Configuring RDMA Over Converged Ethernet (RoCE) v2

Configuring SMB Direct with RoCE v2 in Windows

Configuring Mode 1 on Cisco Intersight

Use these steps to configure the RoCE v2 Mode 1 interface on Cisco Interisght.

To avoid possible RDMA packet drops, ensure same no-drop COS is configured across the network. The following steps allows you to configure a no-drop class in System QoS policies and use it for RDMA supported interfaces.

For Cisco UCS M8 C-Series or X-Series servers, the VIC 15000 series is supported, while the Cisco UCS VIC 1400 Series, 14000 Series is not compatible with M8 servers.

Procedure

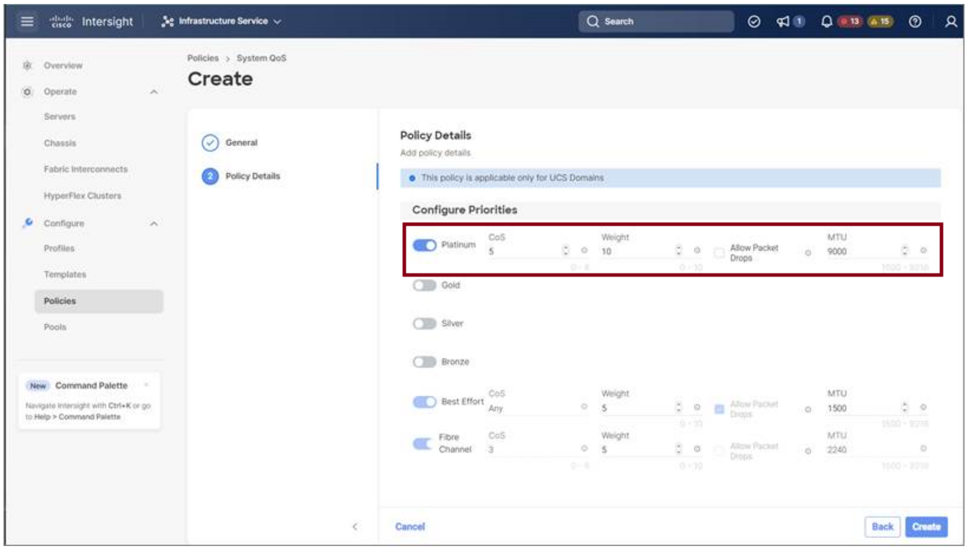
Step 1 Navigate to **CONFIGURE** > **Policies**. Click **Create Policy**, select **UCS Domain** platform type, search or choose **System QoS**, and click **Start**.

Step 2 In the **General** page, enter the policy name and click **Next**, and then in the **Policy Details** page, configure the property setting for System QoS policy as follows:

- For **Priority**, choose **Platinum**
- For **Allow Packet Drops**, uncheck the check box.

Note

For more information on MTU field, see *MTU Properties* in Guidelines for Using SMB Direct support on Windows using RDMA over converged Ethernet (RoCE) v2



Policies > System QoS

Create

Policy Details

Add policy details

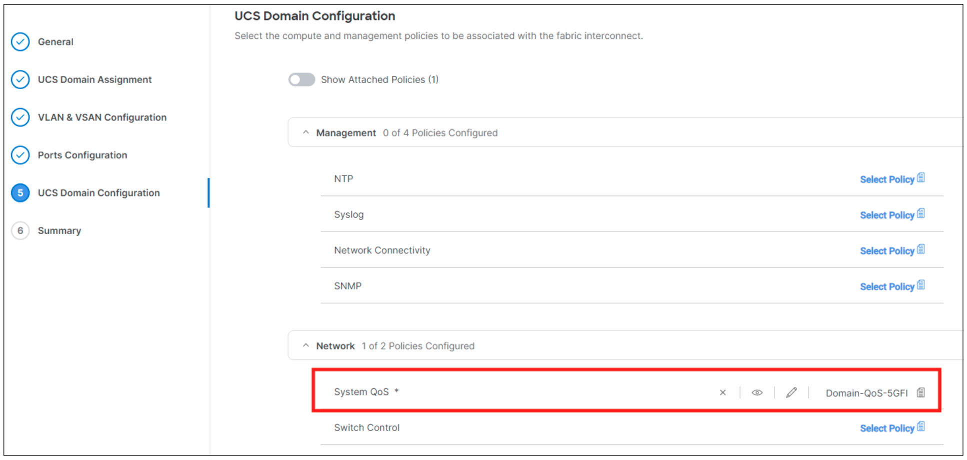
This policy is applicable only for UCS Domains

Configure Priorities

	CoS	Weight	Allow Packet Drops	MTU
Platinum	5	10	□	9000
Gold				
Silver				
Bronze				
Best Effort	Any	5	☑	1500
Fibre Channel	3	5	□	2240

Step 3 Click **Create**

Step 4 Associate the System QoS policy to the Domain Profile and deploy.



UCS Domain Configuration

Select the compute and management policies to be associated with the fabric interconnect.

Show Attached Policies (1)

Management 0 of 4 Policies Configured

NTP	Select Policy
Syslog	Select Policy
Network Connectivity	Select Policy
SNMP	Select Policy

Network 1 of 2 Policies Configured

System QoS *	Domain-QoS-5GFI
Switch Control	Select Policy

Note

For more information, see *Creating System QoS Policy* in Configuring Domain Policies and Configuring Domain Profiles.

The System QoS Policy is successfully created and deployed to the Domain Profile.

What to do next

Configure the server profile with RoCE v2 vNIC settings in LAN Connectivity policy.

Enabling RoCE Settings in LAN Connectivity Policy

Use these steps to configure the RoCE v2 vNIC settings in Mode 1. In Cisco Intersight LAN Connectivity policy, you can enable the RoCE settings on **Ethernet QoS** policy and **Ethernet Adapter** policy for Mode 1 configuration as follows:

Procedure

Step 1 Navigate to **CONFIGURE** > **Policies**. Click **Create Policy**, select **UCS Server** platform type, search or choose **LAN Connectivity** policy, and click **Start**.

Step 2 In the policy **General** page, enter the policy name, select the Target Platform as **UCS Server (Standalone)** or **UCS Server (FI-Attached)**, and click **Next**.

Step 3 In the **Policy Details** page, click **Add vNIC** to create a new vNIC.

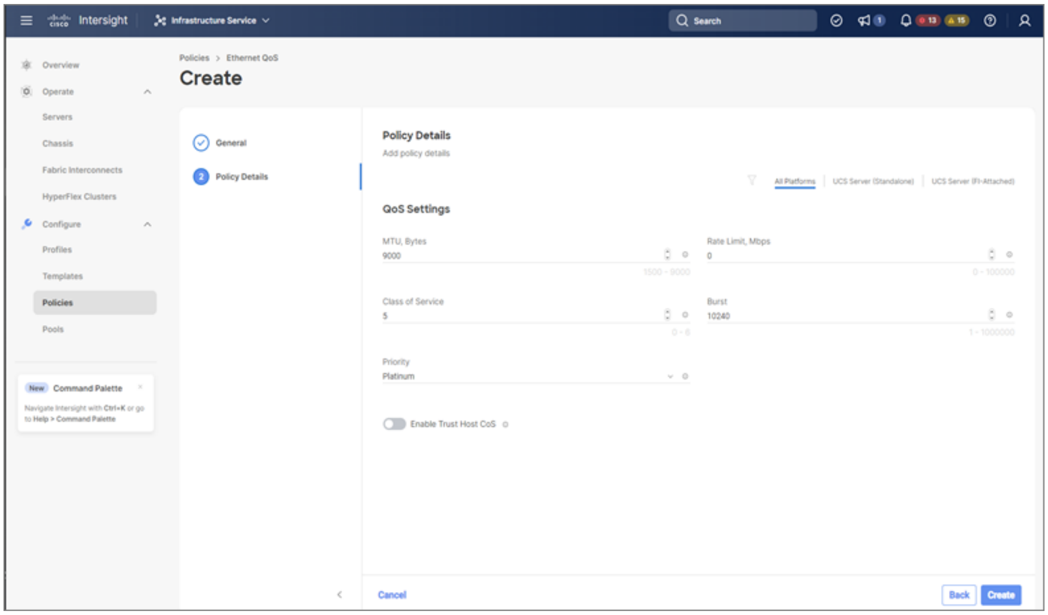
Step 4 In the **Add vNIC** page, follow the configuration parameters to enable the RoCE vNIC settings:

- In the **General** section, provide a name for virtual ethernet interface.
- In the **Consistent Device Naming (CDN)** section of the Standalone server or the **Failover** section of FI-attached server, do the following:
  - Click **Select Policy** link below the **Ethernet QoS**. Use the **Create New** button to create a new Ethernet QoS policy with the following property settings:
    - For **MTU**, choose or enter **1500, 4096, or 9000**
    - For **Priority**, choose **Platinum** or **any no-drop**
    - For **Class of Service**, choose or enter **5**

      Note
      This property is available only on Standalone servers.

    - Slide to **Enable Trust Host CoS** toggle button.

      Note
      This property is available only on Intersight Managed Mode servers.



Policy Details

QoS Settings

MTU, Bytes: 9000 (1500 - 9000)

Rate Limit, Mbps: 0 (0 - 100000)

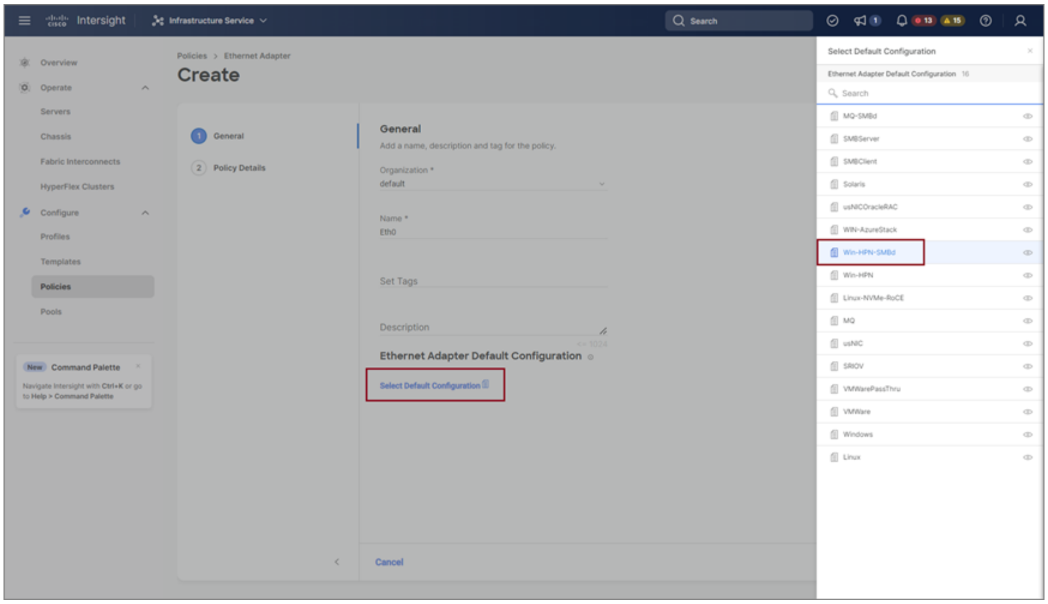
Class of Service: 5 (0 - 6)

Burst: 10240 (1 - 1000000)

Priority: Platinum

Enable Trust Host CoS

- Click **Select Policy** link below the **Ethernet Adapter**. Follow on to click Create an Ethernet Adapter Policy:
  - **Use the Default Configuration**: Click **Create New** to create a new policy. In the **General** page, enter the name of the policy and under Ethernet Adapter Default Configuration click **Select Default Configuration** to search and select **Win-HPN-SMBd**, the pre-defined Ethernet Adapter Default Configuration. Click **Next** and then **Create**.



General

Add a name, description and tag for the policy.

Organization *: default

Name *: Eth0

Set Tags

Description

<= 1024

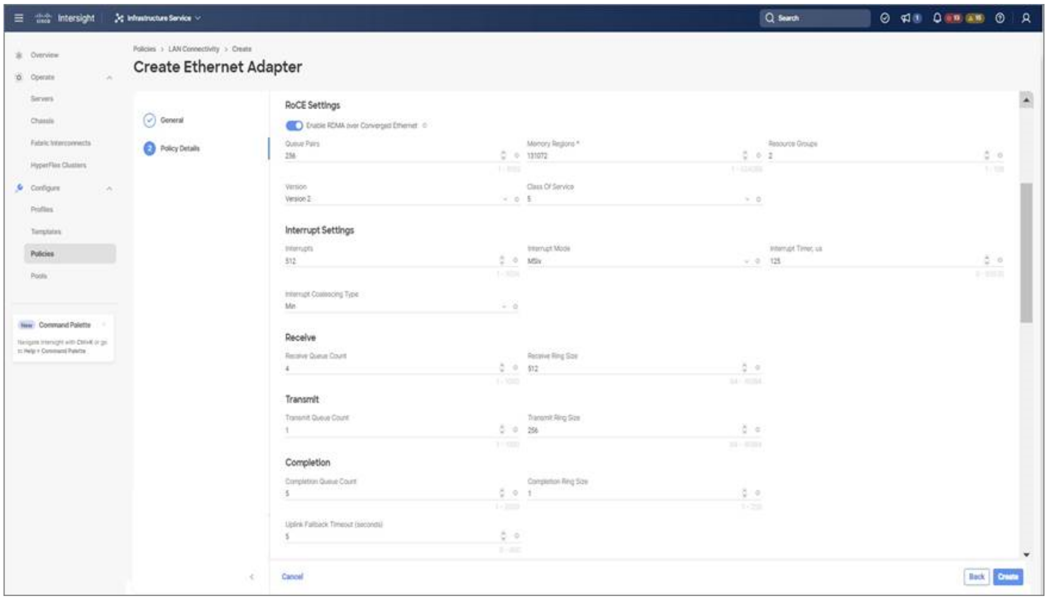
Ethernet Adapter Default Configuration

Select Default Configuration

Ethernet Adapter Default Configuration 16

- MQ-SMBd
- SMBServer
- SMBClient
- Solaris
- usNICOracleRAC
- WIN-AzureStack
- Win-HPN-SMBd
- Win-HPN
- Linux-NVMe-RoCE
- MQ
- usNIC
- SRIOV
- VMWarePassThru
- VMWare
- Windows
- Linux

  - **Configure RoCE Settings in the policy**: Click **Create New** to create a new policy. In the **General** page, enter the name of the policy. Under Policy Details page on right pane, use the following property settings, then click **Next**, and then **Create**..
    - For **Enable RDMA over Converged Ethernet**, slide to enable.
    - For **Queue Pairs**, choose or enter **256**
    - For **Memory Regions**, choose or enter **131072**
    - For **Resource Groups**, choose or enter **2**
    - For **Version**, select **Version 2**



Create Ethernet Adapter

RoCE Settings

Enable RDMA over Converged Ethernet

Queue Pairs: 256

Memory Regions *: 131072

Resource Groups: 2

Version: Version 2

Class Of Service: 5

Interrupt Settings

Interrupts: 512

Interrupt Mode: MSIx

Interrupt Timer, us: 125

Interrupt Coalescing Type: Min

Receive

Receive Queue Count: 4

Receive Ring Size: 512

Transmit

Transmit Queue Count: 1

Transmit Ring Size: 256

Completion

Completion Queue Count: 5

Completion Ring Size: 1

Uplink Fallback Timeout (seconds): 5

- Click **Add** to add and save the new vNIC settings.

Note
All the fields with * are mandatory for creating LAN Connectivity Policy. Ensure they are filled out or selected with appropriate policies.

Step 5 Click **Create** to complete the LAN Connectivity policy with RoCE v2 property settings.

Step 6 Associate the LAN Connectivity policy to the server profile and deploy.

Note
For more information, see *Creating a LAN Connectivity Policy*, *Creating an Ethernet QoS Policy*, and *Creating an Ethernet Adapter Policy* in Configuring UCS Server Policies and Configuring UCS Server Profiles.

The LAN Connectivity policy with the Ethernet QoS policy and Ethernet Adapter policy vNIC setting is successfully created and the server profile is deployed to enable RoCE v2 configuration.

What to do next

Once the policy configuration for RoCE v2 is complete, proceed to enable IOMMU in the BIOS policy.

Configuring SMB Direct Mode 1 on the Host System

You will configure connection between smb-client and smb-server on two host interfaces. For each of these servers, smb-client and smb-server, configure the RoCE v2-enabled vNIC as described below.

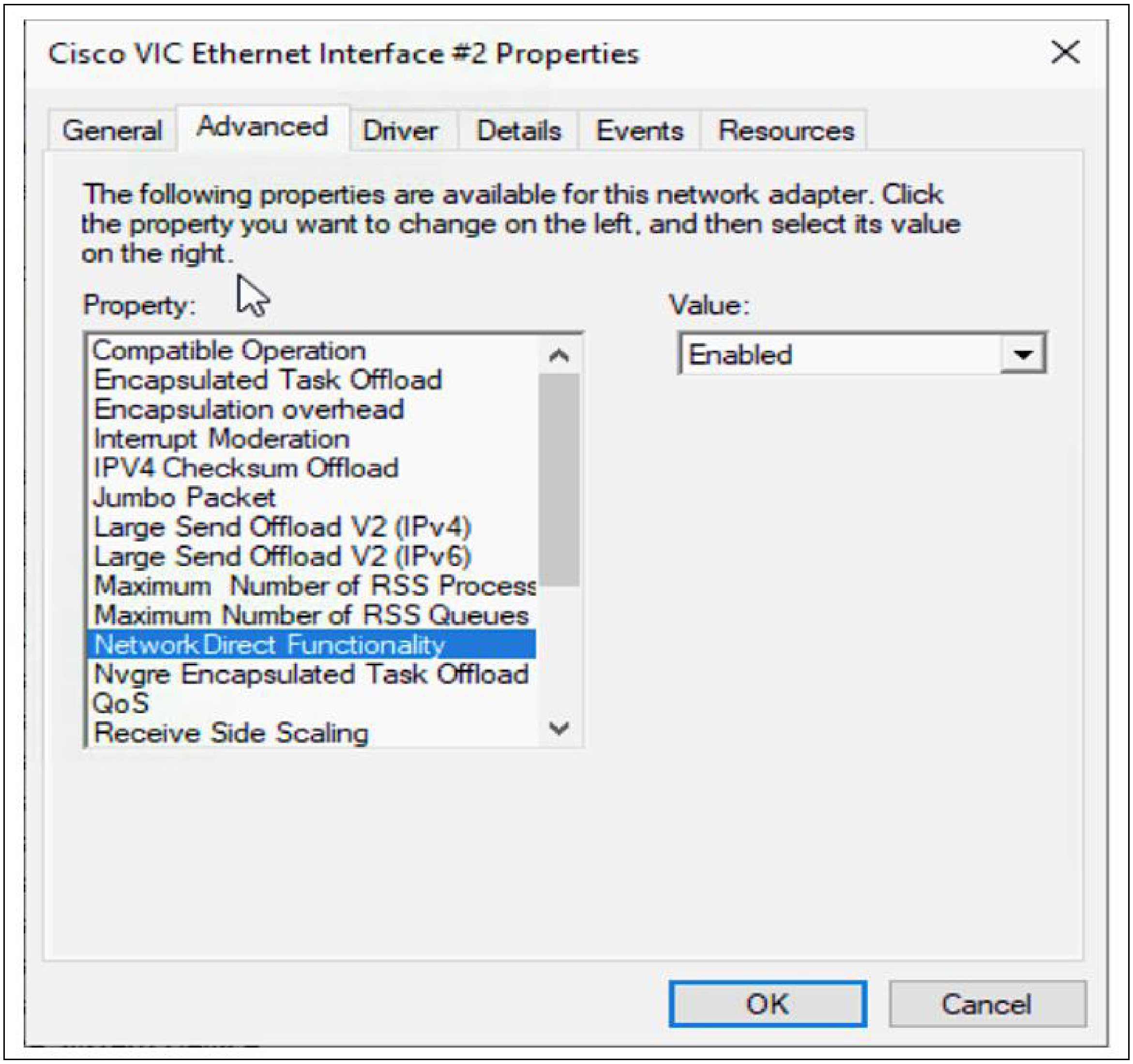
Before you begin

Configure RoCE v2 for Mode 1 in Cisco Intersight.

Procedure

Step 1 In the Windows host, go to the Device Manager and select the appropriate Cisco VIC Internet Interface.

Step 2 Go to **Tools** > **Computer Management** > **Device Manager** > **Network Adapter** > click on **VIC Network Adapter** > **Properties** > **Advanced** > **Network Direct Functionality**. Perform this operation for both the smb-server and smb-client vNICs.



The following properties are available for this network adapter. Click the property you want to change on the left, and then select its value on the right.

Property:

Compatible Operation
Encapsulated Task Offload
Encapsulation overhead
Interrupt Moderation
IPV4 Checksum Offload
Jumbo Packet
Large Send Offload V2 (IPv4)
Large Send Offload V2 (IPv6)
Maximum Number of RSS Process
Maximum Number of RSS Queues
Network Direct Functionality
Nvgre Encapsulated Task Offload
QoS
Receive Side Scaling

Value:

Enabled

Step 3 Verify that RoCE is enabled on the host operating system using PowerShell.

The `Get-NetOffloadGlobalSetting` command shows NetworkDirect is enabled.

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

ReceiveSideScaling           : Enabled
ReceiveSegmentCoalescing     : Enabled
Chimney                      : Disabled
```

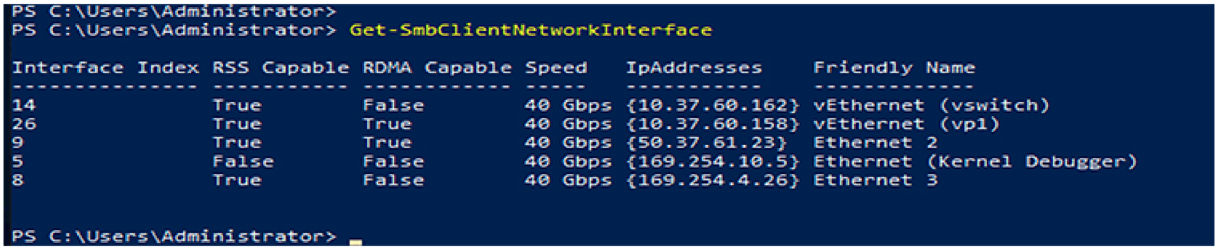
```
TaskOffload                    : Enabled
NetworkDirect                  : Enabled
NetworkDirectAcrossIPSubnets : Blocked
PacketCoalescingFilter         : Disabled
```

Note

If the NetworkDirect setting is showing as disabled, enable it using the command: `Set-NetOffloadGlobalSetting -NetworkDirect enabled`

Step 4 Bring up Powershell and enter the command:

```
get-SmbClientNetworkInterface
```

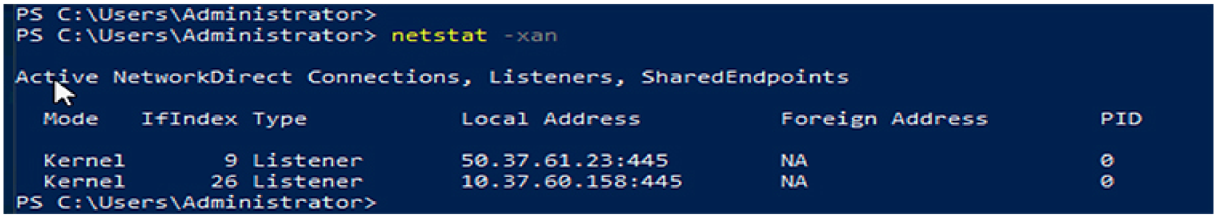


```
PS C:\Users\Administrator>
PS C:\Users\Administrator> Get-SmbClientNetworkInterface

Interface Index RSS Capable RDMA Capable Speed    IpAddresses     Friendly Name
--------------- ----------- ------------ -----    -----------     -------------
14              True        False        40 Gbps {10.37.60.162} vEthernet (vswitch)
26              True        True         40 Gbps {10.37.60.158} vEthernet (vp1)
9               True        True         40 Gbps {50.37.61.23}  Ethernet 2
5               False       False        40 Gbps {169.254.10.5} Ethernet (Kernel Debugger)
8               True        False        40 Gbps {169.254.4.26} Ethernet 3


PS C:\Users\Administrator> _
```

Step 5 Enter **enable - netadapterrdma [-name] ["Ethernetname"]**

Step 6 Verify the overall RoCE v2 Mode 1 configuration at the Host as follows:

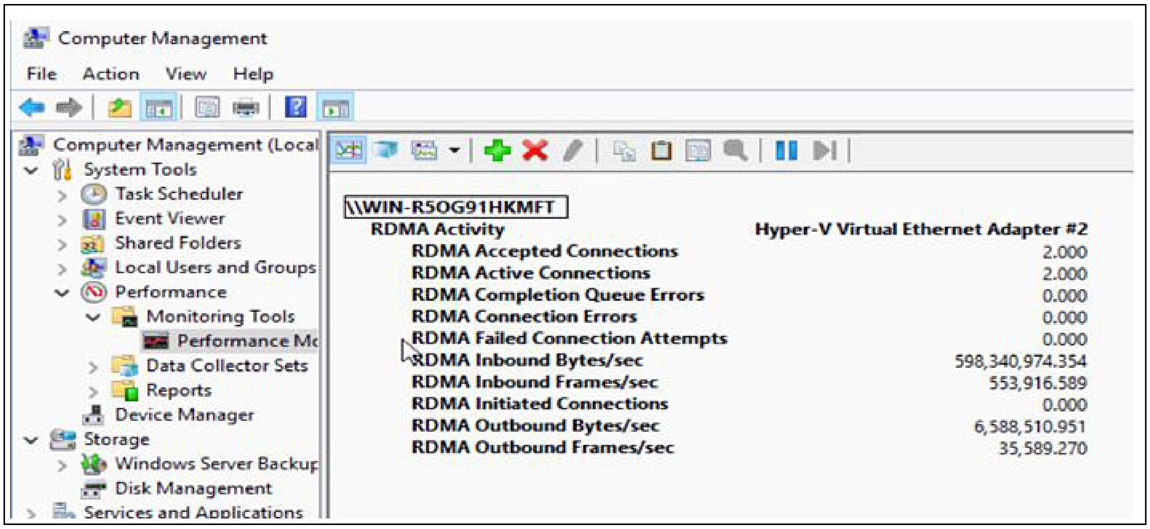
a) Use the Powershell command **netstat -xan** to verify the listeners in both the smb-client and smb-server Windows host; listeners will be shown in the command output.



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

Active NetworkDirect Connections, Listeners, SharedEndpoints

  Mode     IfIndex Type            Local Address          Foreign Address        PID

  Kernel        9 Listener        50.37.61.23:445        NA                     0
  Kernel       26 Listener        10.37.60.158:445       NA                     0
PS C:\Users\Administrator>
```

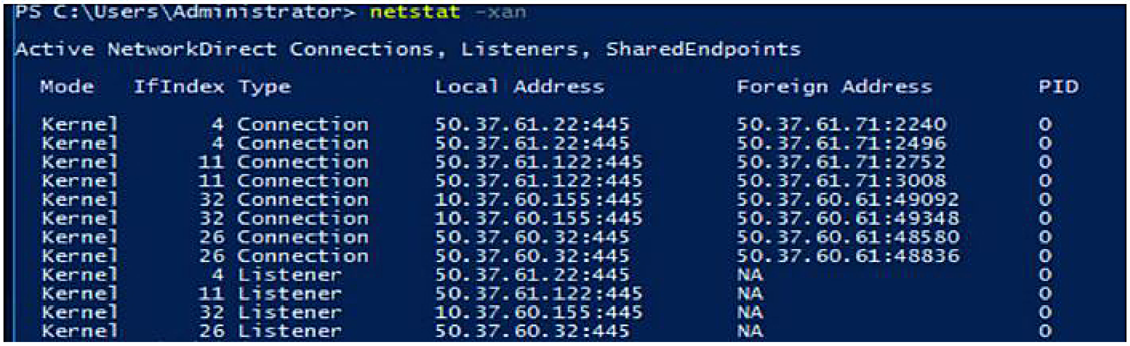
b) Go to the smb-client server fileshare and start an I/O operation.

c) Go to the performance monitor and check that it displays the RDMA activity.



\\WIN-R5OG91HKMFT	Hyper-V Virtual Ethernet Adapter #2
RDMA Activity	
RDMA Accepted Connections	2.000
RDMA Active Connections	2.000
RDMA Completion Queue Errors	0.000
RDMA Connection Errors	0.000
RDMA Failed Connection Attempts	0.000
RDMA Inbound Bytes/sec	598,340,974.354
RDMA Inbound Frames/sec	553,916.589
RDMA Initiated Connections	0.000
RDMA Outbound Bytes/sec	6,588,510.951
RDMA Outbound Frames/sec	35,589.270

Step 7 In the Powershell command window, check the connection entries with the **netstat -xan** output command to make sure they are displayed. You can also run **netstat -xan** from the command prompt. If the connection entry shows up in netstat-xan output, the RoCE v2 mode1 connections are correctly established between client and server.



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

Active NetworkDirect Connections, Listeners, SharedEndpoints

  Mode   IfIndex Type           Local Address          Foreign Address        PID

  Kernel       4 Connection     50.37.61.22:445        50.37.61.71:2240       0
  Kernel       4 Connection     50.37.61.22:445        50.37.61.71:2496       0
  Kernel      11 Connection     50.37.61.122:445       50.37.61.71:2752       0
  Kernel      11 Connection     50.37.61.122:445       50.37.61.71:3008       0
  Kernel      32 Connection     10.37.60.155:445       50.37.60.61:49092      0
  Kernel      32 Connection     10.37.60.155:445       50.37.60.61:49348      0
  Kernel      26 Connection     50.37.60.32:445        50.37.60.61:48580      0
  Kernel      26 Connection     50.37.60.32:445        50.37.60.61:48836      0
  Kernel       4 Listener       50.37.61.22:445        NA                     0
  Kernel      11 Listener       50.37.61.122:445       NA                     0
  Kernel      32 Listener       10.37.60.155:445       NA                     0
  Kernel      26 Listener       50.37.60.32:445        NA                     0
```

Note

IP values are representative only.

Step 8 By default, Microsoft's SMB Direct establishes two RDMA connections per RDMA interface. You can change the number of RDMA connections per RDMA interface to one or any number of connections.

For example, to increase the number of RDMA connections to 4, type the following command in PowerShell:

```
PS C:\Users\Administrator> Set-ItemProperty -Path `
"HKLM:\SYSTEM\CurrentControlSet\Services\LanmanWorkstation\Parameters"
ConnectionCountPerRdmaNetworkInterface -Type DWORD -Value 4 –Force
```

Configuring Mode 2 on Cisco Intersight

Use these steps to configure the RoCE v2 policies in Mode 2. In Cisco Intersight LAN Connectivity Policy, you can enable the RoCE settings on **Ethernet QoS** policy and **Ethernet Adapter** policy, and **VMMQ Adapter** policy for Mode 2 configuration as follows:

You will apply the VMQ Connection Policy as vmmq.

Before you begin

Configure RoCE v2 Policies in Mode 1.

Use the pre-defined default adapter policy “MQ-SMBd”, or configure a user-defined Ethernet adapter policy with the following recommended RoCE-specific parameters:

- RoCE: Enabled
- Version 1: disabled
- Version 2: enabled
- Queue Pairs: 256
- Memory Regions: 65536
- Resource Groups: 2

- Priority: Platinum

Create a VMQ connection policy with the following values:

- Multi queue: Enabled
- Number of sub-vNIC: 16
- VMMQ adapter policy: MQ-SMBd

Procedure

Step 1 Navigate to **CONFIGURE > Policies**. Click **Create Policy**, select **UCS Server** platform type, search or choose **LAN Connectivity** policy, and click **Start**.

Step 2 In the policy **General** page, enter the policy name, select the Target Platform as **UCS Server (Standalone)** or **UCS Server (FI-Attached)**, and click **Next**.

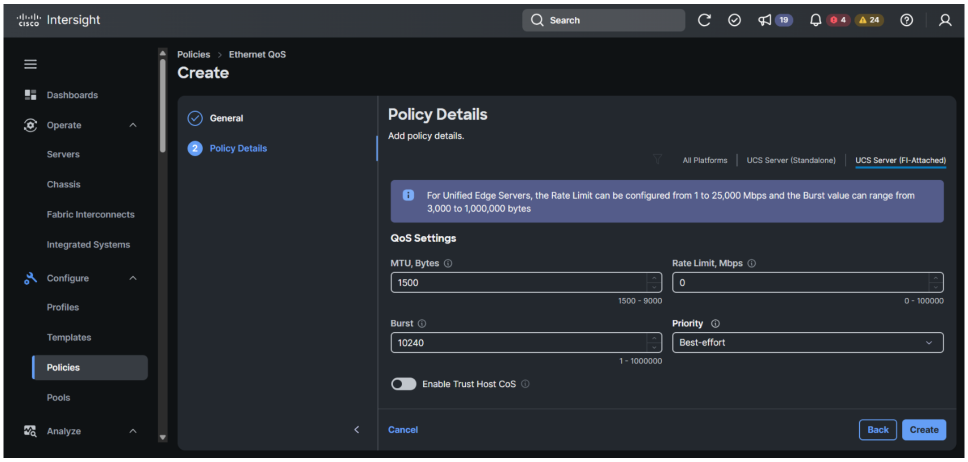
Step 3 In the **Policy Details** page, click **Add vNIC** to create a new vNIC.

Step 4 In the **Add vNIC** page, follow the configuration parameters to enable the RoCE vNIC settings:

a) In the **General** section, provide a name for virtual ethernet interface.

b) In the **Consistent Device Naming (CDN)** section of the Standalone server or the **Failover** section of FI-attached server, do the following:

- Click **Select Policy** link below the **Ethernet QoS**. Use the **Create New** button to create a new Ethernet QoS policy with the following property settings:
  - **MTU**—The Maximum Transmission Unit (MTU) or packet size that the virtual interface accepts. For **MTU**, choose or enter **1500, 4096, or 9000**
  - **Rate Limit, Mbps**—The value in Mbps (0-10G/40G/100G depending on Adapter Model) to use for limiting the data rate on the virtual interface.
  - **Class of Service**—Class of Service to be associated to the traffic on the virtual interface.
  - **Burst**—The burst traffic, in bytes, allowed on the vNIC.
  - For **Priority**, choose or enter **Best-effort**
  - **Enable Trust Host CoS**, slide to enable



Create

Policy Details

Add policy details.

For Unified Edge Servers, the Rate Limit can be configured from 1 to 25,000 Mbps and the Burst value can range from 3,000 to 1,000,000 bytes

QoS Settings

MTU, Bytes
1500
1500 - 9000

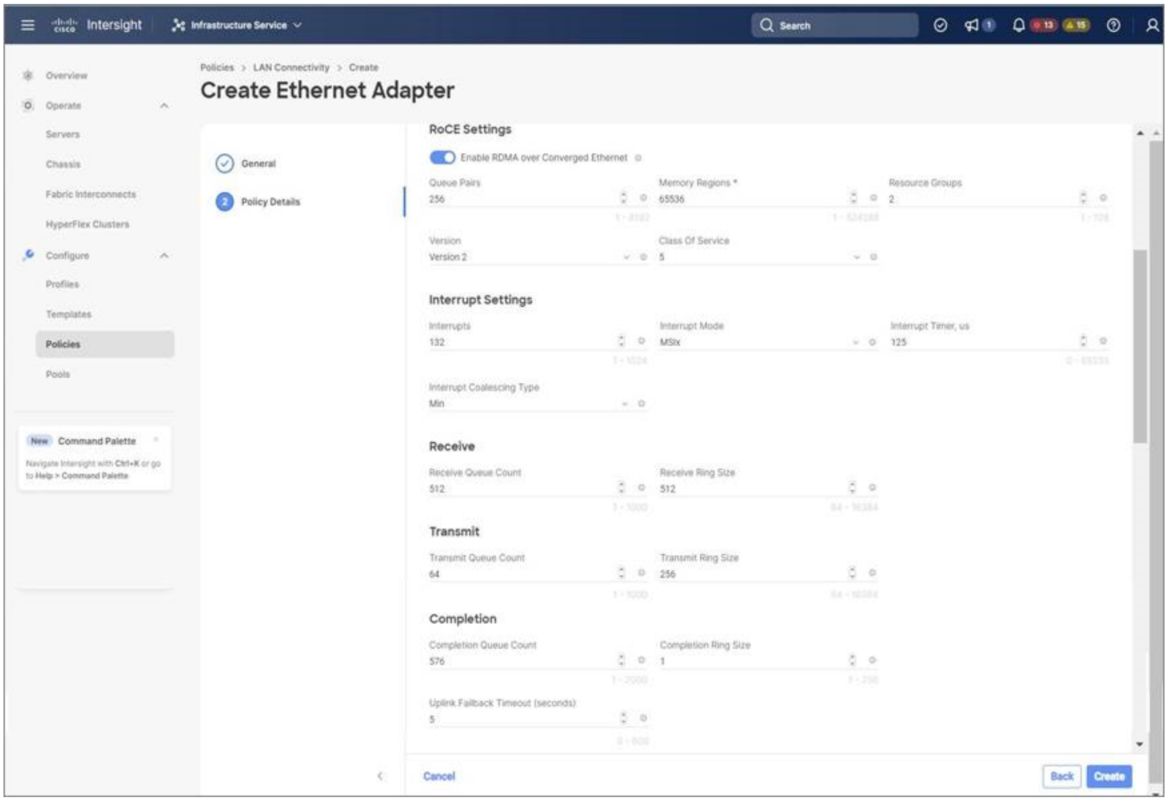
Rate Limit, Mbps
0
0 - 100000

Burst
10240
1 - 1000000

Priority
Best-effort

Enable Trust Host CoS

- Click **Select Policy** link below the **Ethernet Adapter**. Use **Create New** button to create a new Ethernet Adapter policy with the following property settings:
  - For **Enable RDMA over Converged Ethernet**, slide to enable.
  - For **Queue Pairs**, select or enter **256**
  - For **Memory Regions**, select or enter **65536**
  - For **Resource Groups**, select or enter **2**
  - For **Version**, choose **Version 2**
  - For **Class of Service**, choose or enter **5**



Policies > LAN Connectivity > Create

Create Ethernet Adapter

RoCE Settings

Enable RDMA over Converged Ethernet

Queue Pairs	Memory Regions *	Resource Groups
256	65536	2
1 - 8192	1 - 524288	1 - 128

Version	Class Of Service
Version 2	5

Interrupt Settings

Interrupts	Interrupt Mode	Interrupt Timer, us
132	MSIx	125
1 - 1024		0 - 65535

Interrupt Coalescing Type: Min

Receive

Receive Queue Count	Receive Ring Size
512	512
1 - 1000	64 - 16384

Transmit

Transmit Queue Count	Transmit Ring Size
64	256
1 - 1000	64 - 16384

Completion

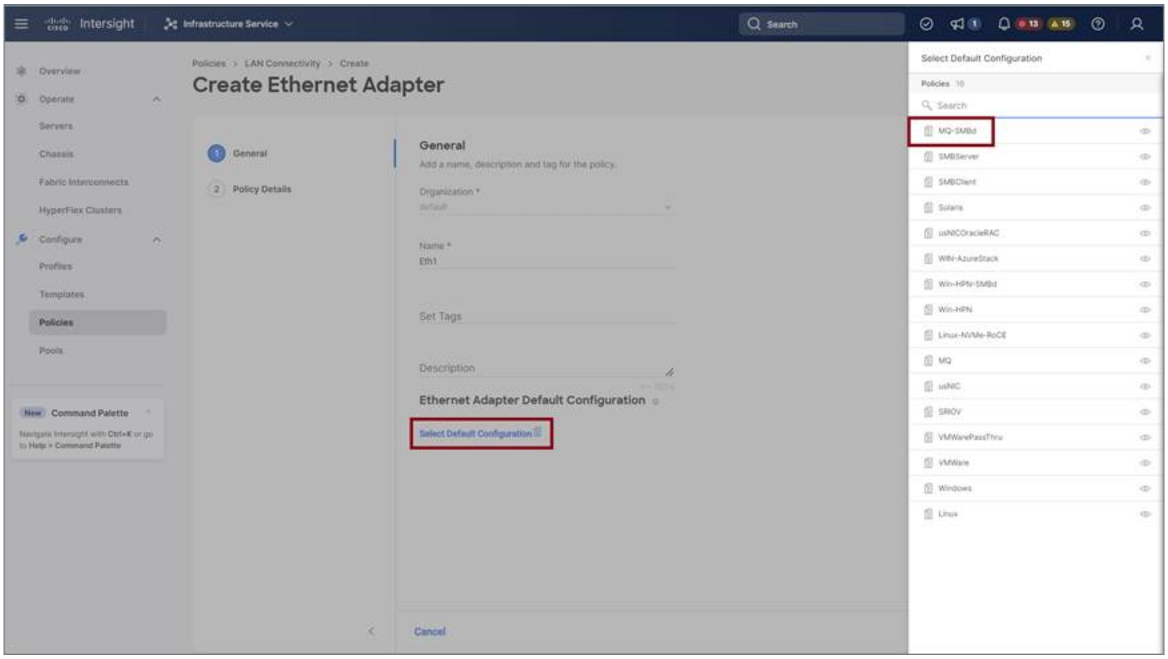
Completion Queue Count	Completion Ring Size
576	1
1 - 2000	1 - 256

Uplink Failback Timeout (seconds): 5 (0 - 600)

- In the **Connection** section, use the following property setting for VMQ Connection and to create VMMQ Adapter policy:
  - For connection, select **VMQ**.
  - **Enable Virtual Machine Multi-Queue** using slider button.
  - For **Number of Sub vNICs**, select or enter **4**
  - For **VMMQ Adapter Policy**, click **Select Policy** link below the VMMQ Adapter Policy and do the following:
    - Click **Create New** to create a new policy. In the **General** page, enter the name of the policy and click **Select Default Configuration** to search and select **MQ-SMBd**, the pre-defined VMMQ Adapter default configuration.

      Attention
      Do not modify the pre-defined parameters under Policy Details page, retain the default settings.

    - Click **Next** and then **Create**.



Create Ethernet Adapter

General

Add a name, description and tag for the policy.

Organization *
default

Name *
Eth1

Set Tags

Description

Ethernet Adapter Default Configuration

Select Default Configuration

- Click **Add** to add and save the new vNIC settings.

Note
All the fields with * are mandatory and ensure it is filled out or selected with appropriate policies.

Step 5 Click **Create** to complete the LAN Connectivity policy with RoCE v2 property settings.

Step 6 Associate the LAN Connectivity policy to the server profile.

Note
For more information on *Creating an Ethernet QoS*, *Ethernet Adapter Policy*, and *VMMQ Adapter Policy*, see Configuring UCS Server Policies and Configuring UCS Server Profiles.

The LAN Connectivity Policy with Ethernet QoS Policy, Ethernet Adapter Policy, and VMMQ Adapter Policy are successfully created and deployed to enable RoCE v2 configuration.

What to do next

Once the policy configuration for RoCE v2 is complete, reboot the server and proceed with the RoCE v2 Mode 2 configuration on the host operating system.

Configuring Mode 2 on the Host System

This task uses Hyper-V virtualization software that is compatible with Windows Server 2019 and Windows Server 2022.

Follow the below procedure for the host operating system configuration for RoCEv2 Mode 2.

Before you begin

- Configure and confirm the connection for Mode 1 for both Cisco Intersight and Host.
- Configure Mode 2 in Cisco Intersight.

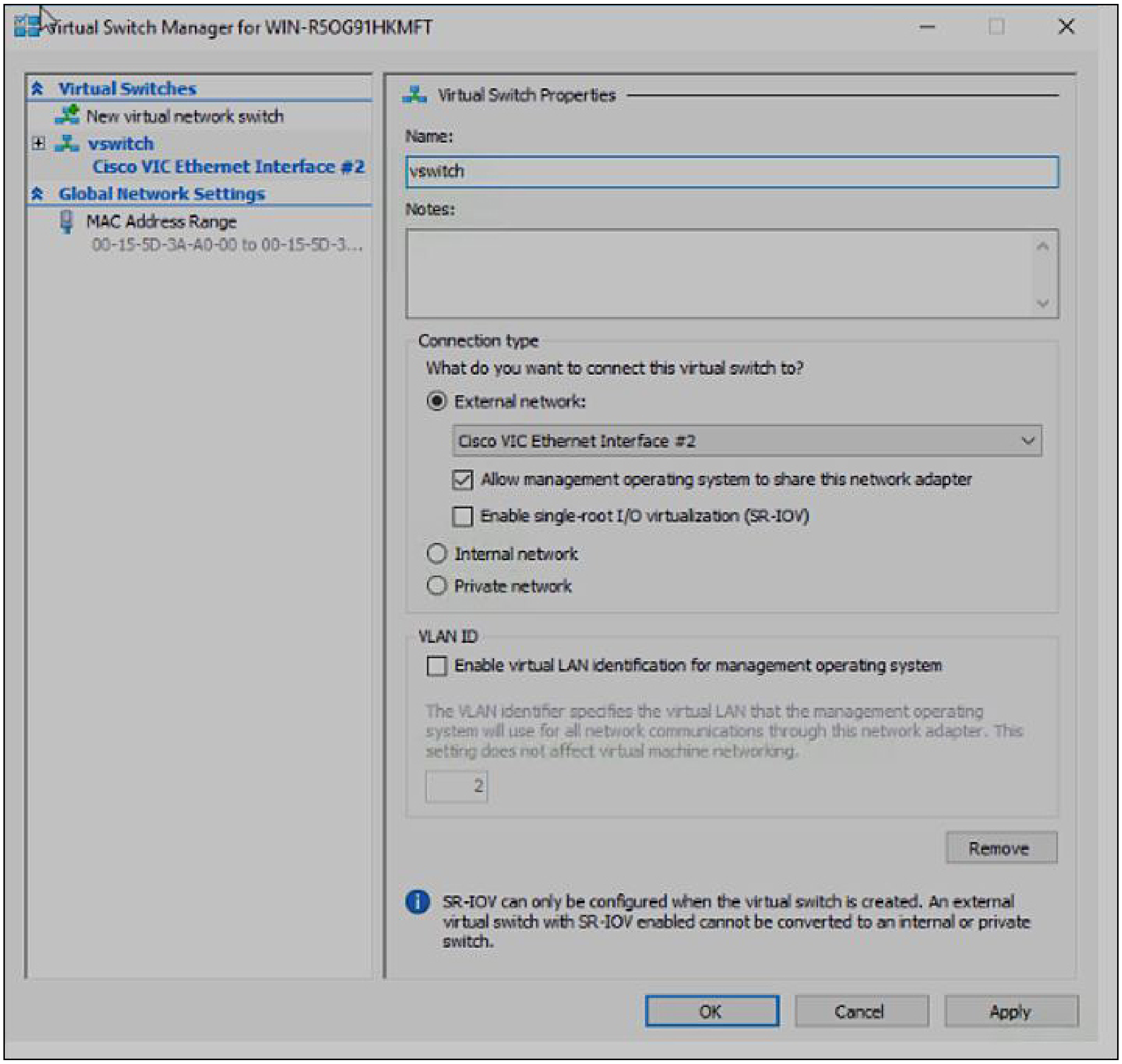
Procedure

Step 1 Go the Hyper-V switch manager.

Step 2 Create a new Virtual Network Switch (vswitch) for the RoCE v2-enabled Ethernet interface.

a) Choose **External Network** and select **VIC Ethernet Interface 2** and **Allow management operating system to share this network adapter**.

b) Click **OK** to create the create the virtual switch.



Virtual Switch Manager for WIN-R5OG91HKMFT

Virtual Switches
New virtual network switch
vswitch
Cisco VIC Ethernet Interface #2
Global Network Settings
MAC Address Range
00-15-5D-3A-A0-00 to 00-15-5D-3...
Virtual Switch Properties

Name: vswitch

Notes:

Connection type

What do you want to connect this virtual switch to?

● External network:

Cisco VIC Ethernet Interface #2

☑ Allow management operating system to share this network adapter

□ Enable single-root I/O virtualization (SR-IOV)

○ Internal network

○ Private network

VLAN ID

□ Enable virtual LAN identification for management operating system

The VLAN identifier specifies the virtual LAN that the management operating system will use for all network communications through this network adapter. This setting does not affect virtual machine networking.

2

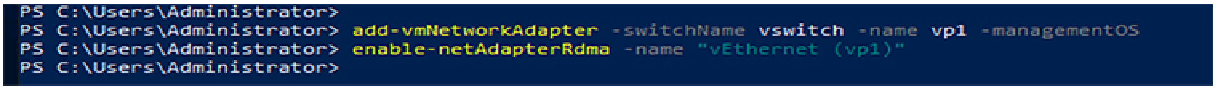
SR-IOV can only be configured when the virtual switch is created. An external virtual switch with SR-IOV enabled cannot be converted to an internal or private switch.

Bring up the Powershell interface.

Step 3 Configure the non-default vport and enable RDMA with the following Powershell commands:

```
add-vmNetworkAdapter -switchname vswitch -name vp1 -managementOS
```

```
enable-netAdapterRdma -name "vEthernet (vp1)"
```



```
PS C:\Users\Administrator>
PS C:\Users\Administrator> add-vmNetworkAdapter -switchName vswitch -name vp1 -managementOS
PS C:\Users\Administrator> enable-netAdapterRdma -name "vEthernet (vp1)"
PS C:\Users\Administrator>
```

a) Configure set-switch using the following Powershell command.

```
new-vmswitch -name setswitch -netAdapterName "Ethernet x" -enableEmbeddedTeam $true
```

This creates the switch. Use the following to display the interfaces:

```
get-netadapterrdma
```

```
add-vmNetworkAdapter -switchname setswtch -name svp1
```

You will see the new vport when you again enter

```
get-netadapterrdma
```

b) Add a vport.

```
add-vmNetworkAdapter -switchname setswtch -name svp1
```

You will see the new vport when you again enter

```
get-netadapterrdma
```

c) Enable the RDMA on the vport:

```
enable-netAdapterRdma -name "vEthernet (svp1)"
```

Step 4 Configure the IPV4 addresses on the RDMA enabled vport in both servers.

Step 5 Create a share in smb-server and map the share in the smb-client.

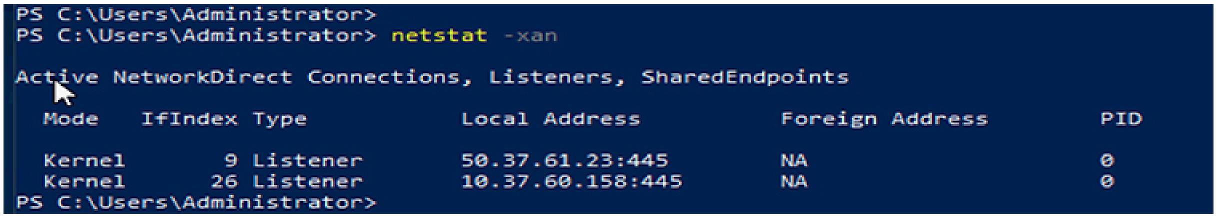
a) For smb-client and smb-server in the host system, configure the RoCE v2-enabled vNIC as described above.

b) Configure the IPV4 addresses of the primary fabric and sub-vNICs in both servers, using the same IP subnet and same unique vlan for both.

c) Create a share in smb-server and map the share in the smb-client.

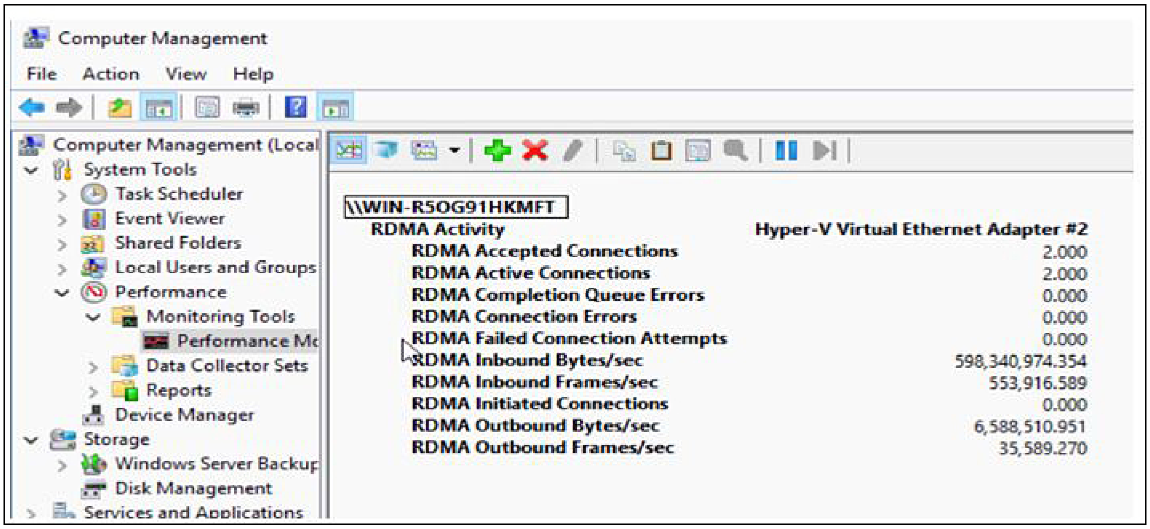
Step 6 Verify the Mode 2 configuration.

a) Use the Powershell command ***netstat -xan*** to display listeners and their associated IP addresses.



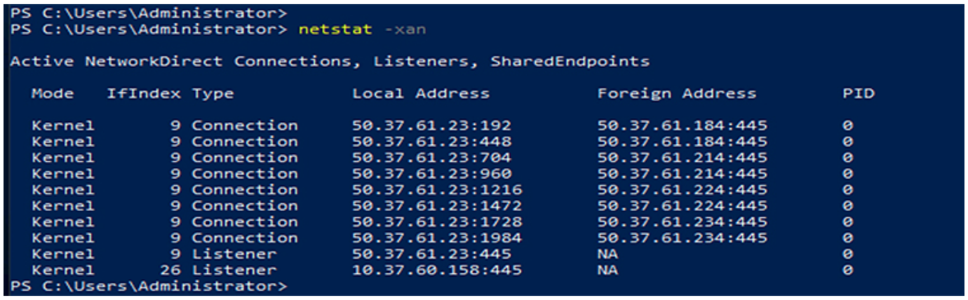
```
PS C:\Users\Administrator>
PS C:\Users\Administrator> netstat -xan

Active NetworkDirect Connections, Listeners, SharedEndpoints

  Mode    IfIndex Type           Local Address          Foreign Address        PID

  Kernel        9 Listener       50.37.61.23:445        NA                     0
  Kernel       26 Listener       10.37.60.158:445       NA                     0
PS C:\Users\Administrator>
```

b) Start any RDMA I/O in the file share in smb-client.



```
\\WIN-R5OG91HKMFT
  RDMA Activity                              Hyper-V Virtual Ethernet Adapter #2
     RDMA Accepted Connections                                            2.000
     RDMA Active Connections                                              2.000
     RDMA Completion Queue Errors                                         0.000
     RDMA Connection Errors                                               0.000
     RDMA Failed Connection Attempts                                      0.000
     RDMA Inbound Bytes/sec                                     598,340,974.354
     RDMA Inbound Frames/sec                                        553,916.589
     RDMA Initiated Connections                                           0.000
     RDMA Outbound Bytes/sec                                      6,588,510.951
     RDMA Outbound Frames/sec                                        35,589.270
```

c) Issue the ***netstat -xan*** command again and check for the connection entries to verify they are displayed.



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

Active NetworkDirect Connections, Listeners, SharedEndpoints

  Mode   IfIndex Type          Local Address          Foreign Address        PID

  Kernel       9 Connection    50.37.61.23:192        50.37.61.184:445       0
  Kernel       9 Connection    50.37.61.23:448        50.37.61.184:445       0
  Kernel       9 Connection    50.37.61.23:704        50.37.61.214:445       0
  Kernel       9 Connection    50.37.61.23:960        50.37.61.214:445       0
  Kernel       9 Connection    50.37.61.23:1216       50.37.61.224:445       0
  Kernel       9 Connection    50.37.61.23:1472       50.37.61.224:445       0
  Kernel       9 Connection    50.37.61.23:1728       50.37.61.234:445       0
  Kernel       9 Connection    50.37.61.23:1984       50.37.61.234:445       0
  Kernel       9 Listener      50.37.61.23:445        NA                     0
  Kernel      26 Listener      10.37.60.158:445       NA                     0
PS C:\Users\Administrator>
```

What to do next

Troubleshoot any items if necessary.

Deleting the RoCE v2 Interface in Cisco Intersight

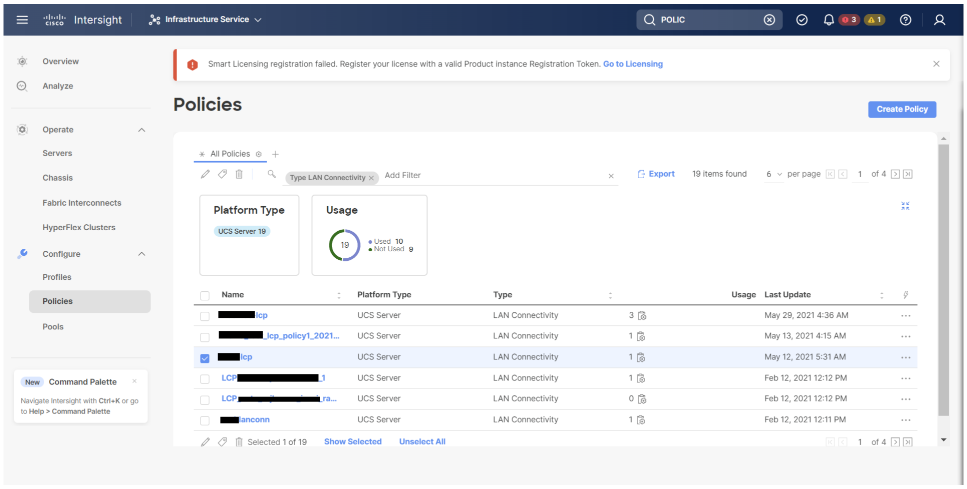
Use these steps to remove the RoCE v2 interface.

Procedure

Step 1 Navigate to **CONFIGURE** > **Policies**. In the **Add Filter** field, select **Type: LAN Connectivity**.

Step 2 Select the appropriate LAN Connectivity policy created for RoCE V2 configuration and use the delete icon on the top or bottom of the policy list.

Step 3 Click **Delete** to delete the policy.



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Policies

	Name	Platform Type	Type	Usage	Last Update
□	[redacted]lcp	UCS Server	LAN Connectivity	3	May 29, 2021 4:36 AM
□	[redacted]_lcp_policy1_2021...	UCS Server	LAN Connectivity	1	May 13, 2021 4:15 AM
☑	[redacted]lcp	UCS Server	LAN Connectivity	1	May 12, 2021 5:31 AM
□	LCP[redacted]_1	UCS Server	LAN Connectivity	1	Feb 12, 2021 12:12 PM
□	LCP[redacted]_ra...	UCS Server	LAN Connectivity	0	Feb 12, 2021 12:12 PM
□	[redacted]lanconn	UCS Server	LAN Connectivity	1	Feb 12, 2021 12:11 PM

Step 4 Upon deleting the RoCE v2 configuration, re-deploy the server profile and reboot the server.

Configuring NVMe over Fabrics (NVMeoF) with RoCE v2 in Linux

Configuring RoCE v2 for NVMeoF on Cisco Intersight

Use these steps to configure the RoCE v2 interface on Cisco Intersight.

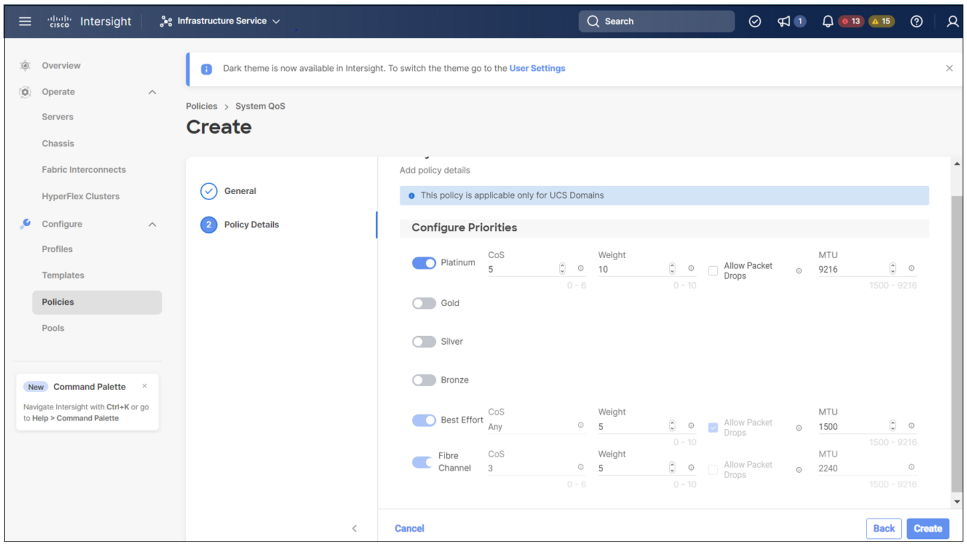
To avoid possible RDMA packet drops, ensure same the no-drop COS is configured across the network. The following steps allow you to configure a no-drop class in System QoS policies and use it for RDMA supported interfaces.

Procedure

Step 1 Navigate to **CONFIGURE** > **Policies**. Click **Create Policy**, select **UCS Domain** platform type, search or choose **System QoS**, and click **Start**.

Step 2 In the **General** page, enter the policy name and click **Next**, and then in the **Policy Details** page, configure the property setting for System QoS policy as follows:

- For **Priority**, choose **Platinum**
- For **Allow Packet Drops**, uncheck the check box.
- For **MTU**, set the value as **9216**.



Dark theme is now available in Intersight. To switch the theme go to the User Settings

Policies > System QoS

Create

Add policy details

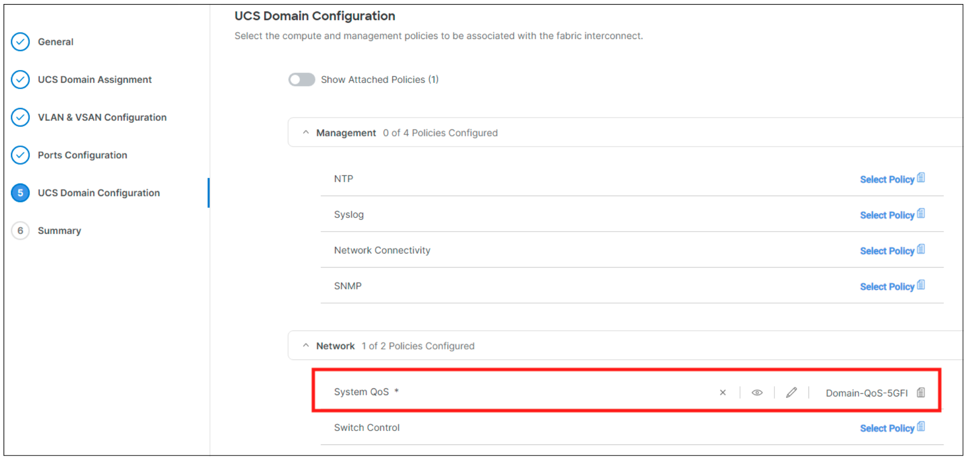
This policy is applicable only for UCS Domains

Configure Priorities

		CoS	Weight	Allow Packet Drops	MTU
Platinum	●	5 (0 - 6)	10 (0 - 10)	□	9216 (1500 - 9216)
Gold	○				
Silver	○				
Bronze	○				
Best Effort	●	Any	5 (0 - 10)	☑	1500 (1500 - 9216)
Fibre Channel	●	3 (0 - 6)	5 (0 - 10)	□	2240 (1500 - 9216)

Step 3 Click **Create**.

Step 4 Associate the System QoS policy to the Domain Profile.



UCS Domain Configuration

Select the compute and management policies to be associated with the fabric interconnect.

Show Attached Policies (1)

Management 0 of 4 Policies Configured

NTP	Select Policy
Syslog	Select Policy
Network Connectivity	Select Policy
SNMP	Select Policy

Network 1 of 2 Policies Configured

System QoS *	Domain-QoS-5GFI
Switch Control	Select Policy

Note

For more information, see *Creating System QoS Policy* in Configuring Domain Policies and Configuring Domain Profiles.

The System QoS Policy is successfully created and deployed to the Domain Profile.

What to do next

Configure the server profile with RoCE v2 vNIC settings in LAN Connectivity policy.

Enabling RoCE Settings in LAN Connectivity Policy

Use these steps to configure the RoCE v2 vNIC settings in Mode 1. In Cisco Intersight LAN Connectivity policy, you can enable the RoCE settings on **Ethernet QoS** policy and **Ethernet Adapter** policy for Mode 1 configuration as follows:

Procedure

Step 1 Navigate to **CONFIGURE** > **Policies**. Click **Create Policy**, select **UCS Server** platform type, search or choose **LAN Connectivity** policy, and click **Start**.

Step 2 In the policy **General** page, enter the policy name, select the Target Platform as **UCS Server (Standalone)** or **UCS Server (FI-Attached)**, and click **Next**.

Step 3 In the **Policy Details** page, click **Add vNIC** to create a new vNIC.

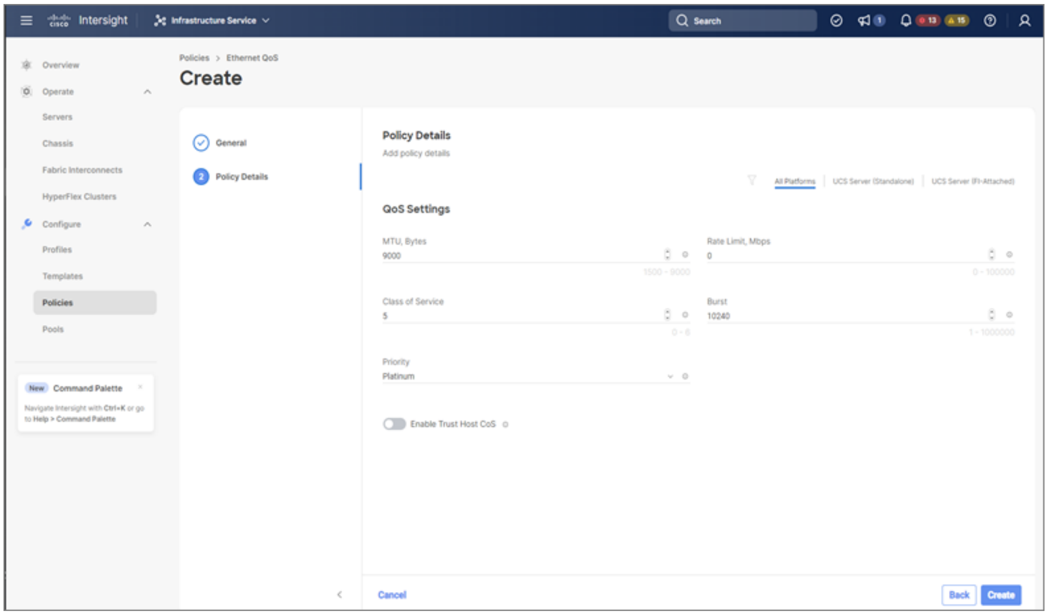
Step 4 In the **Add vNIC** page, follow the configuration parameters to enable the RoCE vNIC settings:

- In the **General** section, provide a name for virtual ethernet interface.
- In the **Consistent Device Naming (CDN)** section of the Standalone server or the **Failover** section of FI-attached server, do the following:
  - Click **Select Policy** link below the **Ethernet QoS**. Use the **Create New** button to create a new Ethernet QoS policy with the following property settings:
    - For **MTU**, choose or enter **1500, 4096, or 9000**
    - For **Priority**, choose **Platinum** or **any no-drop**
    - For **Class of Service**, choose or enter **5**

      Note
      This property is available only on Standalone servers.

    - Slide to **Enable Trust Host CoS** toggle button.

      Note
      This property is available only on Intersight Managed Mode servers.



Policies > Ethernet QoS

Create

Policy Details

Add policy details

QoS Settings

MTU, Bytes: 9000 (1500 - 9000)

Rate Limit, Mbps: 0 (0 - 100000)

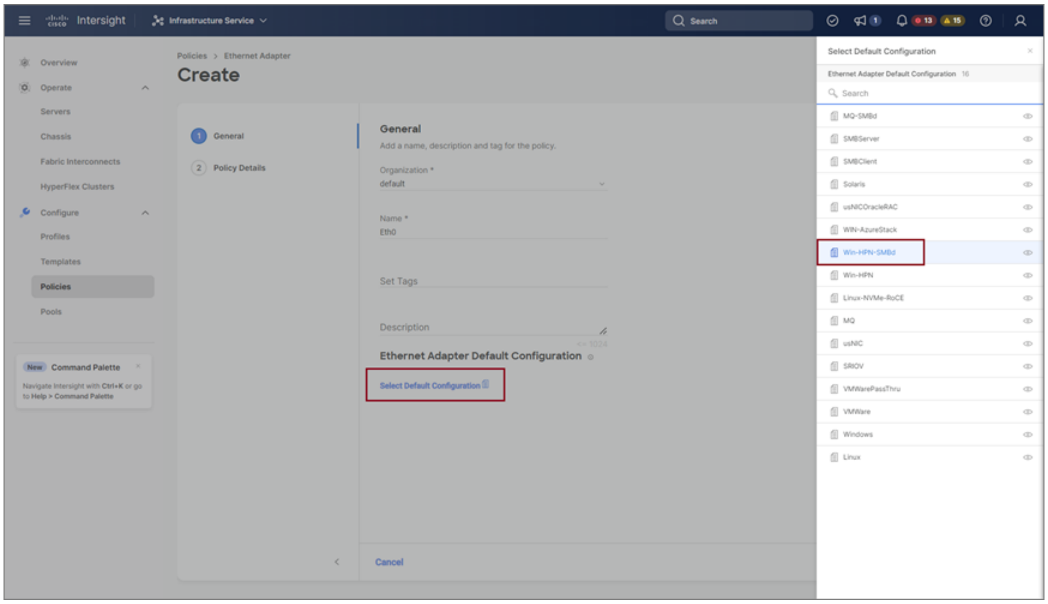
Class of Service: 5 (0 - 6)

Burst: 10240 (1 - 1000000)

Priority: Platinum

Enable Trust Host CoS

- Click **Select Policy** link below the **Ethernet Adapter**. Follow on to click Create an Ethernet Adapter Policy:
  - **Use the Default Configuration**: Click **Create New** to create a new policy. In the **General** page, enter the name of the policy and under Ethernet Adapter Default Configuration click **Select Default Configuration** to search and select **Win-HPN-SMBd**, the pre-defined Ethernet Adapter Default Configuration. Click **Next** and then **Create**.



Policies > Ethernet Adapter

Create

General

Add a name, description and tag for the policy.

Organization *
default

Name *
Eth0

Set Tags

Description
<= 1024

Ethernet Adapter Default Configuration

Select Default Configuration

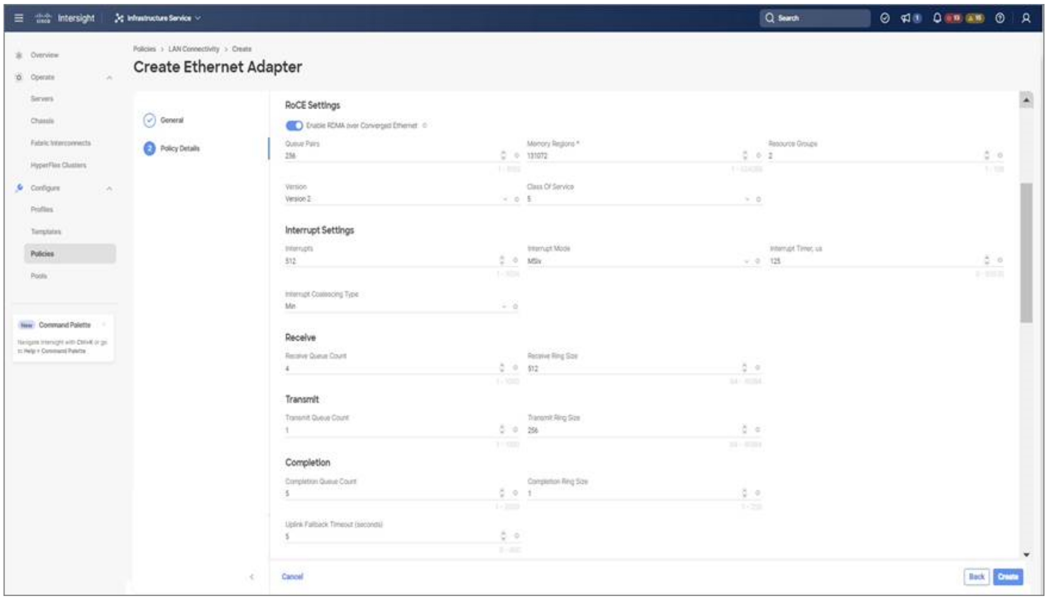
Select Default Configuration

Ethernet Adapter Default Configuration 16

Search

MQ-SMBd
SMBServer
SMBClient
Solaris
usNICOracleRAC
WIN-AzureStack
Win-HPN-SMBd
Win-HPN
Linux-NVMe-RoCE
MQ
usNIC
SRIOV
VMWarePassThru
VMWare
Windows
Linux

  - **Configure RoCE Settings in the policy**: Click **Create New** to create a new policy. In the **General** page, enter the name of the policy. Under Policy Details page on right pane, use the following property settings, then click **Next**, and then **Create**..
    - For **Enable RDMA over Converged Ethernet**, slide to enable.
    - For **Queue Pairs**, choose or enter **256**
    - For **Memory Regions**, choose or enter **131072**
    - For **Resource Groups**, choose or enter **2**
    - For **Version**, select **Version 2**



Create Ethernet Adapter

RoCE Settings

Enable RDMA over Converged Ethernet

Queue Pairs: 256

Memory Regions *: 131072

Resource Groups: 2

Version: Version 2

Class Of Service: 5

Interrupt Settings

Interrupts: 512

Interrupt Mode: MSIx

Interrupt Timer, us: 125

Interrupt Coalescing Type: Min

Receive

Receive Queue Count: 4

Receive Ring Size: 512

Transmit

Transmit Queue Count: 1

Transmit Ring Size: 256

Completion

Completion Queue Count: 5

Completion Ring Size: 1

Uplink Fallback Timeout (seconds): 5

- Click **Add** to add and save the new vNIC settings.

Note
All the fields with * are mandatory for creating LAN Connectivity Policy. Ensure they are filled out or selected with appropriate policies.

Step 5 Click **Create** to complete the LAN Connectivity policy with RoCE v2 property settings.

Step 6 Associate the LAN Connectivity policy to the server profile and deploy.

Note
For more information, see *Creating a LAN Connectivity Policy*, *Creating an Ethernet QoS Policy*, and *Creating an Ethernet Adapter Policy* in Configuring UCS Server Policies and Configuring UCS Server Profiles.

The LAN Connectivity policy with the Ethernet QoS policy and Ethernet Adapter policy vNIC setting is successfully created and the server profile is deployed to enable RoCE v2 configuration.

What to do next

Once the policy configuration for RoCE v2 is complete, proceed to enable IOMMU in the BIOS policy.

Enabling an IOMMU BIOS Settings

Use the following steps to configure the server profile with the RoCE v2 vNIC and enable the IOMMU BIOS policy before enabling the IOMMU in the Linux kernel.

Procedure

Step 1 Navigate to **CONFIGURE** > **Policies**. Click **Create Policy**, select **UCS Server** platform type, search or choose **BIOS**, and click **Start**.

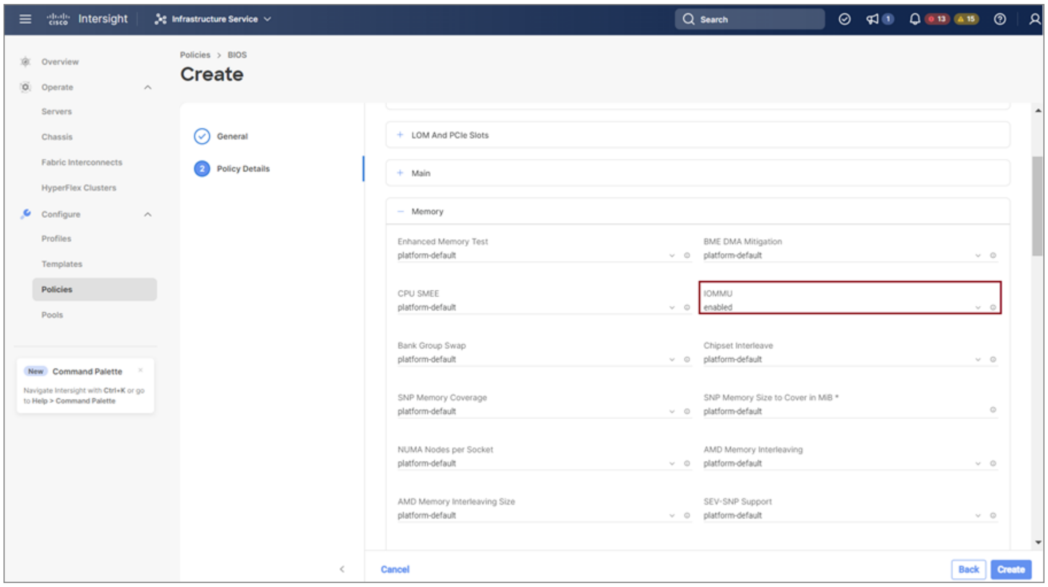
Step 2 On the **General** page, enter the policy name and click **Next**.

Step 3 On the **Policy Details** page, configure the following BIOS:

a) Select **All Platforms**.

b) For a server with an Intel CPU, enable **Intel VT for Directed I/O** under the **Intel Directed I/O** drop-down list and enable **Intel(R) VT** under the **Processor** drop-down list.

c) For a server with an AMD CPU, enable **IOMMU** under the **Memory** drop-down list and enable **SVM Mode** under the **Processor** drop-down list.



Enhanced Memory Test: platform-default
BME DMA Mitigation: platform-default
CPU SMEE: platform-default
IOMMU: enabled
Bank Group Swap: platform-default
Chipset Interleave: platform-default
SNP Memory Coverage: platform-default
SNP Memory Size to Cover in MiB *: platform-default
NUMA Nodes per Socket: platform-default
AMD Memory Interleaving: platform-default
AMD Memory Interleaving Size: platform-default
SEV-SNP Support: platform-default

Step 4 Click **Create**.

Step 5 Associate the BIOS policy to the server profile and reboot the server.

Note
For more information, see *Creating a BIOS Policy* in Configuring Server Policies and Configuring Server Profile.

The BIOS Policy is successfully created and deployed on the server profile.

What to do next

Configure RoCE v2 for NVMeoF on the Host System.

Configuring RoCE v2 for NVMeoF on the Host System

Before you begin

Configure the Server Profile with RoCE v2 vNIC and the IOMMU enabled BIOS policy.

Procedure

Step 1 Open the `/etc/default/grub` file for editing.

Step 2 Add `intel_iommu=on` to the end of `GRUB_CMDLINE_LINUX`.

```
sample /etc/default/grub configuration file after adding intel_iommu=on:
# cat /etc/default/grub
GRUB_TIMEOUT=5
GRUB_DISTRIBUTOR="$(sed 's, release .*$,,g' /etc/system-release)"
GRUB_DEFAULT=saved
GRUB_DISABLE_SUBMENU=true
GRUB_TERMINAL_OUTPUT="console"
GRUB_CMDLINE_LINUX="crashkernel=auto rd.lvm.lv=rhel/root rd.lvm.lv=rhel/swap biosdevname=1 rhgb quiet
 intel_iommu=on
GRUB_DISABLE_RECOVERY="true"
```

Step 3 After saving the file, generate a new grub.cfg file.

For Legacy boot:

```
# grub2-mkconfig -o /boot/grub2/grub.cfg
```

For UEFI boot:

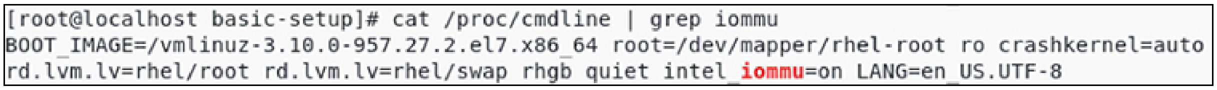
```
# grub2-mkconfig -o /boot/grub2/efi/EFI/redhat/grub.cfg
```

Step 4 Reboot the server. You must reboot your server for the changes to take after enabling IOMMU.

Step 5 Verify the server is booted with `intel_iommu=on` option.

```
cat /proc/cmdline | grep iommu
```

Note its inclusion at the end of the output.



```
[root@localhost basic-setup]# cat /proc/cmdline | grep iommu
BOOT_IMAGE=/vmlinuz-3.10.0-957.27.2.el7.x86_64 root=/dev/mapper/rhel-root ro crashkernel=auto
rd.lvm.lv=rhel/root rd.lvm.lv=rhel/swap rhgb quiet intel_iommu=on LANG=en_US.UTF-8
```

What to do next

Download the enic and enic_rdma drivers.

Installing Cisco enic and enic_rdma Drivers

The enic_rdma driver requires enic driver. When installing enic and enic_rdma drivers, download and use the matched set of enic and enic_rdma drivers on Cisco.com. Attempting to use the binary enic_rdma driver downloaded from Cisco.com with an inbox enic driver, will not work.

Procedure

Step 1 Install the enic and enic_rdma rpm packages:

```
# rpm -ivh kmod-enic-<version>.x86_64.rpm kmod-enic rdma-<version>.x86_64.rpm
```

Note

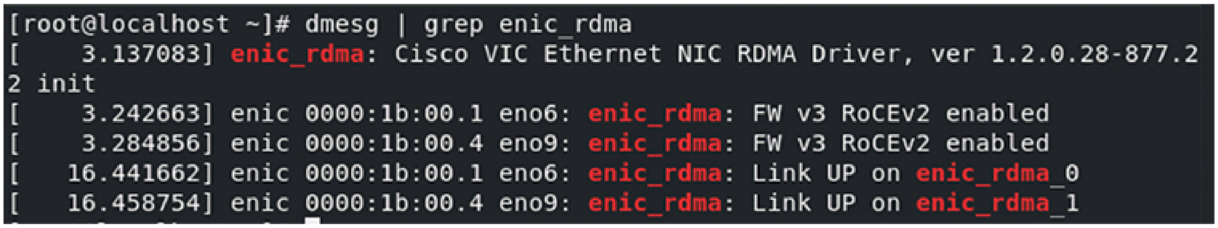
During enic_rdma installation, the enic_rdmalibnvdimm module may fail to install on RHEL 7.7 because the `nvdimm-security.conf` dracut module needs spaces in the `add_drivers` value. For workaround, please follow the instruction from the following links:

https://access.redhat.com/solutions/4386041

https://bugzilla.redhat.com/show_bug.cgi?id=1740383

Step 2 The enic_rdma driver is now installed but not loaded in the running kernel. Reboot the server to load enic_rdma driver into the running kernel.

Step 3 Verify the installation of enic_rdma driver and RoCE v2 interface:



```
[root@localhost ~]# dmesg | grep enic_rdma
[    3.137083] enic_rdma: Cisco VIC Ethernet NIC RDMA Driver, ver 1.2.0.28-877.2
2 init
[    3.242663] enic 0000:1b:00.1 eno6: enic_rdma: FW v3 RoCEv2 enabled
[    3.284856] enic 0000:1b:00.4 eno9: enic_rdma: FW v3 RoCEv2 enabled
[   16.441662] enic 0000:1b:00.1 eno6: enic_rdma: Link UP on enic_rdma_0
[   16.458754] enic 0000:1b:00.4 eno9: enic_rdma: Link UP on enic_rdma_1
```

Step 4 Load the nvme-rdma kernel module:

```
# modprobe nvme-rdma
```

After server reboot, nvme-rdma kernel module is unloaded. To load nvme-rdma kernel module every server reboot, create nvme_rdma.conf file using:

```
# echo nvme_rdma > /etc/modules-load.d/nvme_rdma.conf
```

Note

For more information about enic_rdma after installation, use the **`rpm -q -l kmod-enic_rdma`** command to extract the README file.

What to do next

Discover targets and connect to NVMe namespaces. If your system needs multipath access to the storage, go to the section for Setting Up Device Mapper Multipath, on page 25.

Discovering the NVMe Target

Use this procedure to discover the NVMe target and connect NVMe namespaces.

Before you begin

Install **nvme-cli** version 1.6 or later if it is not installed already.

Configure the IP address on the RoCE v2 interface and make sure the interface can ping the target IP.

Procedure

Step 1 Create an nvme folder in /etc, then manually generate host nqn.

```
# mkdir /etc/nvme
# nvme gen-hostnqn > /etc/nvme/hostnqn
```

Step 2 Create a settos.sh file and run the script to set priority flow control (PFC) in IB frames.

Note
To avoid failure of sending NVMeoF traffic, you *must* create and run this script after *every* server reboot.

```
# cat settos.sh
#!/bin/bash
for f in `ls /sys/class/infiniband`;
do
        echo "setting TOS for IB interface:" $f
        mkdir -p /sys/kernel/config/rdma_cm/$f/ports/1
        echo 186 > /sys/kernel/config/rdma_cm/$f/ports/1/default_roce_tos
done
```

Step 3 Discover the NVMe target by entering the following command.

```
nvme discover --transport=rdma --traddr=<IP address of transport target port>
```

For example, to discover the target at 50.2.85.200:

```
# nvme discover --transport=rdma --traddr=50.2.85.200

Discovery Log Number of Records 1, Generation counter 2
=====Discovery Log Entry 0======
trtype:  rdma
adrfam:  ipv4
subtype: nvme subsystem
treq:    not required
portid:  3
trsvcid: 4420
subnqn:  nqn.2010-06.com.purestorage:flasharray.9a703295ee2954e
traddr:  50.2.85.200
rdma_prtype: roce-v2
rdma_qptype: connected
rdma_cms:    rdma-cm
rdma_pkey: 0x0000
```

Note
To discover the NVMe target using IPv6, put the IPv6 target address next to the `traddr` option.

Step 4 Connect to the discovered NVMe target by entering the following command.

```
nvme connect --transport=rdma --traddr=<IP address of transport target port>> -n <subnqn value from
 nvme discover>
```

For example, to discover the target at 50.2.85.200 and the subnqn value found above:

```
# nvme connect --transport=rdma --traddr=50.2.85.200 -n
nqn.2010-06.com.purestorage:flasharray.9a703295ee2954e
```

Note
To connect to the discovered NVMe target using IPv6, put the IPv6 target address next to the `traddr` option.

Step 5 Use the **nvme list** command to check mapped namespaces:

```
# nvme list
Node             SN                   Model                                    Namespace Usage
                 Format           FW Rev
---------------- -------------------- ---------------------------------------- ---------
-------------------------- ---------------- --------
/dev/nvme0n1     09A703295EE2954E     Pure Storage FlashArray                  72656       4.29  GB
 /   4.29  GB    512   B +  0 B   99.9.9
/dev/nvme0n2     09A703295EE2954E     Pure Storage FlashArray                  72657       5.37  GB
 /   5.37  GB    512   B +  0 B   99.9.9
```

Setting Up Device Mapper Multipath

If your system is configured with Device Mapper multipathing (DM Multipath), use the following steps to set up Device Mapper multipath.

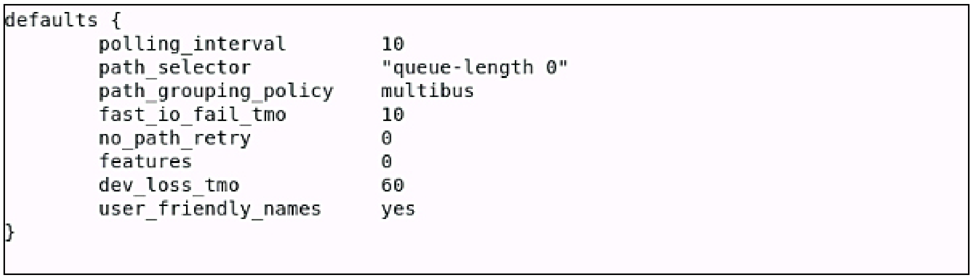
Procedure

Step 1 Install the `device-mapper-multipath` package if it is not installed already

Step 2 Enable and start multipathd:

```
# mpathconf --enable --with_multipathd y
```

Step 3 Edit the etc/multipath.conf file to use the following values :



```
defaults {
        polling_interval        10
        path_selector           "queue-length 0"
        path_grouping_policy    multibus
        fast_io_fail_tmo        10
        no_path_retry           0
        features                0
        dev_loss_tmo            60
        user_friendly_names     yes
}
```

Step 4 Flush with the updated multipath device maps.

```
# multipath -F
```

Step 5 Restart multipath service:

```
# systemctl restart multipathd.service
```

Step 6 Rescan multipath devices:

```
# multipath -v2
```

Step 7 Check the multipath status:

```
# multipath -ll
```

Deleting the RoCE v2 Interface in Cisco Intersight

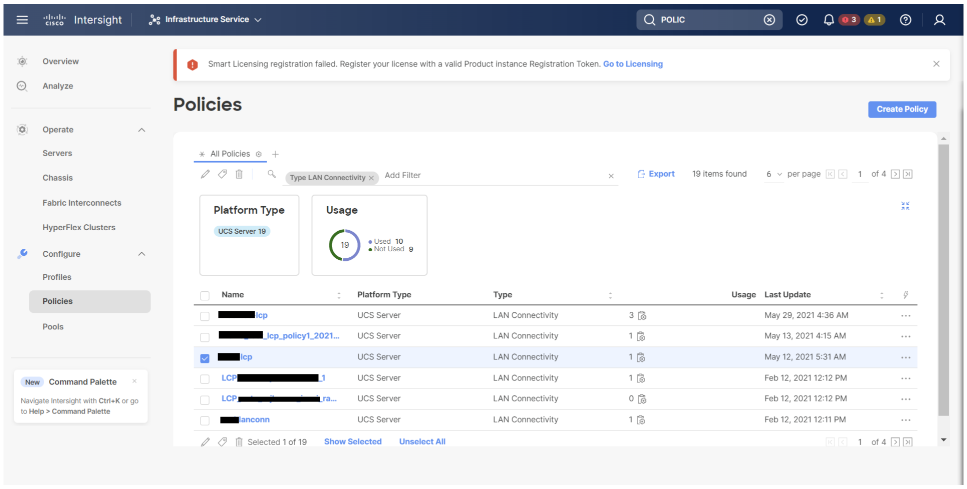
Use these steps to remove the RoCE v2 interface.

Procedure

Step 1 Navigate to **CONFIGURE** > **Policies**. In the **Add Filter** field, select **Type: LAN Connectivity**.

Step 2 Select the appropriate LAN Connectivity policy created for RoCE V2 configuration and use the delete icon on the top or bottom of the policy list.

Step 3 Click **Delete** to delete the policy.



Smart Licensing registration failed. Register your license with a valid Product instance Registration Token. Go to Licensing

Policies

19 items found 6 per page 1 of 4

☐	Name	Platform Type	Type	Usage	Last Update
☐	[redacted]lcp	UCS Server	LAN Connectivity	3	May 29, 2021 4:36 AM
☐	[redacted]_lcp_policy1_2021...	UCS Server	LAN Connectivity	1	May 13, 2021 4:15 AM
☑	[redacted]lcp	UCS Server	LAN Connectivity	1	May 12, 2021 5:31 AM
☐	LCP[redacted]_1	UCS Server	LAN Connectivity	1	Feb 12, 2021 12:12 PM
☐	LCP[redacted]ra...	UCS Server	LAN Connectivity	0	Feb 12, 2021 12:12 PM
☐	[redacted]lanconn	UCS Server	LAN Connectivity	1	Feb 12, 2021 12:11 PM

Selected 1 of 19 1 of 4

Step 4 Upon deleting the RoCE v2 configuration, re-deploy the server profile and reboot the server.

Configuring NVMe with RoCEv2 in ESXi

Configuring RoCE v2 for NVMeoF on Cisco Intersight

Use these steps to configure the RoCE v2 interface on Cisco Intersight.

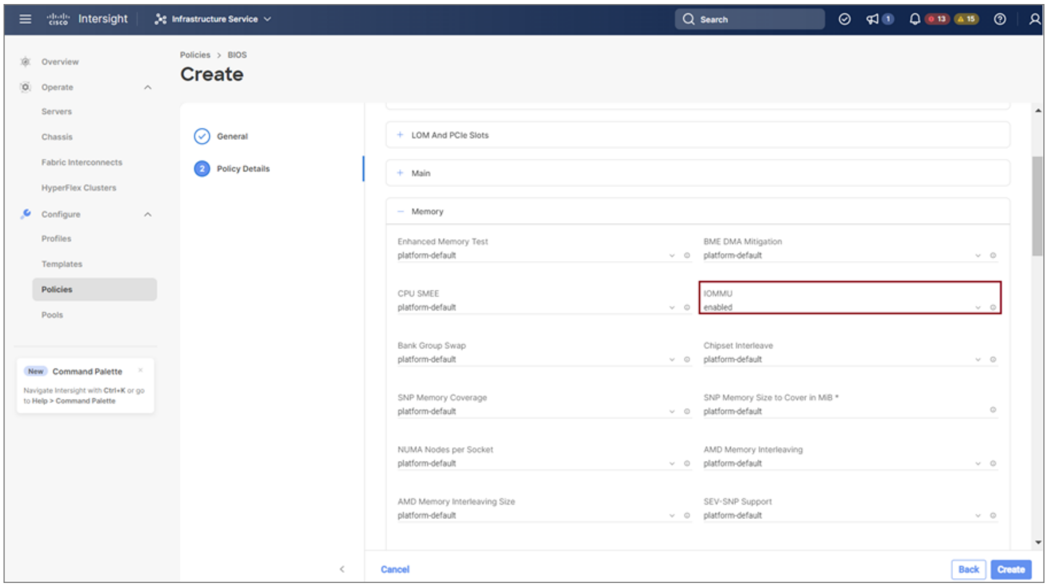
To avoid possible RDMA packet drops, ensure same no-drop COS is configured across the network. The following steps allows you to configure a no-drop class in System QoS policies and use it for RDMA supported interfaces.

Procedure

Step 1 Navigate to **CONFIGURE** > **Policies**. Click **Create Policy**, select **UCS Domain** platform type, search or choose **System QoS**, and click **Start**.

Step 2 In the **General** page, enter the policy name and click **Next**, and then in the **Policy Details** page, configure the property setting for System QoS policy as follows:

- For **Priority**, choose **Platinum**
- For **Allow Packet Drops**, uncheck the check box.
- For **MTU**, set the value as **9216**.



Policies > BIOS

Create

+ LOM And PCIe Slots

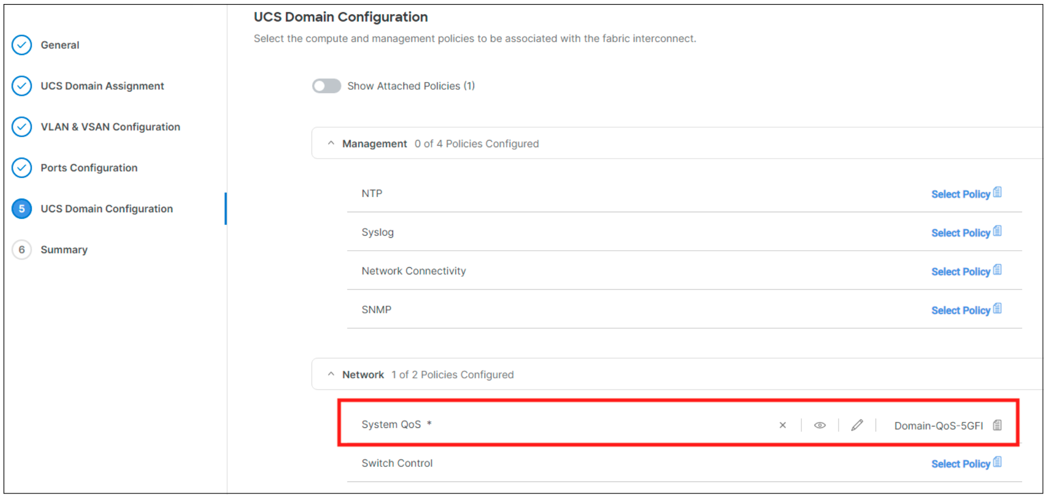
+ Main

– Memory

Enhanced Memory Test platform-default	BME DMA Mitigation platform-default
CPU SMEE platform-default	IOMMU enabled
Bank Group Swap platform-default	Chipset Interleave platform-default
SNP Memory Coverage platform-default	SNP Memory Size to Cover in MiB * platform-default
NUMA Nodes per Socket platform-default	AMD Memory Interleaving platform-default
AMD Memory Interleaving Size platform-default	SEV-SNP Support platform-default

Step 3 Click **Create**.

Step 4 Associate the System QoS policy to the Domain Profile.


General
UCS Domain Assignment
VLAN & VSAN Configuration
Ports Configuration
5 UCS Domain Configuration
6 Summary
Show Attached Policies (1)
Select Policy

UCS Domain Configuration

Select the compute and management policies to be associated with the fabric interconnect.

Management 0 of 4 Policies Configured

NTP	Select Policy
Syslog	Select Policy
Network Connectivity	Select Policy
SNMP	Select Policy

Network 1 of 2 Policies Configured

System QoS *	Domain-QoS-5GFI
Switch Control	Select Policy

Note

For more information, see *Creating System QoS Policy* in Configuring Domain Policies and Configuring Domain Profiles.

The System QoS Policy is successfully created and deployed to the Domain Profile.

What to do next

Configure the server profile with RoCE v2 vNIC settings in LAN Connectivity policy.

Enabling RoCE Settings in LAN Connectivity Policy

Use the following steps to configure the RoCE v2 vNIC. In Cisco Intersight LAN Connectivity policy, you can enable the RoCE settings on **Ethernet Adapter policy** for Linux configuration as follows:

Procedure

Step 1 Navigate to **CONFIGURE > Policies**. Click **Create Policy**, select **UCS Server** platform type, search or choose **LAN Connectivity policy**, and click **Start**.

Step 2 In the policy **General** page, enter the policy name, select the Target Platform as **UCS Server (Standalone)** or **UCS Server (FI-Attached)**, and click **Next**.

Step 3 In the **Policy Details** page, click **Add vNIC** to create a new vNIC.

Step 4 In the **Add vNIC** page, follow the configuration parameters to enable the RoCE v2 vNIC:

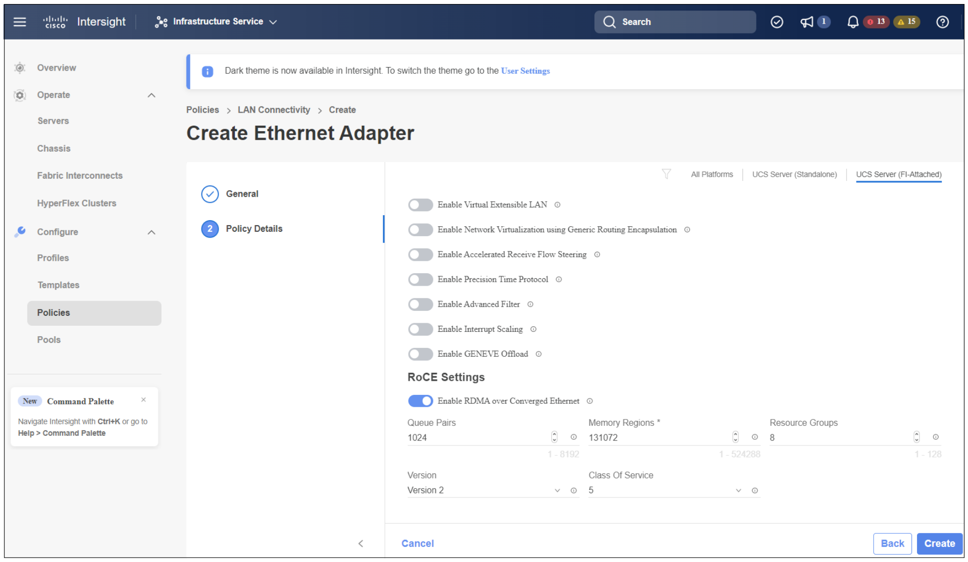
a) In the **General** section, provide a name for virtual ethernet interface.

b) Incase of a Standalone server, click the **Consistent Device Naming (CDN)** or click the **Failover** of a FI-attached server , and do the following:

- Click **Select Policy** under **Ethernet Adapter**.
- In the **Select Policy** window, click **Create New** to create an Ethernet Adapter policy.
- In the **General** page of the Ethernet Adapter Policy, enter the policy name and click **Next**.
- In the **Policy Details** page of the Ethernet Adapter Policy, modify the following property setting:
  - **RoCE Settings**
    - For **Enable RDMA over Converged Ethernet**, slide to enable and set the RoCE on this virtual interface.
    - For **Queue Pairs**, select or enter **1024**
    - For **Memory Regions**, select or enter **131072**
    - For **Resource Groups**, select or enter **8**
    - For **Version**, select **Version 2**
    - For **Class of Service**, select **5**
  - **Interrupt Settings**
    - For **Interrupts**, select or enter **256**.
    - For **Interrupt mode**, select **MSIx**.
    - For **Interrupt Timer, us,** select **125**.
    - For **Interrupt Coalescing Type**, select **Min**.

  - **Receive** Settings
    - For **Receive Queue Count**, select or enter **1**.
    - For **Receiving Ring Size**, select or enter **512**.
  - **Transmit** Settings
    - For **Transmit Queue Count**, select or enter **1**.
    - For **Transmit Ring Size**, select or enter **256**.
  - **Completion** Settings
    - For **Completion Queue Count**, select or enter **2**.
    - For **Completion Ring Size**, select or enter **1**.
    - For **Uplink Failback Timeout(seconds)**, select or enter **5**

- Click **Create** to create an Ethernet Adapter Policy with the above defined settings.



Dark theme is now available in Intersight. To switch the theme go to the User Settings

Policies > LAN Connectivity > Create

Create Ethernet Adapter

Enable Virtual Extensible LAN

Enable Network Virtualization using Generic Routing Encapsulation

Enable Accelerated Receive Flow Steering

Enable Precision Time Protocol

Enable Advanced Filter

Enable Interrupt Scaling

Enable GENEVE Offload

RoCE Settings

Enable RDMA over Converged Ethernet

Queue Pairs	Memory Regions *	Resource Groups
1024	131072	8
1 - 8192	1 - 524288	1 - 128

Version	Class Of Service
Version 2	5

- Click **Add** to save the setting and add the new vNIC.

Note

All the fields with * are mandatory and ensure it is filled out or selected with appropriate policies.

Step 5 Click **Create** to complete the LAN Connectivity policy with RoCE v2 settings.

Step 6 Associate the LAN Connectivity policy to the Server Profile.

Note

For more information, see *Creating a LAN Connectivity Policy* and *Creating an Ethernet Adapter Policy* in Configuring UCS Server Policies and Configuring UCS Server Profiles.

The LAN Connectivity Policy with the Ethernet Adapter policy vNIC setting is successfully created and deployed to enable RoCE v2 configuration.

What to do next

Once the policy configuration for RoCE v2 is complete, configure RoCE v2 for NVMeoF on the Host System.

NENIC Driver Installation

Before you begin

The Ethernet Network Interface Card (eNIC) Remote Direct Memory Access (RDMA) driver requires nenic driver.

Procedure

Step 1 Copy the eNIC vSphere Installation Bundle (VIB) or offline bundle to the ESXi server.

Step 2 Use the command to install nenic driver:

```
esxcli software vib install -v {VIBFILE}
or
esxcli software vib install -d {OFFLINE_BUNDLE}
```

Example:

```
esxcli software vib install -v /tmp/nenic-2.0.4.0-1OEM.700.1.0.15843807.x86_64.vib
```

Note
Depending on the certificate used to sign the VIB, you may need to change the host acceptance level. To do this, use the command:

```
esxcli software acceptance set --level=<level>
```

Depending on the type of VIB installed, you may need to put ESX into maintenance mode. This can be done through the client, or by adding the *--maintenance-mode* option to the above *esxcli*.

What to do next

Configure the Host side for ESXi NVMe RDMA.

ESXi NVMe RDMA Host Side Configuration

NENIC RDMA Functionality

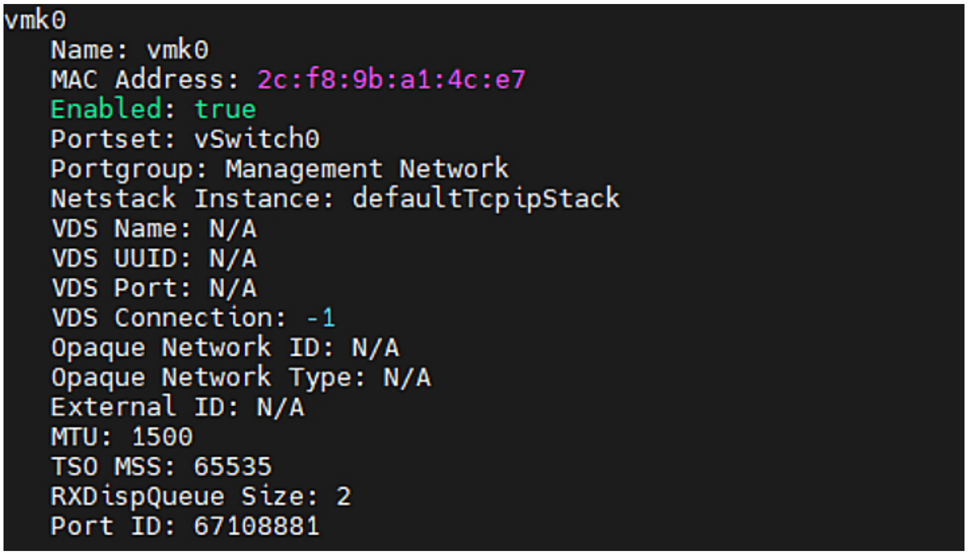
One of the major difference between RDMA on Linux and ESXi is listed below:

- In ESXi, the physical interface (vmnic) MAC is not used for RoCEv2 traffic. Instead, the VMkernel port (vmk) MAC is used.

Outgoing RoCE packets use the vmk MAC in the Ethernet source MAC field, and incoming RoCE packets use the vmk MAC in the Ethernet destination mac field. The vmk MAC address is a VMware MAC address assigned to the vmk interface when it is created.

- In Linux, the physical interface MAC is used in source MAC address field in the ROCE packets. This Linux MAC is usually a Cisco MAC address configured to the VNIC using UCS Manager.

If you ssh into the host and use the **esxcli network ip interface list** command, you can see the MAC address.



```
vmk0
   Name: vmk0
   MAC Address: 2c:f8:9b:a1:4c:e7
   Enabled: true
   Portset: vSwitch0
   Portgroup: Management Network
   Netstack Instance: defaultTcpipStack
   VDS Name: N/A
   VDS UUID: N/A
   VDS Port: N/A
   VDS Connection: -1
   Opaque Network ID: N/A
   Opaque Network Type: N/A
   External ID: N/A
   MTU: 1500
   TSO MSS: 65535
   RXDispQueue Size: 2
   Port ID: 67108881
```

You must create a vSphere Standard Switch to provide network connectivity for hosts, virtual machines, and to handle VMkernel traffic. Depending on the connection type that you want to create, you can create a new vSphere Standard Switch with a VMkernel adapter, only connect physical network adapters to the new switch, or create the switch with a virtual machine port group.

Create Network Connectivity Switches

Use these steps to create a vSphere Standard Switch to provide network connectivity for hosts, virtual machines, and to handle VMkernel traffic.

Before you begin

Ensure you have nenic drivers. Download and install nenic drivers before proceeding with below steps:

Procedure

Step 1 In the vSphere Client, navigate to the host.

Step 2 On the **Configure** tab, expand **Networking** and select **Virtual Switches.**

Step 3 Click on **Add Networking**.

The available network adapter connection types are:

- **Vmkernel Network Adapter**

  Creates a new VMkernel adapter to handle host management traffic

- **Physical Network Adapter**

  Adds physical network adapters to a new or existing standard switch.

- **Virtual Machine Port Group for a Standard Switch**

  Creates a new port group for virtual machine networking.

Step 4 Select connection type **Vmkernel Network Adapter**.

Step 5 Select **New Standard Switch** and click **Next**.

Step 6 Add physical adapters to the new standard switch.

a) Under **Assigned Adapters**, select **New Adapters**.

b) Select one or more adapters from the list and click **OK**. To promote higher throughput and create redundancy, add two or more physical network adapters to the Active list.

c) (Optional) Use the up and down arrow keys to change the position of the adapter in the Assigned Adapters list.

d) Click **Next**.

Step 7 For the new standard switch you just created for the VMadapter or a port group, enter the connection settings for the adapter or port group.

a) Enter a label that represents the traffic type for the VMkernel adapter.

b) Set a VLAN ID to identify the VLAN the VMkernel uses for routing network traffic.

c) Select IPV4 or IPV6 or both.

d) Select an MTU size from the drop-down menu. Select Custom if you wish to enter a specific MTU size. The maximum MTU size is 9000 bytes.

Note

You can enable Jumbo Frames by setting an MTU greater than 1500.

e) After setting the TCP/IP stack for the VMkernel adapter, select a TCP/IP stack.

To use the default TCP/IP stack, select it from the available services.

Note

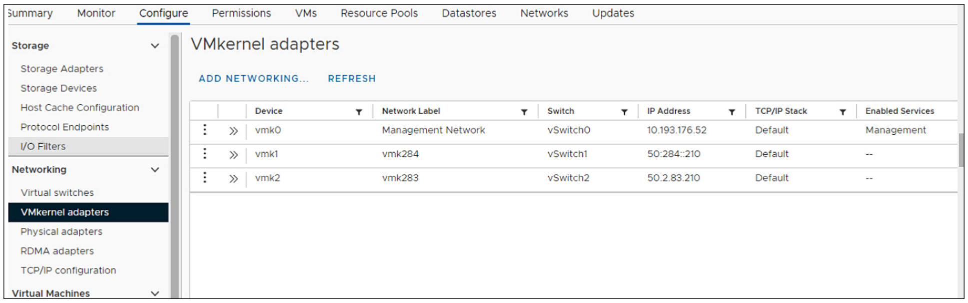
Be aware that the TCP/IP stack for the VMkernel adapter cannot be changed later.

f) Configure IPV4 and/or IPV6 settings.

Step 8 On the **Ready to Complete** page, click **Finish**.

Step 9 Check the VMkernel ports for the VM Adapters or port groups with NVMe RDMA in the vSphere client, as shown in the Results below.

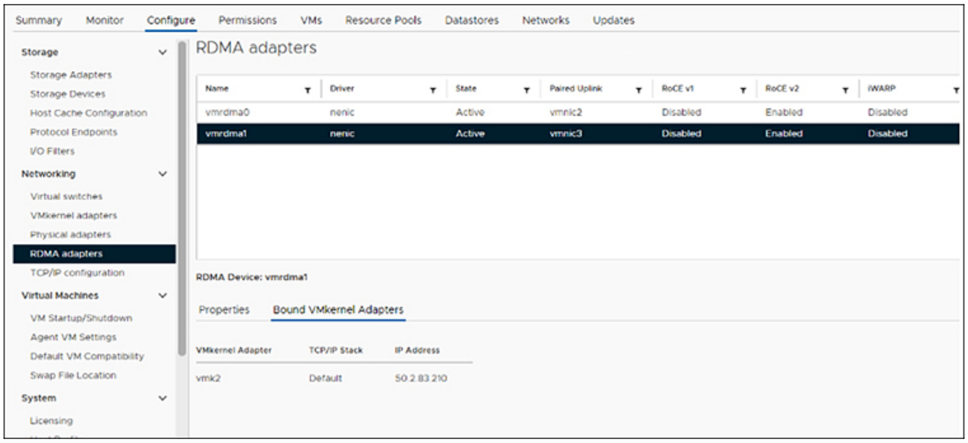
The VMkernel ports for the VM Adapters or port groups with NVMe RDMA are shown below.



VMkernel adapters

Device	Network Label	Switch	IP Address	TCP/IP Stack	Enabled Services
vmk0	Management Network	vSwitch0	10.193.176.52	Default	Management
vmk1	vmk284	vSwitch1	50:284::210	Default	--
vmk2	vmk283	vSwitch2	50.2.83.210	Default	--

The VRDMA Port groups created with NVMeRDMA supported vmnic appear as below.



RDMA adapters

Name	Driver	State	Paired Uplink	RoCE v1	RoCE v2	iWARP
vmrdma0	nenic	Active	vmnic2	Disabled	Enabled	Disabled
vmrdma1	nenic	Active	vmnic3	Disabled	Enabled	Disabled

RDMA Device: vmrdma1

VMkernel Adapter	TCP/IP Stack	IP Address
vmk2	Default	50.2.83.210

What to do next

Create vmhba ports on top of vmrdma ports.

Create VMVHBA Ports in ESXi

Use the following steps for creating vmhba ports on top of the vmrdma adapter ports.

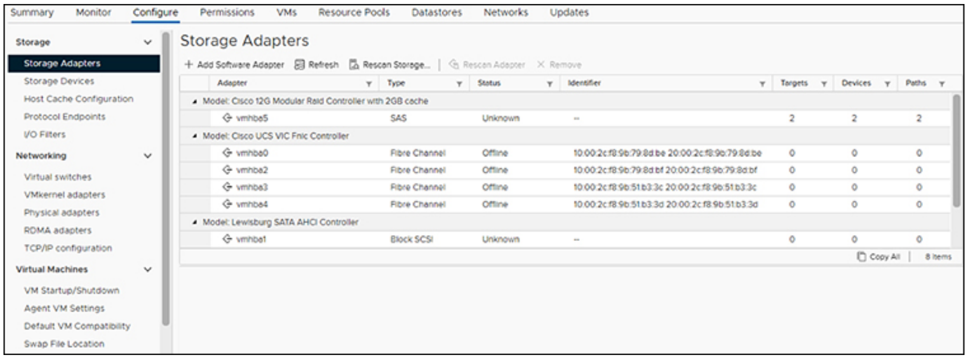
Before you begin

Create the adapter ports for storage connectivity.

Procedure

Step 1 Go to vCenter where your ESXi host is connected.

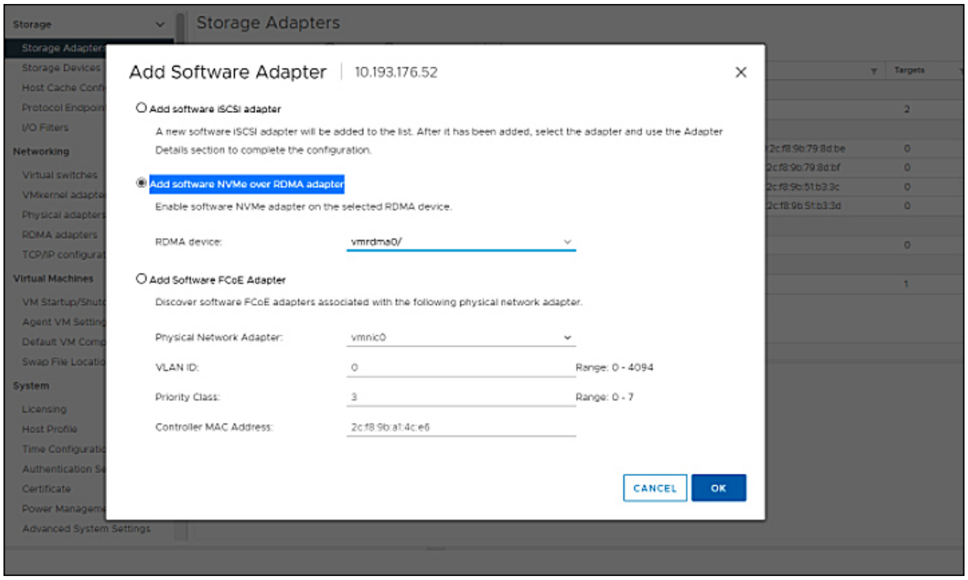
Step 2 Click on **Host>Configure>Storage adapters**.



Storage Adapters

Adapter	Type	Status	Identifier	Targets	Devices	Paths
Model: Cisco 12G Modular Raid Controller with 2GB cache						
vmhba5	SAS	Unknown	--	2	2	2
Model: Cisco UCS VIC Fnic Controller						
vmhba0	Fibre Channel	Offline	10:00:2c:f8:9b:79:8d:be 20:00:2c:f8:9b:79:8d:be	0	0	0
vmhba2	Fibre Channel	Offline	10:00:2c:f8:9b:79:8d:bf 20:00:2c:f8:9b:79:8d:bf	0	0	0
vmhba3	Fibre Channel	Offline	10:00:2c:f8:9b:51:b3:3c 20:00:2c:f8:9b:51:b3:3c	0	0	0
vmhba4	Fibre Channel	Offline	10:00:2c:f8:9b:51:b3:3d 20:00:2c:f8:9b:51:b3:3d	0	0	0
Model: Lewisburg SATA AHCI Controller						
vmhba1	Block SCSI	Unknown	--	0	0	0

Step 3 Click **+Add Software Adapter**. The following dialog box will appear.



Add Software Adapter | 10.193.176.52

○ Add software iSCSI adapter

A new software iSCSI adapter will be added to the list. After it has been added, select the adapter and use the Adapter Details section to complete the configuration.

● Add software NVMe over RDMA adapter

Enable software NVMe adapter on the selected RDMA device.

RDMA device: vmrdma0/

○ Add Software FCoE Adapter

Discover software FCoE adapters associated with the following physical network adapter.

Physical Network Adapter: vmnic0

VLAN ID: 0 Range: 0 - 4094

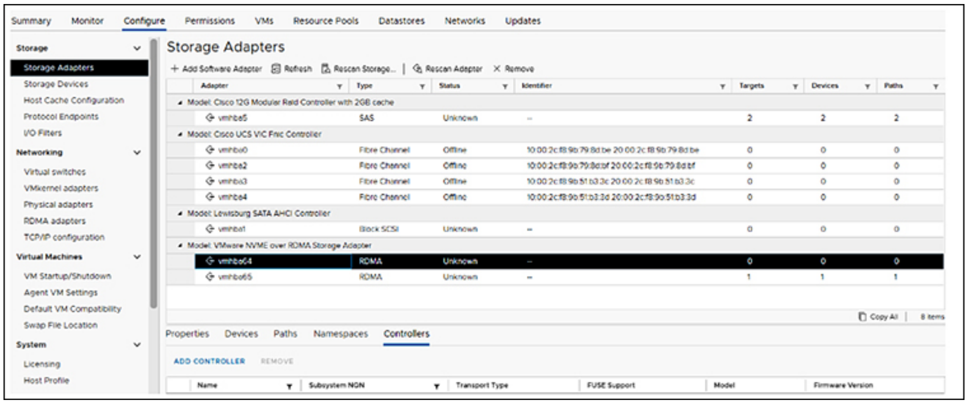
Priority Class: 3 Range: 0 - 7

Controller MAC Address: 2c:f8:9b:a1:4c:e6

Step 4 Select **Add software NVMe over RDMA adapter** and the vmrdma port you want to use.

Step 5 Click **OK**

The vmhba ports for the VMware NVMe over RDMA storage adapter will be shown as in the example below



Storage Adapters

Adapter	Type	Status	Identifier	Targets	Devices	Paths
Model: Cisco 12G Modular Raid Controller with 2GB cache						
vmhba5	SAS	Unknown	--	2	2	2
Model: Cisco UCS VIC Fnic Controller						
vmhba0	Fibre Channel	Offline	10:00:2c:f8:9b:79:8d:be 20:00:2c:f8:9b:79:8d:be	0	0	0
vmhba2	Fibre Channel	Offline	10:00:2c:f8:9b:79:8d:bf 20:00:2c:f8:9b:79:8d:bf	0	0	0
vmhba3	Fibre Channel	Offline	10:00:2c:f8:9b:51:b3:3c 20:00:2c:f8:9b:51:b3:3c	0	0	0
vmhba4	Fibre Channel	Offline	10:00:2c:f8:9b:51:b3:3d 20:00:2c:f8:9b:51:b3:3d	0	0	0
Model: Lewisburg SATA AHCI Controller						
vmhba1	Block SCSI	Unknown	--	0	0	0
Model: VMware NVME over RDMA Storage Adapter						
vmhba64	RDMA	Unknown	--	0	0	0
vmhba65	RDMA	Unknown	--	1	1	1

Name	Subsystem NQN	Transport Type	FUSE Support	Model	Firmware Version

Displaying vmnic and vmrdma Interfaces

ESXi creates a vmnic interface for each nenic VNIC configured to the host.

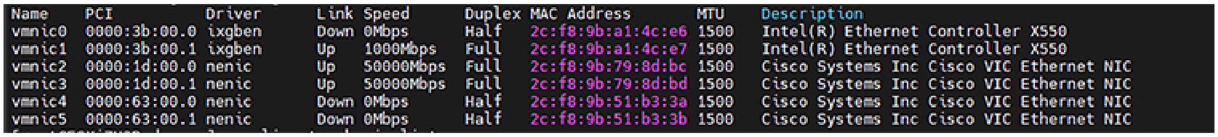
Before you begin

Create Network Adapters and VHBA ports.

Procedure

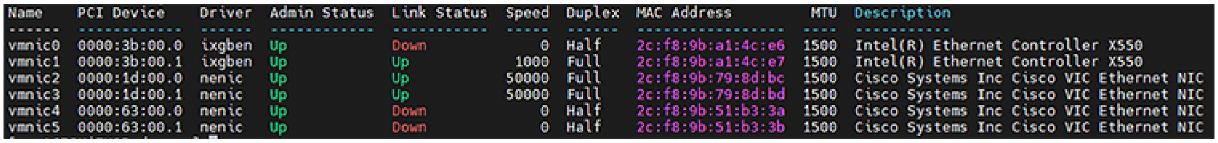
Step 1 Use **ssh** to access the host system.

Step 2 Enter **esxcfg-nics -l** to list the vmnics on ESXi.



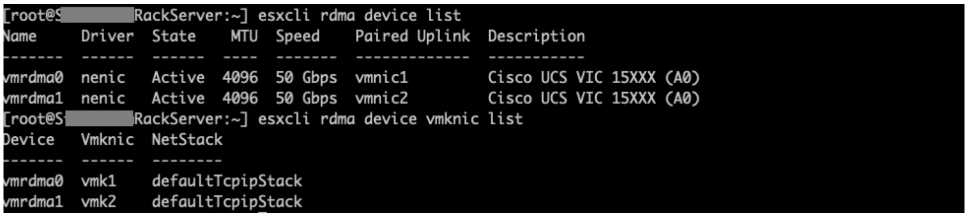
```
Name     PCI            Driver      Link Speed      Duplex MAC Address       MTU    Description
vmnic0   0000:3b:00.0 ixgben      Down 0Mbps      Half   2c:f8:9b:a1:4c:e6 1500   Intel(R) Ethernet Controller X550
vmnic1   0000:3b:00.1 ixgben      Up   1000Mbps   Full   2c:f8:9b:a1:4c:e7 1500   Intel(R) Ethernet Controller X550
vmnic2   0000:1d:00.0 nenic       Up   50000Mbps  Full   2c:f8:9b:79:8d:bc 1500   Cisco Systems Inc Cisco VIC Ethernet NIC
vmnic3   0000:1d:00.1 nenic       Up   50000Mbps  Full   2c:f8:9b:79:8d:bd 1500   Cisco Systems Inc Cisco VIC Ethernet NIC
vmnic4   0000:63:00.0 nenic       Down 0Mbps      Half   2c:f8:9b:51:b3:3a 1500   Cisco Systems Inc Cisco VIC Ethernet NIC
vmnic5   0000:63:00.1 nenic       Down 0Mbps      Half   2c:f8:9b:51:b3:3b 1500   Cisco Systems Inc Cisco VIC Ethernet NIC
```

esxcli network nic list



```
Name    PCI Device    Driver  Admin Status  Link Status  Speed  Duplex  MAC Address        MTU   Description
------  ------------  ------  ------------  -----------  -----  ------  -----------------  ----  -----------
vmnic0  0000:3b:00.0  ixgben  Up            Down             0  Half    2c:f8:9b:a1:4c:e6  1500  Intel(R) Ethernet Controller X550
vmnic1  0000:3b:00.1  ixgben  Up            Up            1000  Full    2c:f8:9b:a1:4c:e7  1500  Intel(R) Ethernet Controller X550
vmnic2  0000:1d:00.0  nenic   Up            Up           50000  Full    2c:f8:9b:79:8d:bc  1500  Cisco Systems Inc Cisco VIC Ethernet NIC
vmnic3  0000:1d:00.1  nenic   Up            Up           50000  Full    2c:f8:9b:79:8d:bd  1500  Cisco Systems Inc Cisco VIC Ethernet NIC
vmnic4  0000:63:00.0  nenic   Up            Down             0  Half    2c:f8:9b:51:b3:3a  1500  Cisco Systems Inc Cisco VIC Ethernet NIC
vmnic5  0000:63:00.1  nenic   Up            Down             0  Half    2c:f8:9b:51:b3:3b  1500  Cisco Systems Inc Cisco VIC Ethernet NIC
```

Step 3 Use **esxcli rdma device list** to list the vmrdma devices. When the enic driver registers with ESXi the RDMA device for a RDMA capable VNIC, ESXi creates a vmrdma device and links it to the corresponding vmnic.

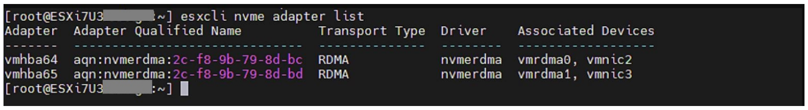


```
[root@S[redacted]RackServer:~] esxcli rdma device list
Name     Driver  State    MTU   Speed    Paired Uplink  Description
-------  ------  ------   ----  -------  -------------  -----------
vmrdma0  nenic   Active   4096  50 Gbps  vmnic1         Cisco UCS VIC 15XXX (A0)
vmrdma1  nenic   Active   4096  50 Gbps  vmnic2         Cisco UCS VIC 15XXX (A0)
[root@S[redacted]RackServer:~] esxcli rdma device vmknic list
Device   Vmknic  NetStack
-------  ------  --------
vmrdma0  vmk1    defaultTcpipStack
vmrdma1  vmk2    defaultTcpipStack
```

Step 4 Use **esxcli rdma device protocol list** to check the protocols supported by the vmrdma interface.

For enic, RoCE v2 is the only protocol supported from this list. The output of this command should match the RoCEv2 configuration on the VNIC.

Step 5 Use **esxcli nvme adapter list** to list the NVMe adapters and the vmrdma and vmnic interfaces it is configured on.



```
[root@ESXi7U3[redacted]~] esxcli nvme adapter list
Adapter  Adapter Qualified Name         Transport Type  Driver    Associated Devices
-------  -----------------------------  --------------  --------  ------------------
vmhba64  aqn:nvmerdma:2c-f8-9b-79-8d-bc  RDMA            nvmerdma  vmrdma0, vmnic2
vmhba65  aqn:nvmerdma:2c-f8-9b-79-8d-bd  RDMA            nvmerdma  vmrdma1, vmnic3
[root@ESXi7U3[redacted]:~]
```

Step 6 All vmhbas in the system can be listed using **esxcli storage core adapter list**. The vmhba configured over RDMA.

Note
For vmhba64 and vmhba65, you may observe that the driver's Link State displays *link-n/a* instead of *Online*. This is a known issue in ESXi 7.0 Update 3. For more information, see Known Issues - ESXi.

NVMe Fabrics and Namespace Discovery

This process is performed through the ESXi command line interface.

Before you begin

Create and configure the Ethernet Adapter Policy.

Procedure

Step 1 Check and enable Nonvolatile Memory Express (NVMe) on the vmrdma device. If NVMe is enabled, the system returns the following message.

Example:

```
esxcli nvme fabrics enable -p RDMA -d vmrdma0
```

Step 2 Discover the NVMe on the array by entering the following command.

```
esxcli nvme fabrics discover -a vmhba64 -l transport_address figure with esxcli nvme fabrics discover
 -a vmhba64 -l 50.2.84.100
```

The NVMe controller displays the output that include Transport Type, Address Family, Subsystem Type, Controller ID, Admin Queue, Max Size, Transport Address, Transport Service ID, and Subsystem NQN.

You will see output on the NVMe controller.

Step 3 Perform NVMe fabric interconnect.

```
esxcli nvme fabrics discover -a vmhba64 -l transport_address p Transport Service
ID -s Subsystem NQN
```

Step 4 The NVMe controller displays a list of the controllers connected to NVMe. The NVMe namespace list should shows all the NVMe drivers discovered.

```
esxcli nvme fabrics discover -a vmhba64 -l transport_address p Transport Service
ID -s Subsystem NQN
```

The following example shows esxcli discovery commands executed on the server.

Example:

```
[root@ESXiUCSA:~] esxcli nvme fabrics enable -p RDMA -d vmrdma0
NVMe already enabled on vmrdma0 [root@ESXiUCSA:~] esxcli nvme fabrics discover -a vmhba64 -l 50.2.84.100
Transport Type Address Family Subsystem Type Controller ID Admin Queue Max Size Transport
Address Transport Service ID Subsystem NQN
-------------- -------------- -------------- ------------- --------------------
----------------- -------------------- -------------
RDMA IPV4 NVM 65535 31 50.2.84.100
4420 nq.210-06.com.purestorage:flasharray:2dp1239anjkl484
[root@ESXiUCSA:~] esxcli nvme fabrics discover -a vmhba64 -l 50.2.84.100 p 4420 -s
nq.210-06.com.purestorage:flasharray:2dp1239anjkl484
Controller already connected
```

Deleting the RoCE v2 Interface in Cisco Intersight

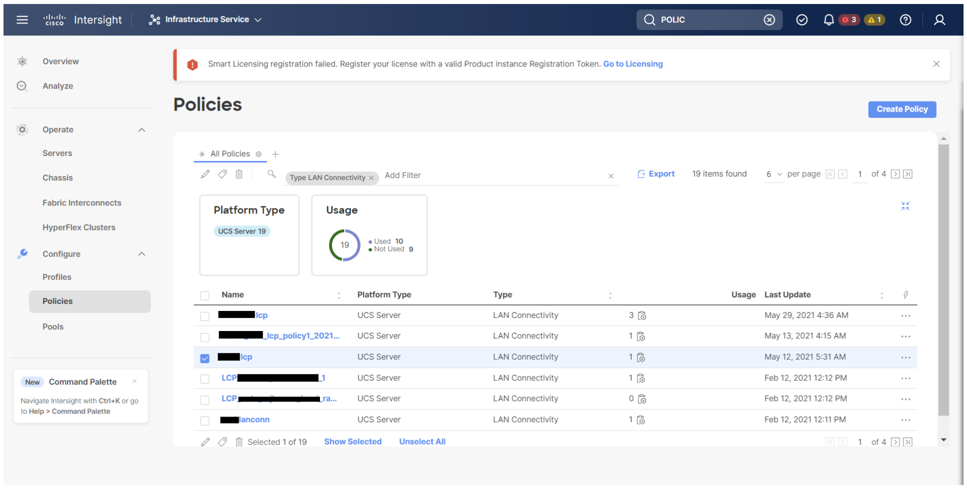
Use these steps to remove the RoCE v2 interface.

Procedure

Step 1 Navigate to **CONFIGURE > Policies**. In the **Add Filter** field, select **Type: LAN Connectivity**.

Step 2 Select the appropriate LAN Connectivity policy created for RoCE V2 configuration and use the delete icon on the top or bottom of the policy list.

Step 3 Click **Delete** to delete the policy.



Smart Licensing registration failed. Register your license with a valid Product instance Registration Token. Go to Licensing

	Name	Platform Type	Type	Usage	Last Update
□	[redacted]lcp	UCS Server	LAN Connectivity	3	May 29, 2021 4:36 AM
□	[redacted]_lcp_policy1_2021...	UCS Server	LAN Connectivity	1	May 13, 2021 4:15 AM
☑	[redacted]lcp	UCS Server	LAN Connectivity	1	May 12, 2021 5:31 AM
□	LCP[redacted]_1	UCS Server	LAN Connectivity	1	Feb 12, 2021 12:12 PM
□	LCP[redacted]_ra...	UCS Server	LAN Connectivity	0	Feb 12, 2021 12:12 PM
□	[redacted]lanconn	UCS Server	LAN Connectivity	1	Feb 12, 2021 12:11 PM

Step 4 Upon deleting the RoCE v2 configuration, re-deploy the server profile and reboot the server.

Known Issues

Windows

Symptom	Conditions	Workaround
On VIC 1400 Series adapters, the neNIC driver for Windows 2019 can be installed on Windows 2016 and the Windows 2016 driver can be installed on Windows 2019. However, this is an unsupported configuration.	Case 1 : Installing Windows 2019 nenic driver on Windows 2016 succeeds-but on Windows 2016 RDMA is not supported. Case 2 : Installing Windows 2016 nenic driver on Windows 2019 succeeds-but on Windows 2019 RDMA comes with default disabled state, instead of enabled state.	The driver binaries for Windows 2016 and Windows 2019 are in folders that are named accordingly. Install the correct binary on the platform that is being built/upgraded.

Linux

Symptom	Conditions	Workaround

When sending high bandwidth NVMe traffic on some Cisco Nexus 9000 switches, the switch port that connected to the storage sometimes reaches the max PFC peak and does not automatically clear the buffers. In Nexus 9000 switches, the nxos command "**`show hardware internal buffer info pkt-stats input peak`**" shows that the `Peak_cell` or `PeakQos` value for the port reaches more than 1000.	The NVMe traffic will drop.	To recover the switch from this error mode.
		1. Log into the switch.
		2. Locate the port that connected to the storage and shut down the port using "shutdown" command
		3. Execute the following commands one by one:
		`# clear counters`
		`# clear counter buffers module 1`
		`# clear qos statistics`
		4. Run **`no shutdown`** on the port that was shut down.

ESXi

Symptom	Conditions	Workaround
When using the command **esxcli storage core adapter list** to list the vmhba, the Driver's Link State for vmhba64 and vmhba65 rdma ports displays *Link-n/a* instead of *Online*. **Note** VMware Developer Center Partner Network (DCPN) Case ID - 00113157	This is a known issue in ESXi 7.0 Update 3.	None