\Administrator>cxgbtool nic0 hardware link_cfg autoneg off

C:\Users\Administrator>cxgbtool nic0 hardware link_cfg
Link Configuration
       Supported auto-negotiation     : Yes
       Advertised auto-negotiation    : No
       Speed                          : 25Gbps
       Auto-negotiation               : Off
       Link State                     : Disconnected
```

Figure 52 - Disable auto-negotiation

- Changing link speed:
  25G port can be set to 10G and 100G port can be set to 25G/40G/50G. Auto-negotiation should be disabled on all connected machines while changing link speed.

```
C:\Users\Administrator>cxgbtool nic0 hardware link_cfg autoneg off speed 10000

C:\Users\Administrator>cxgbtool nic0 hardware link_cfg
Link Configuration
        Supported auto-negotiation      : Yes
        Advertised auto-negotiation     : No
        Speed                           : 10Gbps
        Auto-negotiation                : Off
        Link State                      : connected
```

Figure 53 - Change Link Speed

Important *Before setting 40G or 10G speeds, FEC should be disabled on the port using:*

```
C:\Users\Administrator>cxgbtool nic0 hardware fec off
```

- **cudbg**
  - **collect**

Description: Collect Chelsio adapter debug logs to a compressed file.

Syntax: `cxgbtool <vbdIface> cudbg collect <entities> <outputFile> <options>`

Examples:

- Collecting debug log for all entities

```
C:\Users\Administrator>cxgbtool vbd0 cudbg collect all dump_file
cxgbtool: This may take a while. Please be patient
cxgbtool: Writing cudbg block to file dump_file... size: 12634452 bytes
cxgbtool: Done writing cudbg data to file dump_file
```

Figure 54 - Collect all logs

- Collecting debug log skipping specific debug entities

```
C:\Users\Administrator>cxgbtool vbd0 cudbg collect all dump_file skip edc1,edc0
cxgbtool: This may take a while. Please be patient
cxgbtool: Writing cudbg block to file dump_file... size: 12082984 bytes
cxgbtool: Done writing cudbg data to file dump_file
```

Figure 55 - Skip few entities in log collection

- Collecting debug log avoiding entities that can affect running traffic

```
C:\Users\Administrator>cxgbtool vbd0 cudbg collect all dump_file safe
cxgbtool: This may take a while. Please be patient
cxgbtool: Writing cudbg block to file dump_file... size: 48484 bytes
cxgbtool: Done writing cudbg data to file dump_file
```

Figure 56 - Safe mode log collection

9. Software/Driver Uninstallation

Similar to installation, Chelsio Unified Wire can be uninstalled using the Installer or zip package. Refer the relevant section depending on the method of installation used to install drivers.

9.1. Installer

Chelsio Unified Wire Installer can be uninstalled using two methods: **GUI** or **CLI** mode. GUI mode requires user interaction and uninstallation occurs with options specified by the user. Whereas, CLI mode does not require any user input.

9.1.1. GUI mode (Installer)

i. Run the **ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe** application.
ii. Select **Modify** to add or remove features. Select **Repair** to repair the previous installation. Select **Remove** to uninstall the application. After you have selected the appropriate option, click **Next**.

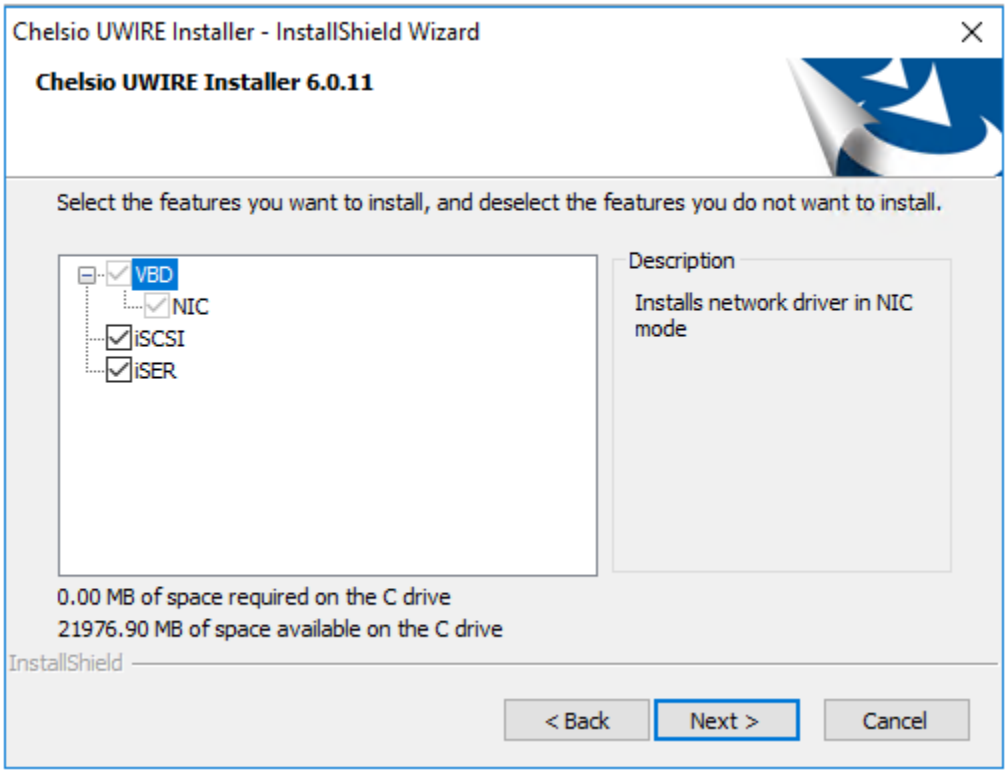

Figure 57 - Adding or removing features using 'Modify' option

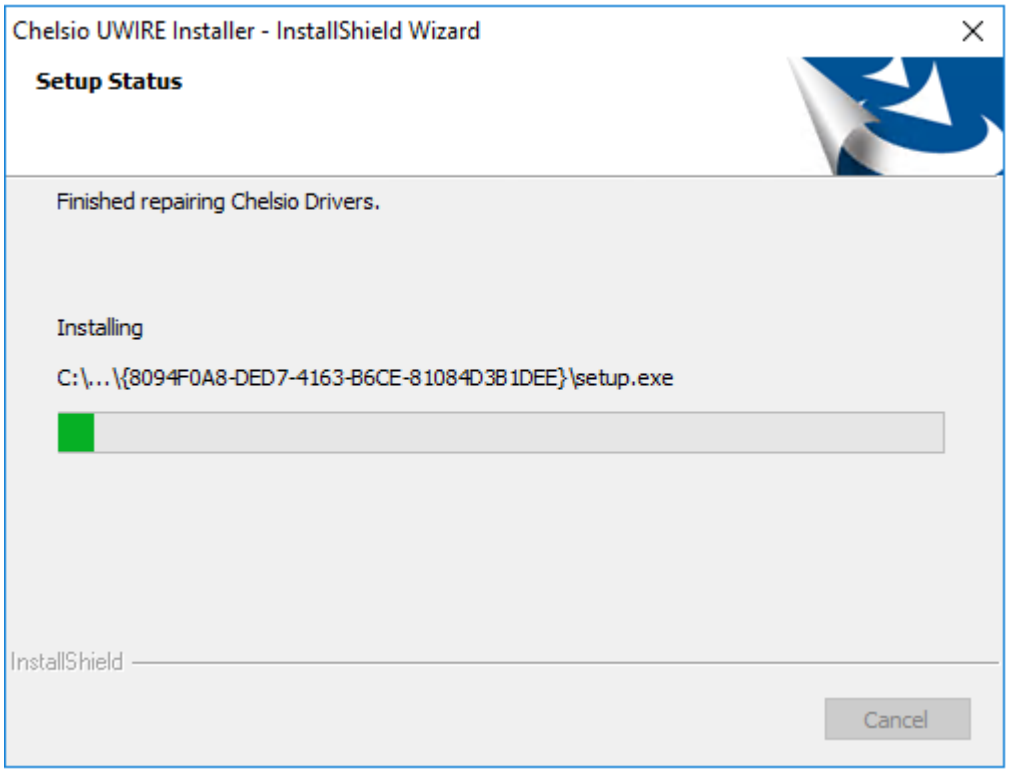

Figure 58 - Repairing previous installation using 'Repair' option

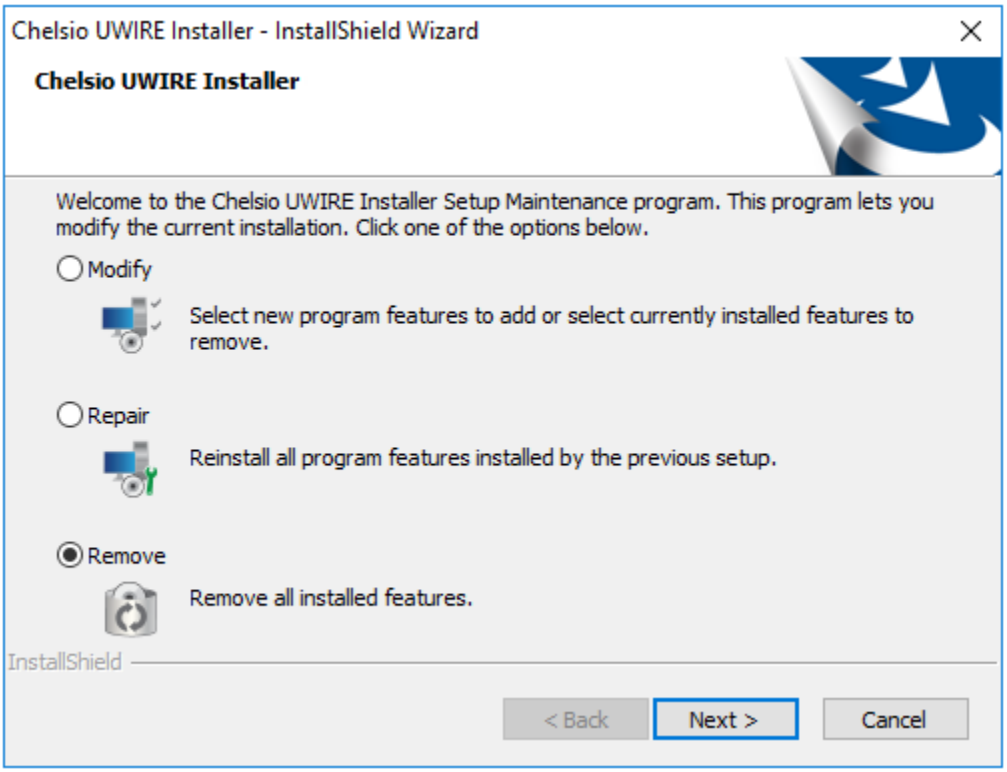

Figure 59 – Uninstalling Unified Wire using 'Remove' option

iii. Click on the **Finish** button to exit from the installer.

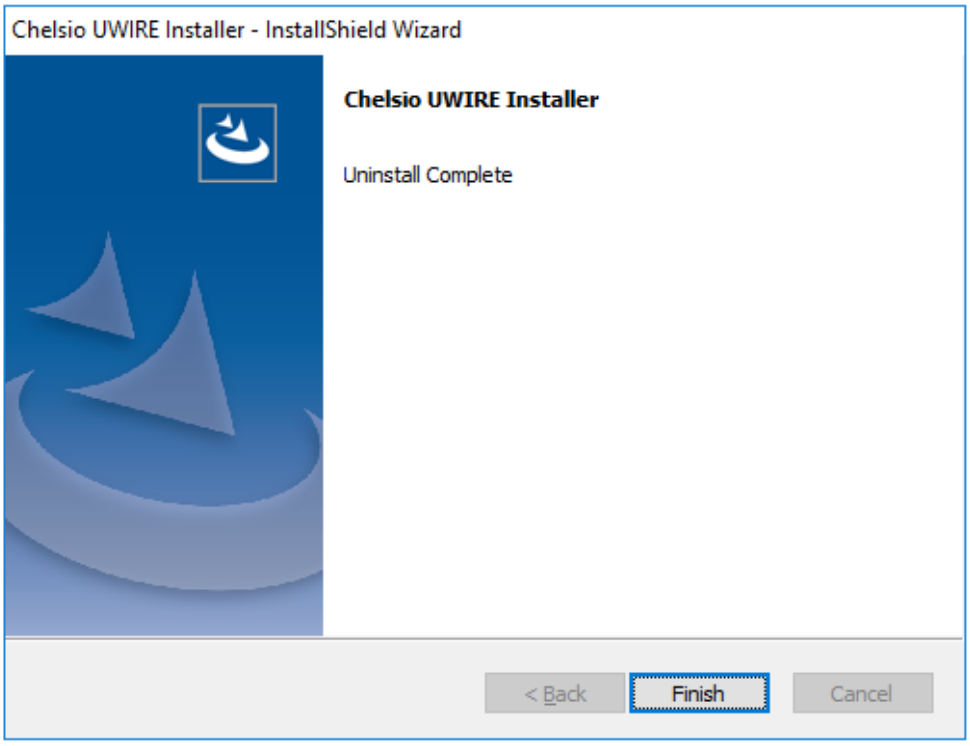

Figure 60 - Finishing uninstallation

Note *This method of uninstallation is possible only if the drivers were installed using Unified Wire Installer.*

9.1.2. CLI Mode

To uninstall all the drivers, execute the following command:

```
C:\Users\Administrator>ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe -un all
```

To uninstall a particular driver, execute the following command:

```
C:\Users\Administrator>ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe -rm <driver(s)>
```

Example: To uninstall iSCSI Storport Miniport driver

```
C:\Users\Administrator>ChelsioUwire_x.x.x.x_WIN_yyy.y.yy.exe -rm iSCSI
```

9.2. Zip Package

If the driver components were installed using the zip package, they will have to be uninstalled manually. The following section lists the various components and their respective methods of uninstallation.

Important *The driver components need to be uninstalled strictly in the order described here. Using any other order is not supported.*

NDIS Miniport driver

i. Open the **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on the **Network Adapters**, right click on the **Chelsio Network Adapter** and select **Uninstall.**

Note *In case of Virtual Functions in VM, use Chelsio VF Network Adapter.*

ii. Select the **Delete the driver software for this device** checkbox when **Confirm Device Uninstall** is prompted and click **OK.**

Repeat the same procedure for the other ports.

iSCSI Storport Miniport driver

i. Open the **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on **Storage controllers**, right-click on **Chelsio iSCSI Initiator** and select **Uninstall.**
ii. Select **Delete the driver software for this device** checkbox when **Confirm Device Uninstall** is prompted and click **OK.**

Repeat the same procedure for other ports**.**

iSER Storport Miniport driver

i. Open the **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on **Storage controllers**, right-click on **Chelsio iSER Initiator** and select **Uninstall.**
ii. Select **Delete the driver software for this device** checkbox when **Confirm Device Uninstall** is prompted and click **OK.**

Repeat the same procedure for other ports.

NVMe Storport Miniport driver

i. Open the **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on **Storage controllers**, right-click on **Chelsio NVMeOF Initiator** and select **Uninstall.**
ii. Select the **Delete the driver software for this device** checkbox when **Confirm Device Uninstall** is prompted and click **OK.**

Repeat the same procedure for the other ports.

Virtual Bus driver

i. Open the **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on the **System Devices**, right click on the **Chelsio Bus Enumerator** and select **Uninstall.**

Note *In case of Virtual Functions in VM, use **Chelsio Bus Enumerator [Virtual Function].***

ii. Select the **Delete the driver software for this device** checkbox when **Confirm Device Uninstall** is prompted and click **OK.**

Generic Function

i. Open the **Device Manager** (Control Panel -> System & Security-> System -> Device Manager), click on the **Network Adapters**, right click on the **Chelsio Generic Function** and select **Uninstall.**

ii. Select the **Delete the driver software for this device** checkbox when **Confirm Device Uninstall** is prompted and click **OK.**

Repeat the same procedure for the other **Generic Functions.**

II. NDIS Function

1. Introduction

Chelsio's Terminator series of Unified Wire adapters provide extensive support for NIC operation, including all stateless offload mechanisms for both IPv4 and IPv6 (IP, TCP and UDP checksum offload, LSO - Large Send Offload aka TSO - TCP Segmentation Offload, Network Direct and assist mechanisms for accelerating RSC - Receive Segment Coalescing).

1.1. Hardware Requirements

1.1.1. Supported Adapters

Following is the list of supported Chelsio adapters:

- 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

Following is the list of NDIS components and supported Windows versions:

Windows Version	NDIS Components
Server 2022	NIC, NVGRE, VXLAN, Timestamps, PacketDirect, VMMQ/vRSS
Server 2019	
11 Client	NIC
10 Client	

2. Software/Driver Configuration and Fine-tuning

2.1. Advanced Configuration

The below sections provide the advanced configuration options for Chelsio devices.

2.1.1. VBD Driver Parameters

To see all tunable VBD driver parameters, open the **Device Manager**, click on the **System Devices**, double click on the **Chelsio Bus Enumerator**, and then click the **Advanced** tab.

- **iSCSI Instances**
  - *Description*: Specify the number of iSCSI instances.
  - *Value*: 0-2 | default
  - *Default*: 0
- **iSER Instances**
  - *Description*: Specify the number of iSER instances.
  - *Value*: 0-2 | default
  - *Default*: 0
- **NIC Instances**
  - *Description*: Specify the number of NIC instances.
  - *Value*: 0-8 | default
  - *Default*: default
- **NVMeoF Instances**
  - *Description*: Specify the number of NVMeoF instances.
  - *Value*: 0-2 | default
  - *Default*: 0

Note *Value will be 0-4 | default for T5 4-port adapters.*

2.1.2. NDIS Miniport Driver Parameters

To see or change the tunable NDIS Driver parameters, open the **Device Manager**, click on the **Network adapters**, double click on any **Chelsio Network Adapter**, and then click the **Advanced** tab. They can also be changed from CLI using the below commands, especially in case of Server Core installations where there is no GUI.

```
PS C:\Users\Administrator> Get-NetAdapterAdvancedProperty -Name <NetAdapter>
PS C:\Users\Administrator> Set-NetAdapterAdvancedProperty -Name <NetAdapter>
-DisplayName <ParameterName> -DisplayValue <Value>
```

Encapsulated Task Offload

- *Description*: Configure stateless offloads (checksums, LSO, VMQ and filtering) for encapsulated traffic.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Encapsulated Overhead

- *Description*: Specify the amount of overhead required in Ethernet frames due to virtual network overlay encapsulation such as VXLAN and NVGRE.
- *Value*:
  - *32*
  - 64
  - 96
  - 128
  - 160
  - 192
  - 224
  - 256
- *Default*: 0

Flow Control

- *Description*: Enable or disable the receipt or transmission of PAUSE frames. If Rx is enabled, all incoming PAUSE frames will be honoured. If Tx is enabled, the HW will send PAUSE frames when its MAC Rx FIFO usage is beyond a high-watermark. If Disabled option is selected, no PAUSE will be sent. When Rx MAC FIFO gets full, further ingress packets will be dropped. If Rx & Tx Enabled is selected, both are enabled.
- *Value*:
  - Auto Negotiation
  - Disabled
  - Rx & Tx Enabled
  - Rx Enabled
  - Tx Enabled
- *Default*: Auto Negotiation

Note

If NDIS function driver is installed using Unified Wire installer, the Flow Control will be set to Auto Negotiation by default. However, if the driver is installed manually (using zip package), it will be disabled by default in Windows Server OSs. It is highly recommended to set it to Auto Negotiation, irrespective of installation method.

Interrupt Moderation

- *Description*: Control the interrupts generated by NIC hardware.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Interrupt Moderation Rate

- *Description*: Set the interrupt rate.
- *Value*:
  - Extreme
  - High
  - Low
  - Minimal
  - Moderate
- *Default*: Low

IPv4 Checksum Offload

- *Description*: Allow the checksum to be computed by the adapter for IPV4 packets.
- *Value*:
  - Disabled
  - Rx & Tx Enabled
  - Rx Enabled
  - Tx Enabled
- *Default*: Rx & Tx Enabled

Jumbo Packet (Maximum Transmission Unit)

- *Description*: Specify the Maximum Transmission Unit (MTU) value.
- *Value*: 1514 - 9014
- *Default*: 1514

Large Send Offload V2 (IPv4)

- *Description*: Configuring Large Send Offload (LSO) using version 2 for the IPv4 traffic.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Large Send Offload V2 (IPv6)

- *Description*: Configuring Large Send Offload (LSO) using version 2 for the IPv6 traffic.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Locally Administered Address

- *Description*: Specify a new MAC address for the port. If Not Present, the default MAC from EEPROM is used. If specified, the new MAC overwrites the default MAC. This specified MAC is persistent across machine reboot.
- *Value*: Not Present | Any legal 6-byte MAC address
- *Default*: Not Present

Maximum Number of RSS Processors

- *Description*: Change the number of RSS Processors.
- *Value*: 1-64

- *Default*: 16

Maximum Number of RSS Queues

- *Description*: Change the number of RSS Queues.
- *Value*: 1-16
- *Default*: 16

Maximum RSS Processor Number

- *Description*: Set the number of RSS processors to help the overall performance.
- *Value*: 0-63
- *Default*: 63

NDIS QoS

- *Description*: Enable or disable NDIS Quality of Service for DCB interface.
- *Value*: Disabled | Enabled
- *Default*: Disabled

Note *If NDIS function driver is installed using Unified Wire installer, NDIS QoS will be disabled by default. However, if the driver is installed manually (using zip package), it will be enabled by default. It is highly recommended to set it to Disabled, irrespective of installation method.*

NetworkDirect Functionality

- *Description*: Enable or disable Network Direct Functionality.
- *Value*: Disabled | Enabled
- *Default*: Enabled

NetworkDirect Interrupt Moderation

- *Description*: Control the interrupts generated during NDK traffic.
- *Value*: Disabled | Enabled
- *Default*: Enabled

For more information, refer http://msdn.microsoft.com/en-us/library/windows/hardware/ff556017%28v=vs.85%29.aspx

Nvgre Task Offload

- *Description*: Enable or disable offloading processing of NVGRE encapsulated frames.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Packet Direct

- *Description*: Enable or disable PacketDirect feature.
- *Value*: Disabled | Enabled
- *Default*: Disabled

Note *This feature is available for experimental usage only.*

Preferred NUMA node

- *Description*: The NUMA node that the adapter can allocate memory from.
- *Value*: 0 - 65535
- *Default*: 65535

PTP Hardware Timestamp

- *Description*: Enable or Disable Hardware timestamping for transmit and receive packets.
- *Value*: Disabled | Enabled
- *Default*: Disabled

Receive Side Scaling (RSS)

- *Description*: Control the RSS functions. If on, the Microsoft RSS function is enabled. If off, the Chelsio RSS function is enabled.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Recv Segment Coalescing (IPv4)

- *Description*: Enable or disable the Receive Segment Coalescing feature for IPv4 traffic. This is a receiver packets aggregating feature which helps reduce the receive host CPU load and improve throughput in a network environment where CPU can be the bottleneck.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Recv Segment Coalescing (IPv6)

- *Description*: Enable or disable the Receive Segment Coalescing feature for IPv6 traffic.
- *Value*: Disabled | Enabled
- *Default*: Enabled

RSS Base processor

- *Description*: Specify the number of the base RSS processors.
- *Value*: 0-63
- *Default*: 0

RSS load balancing profile

- *Description*: Control the RSS load balancing profile.
- *Value*:
  - Closest Processor
  - Closest Processor Static
  - Conservative Scaling
  - NUMA Scaling
  - NUMA Scaling Static
- *Default*: NUMA Scaling Static

Rx Ethernet Queue Size

- *Description*: Set different Rx Queue sizes. Driver ships with reasonable defaults.
- *Value*: 512-4096
- *Default*: 2048

Rx Offload Queue Size

- *Description*: Set different Offload Rx Queue sizes. Driver ships with reasonable defaults.
- *Value*: 256-2048
- *Default*: 512

Note *This feature is not fully tested and available for experimental usage only.*

Software Timestamp

- *Description*: Configure the driver to generate software timestamps.
- *Value*:
  - Disabled
  - RxAll
  - RxAll & TaggedTx
  - RxAll & TxAll
  - TaggedTx
  - TxAll
- *Default*: Disabled

SR-IOV

- *Description*: Enable or disable SR-IOV feature.
- *Value*: Disabled | Enabled
- *Default*: Enabled

TCP Checksum Offload (IPv4)

- *Description*: Configure computation of TCP checksum by the adapter for IPv4 packets.
- *Value*:
  - Disabled
  - Rx & Tx Enabled
  - Rx Enabled
  - Tx Enabled
- *Default*: Rx & Tx Enabled

TCP Checksum Offload (IPv6)

- *Description*: Configure computation of TCP checksum by the adapter for IPv6 packets.
- *Value*:
  - Disabled
  - Rx & Tx Enabled
  - Rx Enabled
  - Tx Enabled
- *Default*: Rx & Tx Enabled

Tx Ethernet Queue Size

- *Description*: Set different Tx Queue sizes. Driver ships with reasonable defaults.
- *Value*: 512-4096
- *Default*: 1024

Tx Offload Queue Size

- *Description*: Set different Offload Tx Queue sizes. Driver ships with reasonable defaults.
- *Value*: 256-4096
- *Default*: 512

Note *This feature is not fully tested and available for experimental usage only.*

UDP Checksum Offload (IPv4)

- *Description*: Configure computation of UDP checksum by the adapter for IPv4 packets.
- *Value*:
  - Disabled
  - Rx & Tx Enabled
  - Rx Enabled
  - Tx Enabled
- *Default*: Rx & Tx Enabled

UDP Checksum Offload (IPv6)

- *Description*: Configure computation of UDP checksum by the adapter for IPv6 packets.
- *Value*:
  - Disabled
  - Rx & Tx Enabled
  - Rx Enabled
  - Tx Enabled
- *Default*: Rx & Tx Enabled

User Mode NetworkDirect

- *Description*: Enable or disable Microsoft's Remote Direct memory Access (RDMA) interface for high speed, low latency networks.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Virtual Machine Queues

- *Description*: Enable or disable the virtual machine queue feature on the interface.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Virtual Switch RSS

- *Description*: Enable or disable Virtual Switch Receive Side Scaling.
- *Value*: Disabled | Enabled

- *Default*: Enabled

Note *This feature is not available on Windows Client OS.*

VLAN Identifier

- *Description*: Specify the VLAN ID to be inserted.
- *Value*: 0-4095
- *Default*: 0

VMQ LookAhead Split

- *Description*: Enable or disable the ability to split receive buffers into lookahead and post-lookahead buffers.
- *Value*: Disabled | Enabled
- *Default*: Enabled

VMQ VLAN ID Filtering

- *Description*: Enable or disable the ability to filter network packets by using the VLAN identifier in the media access control (MAC) header.
- *Value*: Disabled | Enabled
- *Default:* Enabled

Vxlan Task Offload

- *Description*: Enable or disable offloading processing of VXLAN encapsulated frames.
- *Value*: Disabled | Enabled
- *Default*: Enabled

Vxlan UDP Port Number

- *Description*: Specify the current VXLAN UDP destination port number that is currently operational in the NIC.
- *Value*: 1-65535
- *Default*: 4789

2.2. NVGRE Offload

Chelsio's Terminator based adapters are uniquely capable of offloading the processing of NVGRE encapsulated frames such that all stateless offloads (checksums, LSO, VMQ, RSS and filtering) are preserved, resulting in significant performance benefits. This feature is enabled by default. Configure the relevant customer and provider network settings on the host.

2.3. VXLAN Task Offload

Virtual Extensible LAN (VXLAN), an extension of the existing VLAN protocol, is an encapsulation protocol which creates an overlay network on the existing Layer 3 infrastructure. VXLAN not only

extends VLAN's Ethernet Layer 2 network services but also provides more extensibility, flexibility and scalability for large scale cloud deployments than VLAN.

Chelsio's Terminator based adapters are capable of offloading the processing of VXLAN encapsulated frames such that all stateless offloads (checksums, LSO, VMQ, RSS and filtering) are preserved, resulting in significant performance benefits. This feature is enabled by default.

2.4. Timestamps

Timestamping feature is used to maintain a precise and accurate time for the workloads. This is essential in many markets, especially in the financial where transactions need to be timestamped with minimal latency.

Note *This feature is currently supported on Windows Server 2022, 2019 and 11 Client.*

2.4.1. Hardware Timestamps

Chelsio adapters support hardware timestamping capabilities which can be used by PTP applications. With high precision times, timestamping is done in hardware for both egress and ingress packets without affecting the performance. This feature is disabled by default. Use **NDIS Miniport Driver Parameters** (Device manager → Chelsio Network Adapter Properties → Advanced Tab → PTP Hardware Timestamp) to enable it. The following capabilities are currently supported:

- In receive, hardware detects the packets with PTP event message and generates a timestamp corresponding to when such a packet was received. Both IPv4 and IPv6 are supported.
- In transmit, the hardware generates timestamps for specific packets (tagged by the OS).

2.4.2. Software Timestamps

Chelsio NDIS function driver supports generating software timestamps for the packets. This feature is disabled by default. Use **NDIS Miniport Driver Parameters** (Device manager → Chelsio Network Adapter Properties → Advanced Tab → Software Timestamp) to enable it.

2.5. PacketDirect

PacketDirect Provider Interface (PDPI), an extension to the existing NDIS miniport driver model, gives applications complete control over buffers, poll processors, and sending and receiving packets over a miniport adapter. Chelsio's Unified Wire adapters offer extensive support for this feature leading to a higher throughput performance.

Note *This feature is available for experimental usage only.*

This feature is disabled by default. Follow the steps mentioned below to enable and configure it:

i. Open **Device Manager**, click on **Network adapters**, double click on **Chelsio Network Adapter**, and then click the **Advanced** tab.
ii. Select the *Virtual Switch RSS* property and enable it (if not already enabled).
iii. Select the *Packet Direct* property and enable it. Click OK

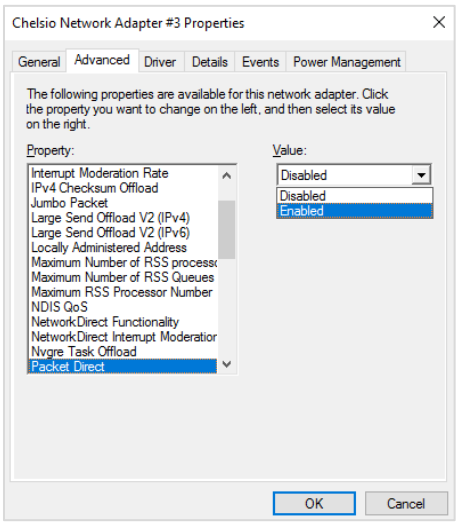

Figure 61 - Enabling Packet Direct

iv. Create a new virtual switch and enable PacketDirect on the host.

```
C:\Users\Administrator> New-VMSwitch -SwitchName <virtual_switch>
-NetAdapterName <chelsio_interface> -EnablePacketDirect $true
```

```
PS C:\Users\Administrator> New-VMSwitch -SwitchName sw0 -NetAdapterName "Ethernet 3" -EnablePacketDirect $true

Name SwitchType NetAdapterInterfaceDescription
---- ---------- ------------------------------
sw0  External   Chelsio Network Adapter
```

Figure 62 - Enable PacketDirect

v. Enable *Azure Virtual Filtering Platform (VFP) Switch Extension* on the switch.

```
C:\Users\Administrator> Enable-VMSwitchExtension -VMSwitchName
<virtual_switch> -Name "Microsoft Azure VFP Switch Extension"
```

```
PS C:\Users\Administrator> Enable-VMSwitchExtension -VMSwitchName sw0 -Name "Microsoft Azure VFP Switch Extension"


Id                  : E9B59CFA-2BE1-4B21-828F-B6FBDBDDC017
Name                : Microsoft Azure VFP Switch Extension
Vendor              :
Version             :
ExtensionType       : Forwarding
ParentExtensionId   :
ParentExtensionName :
SwitchId            : 48f433e2-10ad-447a-8566-bb4864dbcb12
SwitchName          : sw0
Enabled             : True
Running             : True
CimSession          : CimSession: .
ComputerName        : DUKE2
IsDeleted           : False
```

Figure 63 - Enable VFP Switch Extension

vi. Add a virtual network adapter to the virtual machine and connect it to the virtual switch.

```
C:\Users\Administrator> Add-VMNetworkAdapter -VMName <virtual_machine>
-SwitchName <virtual_switch> -Name <virtual_adapter>
```

```
C:\Users\Administrator> Add-VMNetworkAdapter -VMName VM1 -SwitchName sw0 -Name pd_nw1
C:\Users\Administrator>
```

Figure 64 - Add virtual network adapter

vii. Set the number of PacketDirect processors.

```
C:\Users\Administrator> Set-VMNetworkAdapter -VMName <virtual_machine>
-PacketDirectNumProcs <1-8>
```

```
PS C:\Users\Administrator> Set-VMNetworkAdapter -VMName VM1 -PacketDirectNumProcs 4
PS C:\Users\Administrator>
```

Figure 65 - Set PacketDirect processors

viii. Start the VM.

```
C:\Users\Administrator> Start-VM <virtual_machine>
```

ix. On the host, create a PowerShell script (with *.ps1* extension) with the following code.

```
param(
    [string]$switchName = $(throw "please specify a switch name")
    )

$switches = Get-WmiObject -Namespace root\virtualization\v2 -Class
Msvm_VirtualEthernetSwitch
foreach ($switch in $switches) {
               if ( $switch.ElementName -eq $switchName) {
                              $ExternalSwitch = $switch
                              break
               }
}
$vfpCtrlExe = "vfpctrl.exe"
$ports = $ExternalSwitch.GetRelated("Msvm_EthernetSwitchPort",
"Msvm_SystemDevice", $null, $null, $null, $null, $false, $null)
foreach ($port in $ports) {
#if ($port.ElementName -eq "Dynamic Ethernet Switch Port")
#{
    $portGuid = $port.Name
    echo "Disabling VFP on port: " $portGuid
    & $vfpCtrlExe  /disable-port /port $portGuid
#}
}
```

x. Run the script.

```
PS C:\Users\Administrator> <script>.ps1 <virtual_switch>
```

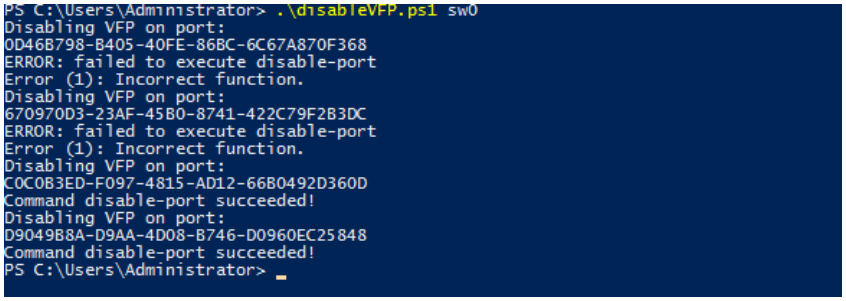

Figure 66 - Running the script

Note *The errors seen in the output are expected.*

xi. Use system performance monitoring utilities, such as *PerfMon*, to add PacketDirect counters and verify if they are updated.

2.6. Virtual Environments

Network throughput of a multi-core Virtual Machine (VM) is limited by the processing power of a single virtual processor, since only one processor handles all the interrupts from a virtual network adapter. Virtual Machine Multi-Queue (VMMQ)/Virtual Switch Receive-side Scaling (vRSS) and Dynamic VMMQ/RSSv2 solve this bottleneck by distributing the network traffic across multiple virtual processors. Dynamic VMMQ/RSSv2, makes RSS algorithm dynamic by taking CPU measurement and making balancing decision at DISPATCH level. The feature also avoids taking global locks by changing only the subset of indirection table which affects current CPUs only. These features are enabled by default.

Important *This is currently supported for 28 VM Network Adapters per Chelsio adapter.*

VMMQ/vRSS

VMMQ/vRSS must be enabled for each VM on the host using:

```
PS C:\Users\Administrator> Set-VMNetworkAdapter -VMName <VM Name>
-VrssEnabled:$true -VmmqEnabled:$true -VmmqQueuePairs <No. of Queues>
```

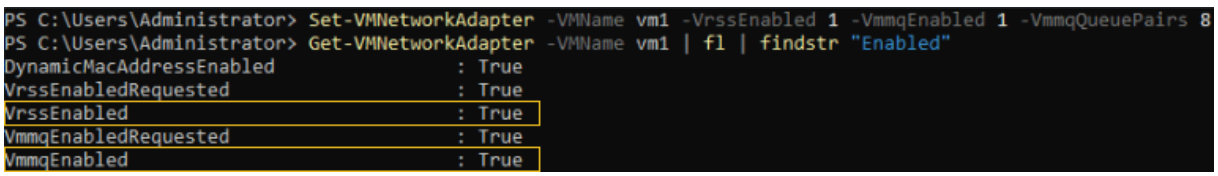

Figure 67 - Enabling VMMQ/vRSS for VM

Dynamic VMMQ/RSSv2

Note *Available on Windows Server 2016 version 1709 and later.*

Additionally, Dynamic VMMQ/RSSv2 must be enabled for each VM on the host using:

```
PS C:\Users\Administrator> Set-VMNetworkAdapter -VMName <VM Name>
-VrssEnabled 1 -VmmqEnabled 1 -VmmqQueuePairs <No. of Queues>
-VrssQueueSchedulingMode Dynamic
```

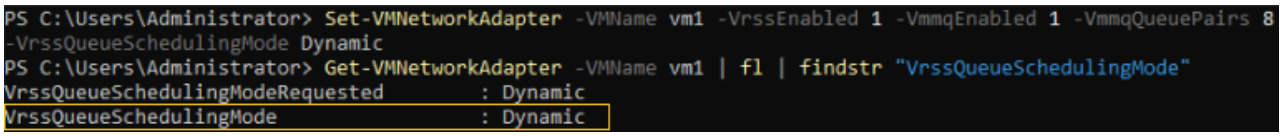

Figure 68 - Enabling Dynamic VMMQ/RSSv2 for VM

III. iWARP (ND)

1. Introduction

ND or Network Direct is Microsoft's new Remote Direct memory Access (RDMA) interface for high speed, low-latency networks such as those running on 10/25/40/50/100 Gigabit Ethernet or InfiniBand, with an architecture that directly bypasses OS and TCP/IP overhead. ND achieves better performance for massively parallel programs that can utilize very low-latency, high-bandwidth, and enables efficient CPU utilization.

1.1. Hardware Requirements

1.1.1. Supported Adapters

Following is the list of supported Chelsio adapters:

- 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

1.2. Software Requirements

1.2.1. Windows Requirement

Currently Chelsio iWARP (ND) driver is available for the following Windows version(s):

- Server 2022
- Server 2019
- 11 Client (Enterprise and "Pro for Workstations" editions)
- 10 Client (Enterprise and "Pro for Workstations" editions)

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

2. Software/Driver Configuration and Fine-tuning

2.1. Registering iWARP(ND) driver

Chelsio Unified Wire Installer registers Chelsio iWARP provider automatically during installation.

In case of zip package, run the following command to register:

```
C:\Users\Administrator>chinstallsp.exe -i
```

The iWARP provider should show up using:

```
C:\Users\Administrator>chinstallsp.exe -l
```

You should see a similar output:

```
0000001019 - Chelsio Network Direct provider
```

2.2. chrping application

chrping application can be used to test RDMA connectivity between the hosts. Configure the Chelsio interfaces on the hosts with the appropriate IP Address, netmask etc. Use the basic ping command to verify connectivity via the Terminator interface. In case of Installer, *chrping.exe* will be copied to *<system_drive>\Windows\System32* folder during installation.

If you are using the zip package, copy *chrping.exe* from *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy\chrping* folder to *<system_drive>\Windows\System32*

The following steps verify RDMA connectivity between a Windows and a Linux host.

Important *Disable iWARP Port Mapper (iwpmd) service on Linux hosts. On RHEL7.X machines, use the below command.*

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

i. Start rping server on Linux host.

```
[root@host~]# rping -s -a <server_ip> -p <port #> -S <data size>
```

ii. Start chrping client on Windows host.

```
C:\Users\Administrator>chrping.exe c <server_ip> t <port #> S <data size>
```

Example:

Connecting to a Linux IPv4 Server.

```
PS C:\Users\Administrator\Desktop> chrping.exe c 10.1.1.5 t 8000 S 1024
Chelsio rdma interop utility v0.1
Bind Succeeded!!StartBuf Base:0x189574a6fd0 RKey:0x12fd85 Len:1024
Bind Succeeded!!RdmaBuf Base:0x189574a73e0 RKey:0x130986 Len:1024
Test complete
```

Figure 69 - IPv4 chrping

Connecting to a Linux IPv6 Server.

```
PS C:\Users\Administrator\Desktop> chrping.exe c 1000::5 t 8000 S 1024
Chelsio rdma interop utility v0.1
Bind Succeeded!!StartBuf Base:0x19437dec4e0 RKey:0x132d89 Len:1024
Bind Succeeded!!RdmaBuf Base:0x19437dec8f0 RKey:0x13368a Len:1024
Test complete
```

Figure 70 - IPv6 chrping

2.3. HMA

The Host Memory Access(HMA) implements a bridge between the Memory Arbiter (MA) and the PCIE so that the Host Memory is available to all clients. The translation from the MA memory map to the Host Memory map is performed based on the client number and the address of the transaction, both of which are used as index to look up a 64-bit offset within the Host Memory.

Currently 256 IPv4/128 IPv6 Network Direct offload connections are supported on T6225-SO-CR adapter. You can view the number of connections offloaded by using

```
C:\Users\Administrator> cxgbtool <nicIface> hardware tid_info
```

```
PS C:\> cxgbtool nic0 hardware tid_info
TID range: 0..255, in use: 128
STID range: 256..319, in use: 10
ATID range: 0..127, in use: 0
FTID range: 320..687
HW TID usage: 0 IP users, 128 IPv6 users
```

Figure 71 - HMA Offload connections

IV. SMB Direct

1. Introduction

SMB Direct is an extension of the Server Message Block (SMB) technology by Microsoft used for file operations. The *Direct* part implies the use of various high speed Remote Data Memory Access (RDMA) methods to transfer large amounts of data with little CPU intervention. By using RDMA as a transport medium for SMB, unprecedented levels of performance and efficiency can be achieved. With fully offloaded RDMA support, Chelsio Unified Wire adapters deliver large performance and efficiency gains to Windows users in a seamless, plug and play fashion.

1.1. Hardware Requirements

1.1.1. Supported Adapters

Following is the list of supported Chelsio adapters:

- 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

1.2. Software Requirements

1.2.1. Windows Requirement

Following is the list of SMB Direct components and supported Windows versions:

Windows Version	SMB Direct Components
Server 2022	SMB Direct*, SR, S2D
Server 2019	
11 Client^	SMB Direct
10 Client^	

^ *Enterprise and "Pro for Workstations" editions*
* *SMB Direct and RDMA with Virtual Switch (Mode 2)*

2. Software/Driver Configuration and Fine-tuning

2.1. Enabling SMB Direct

SMB Direct is installed and enabled by default on Windows Server 2022/2019/2016 and Client 11/10 (Enterprise and "Pro for Workstations" editions). RDMA functionality on Chelsio adapters will be enabled after installing the driver from the package.

Configuration

You can use the PowerShell command `Get-NetAdapterRdma` to get a list of RDMA capable interfaces in your system. At least one adapter should indicate “RDMA Capable” true to take advantage of SMB RDMA capability.

The next step is to configure your network so that SMB server and client machines can communicate with each other. Please configure the Microsoft firewall to allow traffic between the SMB clients and server.

Important *When using with Linux machines, disable iWARP Port Mapper (iwpmd) service on them. On RHEL7.X machines, use the below command.*

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

2.2. Verifying RDMA

There are number of ways to verify if RDMA is working:

2.2.1. Verify active connections using PowerShell

Open PowerShell window and execute the command `Get-SmbConnection`

2.2.2. Use Event Viewer

You can use Event Viewer to view SMB connection events. To do this:

i. Open Event Viewer
ii. In the console tree, expand **Event Viewer.**
iii. Navigate to **Application and Service Logs**-> **Microsoft**->**Windows**->**SMBClient** ->**Operational**

2.3. RDMA with Virtual Switch (Mode 2)

In this mode, you can run RDMA traffic using a virtual switch. This feature is enabled by default in the driver, but must be enabled on the Hyper-V Virtual Ethernet adapter. Follow the steps mentioned below to enable the feature:

i. If you haven't done already, run the Chelsio Unified Wire Installer which will install NDIS function driver.
ii. Verify if the driver is installed and loaded using the *Get-NetAdapter* command. The *InterfaceDescription* field should list Chelsio adapter as shown in the image below:

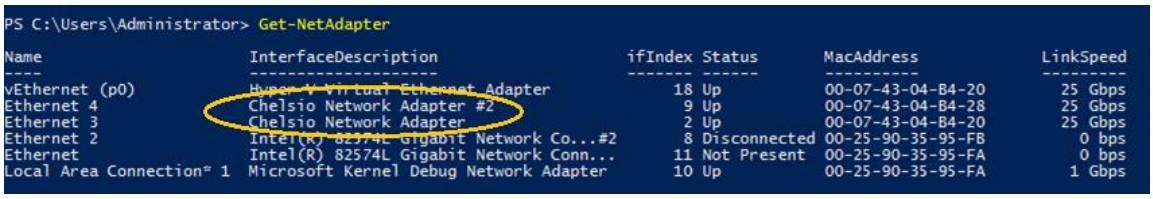

Figure 72 - Verifying Chelsio driver

iii. Next, create a virtual switch using the following syntax:

```
PS C:\Users\Administrator> New-VMSwitch -Name <virtual_switch>
-NetAdapterName <chelsio_interface>
```

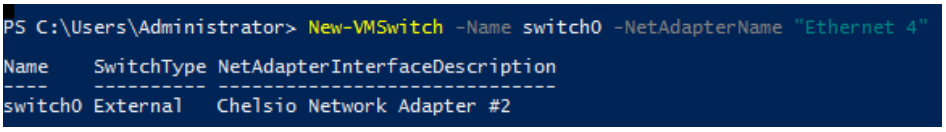

Figure 73 - Creating virtual switch

iv. Using *Get-NetAdapter* command, verify if the virtual switch is created successfully. The Mac address of the switch and the port on which the switch was created, should be same.

Figure 74 - Verifying virtual switch

v. Enable RDMA on the virtual switch using *Enable-NetAdapterRdma* command.

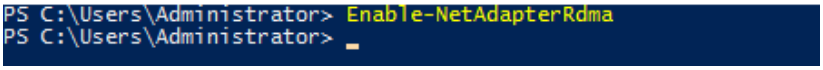

Figure 75 - Enabling RDMA on virtual switch

vi. Run *Get-NetAdapterRdma* command to verify if RDMA is enabled on the switch.

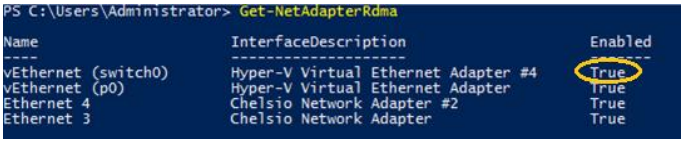

Figure 76 - Verifying RDMA on virtual switch

2.4. Storage Replica

Storage Replica (SR) is a Windows Server 2016 feature which enables block-level replication between clusters or individual servers for disaster recovery, and stretching of failover clusters to metropolitan (MAN) and wide area (WAN, US coast-to-coast) distances for high availability. SR provides two modes of operation: *synchronous* and *asynchronous* replication. Synchronous replication enables mirroring of data with zero data loss at the volume level, whereas asynchronous replication trades off full data replication guarantees for reduced latency by locally completing I/O operations.

Currently, Unified Wire supports Server to Server replication mode. In this mode, data is synced between two servers and each server keeps an identical copy of the same volume. For more information on how to setup and configure in this mode, please refer to Microsoft's official documentation.

2.5. Storage Spaces Direct (S2D)

Chelsio's high performance iWARP RDMA adapters enable incremental, non-disruptive server installs, and support the ability to work with any standard Ethernet switch, delivering a brownfield strategy to enable high performance, low cost, scalable Azure Stack Hyper Converged Infrastructure (HCI) deployments. Major benefits include cost savings on switches at higher speeds with each deployment. Windows SMB Direct over iWARP RDMA provides higher performance by giving direct access to the data residing on hyper-converged or disaggregated storage, while the CPU reduction enables a larger number of VMs per Hyper-V server, enabling savings in power dissipation, system configuration and deployment scale throughout the life of the installation. They prove to be a best fit for both networking and virtualization requirements, as well as hyper-converged scalable storage solutions like Storage Spaces Direct (S2D), a core storage feature for Azure Stack solution.

2.5.1. Configuring S2D

Connect all the ports of the Chelsio adapters to a Switch (Please refer Switch Configuration section for sample configurations). Install Unified Wire on all the machines in the Mesh Topology. Refer to Chelsio Unified Wire chapter. To configure S2D, follow the steps mentioned below:

i. Install Hyper-V and Failover cluster roles on all the nodes.
ii. Set the following Registry entries for Server 2019 and reboot the nodes to enable S2D.

```
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ClusSvc\Parameters]
"S2D"=dword:1
[HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\NetworkController]
"Enabled"=dword:1
```

iii. Add the Nodes to a domain.

iv. RDMA will be enabled by default for the Chelsio Ports. Verify using the following command.

```
PS C:\> Get-NetAdapterRdma
```

```
PS C:\> Get-NetAdapterRdma

Name                      InterfaceDescription                Enabled    PFC        ETS
----                      --------------------                -------    ---        ---
ch--p1                    Chelsio Network Adapter #10         True       False      False
ch--p0                    Chelsio Network Adapter #9          True       False      False
```

Figure 77 - RDMA for Chelsio Ports

v. The disks intended to be used for S2D need to be empty and without partitions or other data. If a disk has partitions or other data, it will not be included in the S2D system. Check the status of all the disks using the below command.

```
PS C:\> Get-Disk
```

```
PS C:\> Get-Disk

Number Friendly Name                  Serial Number                HealthStatus       OperationalStatus      Total Size Partition
                                                                                                               Style
------ -------------                  -------------                ------------       -----------------      ---------- ----------
0      DELL PERC H710                 00fb24aea747143c2200ea91fb60f681 Healthy            Online                   3.82 TB MBR
1      INTEL SSDPECME016T4            CVF85475002B1P6BGN-1_00000001.   Healthy            Offline                745.21 GB RAW
2      INTEL SSDPECME016T4            CVF85475002B1P6BGN-2_00000001.   Healthy            Offline                745.21 GB RAW
3      INTEL SSDPECME016T4            CVF8547500181P6BGN-1_00000001.   Healthy            Offline                745.21 GB RAW
4      INTEL SSDPECME016T4            CVF8547500181P6BGN-2_00000001.   Healthy            Offline                745.21 GB RAW
6      INTEL SSDPEDKE020T7            0100_0000_0100_0000_5CD2_E4F2...  Healthy            Offline                  1.82 TB RAW
5      MTFDHAX2T4MCF-1AN1ZABYY        CFE0_0003_0F24_B300.             Healthy            Offline                  2.18 TB RAW
```

Figure 78 - Check Disks status

Note *Storage Spaces Direct does not support disks connected via multiple paths, and the Microsoft Multipath MPIO software stack.*

vi. Before creating the cluster, validate the nodes using the cluster validation tool.

```
PS C:\>  Test-Cluster –Node <Node1,Node2,...> –Include “Storage Spaces
Direct”,Inventory,Network,”System Configuration”
```

```
PS C:\> Test-Cluster -Node azure1.chddc.com,azure2.chddc.com,azure3.chddc.com -Include "Storage Spaces Direct",Inventory,Network,"System Configuration"

WARNING: System Configuration - Validate All Drivers Signed: The test reported some warnings..
WARNING: System Configuration - Validate Software Update Levels: The test reported some warnings..
WARNING: Storage Spaces Direct - Verify Node and Disk Configuration: The test reported some warnings..
WARNING:
Test Result:
HadUnselectedTests, ClusterConditionallyApproved
Testing has completed for the tests you selected. You should review the warnings in the Report.  A cluster solution is supported by Microsoft only if
 you run all cluster validation tests, and all tests succeed (with or without warnings).
Test report file path: C:\Users\administrator.CHDDC\AppData\Local\Temp\Validation Report 2018.11.01 At 23.48.34.htm

Mode                LastWriteTime         Length Name
----                -------------         ------ ----
-a----        11/1/2018  11:49 PM        1209359 Validation Report 2018.11.01 At 23.48.34.htm
```

Figure 79 - Cluster Validation

vii. Create a cluster using the nodes validated in the previous step.

```
PS C:\> New-Cluster –Name <ClusterName> –Node <Node1,Node2,...> –NoStorage
-StaticAddress <static_ip> -Verbose
```

Figure 80 - Cluster Creation

Note *Without the –NoStorage parameter, the disks may be automatically added to the cluster and you will need to remove them before enabling S2D. Otherwise they will not be included in the S2D pool.*

viii. Enable S2D and create a storage pool.

```
PS C:\>Enable-ClusterS2D -CacheState <State> -Verbose
```

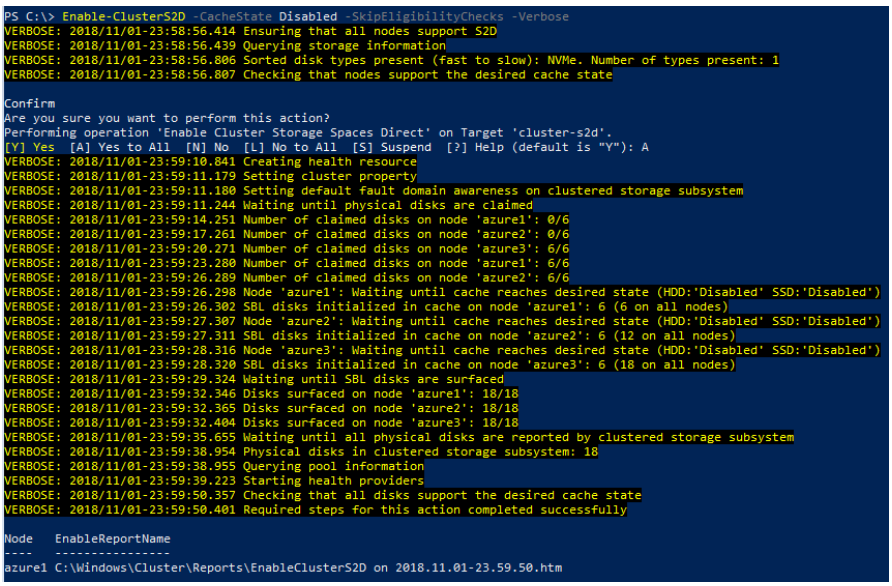

Figure 81 - Enable S2D

ix. Create virtual disks on the storage pool created.

```
PS C:\Users\Administrator>Get-ClusterNode |% { New-Volume -
StoragePoolFriendlyName s2d -FriendlyName $_ -FileSystem CSVFS_ReFS -Size
500GB -Verbose  }
PS C:\Users\Administrator>New-Volume -StoragePoolFriendlyName s2d -
FriendlyName Collect -FileSystem CSVFS_ReFS -Size 100GB -Verbose
```

x. Create or deploy VMs. The VM's files should be stored on the virtual disks.

2.5.2. Switch Configuration

Chelsio iWARP RDMA does not require any configuration of DCB, PFC, ETC, ECN etc. on the Switch. It is recommended to disable them and enable regular flow control on switch ports. The following section shows the sample configuration on few switches.

- **Dell/Force 10 S4810 Switch**

```
Force10#configure
Force10(conf)#no dcb enable
Force10(conf)#interface fortyGigE 0/48
Force10(conf-if-fo-0/48)#flowcontrol rx on tx on
Force10(conf-if-fo-0/48)#shutdown
Force10(conf-if-fo-0/48)#no shutdown
```

- **Dell EMC S5148F-ON**

```
OS10# configure terminal
OS10(config)# interface ethernet 1/1/6
OS10(conf-if-eth1/1/6)# no lldp transmit
OS10(conf-if-eth1/1/6)# no lldp receive
OS10(conf-if-eth1/1/6)# no priority-flow-control
OS10(conf-if-eth1/1/6)# flowcontrol receive on
OS10(conf-if-eth1/1/6)# flowcontrol transmit on
OS10(conf-if-eth1/1/6)# shutdown
OS10(conf-if-eth1/1/6)# no shutdown
```

- **Cisco Nexus 5010**

```
ciscoswitchcert2# configure
ciscoswitchcert2(config)# interface ethernet 1/1
ciscoswitchcert2(config-if)# no lldp transmit
ciscoswitchcert2(config-if)# no lldp receive
ciscoswitchcert2(config-if)# priority-flow-control mode off
ciscoswitchcert2(config-if)# flowcontrol receive on
ciscoswitchcert2(config-if)# flowcontrol send on
ciscoswitchcert2(config-if)# shutdown
ciscoswitchcert2(config-if)# no shutdown
```

- **Mellanox 2410 Switch**

```
sn2410 [standalone: master] # configure terminal
sn2410 [standalone: master] (config) # interface ethernet 1/1
sn2410 [standalone: master] (config interface ethernet 1/1) # shutdown
sn2410 [standalone: master] (config interface ethernet 1/1) # no lldp
transmit
sn2410 [standalone: master] (config interface ethernet 1/1) # no lldp
receive
sn2410 [standalone: master] (config interface ethernet 1/1) # no dcb
priority-flow-control mode
sn2410 [standalone: master] (config interface ethernet 1/1) # flowcontrol
send on
sn2410 [standalone: master] (config interface ethernet 1/1) # flowcontrol
receive on
sn2410 [standalone: master] (config interface ethernet 1/1) # no shutdown
```

2.6. HMA

The Host Memory Access(HMA) implements a bridge between the Memory Arbiter (MA) and the PCIE so that the Host Memory is available to all clients. The translation from the MA memory map to the Host Memory map is performed based on the client number and the address of the transaction, both of which are used as index to look up a 64-bit offset within the Host Memory.

Currently 256 IPv4/128 IPv6 SMB Direct offload connections are supported on T6225-SO-CR adapter. You can view the number of connections offloaded by using

```
C:\Users\Administrator> cxgbtool <nicIface> hardware tid_info
```

```
PS C:\> cxgbtool nic0 hardware tid_info
TID range: 0..255, in use: 128
STID range: 256..319, in use: 10
ATID range: 0..127, in use: 0
FTID range: 320..687
HW TID usage: 0 IP users, 128 IPv6 users
```

Figure 82 - HMA Offload connections

Once the offload connections limit is reached, connections will continue to establish in regular NIC mode.

2.7. Troubleshooting

If RDMA is not working in your system, please check for the following:

- Operating system version should be Windows Server 2022/2019/2016 or 11/10 Client (Enterprise and "Pro for Workstations" editions).
- Verify network interface configurations on both sides.
- Please ensure that the interfaces are reachable using *ping* command.
- In the Event Viewer (on the client side), please ensure that the traffic running is not over TCP.
- Verify that SMB driver is loaded and working.

```
C:\Users\Administrator>driverquery.exe | findstr /I smb
```

- Verify that Chelsio driver is loaded and working.

```
C:\Users\Administrator>driverquery.exe | findstr /I chel
```

- Confirm that traffic is running over Chelsio adapter.
- Look for potential errors in Event Log.

V. Mesh Topology

1. Introduction

Chelsio's fifth/sixth generation (T5/T6), high performance 10/25/40/50/100GbE adapters enable incremental, non-disruptive server installs, and support the ability to work without requiring any discrete external network switch, delivering a brownfield strategy to enable high performance, low cost, scalable deployments. Major benefits include cost savings on switches at higher speeds with each deployment. Mesh topology involves connecting each node to every other node.

1.1. Hardware Requirements

1.1.1. Supported Adapters

Following is the list of supported Chelsio adapters:

- T62100-CR
- T62100-LP-CR
- T62100-SO-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
- T580-SO-CR*
- T540-CR
- T540-LP-CR
- T540-SO-CR*
- T540-BT
- T520-CR
- T520-LL-CR
- T520-SO-CR*
- T520-BT

** NIC only supported*

1.2. Software Requirements

Currently the Chelsio Mesh Topology is available for the following Windows version(s):

- Server 2022
- Server 2019
- 11 Client
- 10 Client

1.3. Mesh topology

Each node should be connected to other node. Supported configs using this approach: N ports per node, N+1 node cluster. The below is a 5-node Mesh using 4-port Chelsio adapters. NIC ports on each server connected to each other (1<->2, 1<->3, 1<->4, 1<->5, 2<->3, 2<->4, 2<->5, 3<->4, 3<->5, 4<->5).

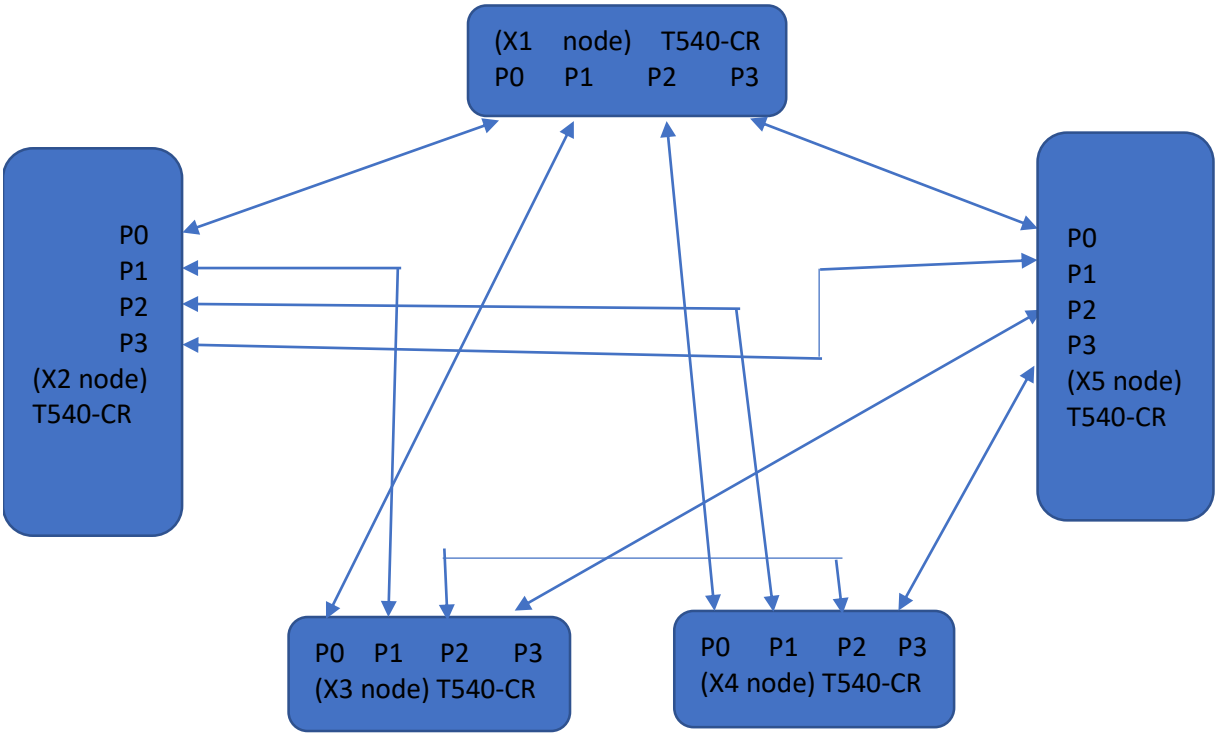

Figure 83 - Mesh Topology

2. Software/Driver Installation

Install Unified Wire on all the machines in the Mesh Topology. Refer to Chelsio Unified Wire chapter.

3. Software/Driver Configuration and Fine-tuning

Configure the required IP addresses on all the interfaces. You should be able to run NIC and SMB Direct traffic between the nodes of mesh topology.

Example:

3 nodes are connected to each other in mesh topology with the following IP addresses.

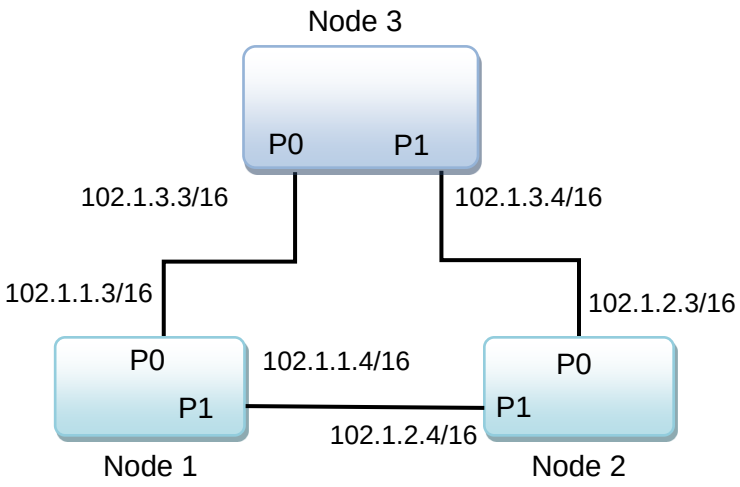

Figure 84 - Sample connectivity

Node3 can communicate to node1,

```
PS C:\Users\Administrator> ping 102.1.1.3
```

Node3 can communicate to node2,

```
PS C:\Users\Administrator> ping 102.1.2.3
```

VI. NDIS SR-IOV

1. Introduction

The ever-increasing network infrastructure of IT enterprises has led to a phenomenal increase in maintenance and operational costs. IT managers are forced to acquire more physical servers and other data center resources to satisfy storage and network demands. To solve the Network and I/O overhead, users are opting for server virtualization which consolidates I/O workloads onto lesser physical servers thus resulting in efficient, dynamic and economic data center environments. Other benefits of Virtualization include improved disaster recovery, server portability, cloud computing, Virtual Desktop Infrastructure (VDI), etc. Chelsio's Unified Wire adapters with full support for PCI-SIG SR-IOV and virtualization features deliver increased bandwidth, lower latency and lower power to maximize cloud scaling and utilization.

1.1. Hardware Requirements

1.1.1. Supported Adapters

The following are the adapters that are compatible with the Chelsio NDIS SR-IOV components:

Chelsio Adapter	NDIS SR-IOV Components
T62100-SO-CR	NDIS SR-IOV
T580-SO-CR	
T540-SO-CR	
T520-SO-CR	
T62100-CR	NDIS SR-IOV, Guest RDMA
T62100-LP-CR	
T6425-CR	
T6225-CR	
T6225-LL-CR	
T6225-SO-CR	
T580-CR	
T580-LP-CR	
T540-BT	
T540-CR	
T540-LP-CR	
T520-CR	
T520-LL-CR	
T520-BT	

1.2. Software Requirements

Following is the list of NDIS SR-IOV components and supported Windows versions:

Windows Version	NDIS Components
Server 2022	NDIS SR-IOV, Guest RDMA
Server 2019	

1.3. Prerequisites

SR-IOV should be enabled in the machine.

2. Software/Driver Configuration and Fine-tuning

Please ensure that Unified Wire is installed on the host before proceeding. Refer Software/Driver Installation section of the **Chelsio Unified Wire** chapter for step-by-step instructions.

2.1. Enabling SR-IOV

The adapter's configuration should be updated to make use of the SR-IOV feature. Change the Serial Init to SR-IOV using Chelsio Management feature as explained here.

Important

*To use the adapter in non-SRIOV scenarios in Windows or with other operating systems, the configuration type must be changed to **NON-SRIOV (Default)**.*

2.2. Host Configuration

i. Create a vSwitch with SR-IOV enabled using Chelsio adapter:

a) Open *Hyper-V Manager* application.

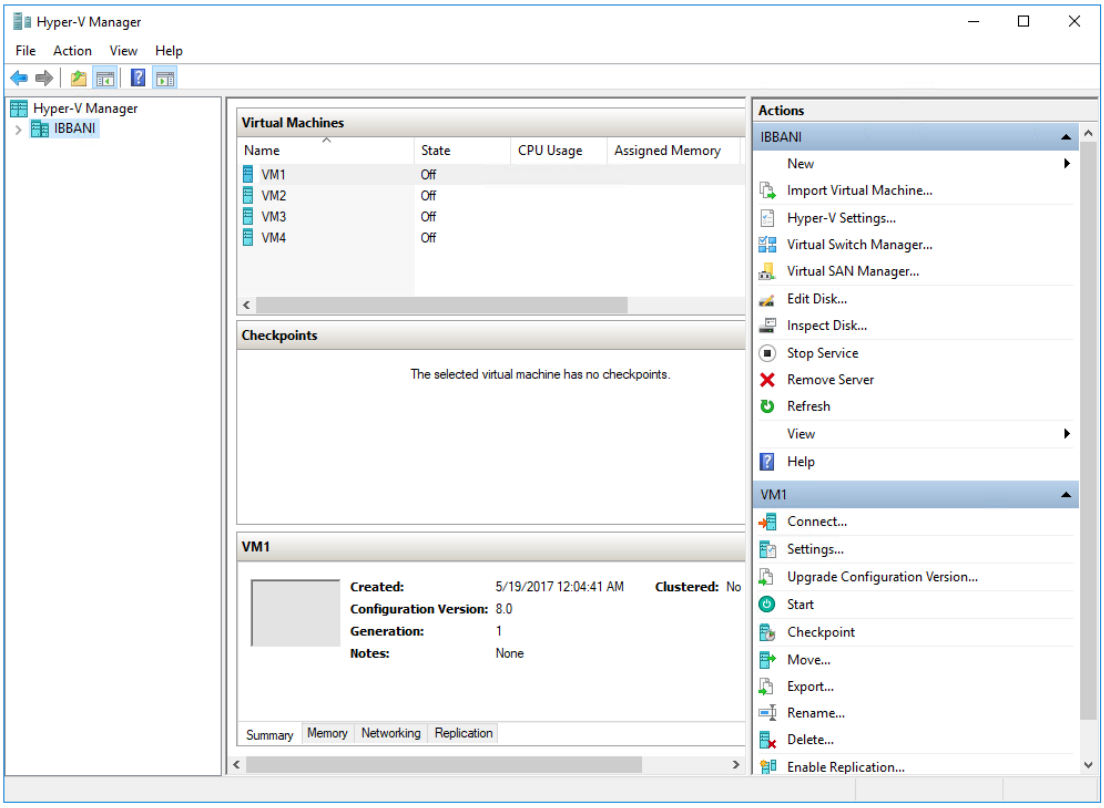

Figure 85 - Hyper-V Manager

b) Click the *Virtual Switch Manager* link under *Actions*.

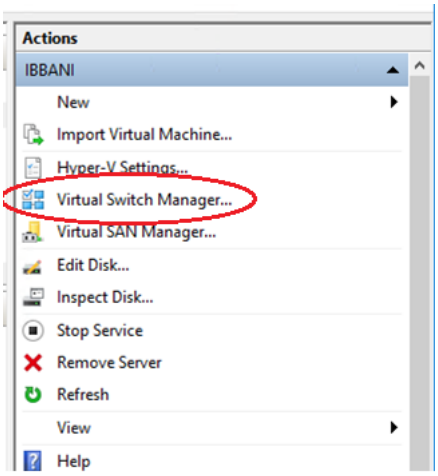

Figure 86 - Opening Virtual Switch Manager

c) Select *External* as the type of virtual switch to create. This will provide the VMs access to the external network. Click *Create Virtual Switch*.

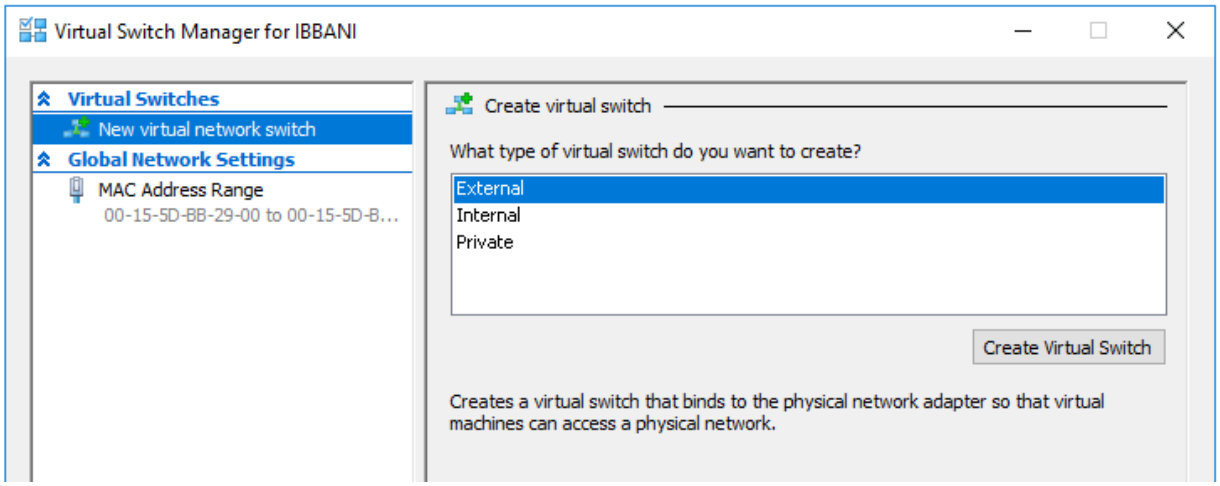

Figure 87 - Creating Virtual Switch

d) Provide a name for the vSwitch. Select the Chelsio adapter to connect the vSwitch to and select *Enable single-root I/O virtualization (SR-IOV)*. Click **OK**.

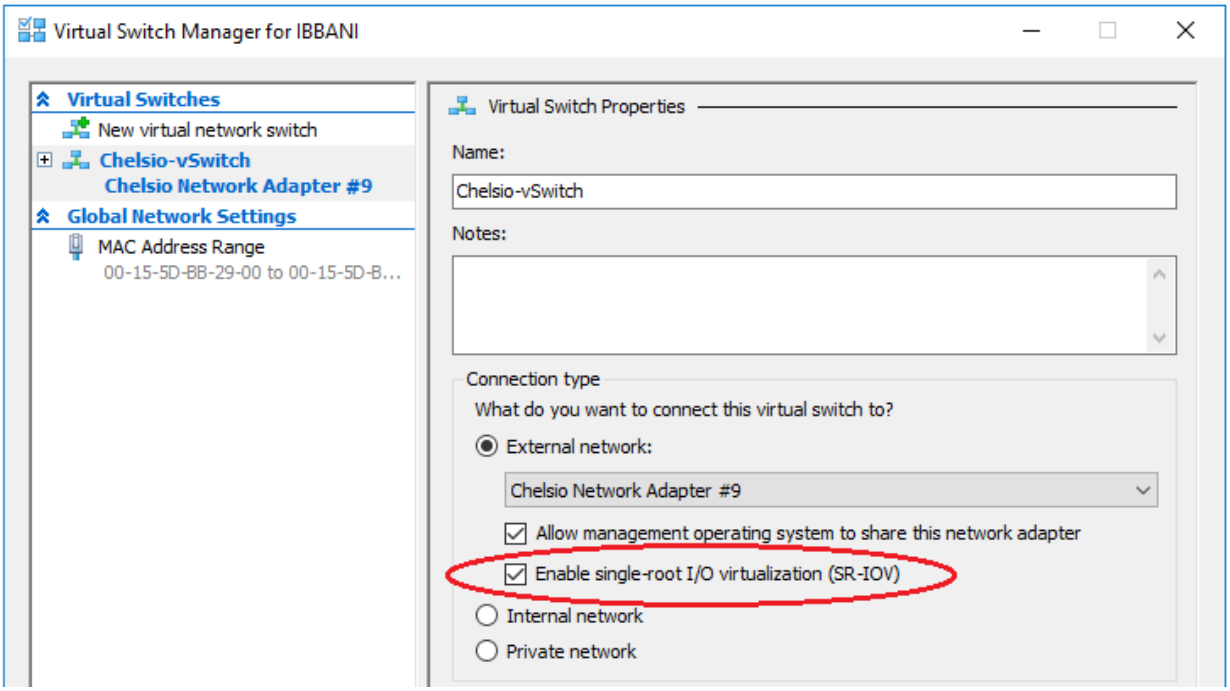

Figure 88 - Enabling SR-IOV on vSwitch

e) Click **Yes** on the prompt that appears next.

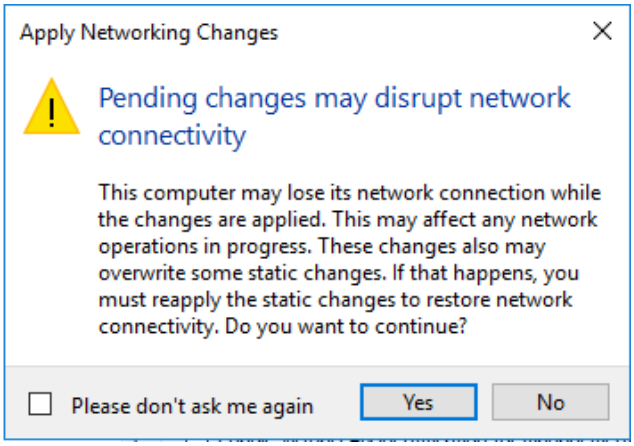

Figure 89 - Confirming Changes

ii. Assign a virtual network adapter with SR-IOV enabled to the VM.
   a) Open Hyper-V Manager. Right-click on the VM and select *Settings*.

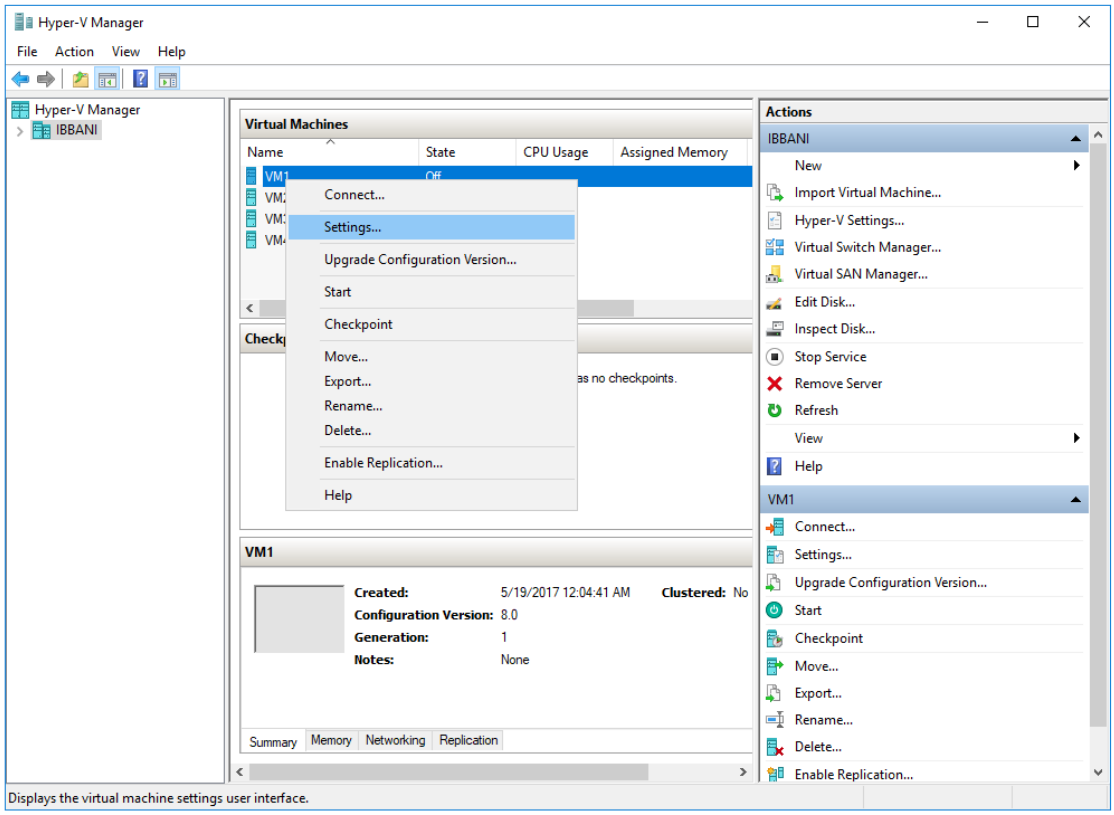

Figure 90 - Hyper-V Manager

b) Expand the *Network Adapter* link, click *Hardware Acceleration* and select *Enable SR-IOV*. Click **OK**.

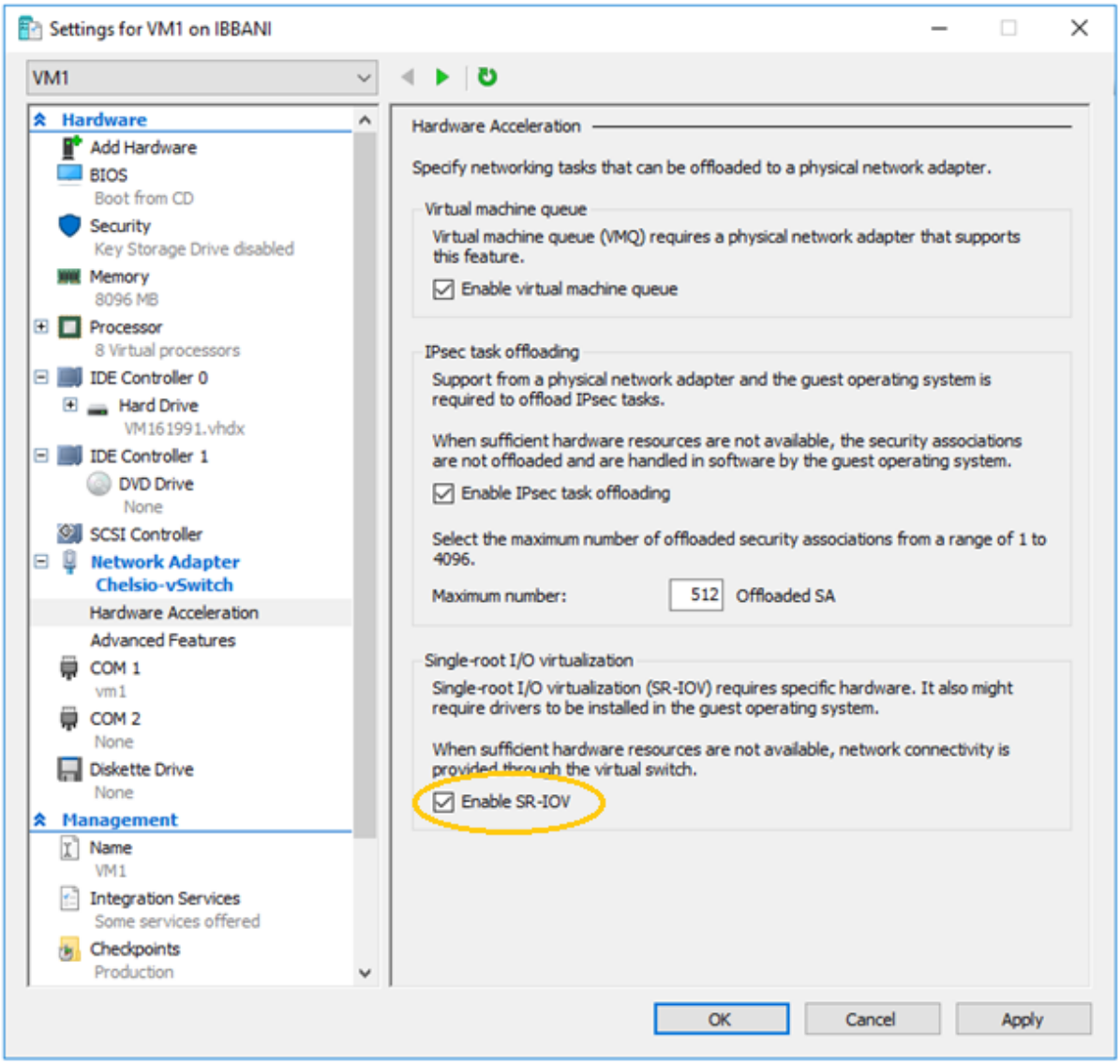

Figure 91 - Enabling SR-IOV on Virtual Network Adapter

c) Right-click on the VM and select *Start* to start the VM.

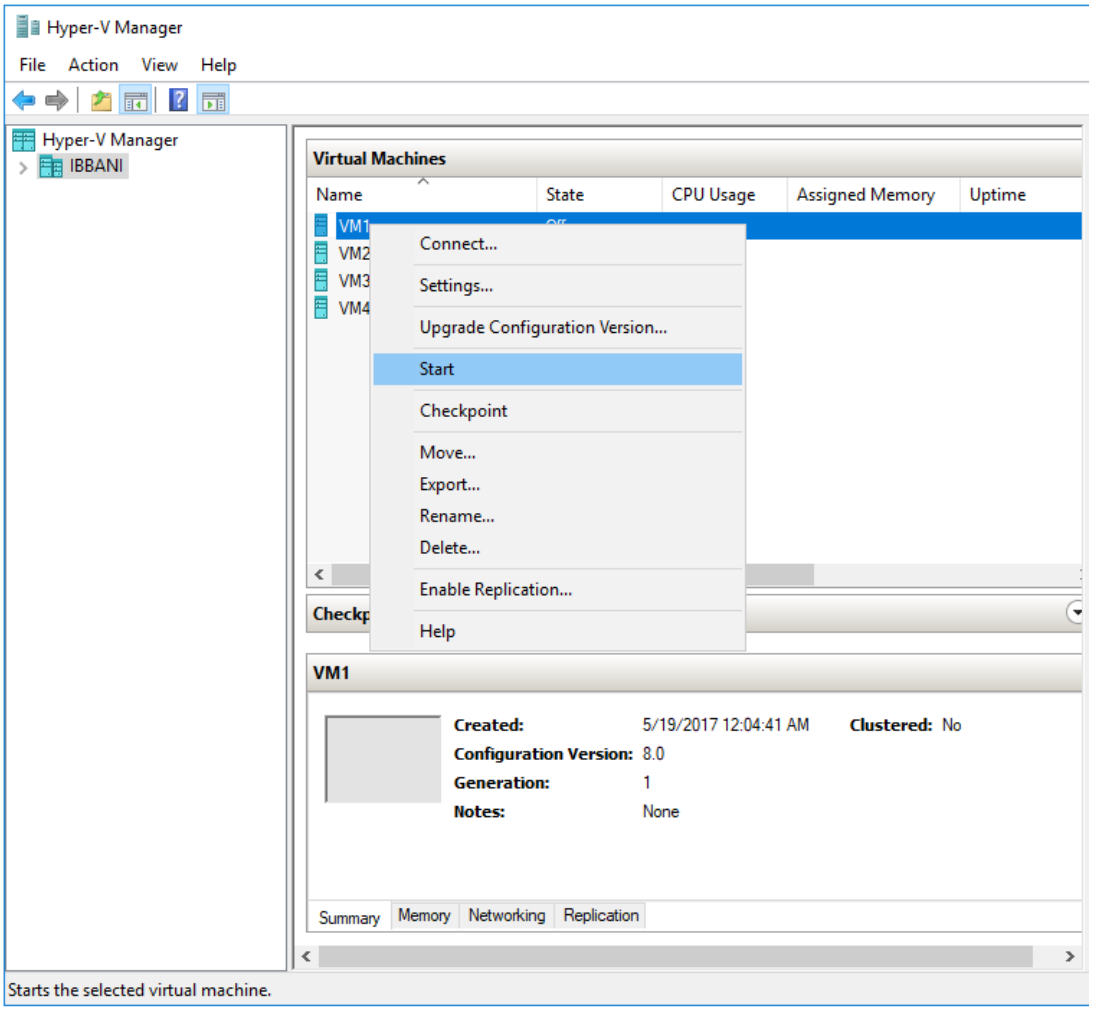

Figure 92 - Starting VM

2.3. Guest (VM) Configuration

i. Use VM Connect as described here and access the Unified Wire package on the Guest (VM). Proceed with the Unified Wire installation as described in the Software/Driver Installation section of the **Unified Wire** chapter.

ii. Verify if SR-IOV was enabled successfully on the host:

```
PS C:\Users\Administrator> Get-VMNetworkAdapter <vm_name> | fl
```

The *VFDataPathActive* parameter must display *True* as shown in the image below. This, however, is possible only if the physical port has an active link.

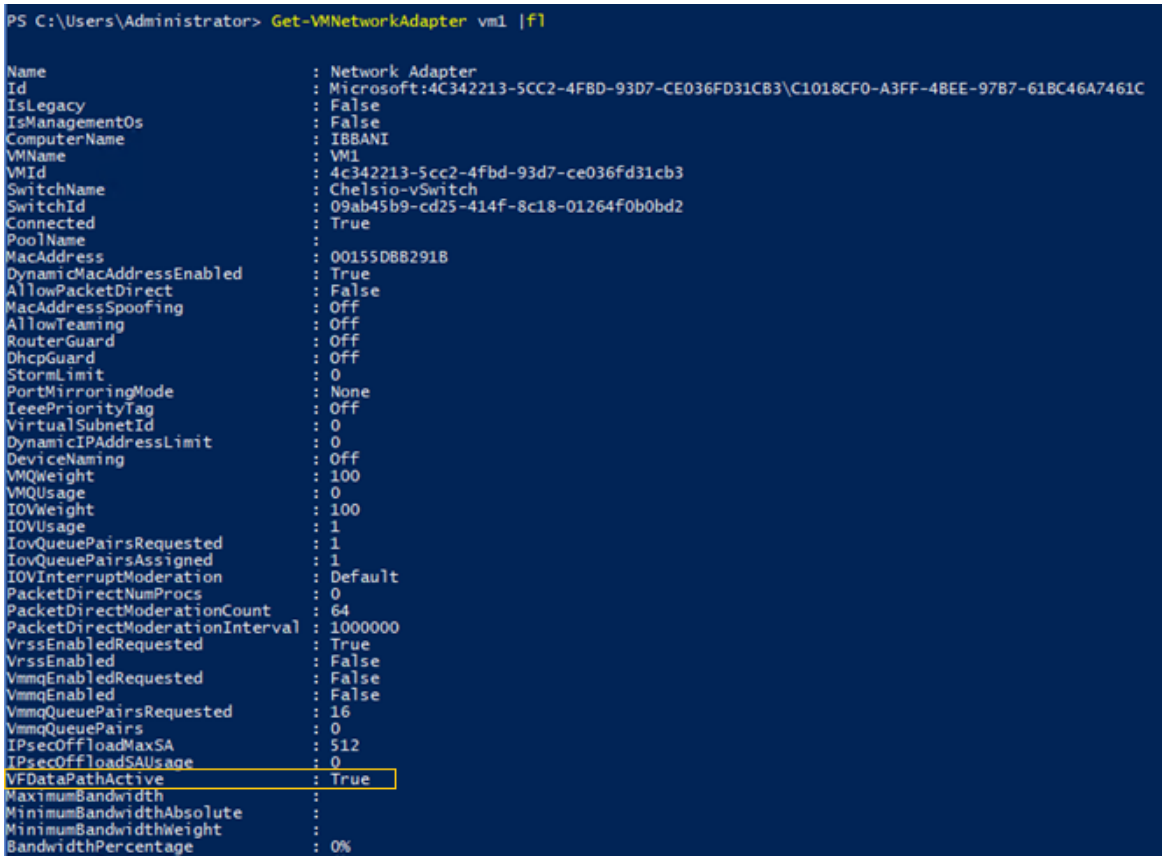

Figure 93 - Verifying if SR-IOV was enabled successfully

To uninstall Unified Wire, please refer Software/Driver Uninstallation section of the Chelsio Unified Wire chapter for step-by-step instructions.

2.4. Guest RDMA (Mode 3)

In this mode, you can run RDMA traffic on Guest (VM) using a virtual switch. This feature is enabled by default in the driver, but must be enabled on the *Microsoft Hyper-V Virtual Ethernet* adapter.

Note *Both Host and Guest should be installed with Windows Server 2016 version 1709 and later.*

Follow the steps mentioned below to enable the feature:

i. If you haven't done already, run the Chelsio Unified Wire Installer which will install NDIS function driver.
ii. Configure Chelsio adapter as described in the Enabling SR-IOV section.
iii. Enable SR-IOV support on the host as described in the Host Configuration section.
iv. Enable Guest RDMA for VM using the following command on the host:

```
PS C:\Users\Administrator> Set-VMNetworkAdapterRdma -VMNetworkAdapterName
<adapter_name> -VMName <vm_name> -RdmaWeight 100
```

Note Make sure that VM is turned off before running the above command.

Example:

```
PS C:\Users\Administrator> Set-VMNetworkAdapterRdma -VMNetworkAdapterName "Network Adapter" -VMName VM1 -RdmaWeight 100
PS C:\Users\Administrator>
```

Figure 94 - Enabling Guest RDMA for VM

To enable Guest RDMA on all VM network adapters, run the following command on the host:

```
PS C:\Users\Administrator> Set-VMNetworkAdapterRdma -VMNetworkAdapterName *
-VMName <VMName> -RdmaWeight 100
```

v. Verify if Guest RDMA was enabled successfully using the *Get-VMNetworkAdapterRdma* command. The *Rdmaweight* parameter should show 100.

```
PS C:\Users\Administrator> Get-VMNetworkAdapterRdma vm1

RdmaWeight     : 100
ParentAdapter  : VMNetworkAdapter (Name = 'Network Adapter', VMName = 'VM1') [VMId = '4c342213-5cc2-4fbd-93d7-ce036fd31cb3']
IsTemplate     : False
CimSession     : CimSession: .
ComputerName   : IBBANI
IsDeleted      : False
```

Figure 95 - Verifying if Guest RDMA was enabled successfully

vi. In *Hyper-V Manager*, right-click on the VM and select *Start* to start the VM.

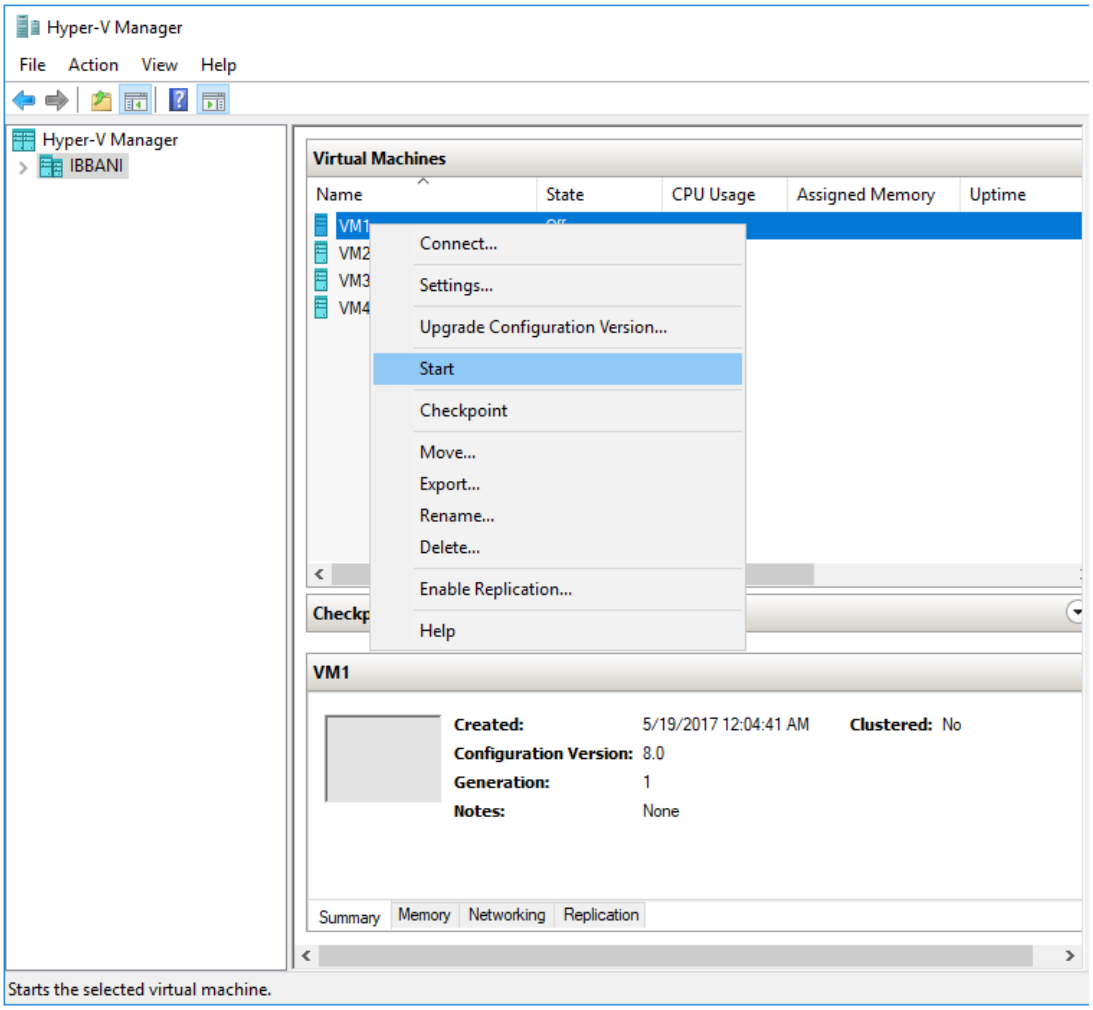

Figure 96 - Starting VM

vii. If you haven't done already, run the Chelsio Unified Wire Installer on VM which will install NDIS function driver.

viii. Open **Device Manager** on VM, click on **Network Adapters**, right click on **Microsoft Hyper-V Network Adapter** and select **Properties.**

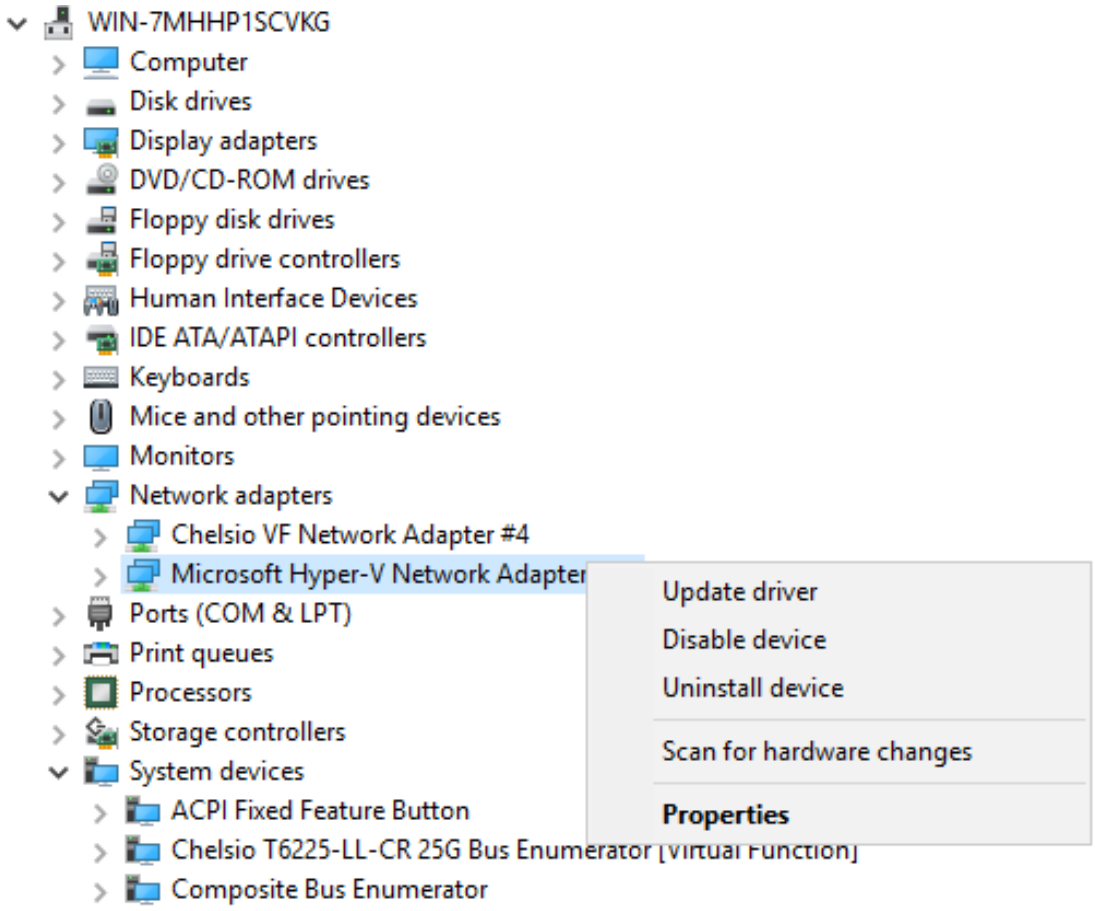

Figure 97 - Device Manager on VM

ix. In the **Advanced** tab, select the *Network Direct (RDMA)* property from the list and enable it. Click **OK**.

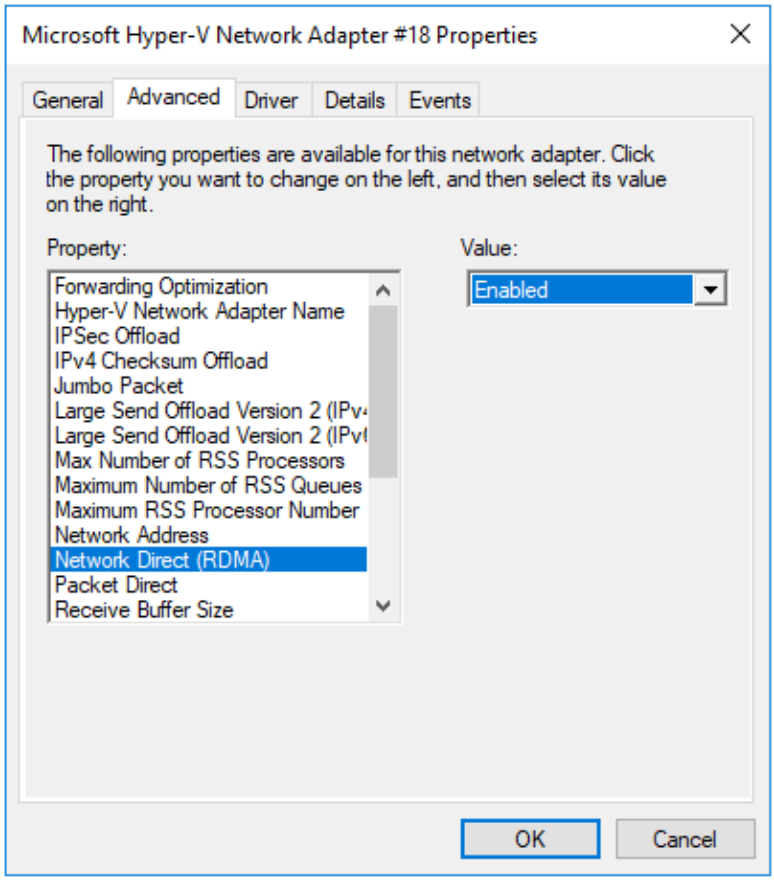

Figure 98 - Enabling Guest RDMA on Microsoft Hyper-V Network Adapter

x. To verify if RDMA was enabled successfully, open PowerShell with administrative privileges and run *Get-NetAdapterRdma*, *Get-SmbClientNetworkInterface* and *Get-SmbServerNetworkInterface* commands. You should see a similar output:

```
PS C:\Users\Administrator> Get-NetAdapterRdma

Name                      InterfaceDescription                    Enabled
----                      --------------------                    -------
Ethernet 21               Microsoft Hyper-V Network Adapter #18   True
Ethernet 22               Chelsio VF Network Adapter #4           True


PS C:\Users\Administrator> Get-SmbClientNetworkInterface

Interface Index RSS Capable RDMA Capable Speed   IpAddresses                                   Friendly Name
--------------- ----------- ------------ -----   -----------                                   -------------
12              True        True         25 Gbps {fe80::f0fa:848f:51f2:d5ec, 101.1.1.39}       Ethernet 21


PS C:\Users\Administrator> Get-SmbServerNetworkInterface

Scope Name Interface Index RSS Capable RDMA Capable Speed   IpAddress
---------- --------------- ----------- ------------ -----   ---------
*          12              True        True         25 Gbps fe80::f0fa:848f:51f2:d5ec
*          12              True        True         25 Gbps 101.1.1.39
```

Figure 99 - Verifying if Guest RDMA was enabled successfully

Note If the output of any one of the three commands is not *true*, then disable and enable the physical Chelsio network adapter on the host and try again.

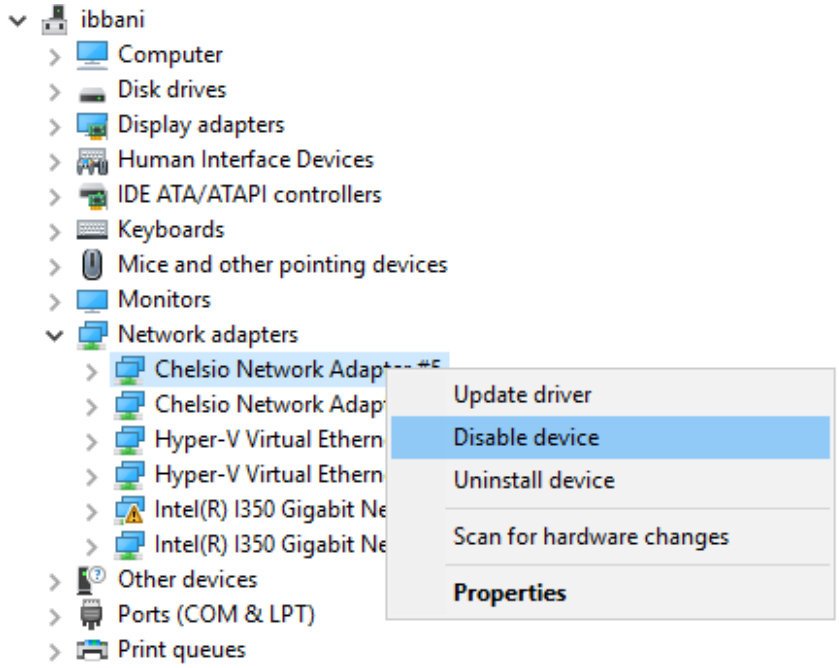

Figure 100 - Troubleshooting

You should be able to run RDMA traffic on the VM successfully now. Use a network traffic monitoring tool (like Windows Performance Monitor) to verify.

Important *When using with Linux machines, disable iWARP Port Mapper (iwpmd) service on them. On RHEL7.X machines, use the below command.*

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

2.4.1. Guest RDMA with VLAN

If VLAN is configured/updated for the VM network adapter (on the Host), Disable and Enable the **Chelsio Bus Enumerator [Virtual Function]** (on the VM: Device Manager -> System Devices) for the changes to take effect. Issue the below command on VM to check if the VF interface is listed as a Listener.

```
PS C:\Users\Administrator\Desktop> netstat -xan
```

If not listed, Disable and Enable the **Chelsio VF Network Adapter** (on the VM: Device Manager -> Network Adapters) and check if it is listed as a Listener.

VII. iSCSI Storport Miniport

1. Introduction

The Chelsio Terminator series of Adapters 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 transmitting, Chelsio h/w computes and inserts the Header and Data digest into the PDUs. On receiving, Chelsio h/w computes and verifies the Header and Data digest of the PDUs.

- **Direct Data Placement (DDP)**
  Chelsio h/w can directly place the iSCSI Data-In or Data-Out PDU's payload into pre-posted final 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 transmitting, Chelsio h/w 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 receiving, Chelsio h/w 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 payload data will be sent to the host too.

1.1. Hardware Requirements

1.1.1. Supported Adapters

Following is the list of supported Chelsio adapters:

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

1.2. Software Requirements

1.2.1. Windows Requirement

Currently iSCSI Storport Miniport driver is available for Windows versions.

- Server 2022
- Server 2019
- 11 Client
- 10 Client

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

2. Software/Driver Configuration and Fine-tuning

2.1. Configuring iSCSI Initiator

2.1.1. Configuring IP

There are two ways to assign IP to Chelsio iSCSI interface:

- **DHCP**: NIC driver (NDIS) must be installed (see Software/Driver Installation). Upon installing the driver, DHCP will be enabled by default and the NIC interface will be assigned an IP automatically. The same IP can be used by the iSCSI interface as well.
- **Static**: To assign a static IP to the iSCSI interface use the Device Manager, as explained below:

1. Open **Device Manager**, right click on **Chelsio iSCSI Initiator** under **Storage controllers** and click on **Properties**.

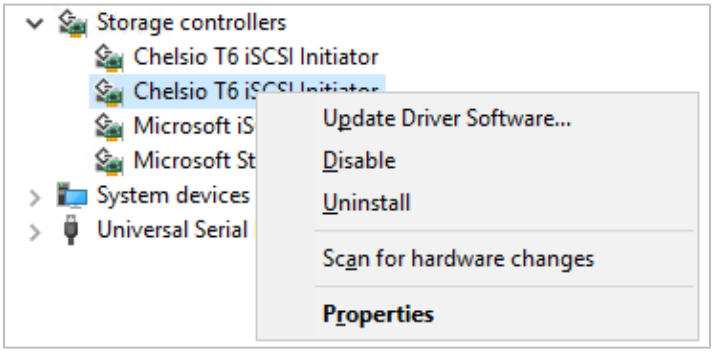

Figure 101 - Device Manager

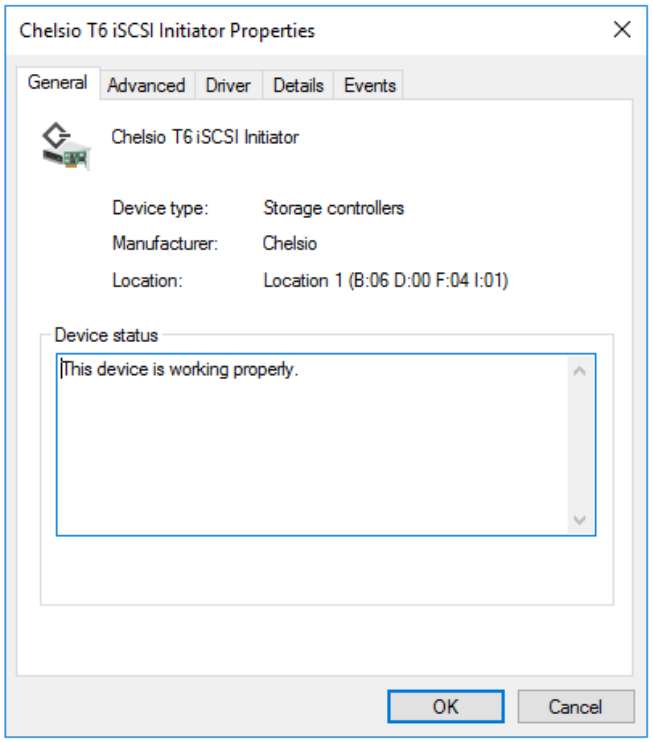

Figure 102 - Chelsio adapter physical port properties

2. Click on **Advanced** tab and select IP option and add IP. Similarly add subnet mask and default gateway.

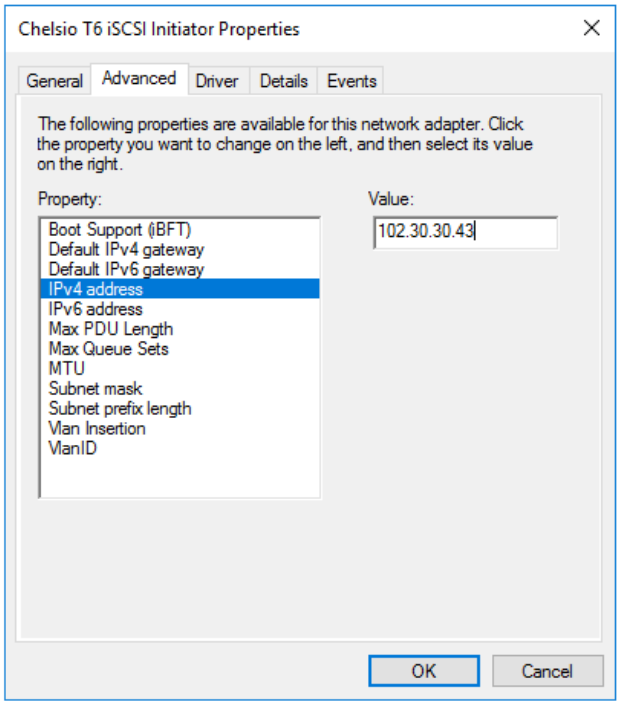

Figure 103 - Assigning IPv4 address

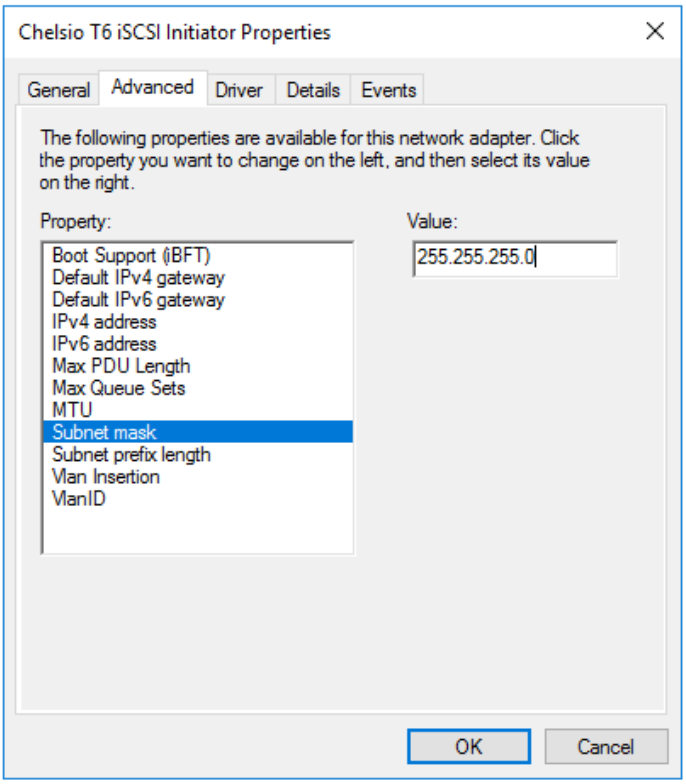

Figure 104 - Adding Subnet mask

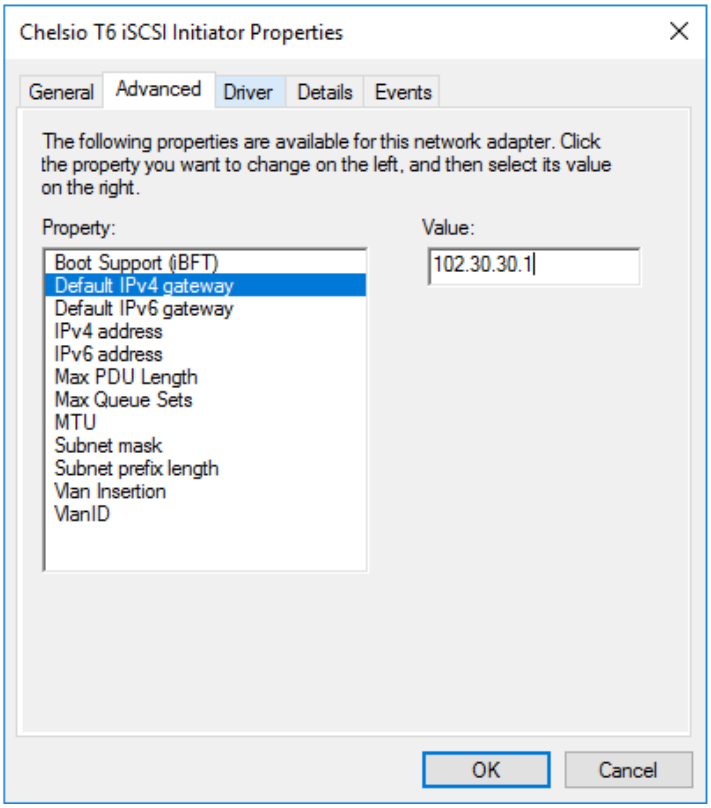

Figure 105 - Adding Default IPv4 gateway

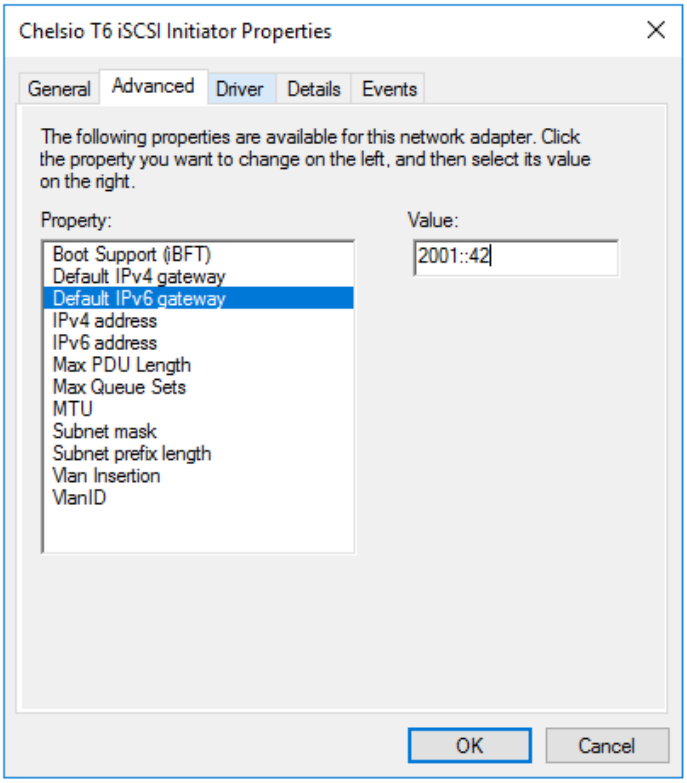

Figure 106 - Assigning IPv6 address

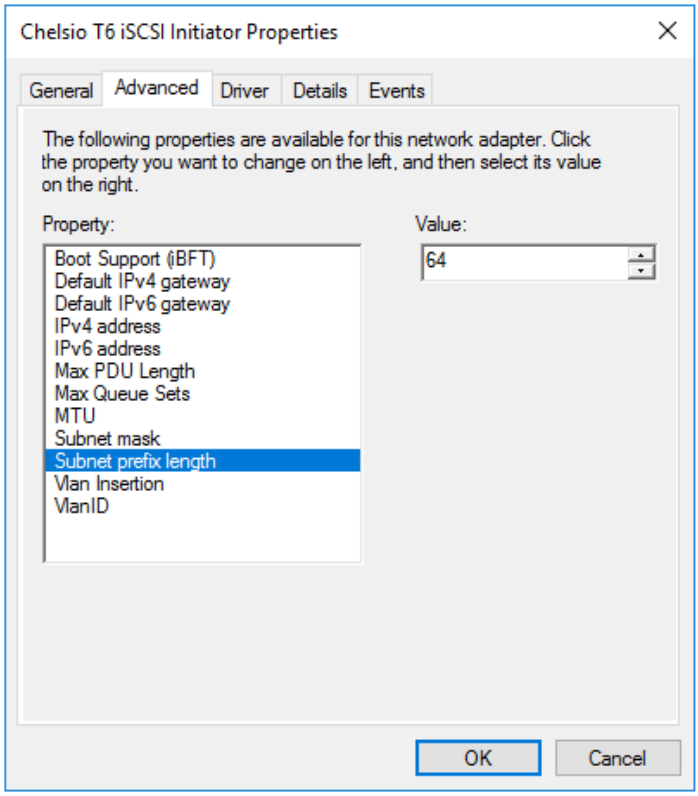

Figure 107 - Adding Subnet prefix length

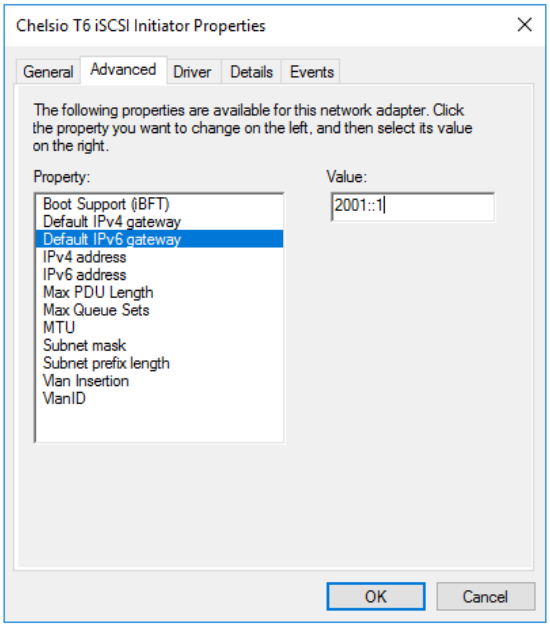

Figure 108 - Adding Default IPv6 gateway

2.1.2. Configuring Optional Parameters

Configure the below optional parameters based on your requirement.

- The *Max PDU Length* parameter can be used to improve iSCSI performance. The default value of the parameter (indicated by 0) is set based on the MTU: 1024 for MTU 1500, 8192 for MTU 9000. However, these default values can be overridden by entering the value in increments of 512.

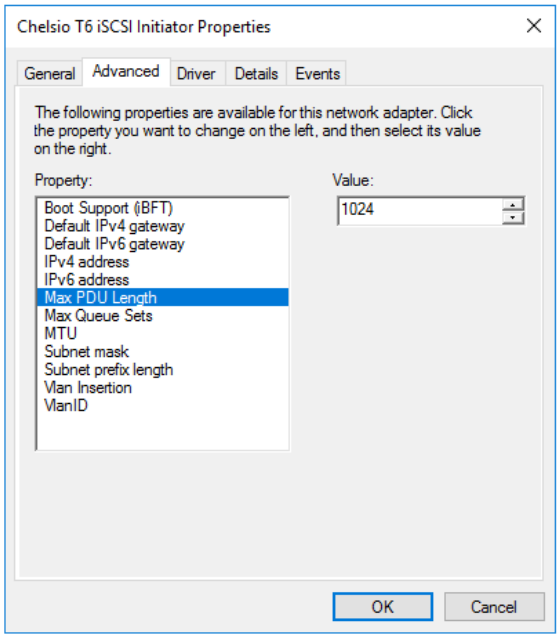

Figure 109 – Setting Max PDU Length

- Set the maximum iSCSI queue sets. This parameter can be used to improve performance.

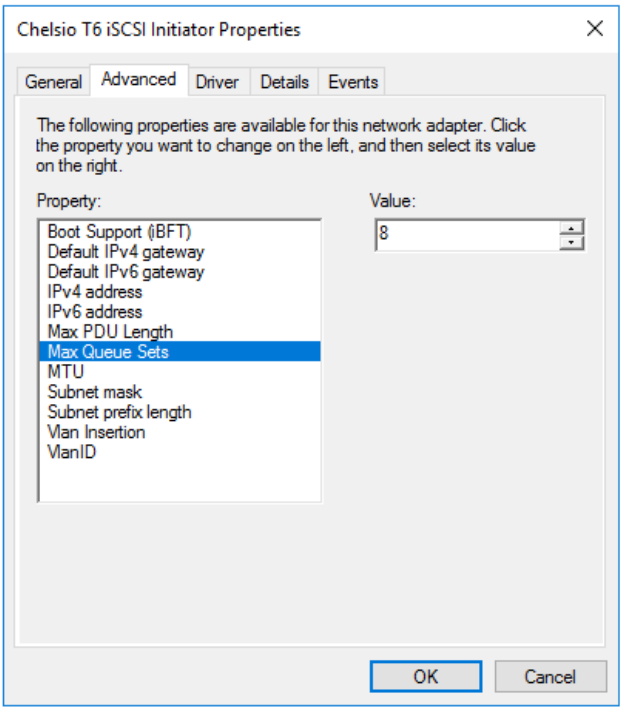

Figure 110 – Setting Max Queue Sets

- Select MTU and assign value as per requirement.

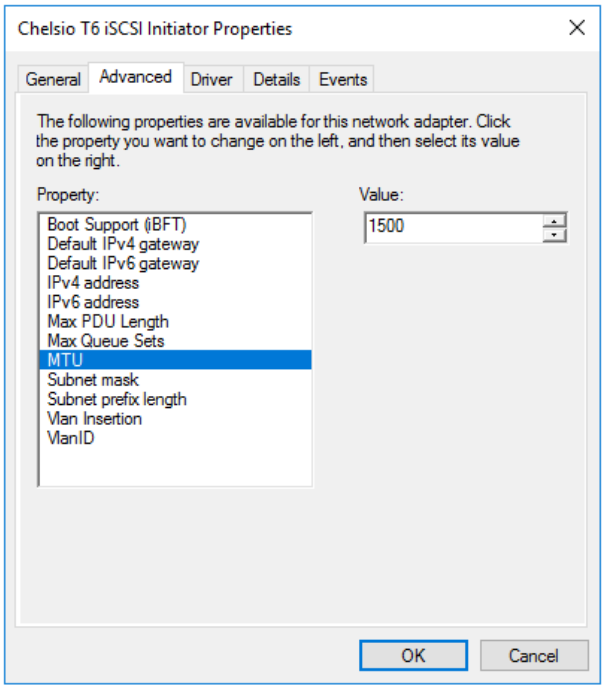

Figure 111 - Setting MTU

- VLAN is disabled by default. To enable it, click on “Vlan Insertion” and select value as “Enabled”.

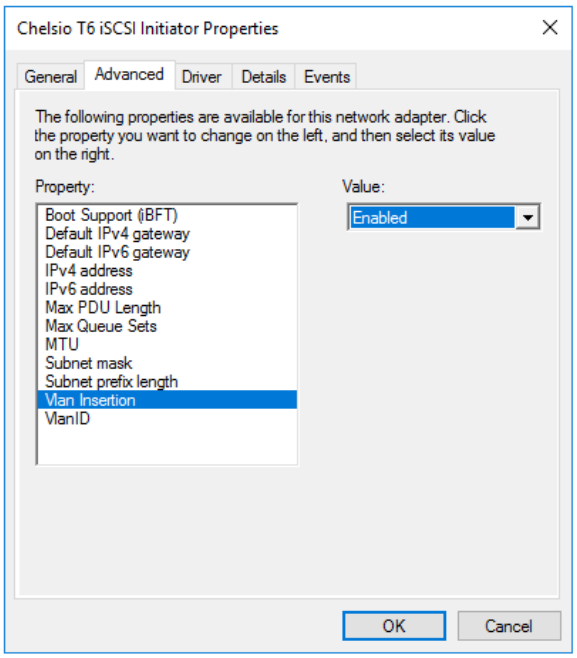

Figure 112 - Enabling VLAN

- Assign the required VLAN ID and click **OK.**

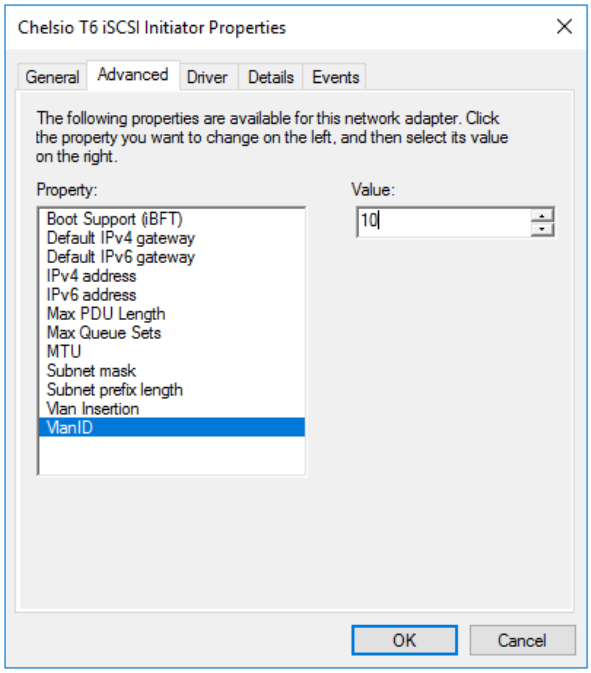

Figure 113 - Assigning VLAN Id

Repeat the above-mentioned steps to assign these driver properties on other ports.

2.2. iSCSI Target Discovery and Login

Before target discovery, make sure an IP address, either static or using DHCP, is assigned to the respective Chelsio iSCSI node (see previous section).

Note

- *Connecting to more than 64 targets on single port using Chelsio iSCSI Initiator is currently not supported.*
- *In case of Microsoft target, a maximum of 6 targets can be discovered by default. To increase this, change the maximum iSCSI PDU length to 8192 in* ***Device Manager*** *as explained here.*

Following are the set of instructions to discover the target and login to it using the Chelsio iSCSI interface:

1. To start the Initiator configuration, go to Control Panel and click on the **iSCSI Initiator** option**.**

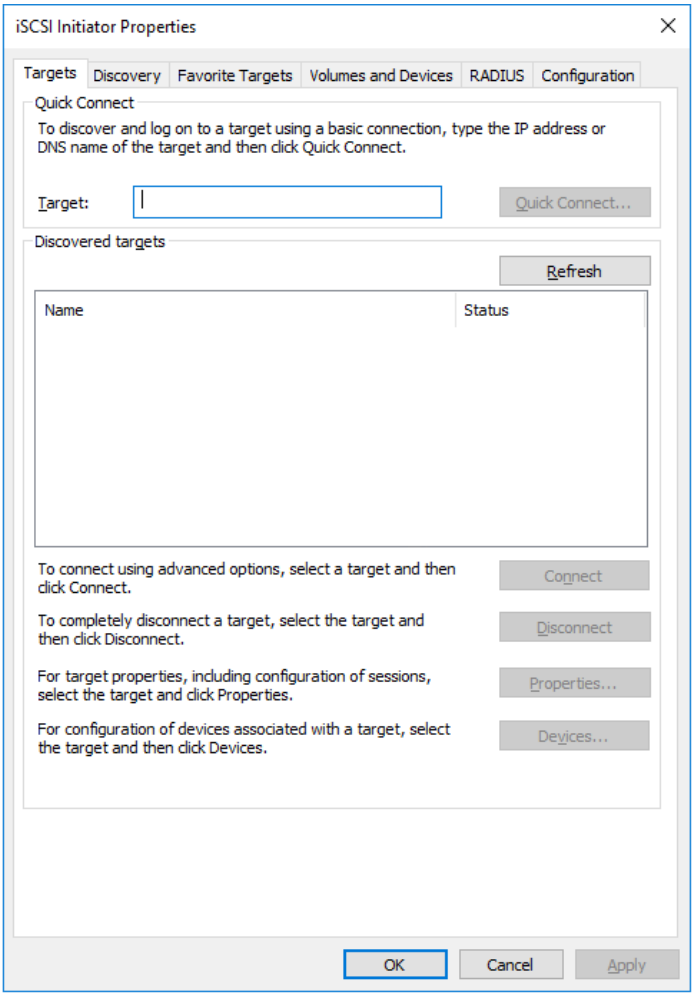

Figure 114 - iSCSI Initiator Properties: Targets tab

2. Choose the **Discovery** tab and click on **Discover Portal**.

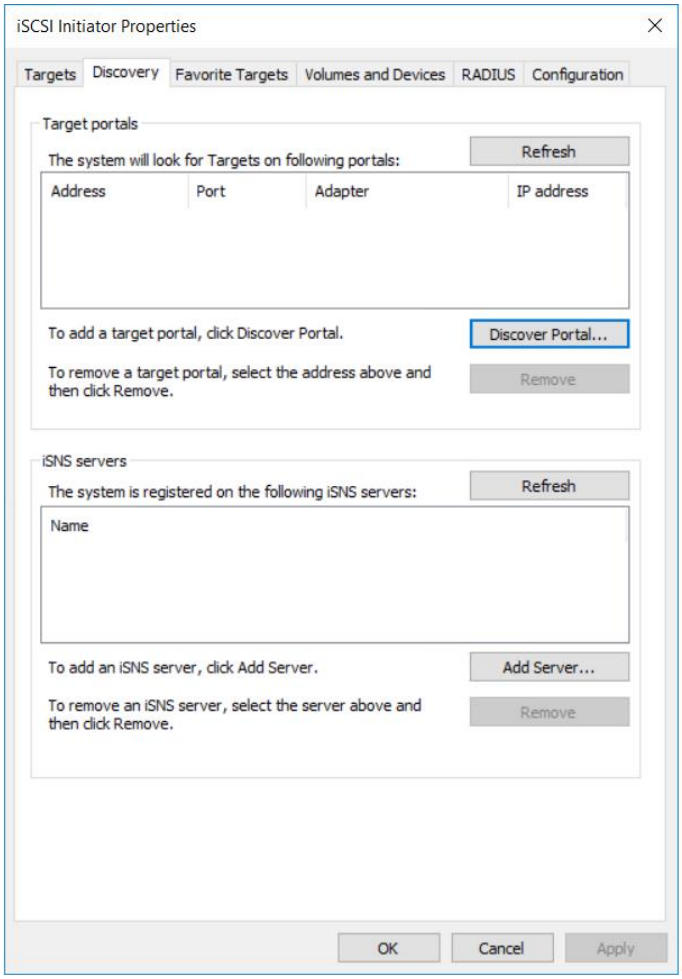

Figure 115 - iSCSI Initiator Properties: Discovery tab

3. Click on **Advanced** button.

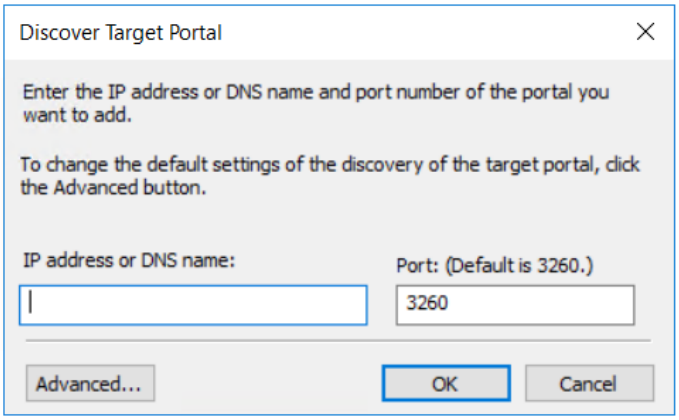

Figure 116 - Discovery Target Portal window

4. In the **Advanced Settings** window, select **Chelsio iSCSI interface** as the local adapter.

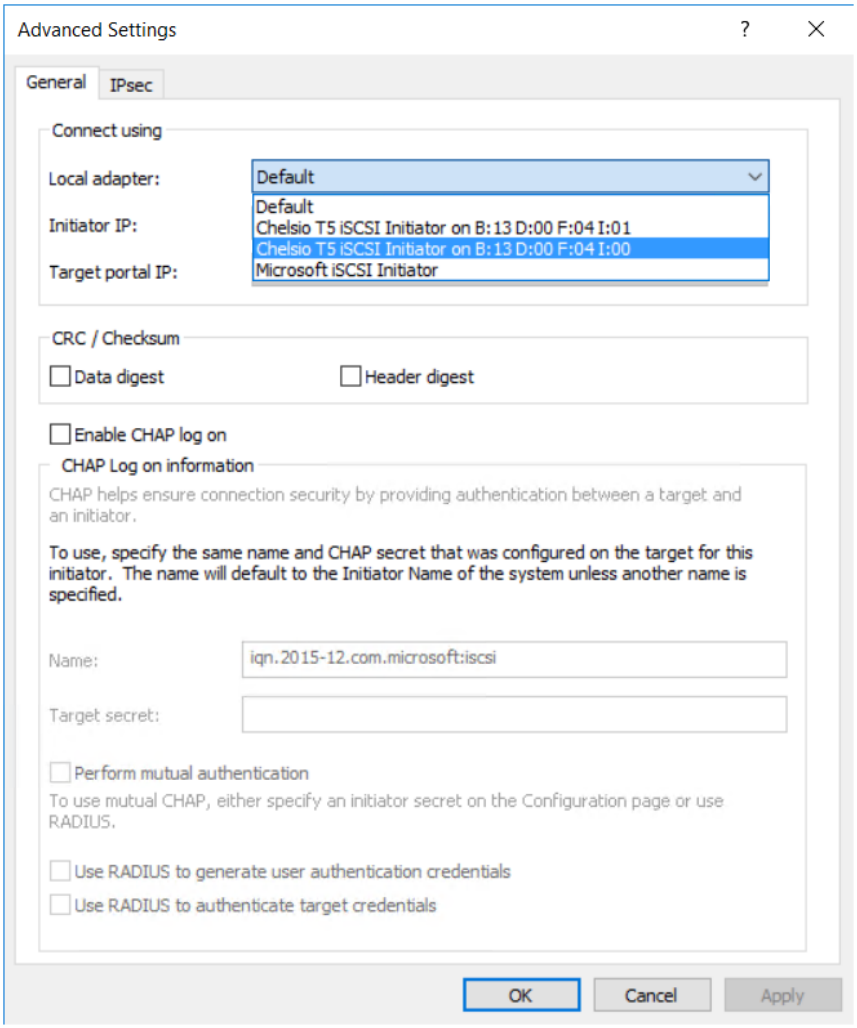

Figure 117 - Discovery Target Portal Advanced Settings: Selecting Local adapter

5. Select the corresponding Chelsio iSCSI Interface IP as the Initiator IP and click **OK**.

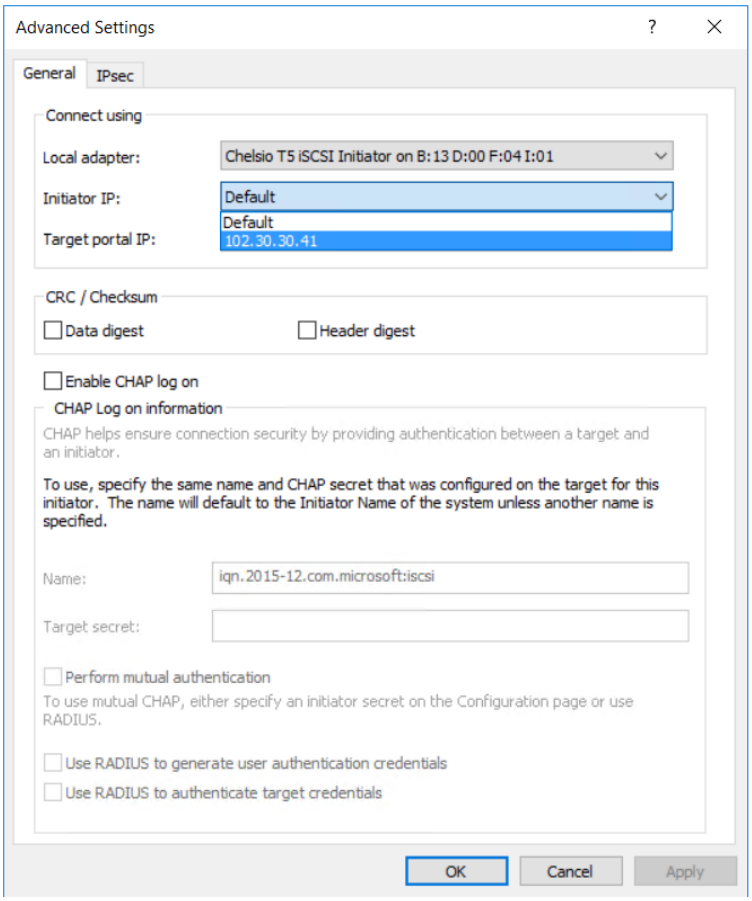

Figure 118 - Discovery Target Portal Advanced Settings: Specifying Initiator IP

6. Enter the IP address (DNS name not supported) of the target machine and the corresponding port number and click **OK** on the **Discover Target Portal** Window. Note that the default port number for iSCSI traffic is 3260.

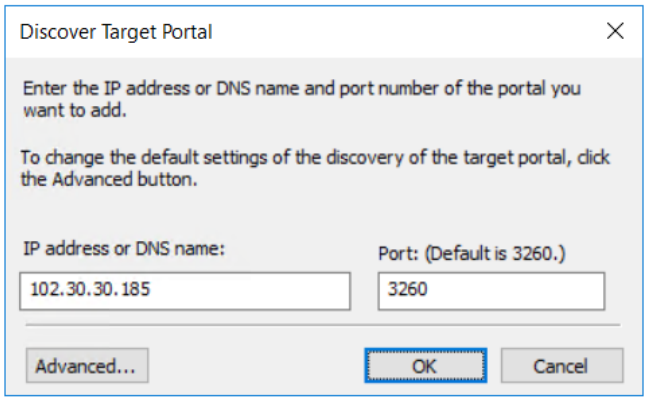

Figure 119 - Adding Target portal

7. Once target portal is added, details like target and initiator machine IP, Port number and Chelsio iSCSI interface IP will be displayed.

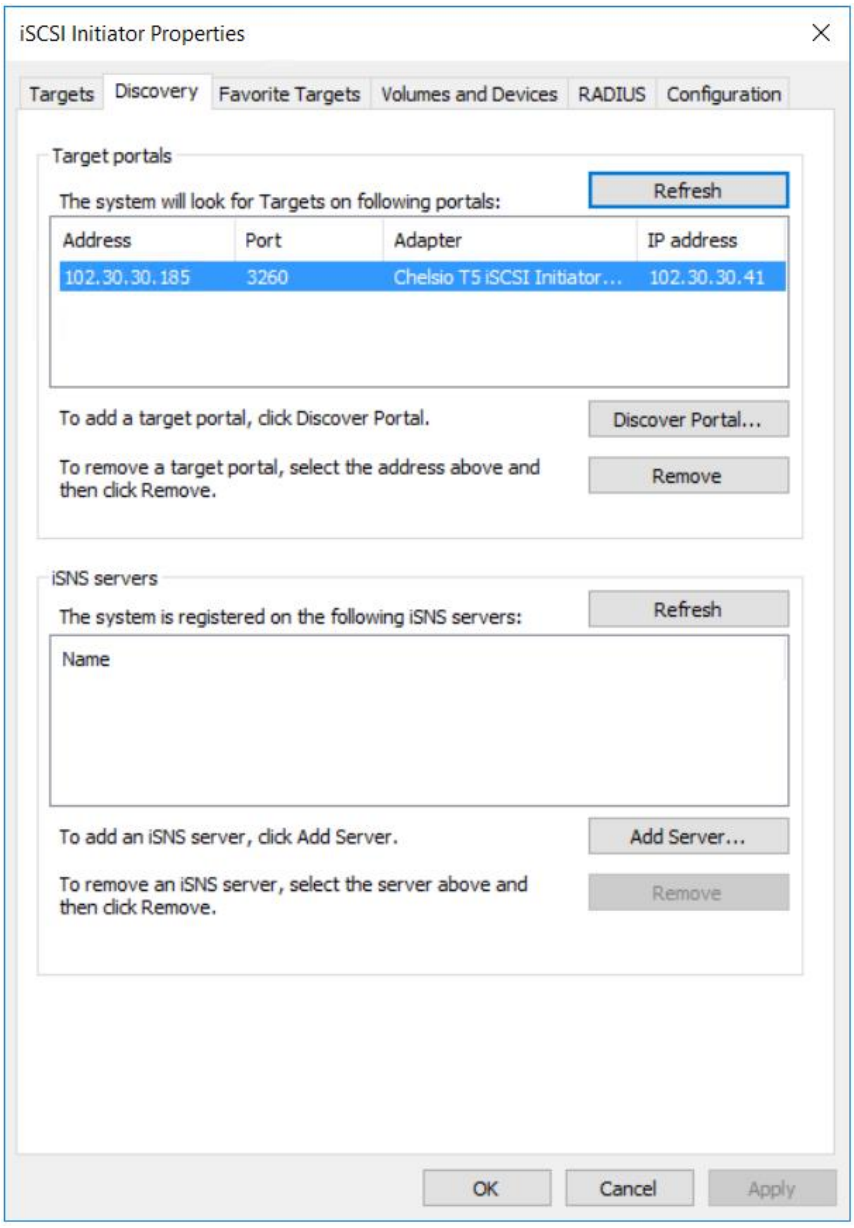

Figure 120 - Target portal added

8. Click on the **Targets** tab to see the list of targets available, choose a particular target and click on **Connect**.

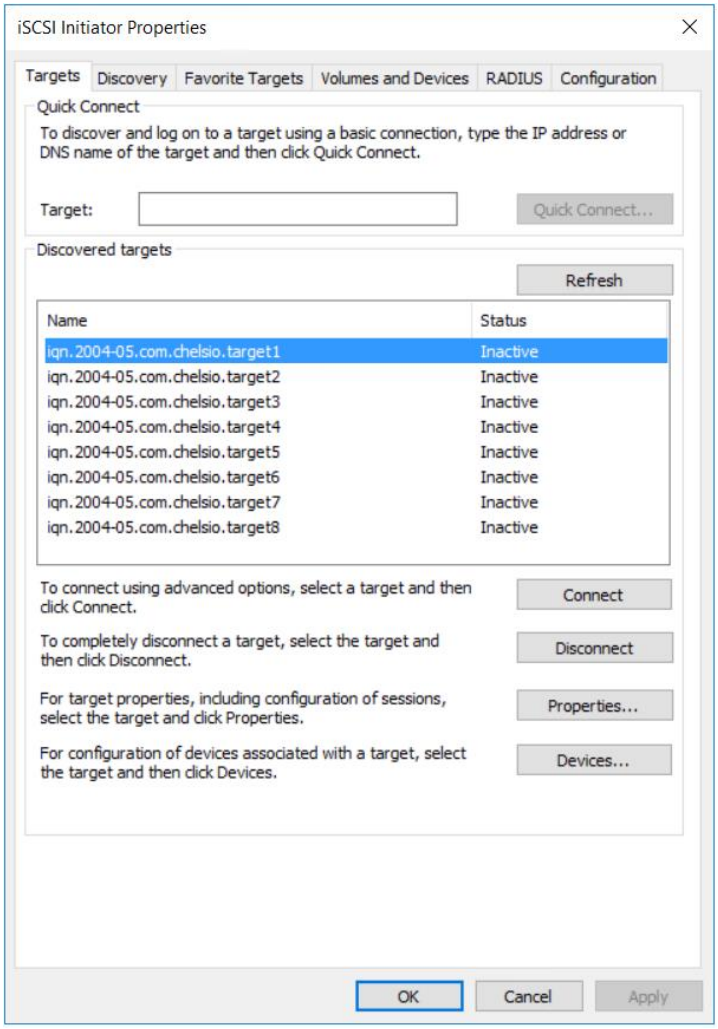

Figure 121 - Targets tab displaying list of available targets

9. A window pops up showing the Target Name, Click **OK**.

Figure 122 - Connecting to Target

10. After logging in to the target, the state of the target will change from *Inactive* to *Connected*.

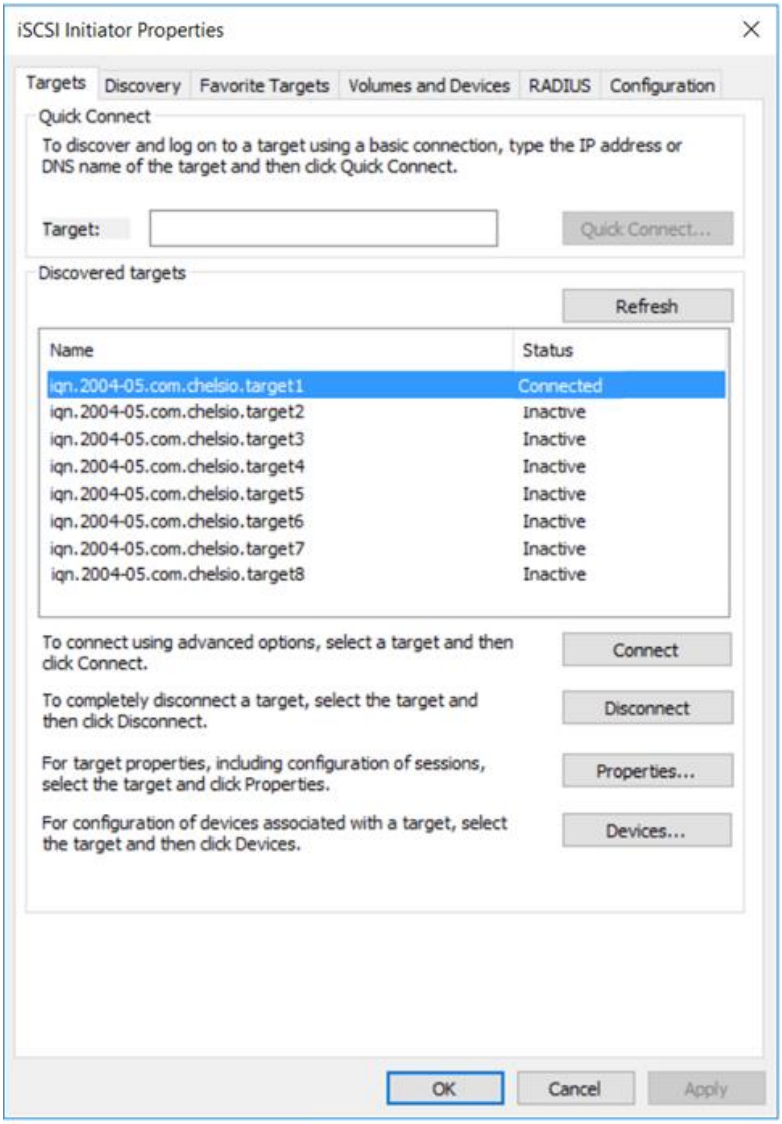

Figure 123 - iSCSI target connected

11. After successful login, go to **Disk Management** and make the respective volume online.

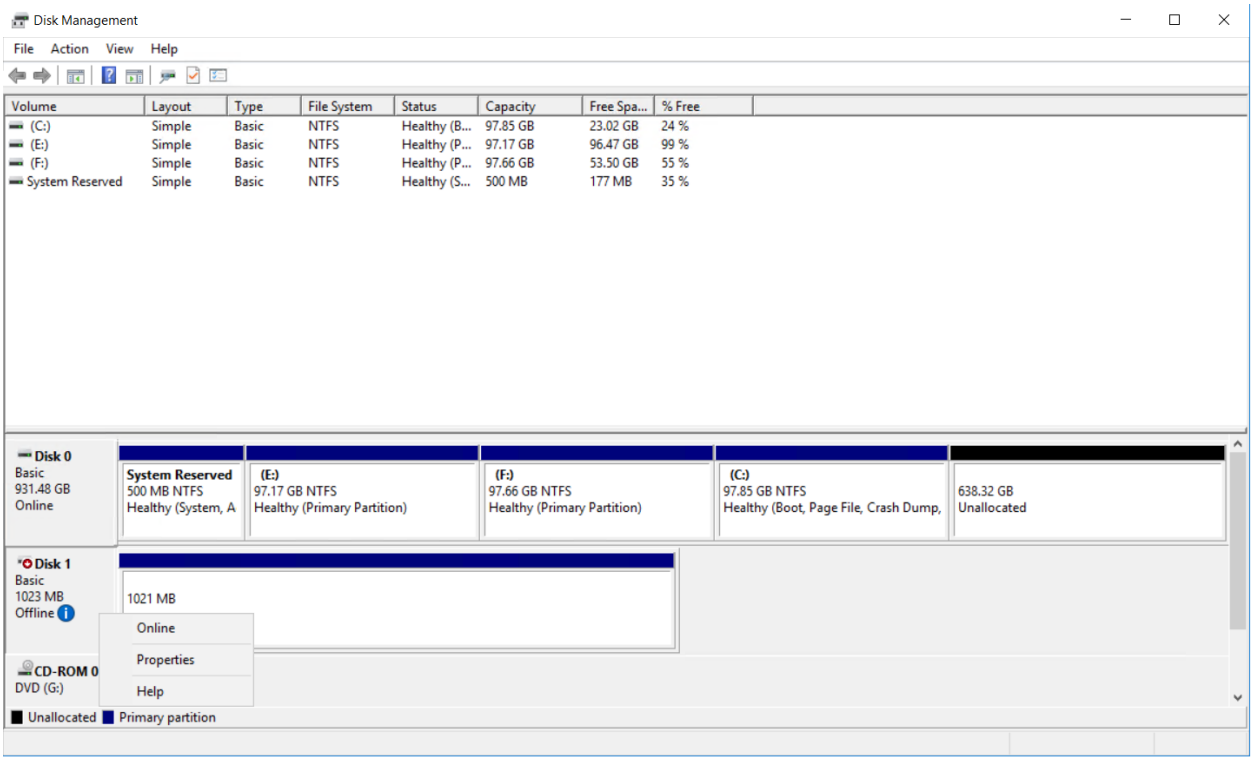

Figure 124 - Disk Management: making volume online

2.3. HMA

The Host Memory Access(HMA) implements a bridge between the Memory Arbiter (MA) and the PCIE so that the Host Memory is available to all clients. The translation from the MA memory map to the Host Memory map is performed based on the client number and the address of the transaction, both of which are used as index to look up a 64-bit offset within the Host Memory.

Currently 128 IPv4/IPv6 iSCSI Initiator Offload connections are supported on T6225-SO-CR adapter. You can view the number of connections offloaded by using

```
C:\Users\Administrator> cxgbtool <nicIface> hardware tid_info
```

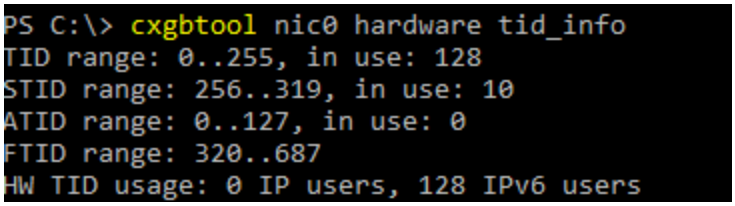

Figure 125 - HMA Offload connections

VIII. iSER Storport Miniport

1. Introduction

The iSCSI Extensions for RDMA (iSER) protocol is a translation layer for operating iSCSI over RDMA transports, such as iWARP/Ethernet or InfiniBand.

1.1. Hardware Requirements

1.1.1. Supported Adapters

Following is the list of supported Chelsio adapters:

- T62100-CR
- T62100-LP-CR
- T6425-CR
- T6225-CR
- T6225-LL-CR
- T6225-SO-CR *(Memory-free; 32 IPv4/IPv6 offload connections supported)*
- T580-CR
- T580-LP-CR
- T540-CR
- T540-LP-CR
- T540-BT
- T520-CR
- T520-LL-CR
- T520-BT

1.2. Software Requirements

1.2.1. Windows Requirement

Currently iSER Storport Miniport driver is available for the following Windows versions.

- Server 2022
- Server 2019
- 11 Client
- 10 Client

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

2. Software/Driver Configuration and Fine-tuning

2.1. Configuring iSER Target

The iSER target must be configured before establishing connection. For more information, please refer Unified Wire for Linux documentation available at the Chelsio Download Center.

Important *Disable iWARP Port Mapper (iwpmd) service on the target machine. On RHEL7.X machines, use the below command.*

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

2.2. Configuring iSER Initiator

The iSER interface uses the same IP as the NIC interface. If not already done, assign an IP to Chelsio interface as described in the Assigning IP Address section, before proceeding.

If a vSwitch is created on the physical port, disable and enable the physical port using the below command for the iSER driver to pick up the IP address.

```
C:\Users\Administrator> restart-netadapter <physical port name>
```

2.3. iSER Target Discovery and Login

The following example describes the method to discover and login to iSER target using the Chelsio iSER interface:

i. To start the initiator configuration, go to **Control Panel** and click **iSCSI Initiator** in **Administrative Tools.**

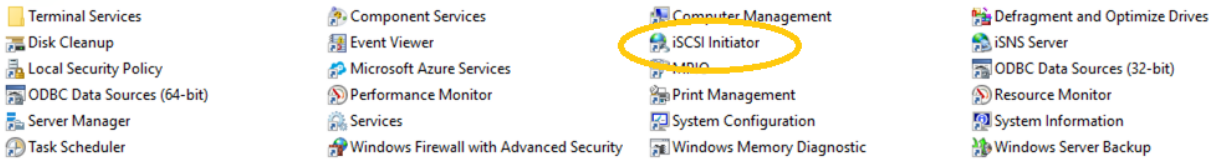

Figure 126 – Administrative Tools: iSCSI Initiator

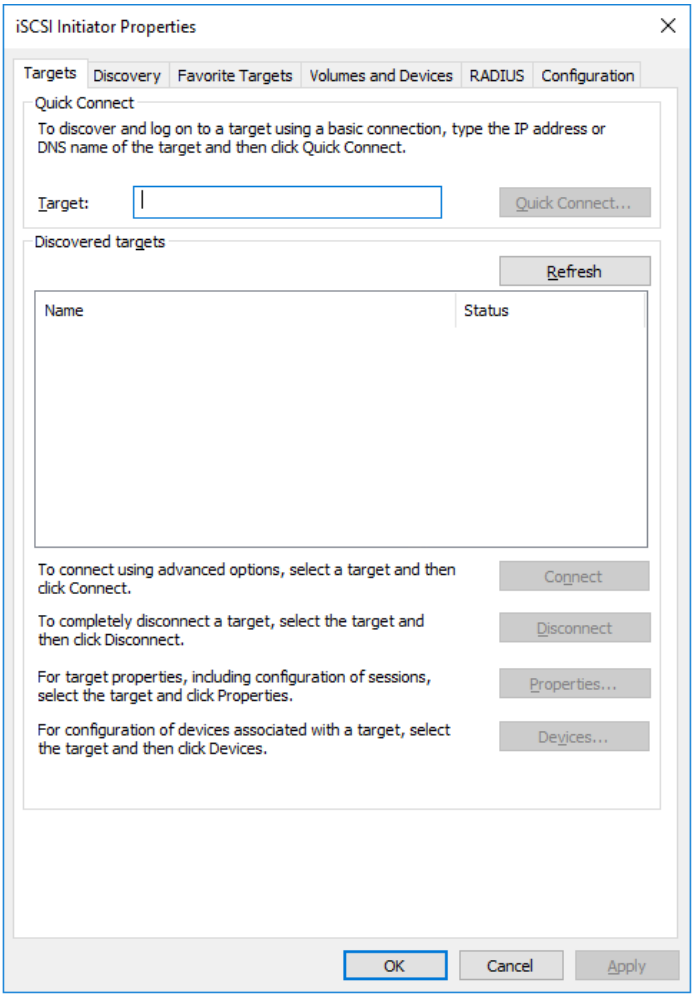

Figure 127 - iSCSI Initiator Properties: Targets tab

ii. Click the **Discovery** tab and then **Discover Portal...**

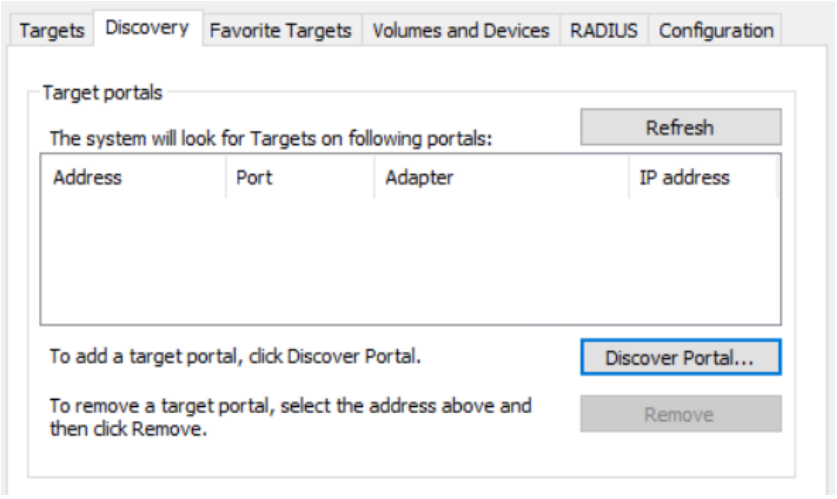

Figure 128 - iSCSI Initiator Properties: Discovery tab

iii. Click on **Advanced…**

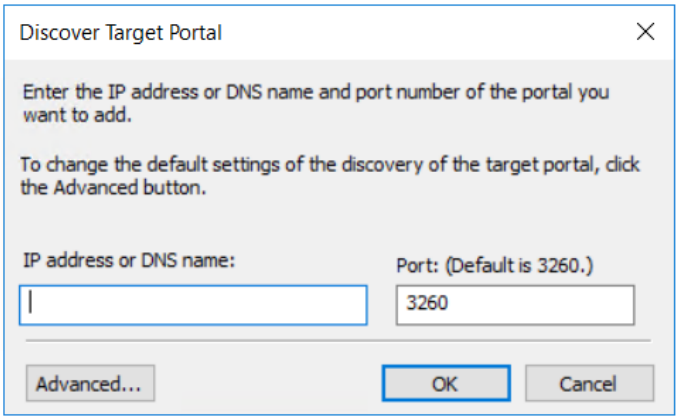

Figure 129 - Discovery Target Portal window

iv. In the **Advanced Settings** window, select **Chelsio iSER Initiator** as the local adapter, the corresponding Chelsio interface IP as the initiator IP and click **OK**.

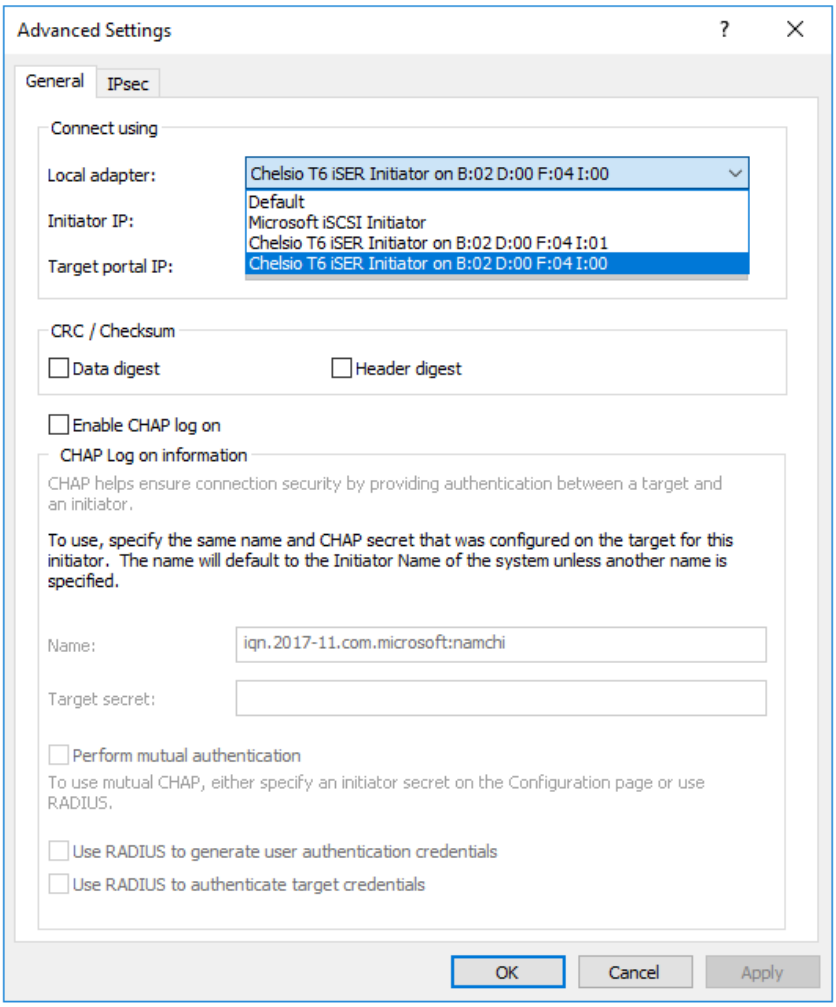

Figure 130 - Discovery Target Portal Advanced Settings: Selecting Local adapter

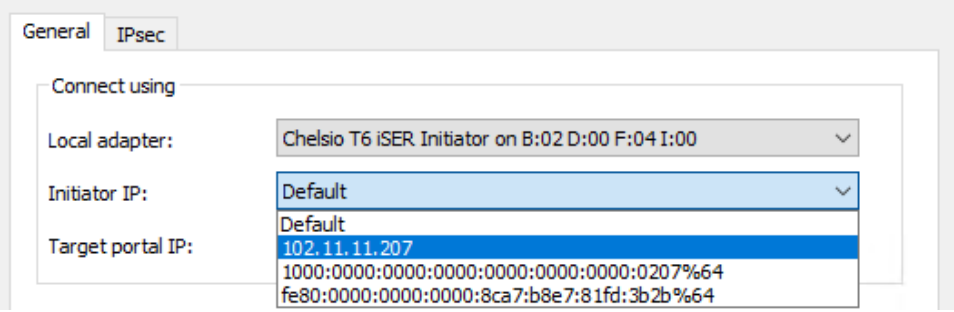

Figure 131 - Discovery Target Portal Advanced Settings: Specifying Initiator IP

v. On the **Discover Target Portal** Window, enter the IP address (DNS name not supported) of the target machine and the corresponding port number, and click **OK**. Note that the default port number for iSER traffic is 3260.

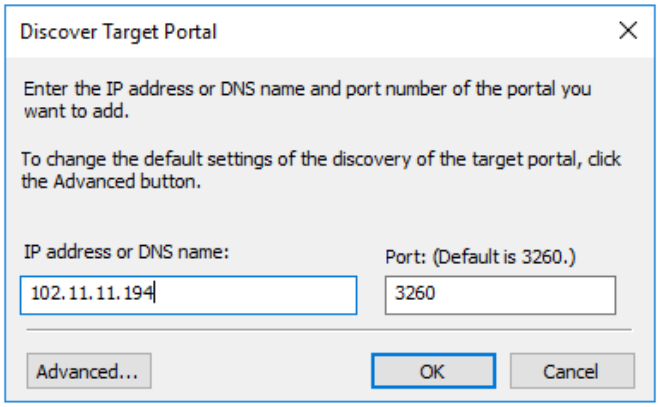

Figure 132 - Adding Target portal

vi. Once target portal is added, details like target and initiator machine IP, port number and Chelsio interface IP will be displayed.

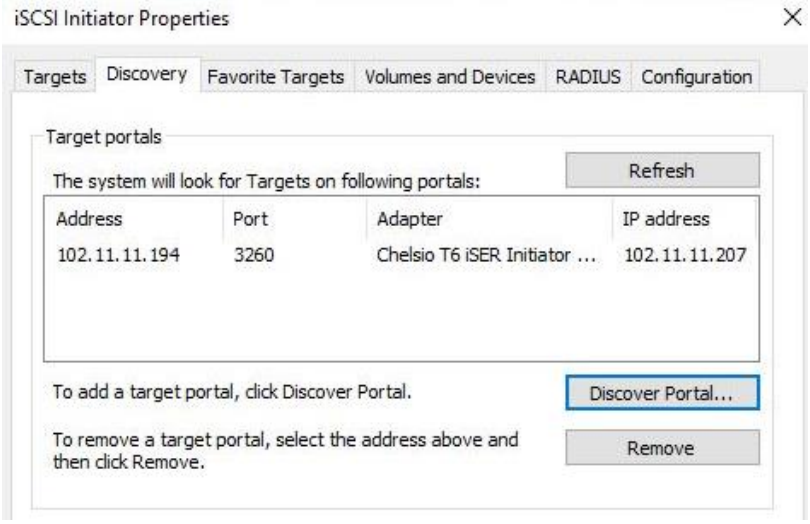

Figure 133 - Target portal added

vii. Click the **Targets** tab to see the list of targets available. Choose a target and click **Connect**.

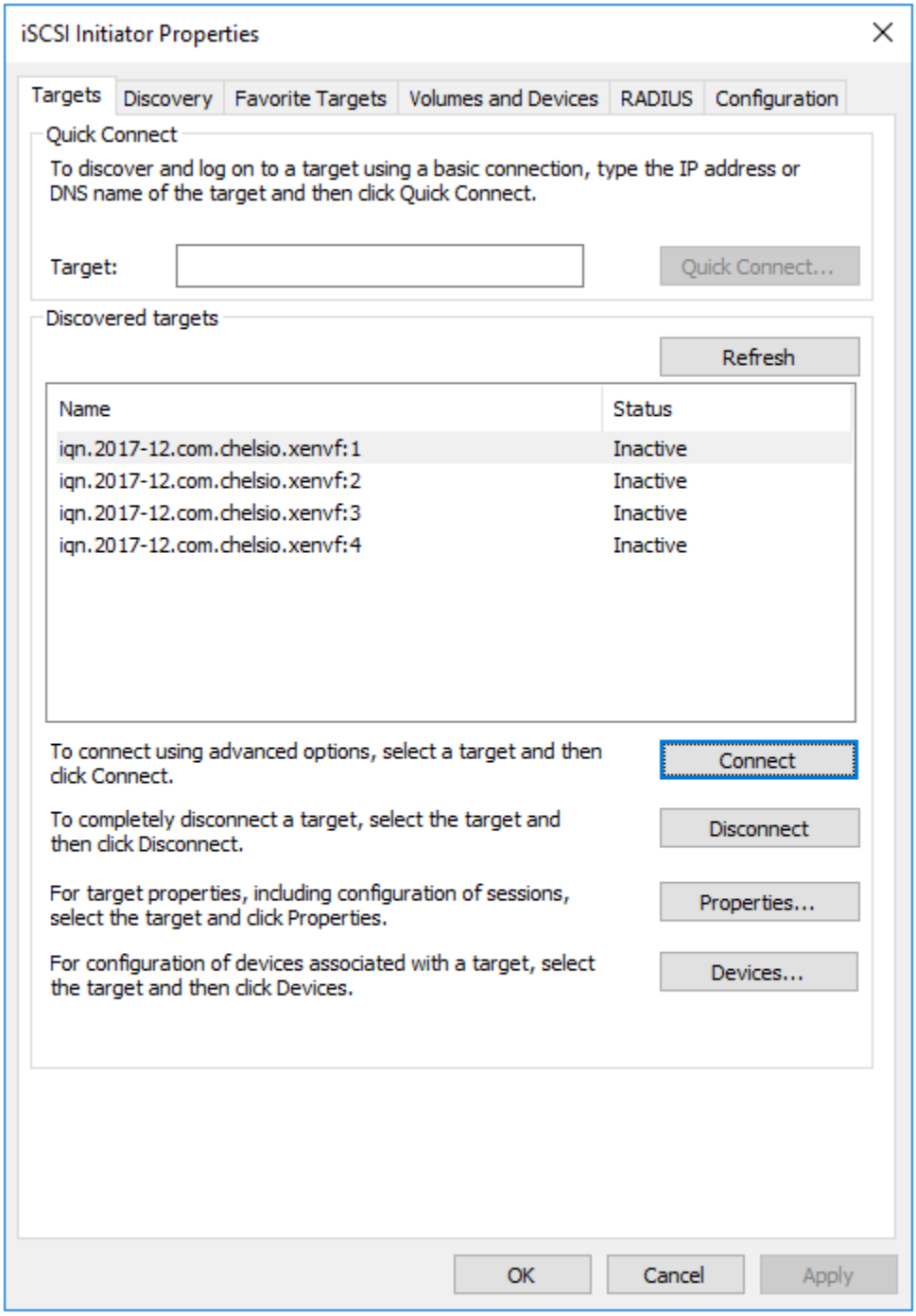

Figure 134 - Targets tab displaying list of available targets

viii. **Connect To Target** window pops up displaying the Target name.

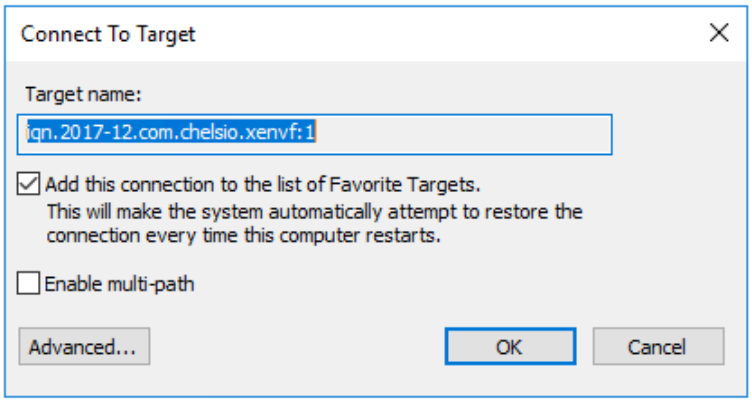

Figure 135 - Connecting to Target

ix. Click **Advanced..**, select Chelsio iSER interface and corresponding Initiator and Target portal IPs. Click **OK**.

Figure 136 - Advanced Settings

x. Click **OK** to close the **Connect To Target** window.

xi. After successful login, target's status will change from *Inactive* to *Connected*.

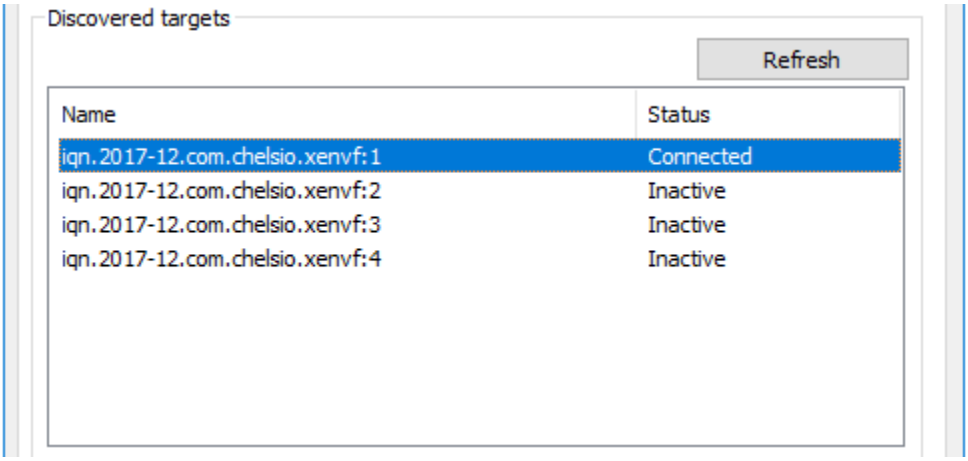

Figure 137 - iSER target connected

xii. The discovered LUN will appear as an offline disk in the **Disk Management** application. Right-click the disk and select *Online*.

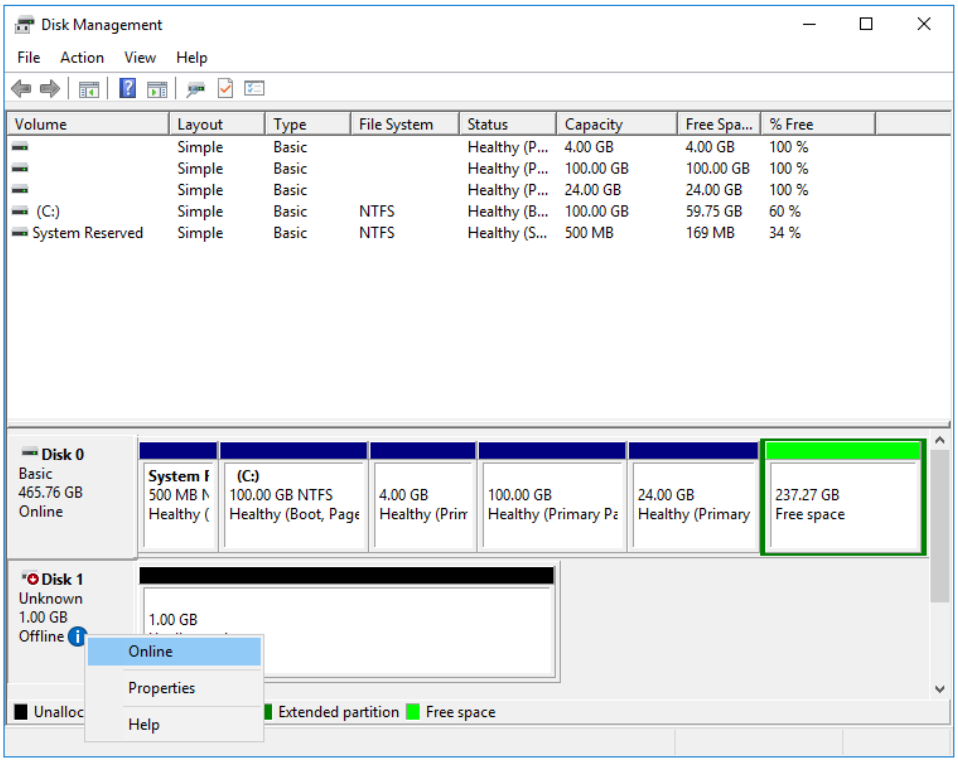

Figure 138 - Disk Management: making volume online

2.4. HMA

The Host Memory Access(HMA) implements a bridge between the Memory Arbiter (MA) and the PCIE so that the Host Memory is available to all clients. The translation from the MA memory map to the Host Memory map is performed based on the client number and the address of the transaction, both of which are used as index to look up a 64-bit offset within the Host Memory.

Currently 32 IPv4/IPv6 iSER Initiator Offload connections are supported on T6225-SO-CR adapter. You can view the number of connections offloaded by using

```
C:\Users\Administrator> cxgbtool <nicIface> hardware tid_info
```

IX. NVMe Storport Miniport

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.

1.1. Hardware Requirements

1.1.1. Supported Adapters

Following is the list of supported Chelsio adapters:

- 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

1.2. Software Requirements

1.2.1. Windows Requirement

Currently Chelsio NVMe Storport Miniport driver is available for following Windows versions:

- Server 2022
- Server 2019
- 11 Client (Enterprise and "Pro for Workstations" editions)
- 10 Client (Enterprise and "Pro for Workstations" editions)

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

2. Software/Driver Configuration and Fine-tuning

2.1. Connecting to NVMe target

Configure the NVMe target machine with the IP Address, Target name, disks etc.

Important *Disable iWARP Port Mapper (iwpmd) service on the target machine. On RHEL7.X machines, use the below command.*

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

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

i. Configure the Initiator with DHCP or static IP Address. If it is connected to a network with a DHCP server, Chelsio network interfaces will acquire DHCP IPs automatically. To assign static IPs, follow the steps mentioned below:
   a. Double click on the Network Connections icon and choose the Chelsio card entry and double click it.
   b. Click on the Properties button from the Local Area Connection X Status.
   c. Select “Internet Protocol (TCP/IP)” from the list and click on Properties button below it.
   d. From the Internet Protocol (TCP/IP) Properties window, assign an IP Address (e.g. 192.169.1.10) and subnet mask (e.g. 255.255.255.0).
   e. Click on Ok and close on the other window.

   Check to see if you can ping to the target machine.

ii. *nvmetool* utility should be used to connect to the target. In case of Installer, it will be copied to <*system_drive*>*Windows**System32* folder during installation.

   If you are using the zip package, copy *nvmetool.exe* from *ChelsioUwire_x.x.x.x_WIN_yyy.y.yy* folder to <*system_drive*>*Windows**System32* folder.
   .

iii. Scan the system for available NVMe initiator devices.

```
PS C:\Users\Administrator> nvmetool.exe findnvmehosts
```

```
C:\Users\Administrator>nvmetool FindNvmeHosts
NVMeOF Initiator Utility. Version 1.3
Copyright (c) 2018 Chelsio Communications. All rights reserved.

NVMeOF Host found at PortId: 0
 Interface Name   : Ethernet
 MAC  Address     : 00-07-43-AB-CD-EF
 IPv6 Address     : fe80::bc0e:ad84:b7a2:593f
 IPv4 Address     : 102.1.1.98
NVMeOF Host found at PortId: 1
 Interface Name   : Ethernet 2
 MAC  Address     : 00-07-43-AB-CD-F7
 IPv6 Address     : fe80::24f3:c13a:1b2d:e439
 IPv4 Address     : 102.2.2.98

Number of NVMeOF hosts found : 2
```

Figure 139 - List NVMe Adapters

iv. Discover the target by specifying the PortId and Target IP Address.

```
PS C:\Users\Administrator> nvmetool.exe DiscoverTargets <PortId>
<TargetIPAddress>
```

```
C:\Users\Administrator>nvmetool DiscoverTargets 0 102.1.1.5
NVMeOF Initiator Utility. Version 1.3
Copyright (c) 2018 Chelsio Communications. All rights reserved.

Connected to Target: nqn.2014-08.org.nvmexpress.discovery, TargetId: 0
 Number of Records         : 5
 ====== Discovery Log Entry 0 ======
 NVMe Transport Type       : rdma
 Address Family            : ipv4
 Subsystem type            : nvme subsystem
 Transport Req             : (null)
 Port Id                   : 1
 Controller Id             : 65535
 Admin Max SQ Size         : 32
 Subsystem Qualified Name  : nvme-ram0
 Transport Address         : 102.1.1.5
 Transport Service Id      : 4420
 ====== Discovery Log Entry 1 ======
 NVMe Transport Type       : rdma
 Address Family            : ipv4
 Subsystem type            : nvme subsystem
 Transport Req             : (null)
 Port Id                   : 1
 Controller Id             : 65535
 Admin Max SQ Size         : 32
 Subsystem Qualified Name  : nvme-ram1
 Transport Address         : 102.1.1.5
 Transport Service Id      : 4420
```

Figure 140 - Discover NVMe target

v. Connect to the target by specifying the PortId, Target Name and Target IP Address.

```
 PS C:\Users\Administrator> nvmetool.exe ConnectTarget <PortId> <Targetnqn>
<TargetIPAddress>
```

```
C:\Users\Administrator>nvmetool ConnectTarget 0 nvme-ram0 102.1.1.5
NVMeOF Initiator Utility. Version 1.3
Copyright (c) 2018 Chelsio Communications. All rights reserved.

Connected to Target: nvme-ram0, TargetId: 0
```

Figure 141 - Connect to NVMe Target

To connect to all the targets instead of a specific one,

```
PS C:\Users\Administrator> nvmetool.exe ConnectAll <PortId> <TargetIPAddress>
```

```
C:\Users\Administrator>nvmetool ConnectAll 0 102.1.1.5
NVMeOF Initiator Utility. Version 1.3
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Connected to Target: nqn.2014-08.org.nvmexpress.discovery, TargetId: 0
 Number of Records         : 5
Connected to Target: nvme-ram0, TargetId: 0
Connected to Target: nvme-ram1, TargetId: 1
Connected to Target: nvme-ram2, TargetId: 2
Connected to Target: nvme-ram3, TargetId: 3
Connected to Target: nvme-ram4, TargetId: 4
```

Figure 142 - Connect to All targets

vi. List the successful connections.

```
PS C:\Users\Administrator> nvmetool.exe ListTargets <PortId>
```

```
C:\Users\Administrator>nvmetool ListTargets 0
NVMeOF Initiator Utility. Version 1.3
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Target = 0
  VID/SSVID             : 0x0/0x0
  Serial Number         : ededd1f7e0051912
  Model Number          : Linux
  Firmware Revision     : 4.18.0-
  Max Data Transfer     : 0
  Version               : 1.3
  Number Of NameSpace   : 1
  SubNQN                : nvme-ram0
```

Figure 143 - Listing NVMe connections

On successful connection with the target, the NVMe disks will be available for use.

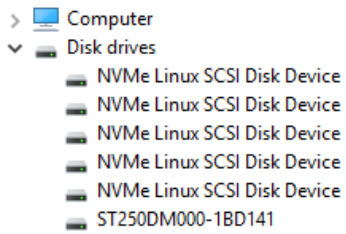

Figure 144 - NVMe Disks available

vii. For targets to be persistent across reboots, execute the below command:

```
PS C:\Users\Administrator> schtasks /create /sc ONLOGON /tn "addnvmerestore"
/tr "nvmetool restorepreviousconfig"
```

viii. The NVMe Host NQN can be updated if required. To read the current host NQN,

```
PS C:\Users\Administrator> nvmetool.exe GetHostNQN
```

```
C:\Users\Administrator>nvmetool GetHostNQN
NVMeOF Initiator Utility. Version 1.3
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HOSTNQN: nqn.2014-08.org.nvmexpress:uuid:4c4c4544-0043-3810-8057-b4c04f545631
```

Figure 145 - Read Host NQN

To change the host NQN,

```
PS C:\Users\Administrator> nvmetool.exe SetHostNQN <NQN>
```

```
C:\Users\Administrator>nvmetool SetHostNQN nqn.2022-23.org.nvmexpress.chelsiop0
NVMeOF Initiator Utility. Version 1.3
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HOSTNQN: nqn.2022-23.org.nvmexpress.chelsiop0
```

Figure 146 - Change/Set Host NQN

To revert host NQN to default value,

```
PS C:\Users\Administrator> nvmetool.exe SetHostNQN DEFAULTHOSTNQN
```

```
C:\Users\Administrator>nvmetool SetHostNQN DEFAULTHOSTNQN
NVMeOF Initiator Utility. Version 1.3
Copyright (c) 2018 Chelsio Communications. All rights reserved.

HOSTNQN: nqn.2014-08.org.nvmexpress:uuid:4c4c4544-0043-3810-8057-b4c04f545631
```

Figure 147 - Set to Default Host NQN

2.2. Disconnecting from NVMe target

To disconnect from the NVMe target, use the below command.

```
PS C:\Users\Administrator> nvmetool.exe RemoveTarget <PortId> <TargetId>
```

```
C:\Users\Administrator>nvmetool RemoveTarget 0 0
NVMeOF Initiator Utility. Version 1.3
Copyright (c) 2018 Chelsio Communications. All rights reserved.

Successfully disconnected from Target: nvme-ram0
```

Figure 148 - Disconnecting from NVMe Target

To disconnect from all the NVMe targets, use the below command.

```
PS C:\Users\Administrator> nvmetool.exe RemoveAll <PortId> <TargetId>
```

```
C:\Users\Administrator>nvmetool RemoveAll 0 102.1.1.5
NVMeOF Initiator Utility. Version 1.3
Copyright (c) 2018 Chelsio Communications. All rights reserved.

Connected to Target: nqn.2014-08.org.nvmexpress.discovery, TargetId: 5
 Number of Records        : 5
Successfully disconnected from Target: nvme-ram0
Successfully disconnected from Target: nvme-ram1
Successfully disconnected from Target: nvme-ram2
Successfully disconnected from Target: nvme-ram3
Successfully disconnected from Target: nvme-ram4
```

Figure 149 - Disconnect from All targets

2.3. HMA

The Host Memory Access (HMA) implements a bridge between the Memory Arbiter (MA) and the PCIE so that the Host Memory is available to all clients. The translation from the MA memory map to the Host Memory map is performed based on the client number and the address of the transaction, both of which are used as index to look up a 64-bit offset within the Host Memory.

Currently 256 IPv4/128 IPv6 NVMe Initiator Offload connections are supported on T6225-SO-CR adapter. You can view the number of connections offloaded by using:

```
C:\Users\Administrator> cxgbtool <nicIface> hardware tid_info
```

Configure the number of IoQueues while connecting to more number of targets. By default, number of IoQueues will be equal to the number of CPU cores.

```
PS C:\Users\Administrator> nvmetool.exe ConnectTarget <PortId> <Targetnqn>
<TargetIPAddress> [<NumIoQueues>]
```

Example: While connecting to 64 NVMe targets from an NVMe Initiator machine with 8 CPU cores, by default 8 IoQueues will be used per target, a total of 512 (8x64) connections. While using T6225-SO-CR (with maximum 256 offload connections) NVMe Initiator, IoQueues should be adjusted to a value of 4 or lesser to successfully connect to all the 64 targets.

X. Data Center Bridging (DCB)

1. Introduction

Data Center Bridging (DCB) refers to a set of bridge specification standards, aimed to create a converged Ethernet network infrastructure shared by all storage, data networking and traffic management services. An improvement to the existing specification, DCB uses priority-based flow control to provide hardware-based bandwidth allocation and enhances transport reliability.

One of DCB's many benefits includes low operational cost, due to consolidated storage, server and networking resources, reduced heat and noise, and less power consumption.
Administration is simplified since the specifications enable transport of storage and networking traffic over a single unified Ethernet network.

Note *Only IEEE configuration supported.*

1.1. Hardware Requirements

1.1.1. Supported Adapters

Following is the list of supported Chelsio adapters:

- 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. Windows Requirements

Currently Chelsio's DCB feature is available for the following Windows versions:

- Server 2022
- Server 2019
- 11 Client
- 10 Client

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

2. Software/Driver Configuration and Fine-tuning

Chelsio network adapters work seamlessly with any legacy switches and do not require the complexity of configuring Data Center Bridging (DCB) protocols either on adapter or network switch. In case DCB is already configured on the switch, the adapter will automatically negotiate the PFC settings configured on the switch.

2.1. Network QoS (optional)

Network Quality of Service (QoS) is an advanced Windows feature that can be used to distribute bandwidth between different kinds of outgoing traffic. This feature ensures efficient usage of resources and minimizes the impact of bandwidth congestion. The bandwidth percentage can be configured either on switch or the host.

2.1.1. Enabling QoS on Host

Network QoS is disabled by default. Use **NDIS Miniport Driver Parameters (**Device manager → Chelsio Network Adapter Properties → Advanced Tab → NDIS QoS) to enable it.

Note *Chelsio QoS requires a minimum of 8 cores to work. In case of multiple sockets, where the number of cores per socket is less than 8, Chelsio adapters must be configured to utilize all the available cores before enabling QoS.*

Run the following command on all Chelsio ports:

```
PS C:\Users\Administrator> Set-NetAdapterRss -Name <interface name> -
MaxProcessorGroup 3
```

2.1.2. Configuring Bandwidth Allocation

- **Switch**

Here is an example of setting bandwidth allocation on a Dell Force10 switch:

i. Log in to the switch and enter the configuration mode:

```
Login: admin
Password:
Force10#enable
Force10#configure
```

ii. Enable DCB and LLDP:

```
Force10(conf)#dcb enable
Force10(conf)#protocol lldp
Force10(conf-lldp)#no disable
```

iii. Set DCBx version to *auto*:

```
Force10(conf-lldp)#dcbx version auto
```

iv. Specify the intervals between hello packets:

```
Force10(conf-lldp)#hello 5
```

v. Create a DCB map. For example, here we are configuring 2 groups/classes:
- Group 0 has BW of 80% with *pfc* enabled.
- Group 1 had BW of 20% with *pfc* disabled.
- Assigning priority groups: Priority 5-7 are under group 0 and 0-4 are under group 1.

```
Force10(conf)#dcb-map win_dcb
Force10(conf-dcbmap-win_dcb)# priority-group 0 bandwidth 80 pfc on
Force10(conf-dcbmap-win_dcb)# priority-group 1 bandwidth 20 pfc off
Force10(conf-dcbmap-win_dcb)# priority-pgid 1 1 1 1 1 0 0 0
```

vi. Enter interface configuration mode and configure protocol LLDP:

```
Force10(conf)#interface tengigabitethernet 0/17
Force10(conf-if-te-0/17)#protocol lldp
Force10(conf-if-te-0/17-lldp)#no disable
```

vii. Set DCBx version to *auto*:

```
Force10(conf-if-te-0/17-lldp)#dcbx version auto
```

viii. Apply the DCB-MAP created:

```
Force10(conf-if-te-0/17)#dcb-map win_dcb
```

Now the host adapter will honour the bandwidth allocation settings configured on the switch.

- **Host**

Here is an example of setting bandwidth allocation on the host:

i. Open PowerShell with administrative privileges and run the following command:

```
PS C:\Users\Administrator> Install-WindowsFeature -Name "Data-Center-
Bridging" -IncludeAllSubFeature -IncludeManagementTools
```

ii. Create new policy:

```
PS C:\Users\Administrator> New-NetQosPolicy -Name rdma -PriorityValue 5 -
NetDirectPortMatchCondition 445
```

iii. Create new rule with bandwidth percentage:

```
PS C:\Users\Administrator> New-NetQosTrafficClass -Name rdma -Priority 5 -
Algorithm ETS -BandwidthPercentage 80 -Verbose
```

The above command allocates 80% of the bandwidth to the policy named 'rdma'.

To change the percentage of an existing ETS rule:

```
PS C:\Users\Administrator> Set-NetQosTrafficClass -Name rdma -Priority 5 -
Algorithm ETS -BandwidthPercentage 10 -Verbose
```

XI. Appendix

1. Troubleshooting

- ***Installer issues***

In case of any failures while running the Chelsio Unified Wire Installer, please collect the below:

- Screenshot of the failure.
- Installer logs from *<system_drive>\Windows\Temp\ChelsioUwire_x.x.x.x_WIN_y.y.y_logs* directory. Compress the directory to a zip package.

- ***Logs collection***

In case of any other issues, follow the below procedure to collect the standard logs:

- Download the *Get-NetView.psm1* file from https://github.com/microsoft/Get-NetView and run the below commands.

```
PS C:\Users\Administrator\Desktop> Set-ExecutionPolicy Unrestricted
PS C:\Users\Administrator\Desktop> Import-Module Get-NetView.psm1
```

- Run the below command and the logs will be collected in a zip package.

```
PS C:\Users\Administrator\Desktop> get-netview
```

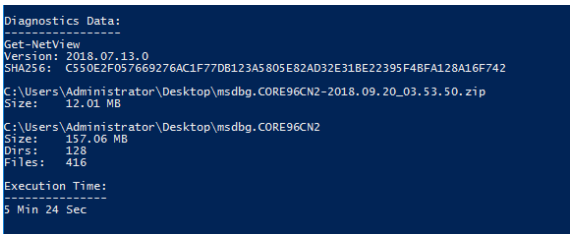

Figure 150 - Get-NetView Logs

- Driver Event tracing logs can be collected using the below procedure:
  - Start the tracing.

```
PS C:\Users\Administrator\Desktop> cxgbtool debug trace nic 0xffff 5 vbd
0xffff 5 iscsi 0xffff 5 iser 0xffff 5 nvme 0xffff 5
```

  - Rerun the test to hit the observed issue.
  - Stop the tracing.

```
PS C:\Users\Administrator\Desktop> cxgbtool debug trace stop
```

cxgbtrace.etl file will be collected in the same path.

In case of BSOD, please collect the *MEMORY.DMP* from *<system_drive>\Windows.* It is recommended to provide complete memory dump. Change the memory dump setting from:

Control Panel -> System -> Advanced system settings -> Advanced -> Startup and Recovery Settings -> System Failure -> Write Debugging Information -> Complete memory dump

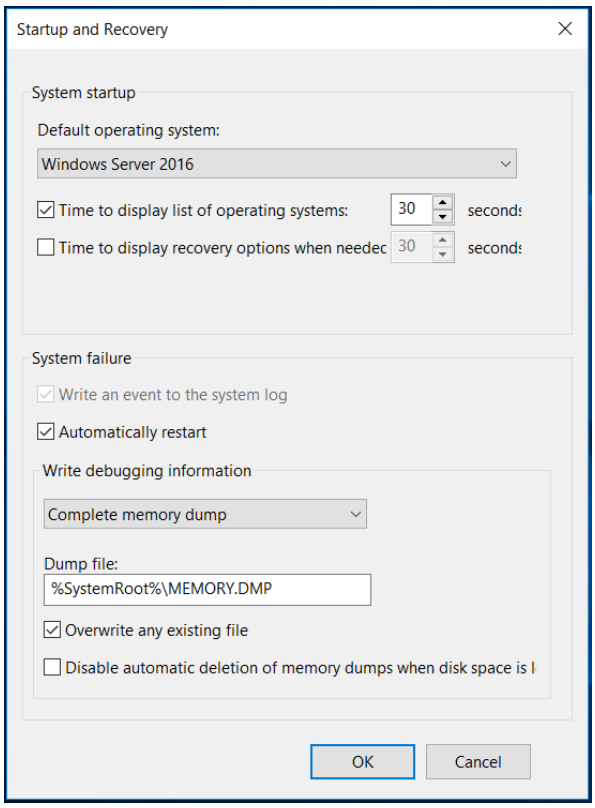

Figure 151 - Configure Complete Memory Dump

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

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