Mellanox WinOF VPI User Manual

Rev 4.60

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Document Revision History

Table 1 - Document Revision History

Document Revision	Date	Changes
Rev 4.60	March 16, 2014	Removed ConnectX®-2 from Section 4.2, "Hardware and Software Prerequisites", on page 39.
	February 13, 2014	Updated the following sections: • Section 3.1, "Hyper-V with VMQ", on page 17 • Section 3.8.1, "Enabling/Disabling NVGRE Offloading", on page 34 Added the following sections: • Section 3.8.3, "Verifying the Encapsulation of the Traffic", on page 36
	December 30, 2013	Updated the following sections: • Section 3.7.2.2, "Configuring Windows Host", on page 31 - Updated the example in Step 5 • Section 6.1.4.1, "Performance Tuning Tool Application", on page 48 - Updated the Options table • Section 6.2, "Application Specific Optimization and Tuning", on page 51 - Removed the "Bus-master DMA Operations" • Section 7, "OpenSM - Subnet Manager", on page 61 - Added an option of how to register OpemSM via the PowerShell • Section 3.8.2, "Configuring the NVGRE using PowerShell", on page 35 Added the following sections: • Section 5.3, "Configuring Quality of Service (QoS)", on page 44 • Appendix B: "NVGRE Configuration Scrips Examples," on page 133
Rev 4.55	December 15, 2013	Updated the following sections: • Section 3.8, "Network Virtualization using Generic Routing Encapsulation", on page 33 • Section 3.8.2, "Configuring the NVGRE using PowerShell", on page 35
	November 07, 2013	Updated the following sections: • Section 3.7.2.2, "Configuring Windows Host", on page 31 • Section 8.4.19.1, "NTttcp Synopsys", on page 123
	October 03, 2013	Added support for Windows Server 2012 R2

Table 1 - Document Revision History

Document Revision	Date	Changes
Rev 4.40	July 17, 2013	Updated the following sections: • Section 3.7.1, "RoCE Overview", on page 30 • Section 7, "OpenSM - Subnet Manager", on page 61 • Section 8.4.19, "NTttcp", on page 122 • Section 10, "Troubleshooting", on page 125 Added Appendix A: "Windows MPI (MS-MPI)," on page 130
	June 10, 2013	Updated the following sections: • Section 2.2, "Downloading Mellanox Firmware Tools", on page 14 • Section 8, "InfiniBand Fabric", on page 62 • Section 10, "Troubleshooting", on page 125 • Section 11, "Documentation", on page 129 • Section , "Options", on page 49 Added the following sections: • "perf_tuning"Appendix ,"Synopsys," on page 49 • Section 2.3.1, "Upgrading Firmware Manually", on page 16 • Section 3.7.2, "RoCE Configuration", on page 30 • Section 6.4, "Adapter Proprietary Performance Counters", on page 55
Rev 4.2	October 20, 2012	Added the following sections: • Section 4, "Deploying Windows Server 2012 and Above with SMB Direct", on page 39, and its subsections • Section 3.2, "Header Data Split", on page 18 • Section 8.2, "part_man - Virtual IPoIB Port Creation Utility", on page 62 Updated Section 6, "Performance Tuning", on page 46
Rev 3.2.0	July 23, 2012	• No changes
Rev 3.1.0	May 21, 2012	• Added section Tuning the IPoIB Network Adapter • Added section Tuning the Ethernet Network Adapter • Added section Performance tuning tool application • Removed section Tuning the Network Adapter • Removed section part_man • Removed section ibdiagnet

Table 1 - Document Revision History

Document Revision	Date	Changes
Rev 3.0.0	February 08, 2012	• Added section RDMA over Converged Ethernet (RoCE) and its subsections • Added section Hyper-V with VMQ • Added section Network Driver Interface Specification (NDIS) • Added section Header Data Split • Added section Auto Sensing • Added section Adapter Teaming • Added section Port Protocol Configuration • Added section Advanced Configuration for InfiniBand Driver • Added section Advanced Configuration for Ethernet Driver • Added section Updated section Tunable Performance Parameters • Added section Merged Ethernet and InfiniBand features sections • Removed section Sockets Direct Protocol and its subsections • Removed section Winsock Direct and Protocol and its subsections • Removed section Added ConnectX®-3 support • Removed section IPoIB Drivers Overview • Removed section Booting Windows from an iSCSI Target
Rev 2.1.3	January 28. 2011	Complete restructure
Rev 2.1.2	October 10, 2010	• Removed section Debug Options. • Updated Section 3, “Uninstalling Mellanox VPI Driver,” on page 11 • Added Section 6, “InfiniBand Fabric,” on page 38 and its subsections • Added Section 6.3, “InfiniBand Fabric Performance Utilities,” on page 71 and its subsections
Rev 2.1.1.1	July 14, 2010	Removed all references of InfiniHost® adapter since it is not supported starting with WinOF VPI v2.1.1
Rev 2.1.1	May 2010	First release

About this Manual

Scope

The document describes WinOF Rev 4.60 features, performance, InfiniBand diagnostic, tools content and configuration. Additionally, this document provides information on various performance tools supplied with this version.

Intended Audience

This manual is intended for system administrators responsible for the installation, configuration, management and maintenance of the software and hardware of VPI (InfiniBand, Ethernet) adapter cards. It is also intended for application developers.

Documentation Conventions

Table 2 - Documentation Conventions

Description	Convention	Example
File names	file.extension	
Directory names	directory	
Commands and their parameters	command param1	mts3610-1 > show hosts
Required item	< >	
Optional item	[ ]	
Mutually exclusive parameters	{ p1, p2, p3 } or {p1 | p2 | p3}	
Optional mutually exclusive parameters	[p1 | p2 | p3]	
Variables for which users supply specific values	Italic font	*enable*
Emphasized words	Italic font	*These are emphasized words*
Note	 <text>	 This is a note..
Warning	 <text>	 May result in system instability.

Common Abbreviations and Acronyms

Table 3 - Abbreviations and Acronyms

Abbreviation / Acronym	Whole Word / Description
B	(Capital) 'B' is used to indicate size in bytes or multiples of bytes (e.g., 1KB = 1024 bytes, and 1MB = 1048576 bytes)
b	(Small) 'b' is used to indicate size in bits or multiples of bits (e.g., 1Kb = 1024 bits)
FW	Firmware
HCA	Host Channel Adapter
HW	Hardware
IB	InfiniBand
LSB	Least significant *byte*
lsb	Least significant *bit*
MSB	Most significant *byte*
msb	Most significant bit
NIC	Network Interface Card
SW	Software
VPI	Virtual Protocol Interconnect
IPoIB	IP over InfiniBand
PFC	Priority Flow Control
PR	Path Record
RDS	Reliable Datagram Sockets
RoCE	RDMA over Converged Ethernet
SL	Service Level
MPI	Message Passing Interface
EoIB	Ethernet over InfiniBand
QoS	Quality of Service
ULP	Upper Level Protocol
VL	Virtual Lane

Related Documents

Table 4 - Related Documents

Document	Description
MFT User Manual	Describes the set of firmware management tools for a single InfiniBand node. MFT can be used for: • Generating a standard or customized Mellanox firmware image Querying for firmware information • Burning a firmware image to a single InfiniBand node
WinOF Release Notes	For possible software issues, please refer to WinOF Release Notes.
SwitchX® User Manual	This document contains information regarding configuring and managing Mellanox Technologies SwitchX® switch platforms listing all of the commands available through MLNX-OS with explanations and examples.

1 Introduction

This User Manual addresses the Mellanox WinOF driver Rev 4.60 package.

Mellanox WinOF is composed of several software modules that contain an InfiniBand and Ethernet driver. The Mellanox WinOF driver supports 10 or 40 Gb/s Ethernet, and 40 or 56 Gb/s InfiniBand network ports. The port type is determined upon boot based on card capabilities and user settings.

2 Firmware Upgrade

The adapter card may not have been shipped with the latest firmware version. The section below describes how to update firmware.

2.1 Downloading Firmware

➢ ***To identify your adapter card, perform the following steps:***

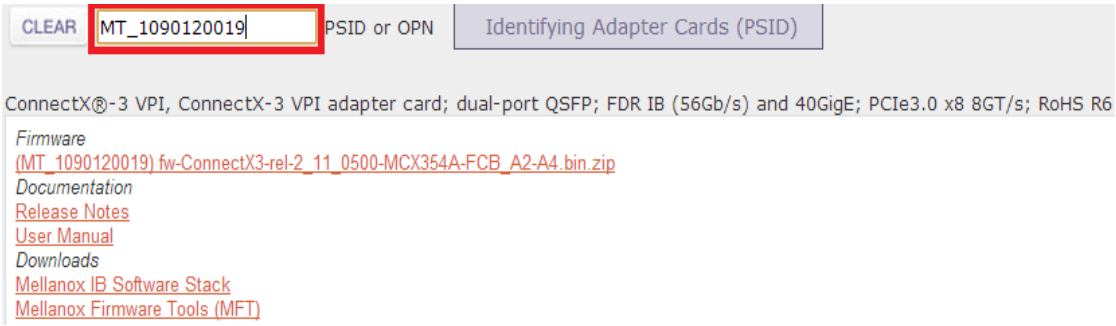
Step 1. Extract the HCA PSID. Run "`vstat`".

```
PS C:\> vstat.exe

        hca_idx=0
        uplink={BUS=PCI_E Gen1, SPEED=2.5 Gbps, WIDTH=x8, CAPS=8.0*x8}
        MSI-X={ENABLED=1, SUPPORTED=128, GRANTED=10, ALL_MASKED=N}
        vendor_id=0x02c9
        vendor_part_id=4099
        hw_ver=0x0
        fw_ver=2.30.1540
        PSID=MT_1090120019
        node_guid=0002:c903:0045:5fd0
        num_phys_ports=2
                port=1
                port_guid=0202:c9ff:fe45:5fd0
                port_state=PORT_DOWN (1)
                link_speed=NA
                link_width=NA
                rate=NA
                port_phys_state=DISABLED (3)
                active_speed=0.00 Gbps
                sm_lid=0x0000
                port_lid=0x0000
                port_lmc=0x0
                transport=RRoCE
                max_mtu=2048 (4)
                active_mtu=256 (1)
                GID[0]=0000:0000:0000:0000:0000:ffff:0707:0701
                GID[1]=fe80:0000:0000:0000:45a4:790c:48d0:6071
```

Step 2. Download the latest firmware using the PSID from the step above.

Go to: http://www.mellanox.com > Support > Support Downloader,



Step 3. Unzip the binary image (.zip file).

2.2 Downloading Mellanox Firmware Tools

Step 1. Download Mellanox Firmware Tools

Go to: http://www.mellanox.com > Products > Firmware Tools.

The tools' package to download is "MFT Software for Windows_x64" for x64 architecture.

Step 2. Install and Run WinMFT.

To install the WinMFT package, double click the MSI package or run it from the command prompt.

Installing the WinMFT package from the command line requires administrator privileges.

Example:

```
PS $ msiexec.exe /i WinMFT_x64_3_0_0_17.msi
```

➢ ***To check the device status:***

Step 1. Start/Stop mst.

```
PS $ mst start
OR
PS $ mst stop
```

Step 2. Check the device's status.

```
PS $ mst status
```

If no installation problems occur, the status command should produce the following output:

```
PS $ mt4099_pciconf0
PS $ mt4099_pci_cr0
```

2.3 Upgrading Firmware

Firmware can be upgraded either manually or automatically as described in the sections below.

2.3.1 Upgrading Firmware Manually

➢ ***To upgrade firmware manually:***

Step 1. Burn the firmware image.

```
PS $ flint -d mt<device id>_pci_cr0 -i <image_name.bin> burn
```

Example:

```
PS $ flint -d mt4099_pci_cr0 -i fw-ConnectX3-rel-2_11_0500-MCX354A-FCA_A1.bin burn
```

Step 2. Reboot the server.

For additional details, please check the MFT user manual under:

http://www.mellanox.com > Products > Firmware Tools

3 Driver Features

The Mellanox VPI WinOF driver release introduces the following capabilities:

- Support for Single and Dual port Adapters
- Up to 16 Rx queues per port
- Rx steering mode (RSS)
- Hardware Tx/Rx checksum calculation
- Large Send off-load (i.e., TCP Segmentation Off-load)
- Hardware multicast filtering
- Adaptive interrupt moderation
- Support for MSI-X interrupts
- Support for Auto-Sensing of Link level protocol

Ethernet Only:

- Hardware VLAN filtering
- Header Data Split
- RDMA over Converged Ethernet (RoCE)
- DSCP over IPv4
- NVGRE hardware off-load in ConnectX®-3 Pro
- Ports TX arbitration/Bandwidth allocation per port

For the complete list of Ethernet and InfiniBand Known Issues and Limitations, WinOF Release Notes (www.mellanox.com -> Products -> InfiniBand/VPI Drivers -> Windows SW/Drivers).

3.1 Hyper-V with VMQ

Mellanox WinOF Rev 4.60 includes a Virtual Machine Queue (VMQ) interface to support Microsoft Hyper-V network performance improvements and security enhancement.

VMQ interface supports:

- Classification of received packets by using the destination MAC address to route the packets to different receive queues
- NIC ability to use DMA to transfer packets directly to a Hyper-V child-partition's shared memory
- Scaling to multiple processors, by processing packets for different virtual machines on different processors.

➢ ***To enable Hyper-V with VMQ using UI:***

Step 1. Open Hyper-V Manager.

Step 2. Right-click the desired Virtual Machine (VM), and left-click Settings in the pop-up menu.

Step 3. In the Settings window, under the relevant network adapter, select “Hardware Acceleration”.

Step 4. Check/uncheck the box “Enable virtual machine queue” to enable/disable VMQ on that specific network adapter.

➢ ***To enable Hyper-V with VMQ using PowerShell:***

Step 1. Enable VMQ on a specific VM: Set-VMNetworkAdapter <VM Name> -VmqWeight 100

Step 2. Disable VMQ on a specific VM: Set-VMNetworkAdapter <VM Name> -VmqWeight 0

3.2 Header Data Split

The header-data split feature improves network performance by splitting the headers and data in received Ethernet frames into separate buffers. The feature is disabled by default and can be enabled in the Advanced tab (Performance Options) from the Properties window.

For further information, please refer to the MSDN library:

http://msdn.microsoft.com/en-us/library/windows/hardware/ff553723(v=VS.85).aspx

3.3 Receive Side Scaling (RSS)

Mellanox WinOF Rev 4.60 IPoIB and Ethernet drivers use NDIS 6.30 new RSS capabilities. The main changes are:

- Removed the previous limitation of 64 CPU cores
- Individual network adapter RSS configuration usage

➢ ***RSS capabilities can be set per individual adapters as well as globally. To do so, set the registry keys listed below:***

Table 5 - Registry Keys Setting

Sub-key	Description
HKLM\SYSTEM\CurrentControlSet\Control\Class\{4d36e972-e325-11ce-bfc1-08002be10318}\<nn>*MaxRSSProcessors	**Maximum number of CPUs allotted.** Sets the desired maximum number of processors for each interface. The number can be different for each interface. Note: Restart the network adapter after you change this registry key.
HKLM\SYSTEM\CurrentControlSet\Control\Class\{4d36e972-e325-11ce-bfc1-08002be10318}\<nn>*RssBaseProcNumber	**Base CPU number.** Sets the desired base CPU number for each interface. The number can be different for each interface. This allows partitioning of CPUs across network adapters. Note: Restart the network adapter when you change this registry key.
HKLM\SYSTEM\CurrentControlSet\Control\Class\{4d36e972-e325-11ce-bfc1-08002be10318}\<nn>*NumaNodeID	**NUMA node affinitization**
HKLM\SYSTEM\CurrentControlSet\Control\Class\{4d36e972-e325-11ce-bfc1-08002be10318}\<nn>*RssBaseProcGroup	Sets the RSS base processor group for systems with more than 64 processors.

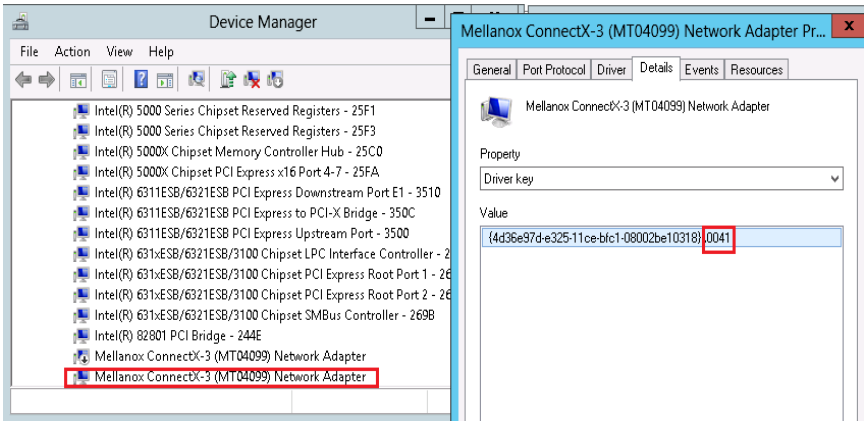
➢ ***To find the nn value of your HCA from the Device Manager please perform the following steps:***

Step 1. Open Device Manager, and go to System devices.

Step 2. Right click -> properties on Mellanox -ConnectX® card.

Step 3. Go to Details tab.

Step 4. Select the Driver key, and obtain the nn number.



3.4 Port Configuration

After WinOF OFED VPI installation, it is possible to modify the network protocol that runs on each port of VPI adapter cards. Each port can be set to run as InfiniBand, Ethernet or Auto Sensing.

3.4.1 Auto Sensing

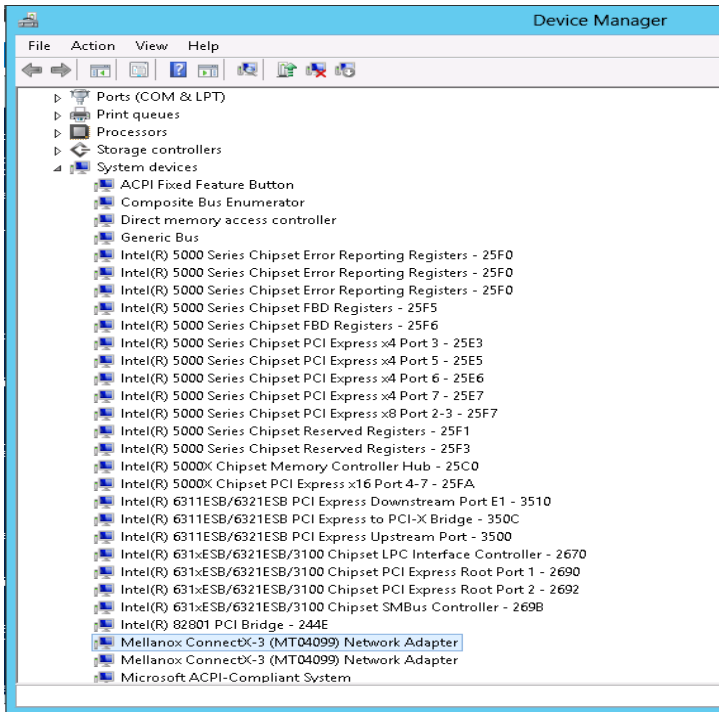
Auto Sensing enables the NIC to automatically sense the link type (InfiniBand or Ethernet) based on the cable connected to the port and load the appropriate driver stack (InfiniBand or Ethernet).

Auto Sensing is performed only when rebooting the machine or after disabling/enabling the mlx4_bus interface from the Device Manager. Hence, if you replace cables during the runtime, the NIC will not perform Auto Sensing.

For further information on how to configure it, please refer to Section 3.4.2, “Port Protocol Configuration”, on page 20.

3.4.2 Port Protocol Configuration

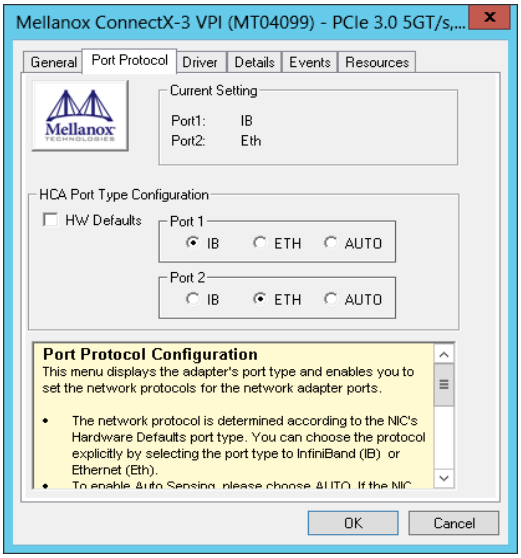
Step 1. Display the Device Manager and expand “System devices”.



Step 2. Right-click on the Mellanox ConnectX Ethernet network adapter and left-click Properties. Select the Port Protocol tab from the Properties window.

The “Port Protocol” tab is displayed only if the NIC is a VPI (IB and ETH).

The figure below is an example of the displayed Port Protocol window for a dual port VPI adapter card.



Step 3. In this step, you can perform the following functions:

- If you choose the HW Defaults option, the port protocols will be determined according to the NIC's hardware default values.
- Choose the desired port protocol for the available port(s). If you choose IB or ETH, both ends of the connection must be of the same type (IB or ETH).
- Enable Auto Sensing by checking the AUTO checkbox. If the NIC does not support Auto Sensing, the AUTO option will be grayed out.

If you choose AUTO, the current setting will indicate the actual port settings: IB or ETH.

3.5 Load Balancing, Fail-Over (LBFO) and VLAN

Windows Server 2012 and above supports load balancing as part of the operating system. Please refer to Microsoft guide "NIC Teaming in Windows Server 2012" following the link below:

http://social.technet.microsoft.com/wiki/contents/articles/14951.nic-teaming-in-windows-server-2012.aspx

For other earlier operating systems, please refer to the sections below.

3.5.1 Adapter Teaming

Adapter teaming can group a group of ports inside a network adapter or a number of physical network adapters into virtual adapters that provide the fault-tolerance and load-balancing functions. Depending on the teaming mode, one or more interfaces can be active. The non-active interfaces in a team are in a standby mode and will take over the network traffic in the event of a link failure in the active interfaces. All of the active interfaces in a team participate in load-balancing operations by sending and receiving a portion of the total network traffic.

3.5.1.1 Teaming (Bundle) Modes

1. **Fault Tolerance**
   Provides automatic redundancy for the server's network connection. If the primary adapter fails, the secondary adapter (currently in a standby mode) takes over. Fault Tolerance is the basis for each of the following teaming types and is inherent in all teaming modes.
2. **Switch Fault Tolerance**
   Provides a failover relationship between two adapters when each adapter is connected to a separate switch.
3. **Send Load Balancing**
   Provides load balancing of transmit traffic and fault tolerance. The load balancing performs only on the send port.
4. **Load Balancing (Send & Receive)**
   Provides load balancing of transmit and receive traffic and fault tolerance. The load balancing splits the transmit and receive traffic statically among the team adapters (without changing the base of the traffic loading) based on the source/destination MAC and IP addresses.

5. **Adaptive Load Balancing**
   The same functionality as Load Balancing (Send & Receive). In case of traffic load in one of the adapters, the load balancing channels the traffic between the other team adapter.
6. **Dynamic Link Aggregation (802.3ad)**
   Provides dynamic link aggregation allowing creation of one or more channel groups using same speed or mixed-speed server adapters.
7. **Static Link Aggregation (802.3ad)**
   Provides increased transmission and reception throughput in a team comprised of two to eight adapter ports through static configuration.

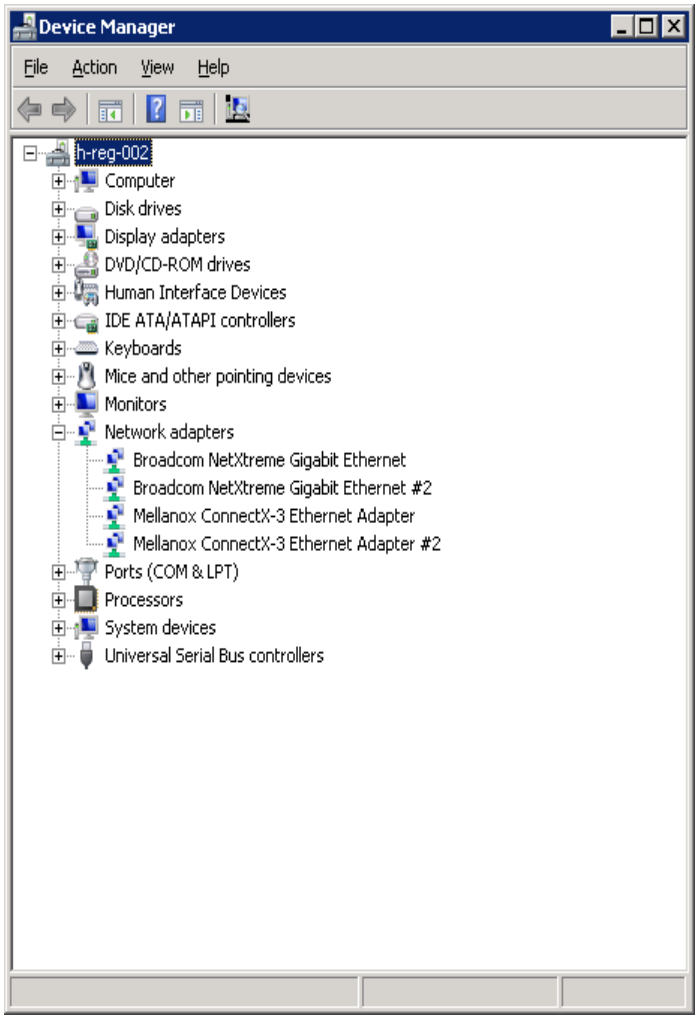
   If the switch connected to the HCA supports 802.3ad the recommended setting is teaming mode 6.

3.5.2 Creating a Load Balancing and Fail-Over (LBFO) Bundle

LBFO is used to balance the workload of packet transfers by distributing the workload over a bundle of network instances and to set a secondary network instance to take over packet indications and information requests if the primary network instance fails.

The following steps describe the process of creating an LBFO bundle.

Step 1. Display the Device Manager.



Step 2. Right-click a Mellanox ConnectX 10Gb Ethernet adapter (under "Network adapters" list) and left click Properties. Select the LBFO tab from the Properties window.

It is not recommended to open the Properties window of more than one adapter simultaneously.

The LBFO dialog enables creating, modifying or removing a bundle.

Only Mellanox Technologies adapters can be part of the LBFO.

➢ ***To create a new bundle, perform the following***

Step 1. Click Create.

Step 2. Enter a (unique) bundle name.

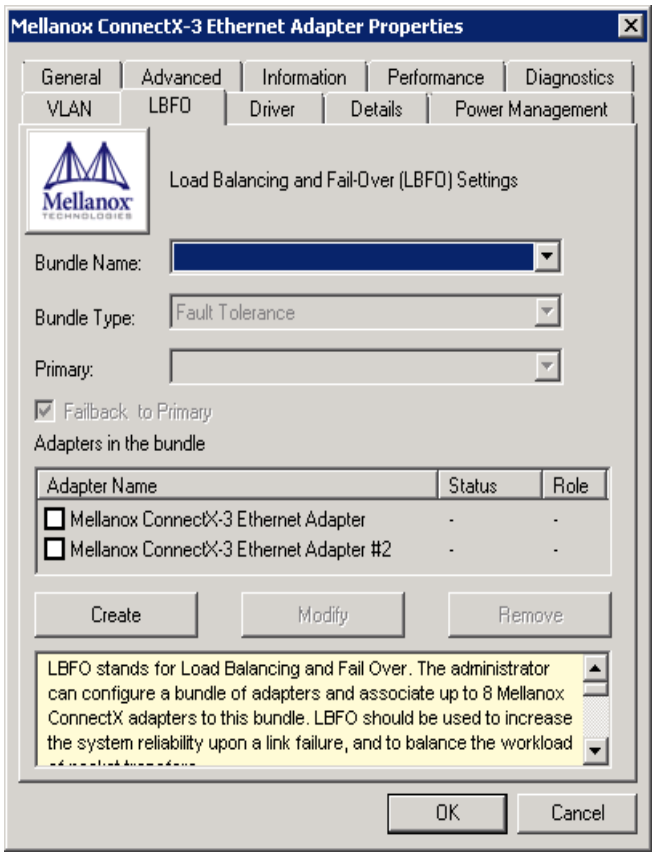
Step 3. Select a bundle type.

Step 4. Select the adapters to be included in the bundle (that have not been associated with a VLAN).

Step 5. [Optional] Select Primary Adapter.
An active-passive scenario used for data transfer of link disconnecting. In such scenario, the system uses one of the other interfaces. When the primary link comes up, the LBFO interface returns to transfer data using the primary interface. If the primary adapter is not selected, the primary interface is selected randomly.

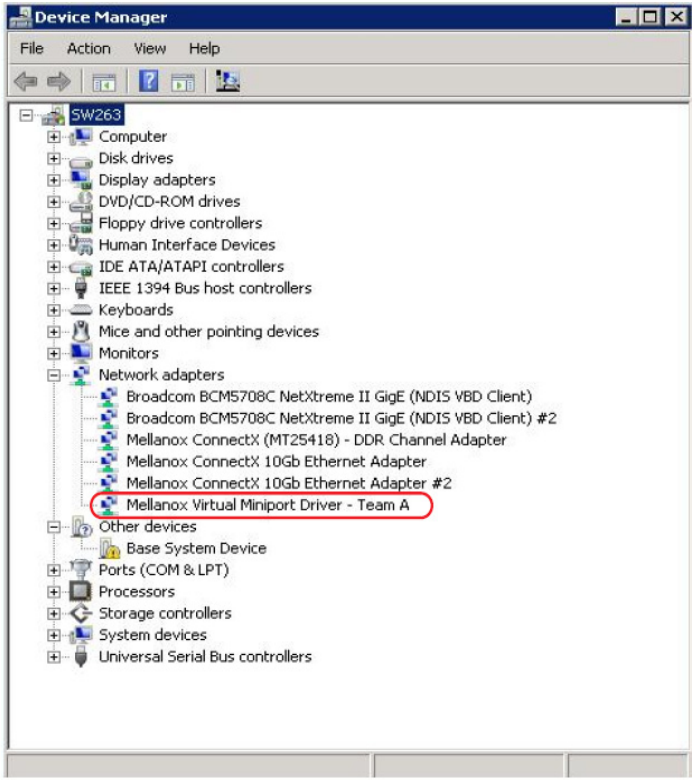
Step 6. [Optional] Failback to Primary

Step 7. Check the checkbox.



The newly created virtual Mellanox adapter representing the bundle will be displayed by the Device Manager under "Network adapters" in the following format (see the figure below):

```
Mellanox Virtual Miniport Driver - Team <bundle_name>
```



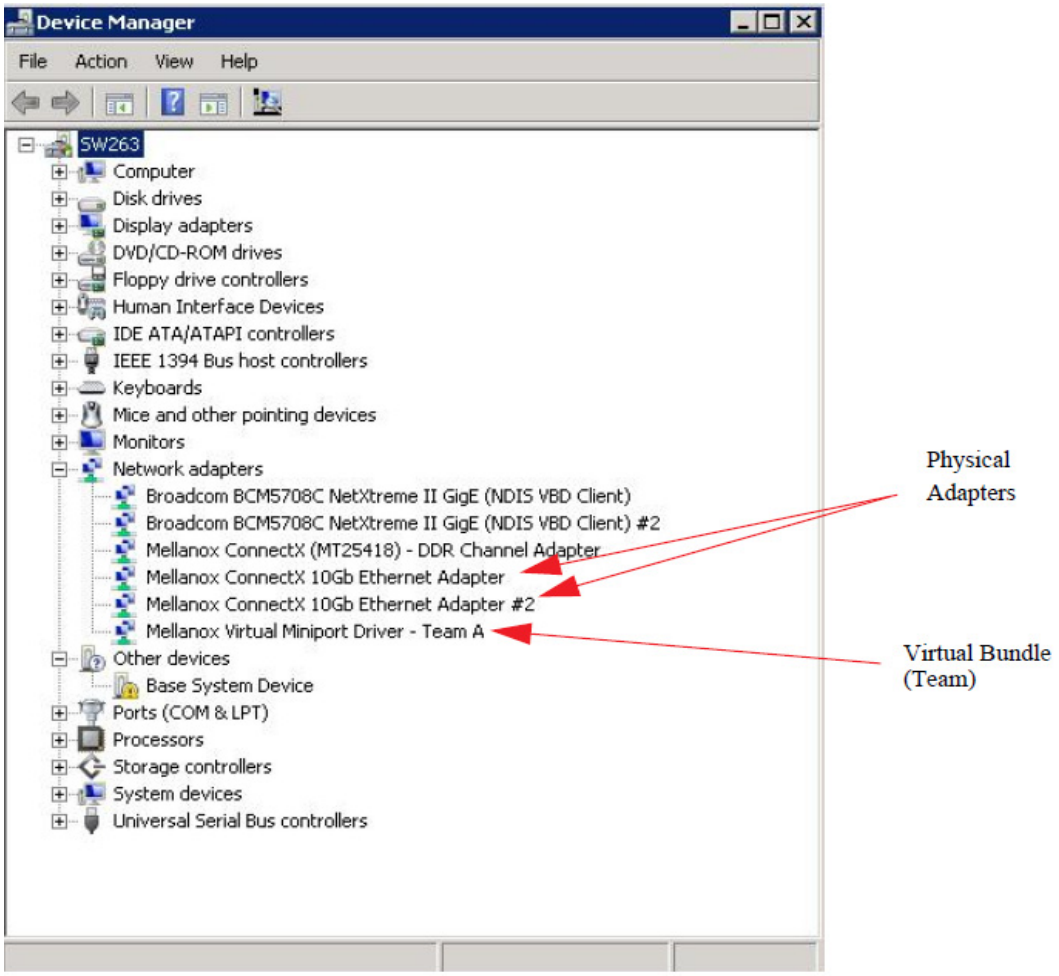
- ***To modify an existing bundle, perform the following:***
  a. Select the desired bundle and click Modify
  b. Modify the bundle name, its type, and/or the participating adapters in the bundle
  c. Click the Commit button
- ***To remove an existing bundle, select the desired bundle and click Remove. You will be prompted to approve this action.***

  Notes on this step:
  a. Each adapter that participates in a bundle has two properties:
     - Status: Connected/Disconnected/Disabled
     - Role: Active or Backup
  b. Each network adapter that is added or removed from a bundle gets refreshed (i.e. disabled then enabled). This may cause a temporary loss of connection to the adapter.
  c. In case a bundle loses one or more network adapters by a “create” or “modify” operation, the remaining adapters in the bundle are automatically notified of the change.

3.5.3 Creating a Port VLAN in Windows 2008 R2

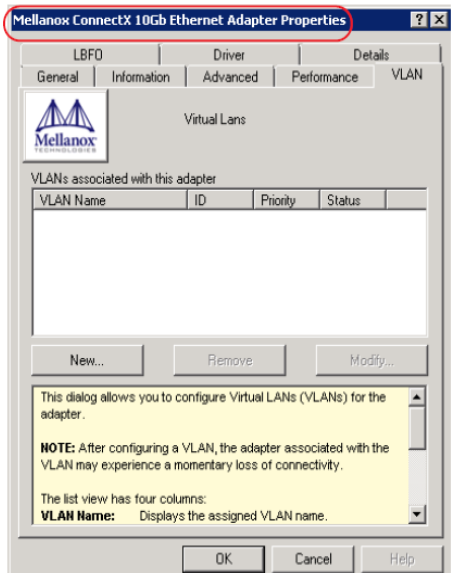
You can create a Port VLAN either on a physical Mellanox ConnectX® EN adapter or a virtual bundle (team). The following steps describe how to create a port VLAN.

Step 1. Display the Device Manager.

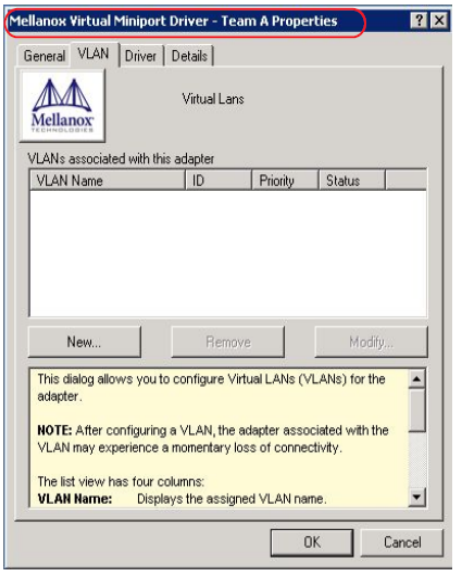


Step 2. Right-click a Mellanox network adapter (under "Network adapters" list) and left-click Properties. Select the VLAN tab from the Properties sheet.

Physical Adapter

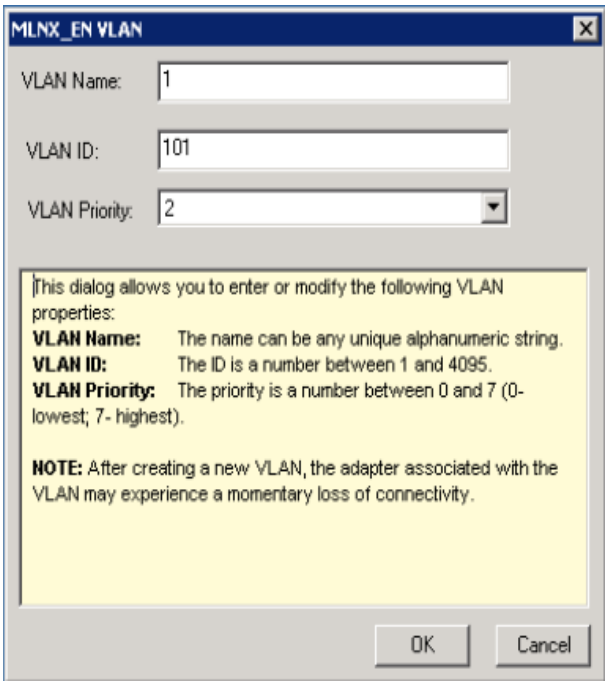


Virtual Bundle (Team)



If a physical adapter has been added to a bundle (team), the VLAN tab will not be displayed.

Step 3. Click New to open a VLAN dialog window. Enter the desired VLAN Name and VLAN ID, and select the VLAN Priority.

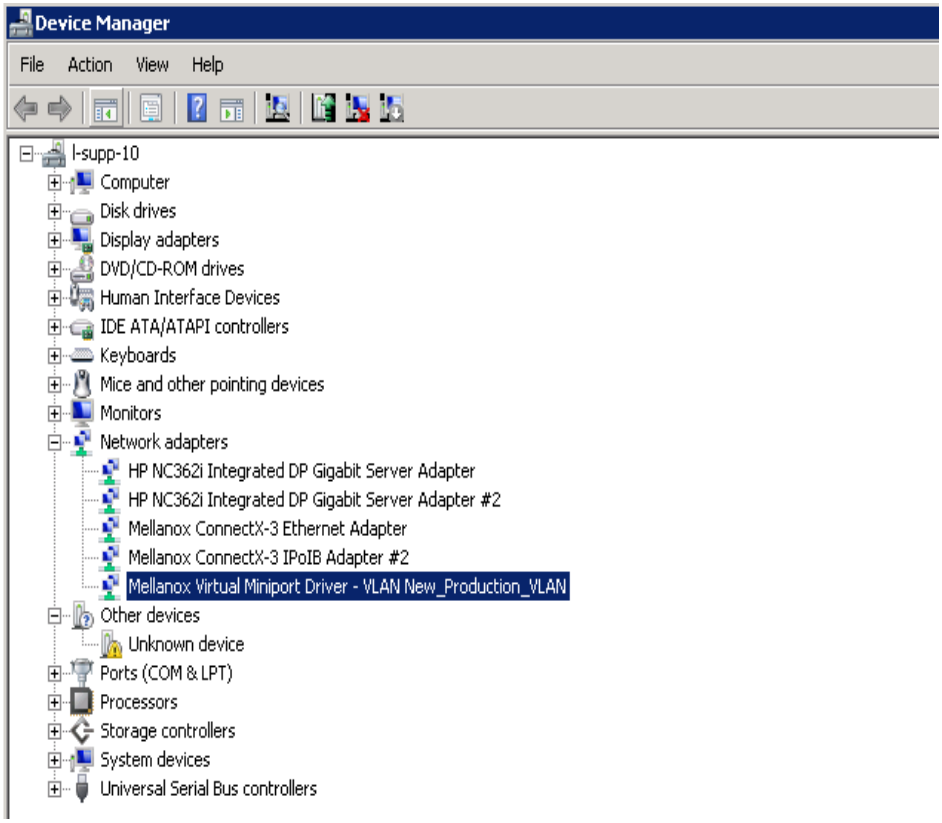


After installing the first virtual adapter (VLAN) on a specific port, the port becomes disabled. This means that it is not possible to bind to this port until all the virtual adapters associated with it are removed.

When using a VLAN, the network address is configured using the VLAN ID. Therefore, the VLAN ID on both ends of the connection must be the same.

Step 4. Verify the new VLAN(s) by opening the Device Manager window or the Network Connections window. The newly created VLAN will be displayed in the following format.

```
Mellanox Virtual Miniport Driver - VLAN <name>
```



3.5.4 Removing a Port VLAN in Windows 2008 R2

➢ ***To remove a port VLAN, perform the following steps:***

Step 1. In the Device Manager window, right-click the network adapter from which the port VLAN was created.

Step 2. Left-click Properties.

Step 3. Select the VLAN tab from the Properties sheet.

Step 4. Select the VLAN to be removed.

Step 5. Click Remove and confirm the operation.

3.5.5 Configuring a Port to Work with VLAN in Windows 2012 and Above

In this procedure you DO NOT create a VLAN, rather use an existing VLAN ID.

➢ ***To configure a port to work with VLAN using the Device Manager.***

Step 1. Open the Device Manager.

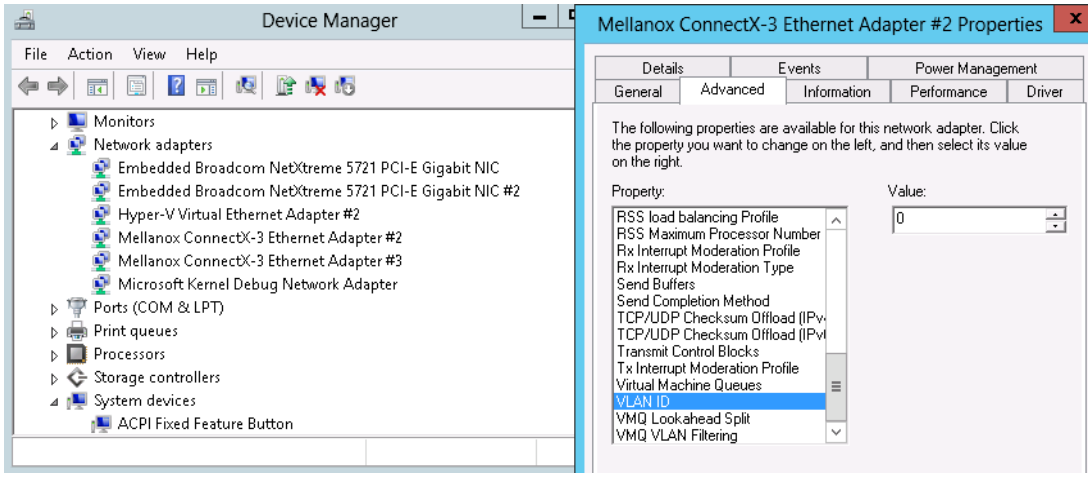
Step 2. Go to the Network adapters.

Step 3. Right click ' Properties on Mellanox ConnectX®-3 Ethernet Adapter card.

Step 4. Go to Advanced tab.

Step 5. Choose the VLAN ID in the Property window.

Step 6. Set its value in the Value window.



3.6 Ports TX Arbitration

On a setup with a dual-port NIC with both ports at link speed of 40GbE, each individual port can achieve maximum line rate. When both ports are running simultaneously in a high throughput scenario, the total throughput is bottlenecked by the PCIe bus, and in this case each port may not achieve its maximum of 40GbE.

Ports TX Arbitration ensures bandwidth precedence is given to one of the ports on a dual-port NIC, enabling the preferred port to achieve the maximum throughput and the other port taking up the rest of the remaining bandwidth.

➢ ***To configure Ports TX Arbitration:***

Step 1. Open the Device Manager.

Step 2. Go to the Network adapters.

Step 3. Right click ' Properties on Mellanox ConnectX®-3 Ethernet Adapter card.

Step 4. Go to Advanced tab.

Step 5. Choose the 'Tx Throughput Port Arbiter' option.

Step 6. Set one of the following values:

- Best Effort (Default) - Default behavior. No precedence is given to this port over the other.
- Guaranteed - Give higher precedence to this port.
- Not Present - No configuration exists, defaults are used.

3.7 RDMA over Converged Ethernet (RoCE)

3.7.1 RoCE Overview

Remote Direct Memory Access (RDMA) is the remote memory management capability that allows server to server data movement directly between application memory without any CPU involvement. RDMA over Converged Ethernet (RoCE) is a mechanism to provide this efficient data transfer with very low latencies on loss-less Ethernet networks. With advances in data center convergence over reliable Ethernet, ConnectX®-2/ConnectX®-3 EN/ ConnectX®-3 Pro EN with RoCE uses the proven and efficient RDMA transport to provide the platform for deploying RDMA technology in mainstream data center application at 10GigE and 40GigE link-speed. ConnectX®-2/ ConnectX®-3/ ConnectX®-3 Pro EN with its hardware offload support takes advantage of this efficient RDMA transport (InfiniBand) services over Ethernet to deliver ultra-low latency for performance-critical and transaction intensive applications such as financial, database, storage, and content delivery networks. RoCE encapsulates IB transport and GRH headers in Ethernet packets bearing a dedicated ether type. While the use of GRH is optional within InfiniBand subnets, it is mandatory when using RoCE. Applications written over IB verbs should work seamlessly, but they require provisioning of GRH information when creating address vectors. The library and driver are modified to provide mapping from GID to MAC addresses required by the hardware.

3.7.2 RoCE Configuration

In order to function reliably, RoCE requires a form of flow control. While it is possible to use global flow control, this is normally undesirable, for performance reasons.

The normal and optimal way to use RoCE is to use Priority Flow Control (PFC). To use PFC, it must be enabled on all endpoints and switches in the flow path.

In the following section we present instructions to configure PFC on Mellanox ConnectX™ cards. There are multiple configuration steps required, all of which may be performed via PowerShell. Therefore, although we present each step individually, you may ultimately choose to write a PowerShell script to do them all in one step. Note that administrator privileges are required for these steps.

For further information, please refer to:

http://blogs.technet.com/b/josebda/archive/2012/07/31/deploying-windows-server-2012-with-smb-direct-smb-over-rdma-and-the-mellanox-connectx-3-using-10gbe-40gbe-roce-step-by-step.aspx

3.7.2.1 Prerequisites

The following are the driver's prerequisites in order to set or configure RoCE:

- ConnectX®-3 firmware version 2.30.3000 or higher

- All InfiniBand verbs applications which run over InfiniBand verbs should work on RoCE links if they use GRH headers.
- Set HCA to use Ethernet protocol:
  Display the Device Manager and expand “System Devices”. Please refer to Section 3.4.2, “Port Protocol Configuration”, on page 20.

3.7.2.2 Configuring Windows Host

Since PFC is responsible for flow controlling at the granularity of traffic priority, it is necessary to assign different priorities to different types of network traffic.
As per RoCE configuration, all ND/NDK traffic is assigned to one or more chosen priorities, where PFC is enabled on those priorities.

Configuring Windows host requires configuring QoS. To configure QoS, please follow the procedure described in Section 5.3, “Configuring Quality of Service (QoS)”, on page 44

3.7.2.2.1 Using Global Pause Flow Control (GFC)

➢ ***To use Global Pause Flow Control (GFC) mode, disable QoS and Priority:***

```
PS $ Disable-NetQosFlowControl
PS $ Disable-NetAdapterQos
```

3.7.3 Configuring SwitchX® Based Switch System

➢ ***To enable RoCE, the SwitchX should be configured as follows:***

- Ports facing the host should be configured as access ports, and either use global pause or Port Control Protocol (PCP) for priority flow control
- Ports facing the network should be configured as trunk ports, and use Port Control Protocol (PCP) for priority flow control

For further information on how to configure SwitchX, please refer to SwitchX User Manual.

3.7.4 Configuring Arista Switch

Step 1. Set the ports that face the hosts as trunk.

```
(config)# interface et10
(config-if-Et10)# switchport mode trunk
```

Step 2. Set VID allowed on trunk port to match the host VID.

```
(config-if-Et10)# switchport trunk allowed vlan 100
```

Step 3. Set the ports that face the network as trunk.

```
(config)# interface et20
(config-if-Et20)# switchport mode trunk
```

Step 4. Assign the relevant ports to LAG.

```
(config)# interface et10
(config-if-Et10)# dcbx mode ieee
(config-if-Et10)# speed forced 40gfull
(config-if-Et10)# channel-group 11 mode active
```

Step 5. Enable PFC on ports that face the network.

```
(config)# interface et20
(config-if-Et20)# load-interval 5
(config-if-Et20)# speed forced 40gfull
(config-if-Et20)# switchport trunk native vlan tag
(config-if-Et20)# switchport trunk allowed vlan 11
(config-if-Et20)# switchport mode trunk
(config-if-Et20)# dcbx mode ieee
(config-if-Et20)# priority-flow-control mode on
(config-if-Et20)# priority-flow-control priority 3 no-drop
```

3.7.4.1 Using Global Pause Flow Control (GFC)

➢ ***To enable GFC on ports that face the hosts, perform the following:***

```
(config)# interface et10
(config-if-Et10)# flowcontrol receive on
(config-if-Et10)# flowcontrol send on
```

3.7.4.2 Using Priority Flow Control (PFC)

➢ ***To enable PFC on ports that face the hosts, perform the following:***

```
(config)# interface et10
(config-if-Et10)# dcbx mode ieee
(config-if-Et10)# priority-flow-control mode on
(config-if-Et10)# priority-flow-control priority 3 no-drop
```

3.7.5 Configuring Router (PFC only)

The router uses L3's DSCP value to mark the egress traffic of L2 PCP. The required mapping, maps the three most significant bits of the DSCP into the PCP. This is the default behavior, and no additional configuration is required.

3.7.5.1 Copying Port Control Protocol (PCP) between Subnets

The captured PCP option from the Ethernet header of the incoming packet can be used to set the PCP bits on the outgoing Ethernet header.

3.7.6 Configuring the RoCE Mode

Configuring the RoCE mode requires the following:

- RoCE mode is configured per-driver and is enforced on all the devices in the system

The supported RoCE modes depend on the firmware installed. If the firmware does not support the needed mode, the fallback mode would be the maximum supported RoCE mode of the installed NIC.

RoCE mode can be enabled and disabled via PowerShell.

•

➢ ***To enable RoCE using the PowerShell:***

- Open the PowerShell and run:

```
Set-MlnxDriverCoreSetting -RoceMode 1
```

➢ ***To disable RoCE using the PowerShell:***

- Open the PowerShell and run:

```
Set-MlnxDriverCoreSetting -RoceMode 0
```

3.8 Network Virtualization using Generic Routing Encapsulation

Network Virtualization using Generic Routing Encapsulation (NVGRE) off-load is currently supported in Windows Server 2012 R2 only.

Network Virtualization using Generic Routing Encapsulation (NVGRE) is a network virtualization technology that attempts to alleviate the scalability problems associated with large cloud computing deployments. It uses Generic Routing Encapsulation (GRE) to tunnel layer 2 packets across an IP fabric, and uses 24 bits of the GRE key as a logical network discriminator (which is called a tenant network ID).

Configuring the Hyper-V Network Virtualization, requires two types of IP addresses:

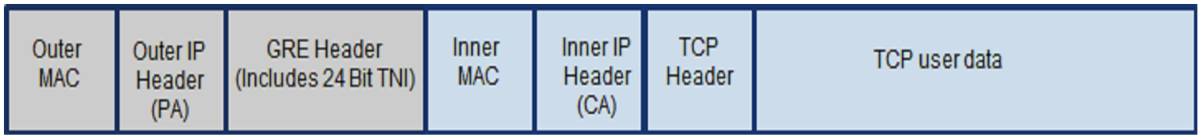
- **Provider Addresses (PA)** - unique IP addresses assigned to each Hyper-V host that are routable across the physical network infrastructure. Each Hyper-V host requires at least one PA to be assigned.
- **Customer Addresses (CA)** - unique IP addresses assigned to each Virtual Machine that participate on a virtualized network. Using NVGRE, multiple CAs for VMs running on a Hyper-V host can be tunneled using a single PA on that Hyper-V host. CAs must be unique across all VMs on the same virtual network, but they do not need to be unique across virtual networks with different Virtual Subnet ID.

The VM generates a packet with the addresses of the sender and the recipient within the CA space. Then Hyper-V host encapsulates the packet with the addresses of the sender and the recipient in PA space.

PA addresses are determined by using virtualization table. Hyper-V host retrieves the received packet, identifies recipient and forwards the original packet with the CA addresses to the desired VM.

NVGRE can be implemented across an existing physical IP network without requiring changes to physical network switch architecture. Since NVGRE tunnels terminate at each Hyper-V host, the hosts handle all encapsulation and de-encapsulation of the network traffic. Firewalls that block GRE tunnels between sites have to be configured to support forwarding GRE (IP Protocol 47) tunnel traffic.

Figure 1: NVGRE Packet Structure



3.8.1 Enabling/Disabling NVGRE Offloading

To leverage NVGRE to virtualize heavy network IO workloads, the Mellanox ConnectX®-3 Pro network NIC provides hardware support for GRE off-load within the network NICs by default.

➢ ***To enable/disable NVGRE off-loading:***

Step 1. Open the Device Manager.

Step 2. Go to the Network adapters.

Step 3. Right click 'Properties on Mellanox ConnectX®-3 Pro Ethernet Adapter card.

Step 4. Go to Advanced tab.

Step 5. Choose the `'Encapsulate Task Offload'` option.

Step 6. Set one of the following values:

- Enable - GRE off-loading is Enabled by default
- Disabled - When disabled the Hyper-V host will still be able to transfer NVGRE traffic, but TCP and inner IP checksums will be calculated by software that significant reduces performance.

3.8.2 Configuring the NVGRE using PowerShell

Hyper-V Network Virtualization policies can be centrally configured using PowerShell 3.0 and PowerShell Remoting.

Step 1. Create a vSwitch.

```
New-VMSwitch <vSwitchName> -NetAdapterName <EthInterfaceName>-AllowManagementOS $true
```

Step 2. Shut down the VMs.

```
Stop-VM -Name <VM Name> -Force -Confirm
```

Step 3. Configure the Virtual Subnet ID on the Hyper-V Network Switch Ports for each Virtual Machine on each Hyper-V Host (Host 1 and Host 2).

```
Add-VMNetworkAdapter -VMName <VMName> -SwitchName <vSwitchName> -StaticMacAddress <StaticMAC
Address>
```

Step 4. Configure the Provider Address and Route records on Hyper-V Host 1 (Host 1 Only).

```
New-NetVirtualizationProviderRoute -InterfaceIndex $NIC.InterfaceIndex -DestinationPrefix <dest-
prefix> -NextHop <nexthopvalue>
```

Step 5. Configure a Subnet Locator and Route records on each Hyper-V Host (Host 1 and Host 2).

```
New-NetVirtualizationLookupRecord -CustomerAddress <VMInterfaceIPAddress 1/n> -ProviderAddress
<HypervisorInterfaceIPAddress1> -VirtualSubnetID <virtualsubnetID> -MACAddress <VMmacaddress1>[a]
-Rule "TranslationMethodEncap"

New-NetVirtualizationLookupRecord -CustomerAddress <VMInterfaceIPAddress 2/n> -ProviderAddress
<HypervisorInterfaceIPAddress2> -VirtualSubnetID <virtualsubnetID> -MACAddress <VMmacaddress2>[a]
-Rule "TranslationMethodEncap"
```

a. This is the VM's MAC address associated with the vSwitch connected to the Mellanox device.

Step 6. Add customer route.

```
New-NetVirtualizationCustomerRoute -RoutingDomainID "{11111111-2222-3333-4444-000000005001}" -
VirtualSubnetID <virtualsubnetID> -DestinationPrefix <VMInterfaceIPAddress/Mask> -NextHop
"0.0.0.0" -Metric 255
```

Step 7. Configure the Provider Address and Route records on Hyper-V Host 1 (Host 1 Only).

```
$NIC = Get-NetAdapter <EthInterfaceName>
New-NetVirtualizationProviderAddress -InterfaceIndex $NIC.InterfaceIndex -ProviderAddress
<HypervisorInterfaceIPAddress> -PrefixLength 24
New-NetVirtualizationProviderRoute -InterfaceIndex $NIC.InterfaceIndex -DestinationPrefix
"0.0.0.0/0" -NextHop <HypervisorInterfaceIPAddress>[a]
```

a. The Hypervisor Interface IP address is 192.168.20.**118** and the -NextHop will be 192.168.20.**1**

Step 8. Configure the Virtual Subnet ID on the Hyper-V Network Switch Ports for each Virtual Machine on each Hyper-V Host (Host 1 and Host 2).

```
Get-VMNetworkAdapter -VMName <VMName> | where {$_.MacAddress -eq <VMmacaddress1>} | Set-VMNet-
workAdapter -VirtualSubnetID <virtualsubnetID>
```

Please repeat steps 5 to 8 on each VM after rebooting the hypervisor.

3.8.3 Verifying the Encapsulation of the Traffic

Once the configuration using PowerShell is completed, verifying that packets are indeed encapsulated as configured is possible through any packet capturing utility. If configured correctly, an encapsulated packet should appear as a packet consisting of the following headers:

Outer MAC, Outer IP, GRE Header, Inner MAC, Original Ethernet Payload.

3.9 Differentiated Services Code Point (DSCP)

DSCP is a mechanism used for classifying network traffic on IP networks. It uses the 6-bit Differentiated Services Field (DS or DSCP field) in the IP header for packet classification purposes. Using Layer 3 classification enables you to maintain the same classification semantics beyond local network, across routers.

Every transmitted packet holds the information allowing network devices to map the packet to the appropriate 802.1Qbb CoS. For DSCP based PFC the packet is marked with a DSCP value in the Differentiated Services (DS) field of the IP header.

3.9.1 Setting the DSCP in the IP Header

Marking DSCP value in the IP header is done differently for IP packets constructed by the NIC (e.g. RDMA traffic) and for packets constructed by the IP stack (e.g. TCP traffic).

- For IP packets generated by the IP stack, the DSCP value is provided by the IP stack. The NIC does not validate the match between DSCP and Class of Service (CoS) values. CoS and DSCP values are expected to be set through standard tools, such as PowerShell command New-NetQosPolicy using PriorityValue8021Action and DSCPAction flags respectively.
- For IP packets generated by the NIC (RDMA), the DSCP value is generated according to the CoS value programmed for the interface. CoS value is set through standard tools, such as PowerShell command New-NetQosPolicy using PriorityValue8021Action flag. The NIC uses a mapping table between the CoS value and the DSCP value configured through the RroceDscpMarkPriorityFlow- Control[0-7] Registry keys

3.9.2 Configuring Quality of Service for TCP and RDMA Traffic

Step 1. Verify that DCB is installed and enabled (is not installed by default).

```
$ Install-WindowsFeature Data-Center-Bridging
```

Step 2. Import the PowerShell modules that are required to configure DCB.

```
$ import-module NetQos
$ import-module DcbQos
$ import-module NetAdapter
```

Step 3. Configure DCB.

```
$ Set-NetQosDcbxSetting -Willing 0
```

Step 4. Enable Network Adapter QoS.

```
$ Set-NetAdapterQos -Name "Cx3Pro_ETH_P1" -Enabled 1
```

Step 5. Enable Priority Flow Control (PFC) on the specific priority 3,5.

```
$ Enable-NetQosFlowControl 3,5
```

3.9.3 Configuring DSCP for TCP Traffic

- Create a QoS policy to tag All TCP/UDP traffic with CoS value 1 and DSCP value 9.

```
$ New-NetQosPolicy "DEFAULT" -PriorityValue8021Action 3 -DSCPAction 9
```

DSCP can also be configured per protocol.

```
$ New-NetQosPolicy "TCP"  -IPProtocolMatchCondition TCP -PriorityValue8021Action 3 -DSCPAction 16
$ New-NetQosPolicy "UDP"  -IPProtocolMatchCondition UDP -PriorityValue8021Action 3 -DSCPAction 32
```

3.9.4 Configuring DSCP for RDMA Traffic

- Create a QoS policy to tag the ND traffic for port 10000 with CoS value 3.

```
$ New-NetQosPolicy "ND10000" -NetDirectPortMatchCondition 10000 - PriorityValue8021Action 3
```

Related Commands:

- Get-NetAdapterQos - Gets the QoS properties of the network adapter
- Get-NetQosPolicy - Retrieves network QoS policies
- Get-NetQosFlowControl - Gets QoS status per priority

3.9.5 Registry Settings

The following attributes must be set manually and will be added to the miniport registry.

Table 6 - DSCP Registry Keys Settings

Registry Key	Description
TxUntagPriorityTag	If 0x1, do not add 802.1Q tag to transmitted packets which are assigned 802.1p priority, but are not assigned a non-zero VLAN ID (i.e. priority-tagged). Default 0x0, for DSCP based PFC set to 0x1.
RxUntaggedMapToLossless	If 0x1, all untagged traffic is mapped to the lossless receive queue. Default 0x0, for DSCP based PFC set to 0x1.
RroceDscpMarkPriorityFlowControl_<ID>	A value to mark DSCP for RoCE v2 packets assigned to CoS=ID, when priority flow control is enabled. The valid values range is from 0 to 63, Default is ID value, e.g. RroceDscpMarkPriorityFlowControl_3 is 3. ID values range from 0 to 7.

For changes to take affect, please restart the network adapter after changing this registry key.

3.9.5.1 Default Settings

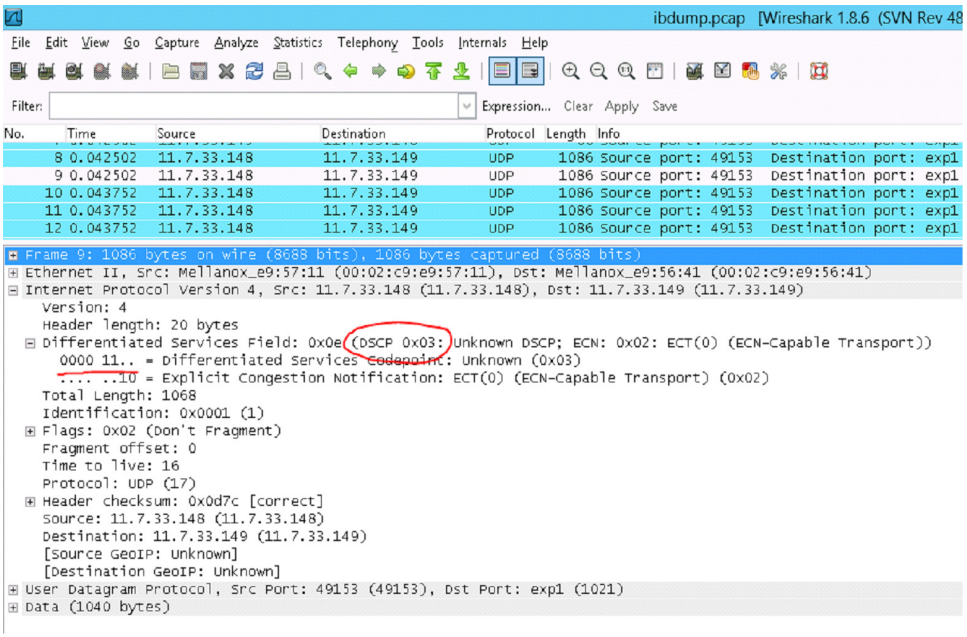
When DSCP configuration registry keys are missing in the miniport registry, the following defaults are assigned.

Table 7 - DSCP Default Registry Keys Settings

Registry Key	Default Value
TxUntagPriorityTag	0
RxUntaggedMapToLossles	0
RroceDscpMarkPriorityFlowControl_0	0
RroceDscpMarkPriorityFlowControl_1	1
RroceDscpMarkPriorityFlowControl_2	2
RroceDscpMarkPriorityFlowControl_3	3
RroceDscpMarkPriorityFlowControl_4	4
RroceDscpMarkPriorityFlowControl_5	5
RroceDscpMarkPriorityFlowControl_6	6
RroceDscpMarkPriorityFlowControl_7	7

3.9.6 DSCP Sanity Testing

To verify that all QoS and DSCP settings were correct, you can capture incoming and outgoing traffic by using the ibdump tool and see the DSCP value in the captured packets as displayed in the figure below.



4 Deploying Windows Server 2012 and Above with SMB Direct

4.1 Overview

The Server Message Block (SMB) protocol is a network file sharing protocol implemented in Microsoft Windows. The set of message packets that defines a particular version of the protocol is called a dialect.

The Microsoft SMB protocol is a client-server implementation and consists of a set of data packets, each containing a request sent by the client or a response sent by the server.

SMB protocol is used on top of the TCP/IP protocol or other network protocols. Using the SMB protocol allows applications to access files or other resources on a remote server, to read, create, and update them. In addition, it enables communication with any server program that is set up to receive an SMB client request.

4.2 Hardware and Software Prerequisites

The following are hardware and software prerequisites:

- Two or more machines running Windows Server 2012 and above
- One or more Mellanox ConnectX®-3, or ConnectX®-3 Pro adapters for each server
- One or more Mellanox InfiniBand switches
- Two or more QSFP cables required for InfiniBand

4.3 SMB Configuration Verification

4.3.1 Verifying SMB Configuration

Use the following PowerShell cmdlets to verify SMB Multichannel is enabled, confirm the adapters are recognized by SMB and that their RDMA capability is properly identified.

- On the SMB client, run the following PowerShell cmdlets:

```
Get-SmbClientConfiguration | Select EnableMultichannel
Get-SmbClientNetworkInterface
```

- On the SMB server, run the following PowerShell cmdlets[1]:

```
Get-SmbServerConfiguration | Select EnableMultichannel
Get-SmbServerNetworkInterface
netstat.exe -xan | ? {$_ -match "445"}
```

1. The NETSTAT command confirms if the File Server is listening on the RDMA interfaces.

4.3.2 Verifying SMB Connection

➢ ***To verify the SMB connection on the SMB client:***

Step 1. Copy the large file to create a new session with the SMB Server.

Step 2. Open a PowerShell window while the copy is ongoing.

Step 3. Verify the SMB Direct is working properly and that the correct SMB dialect is used.

```
Get-SmbConnection
Get-SmbMultichannelConnection
netstat.exe -xan | ? {$_ -match "445"}
```

If you have no activity while you run the commands above, you might get an empty list due to session expiration and no current connections.

4.4 Verifying SMB Events that Confirm RDMA Connection

➢ ***To confirm RDMA connection, verify the SMB events:***

Step 1. Open a PowerShell window on the SMB client.

Step 2. Run the following cmdlets.
NOTE: Any RDMA-related connection errors will be displayed as well.

```
Get-WinEvent -LogName Microsoft-Windows-SMBClient/Operational | ? Message -match "RDMA"
```

5 Driver Configuration

Once you have installed Mellanox WinOF VPI package, you can perform various modifications to your driver to make it suitable for your system's needs

Changes made to the Windows registry happen immediately, and no backup is automatically made.
Do ***not*** edit the Windows registry unless you are confident regarding the changes.

5.1 Configuring the InfiniBand Driver

5.1.1 Modifying IPoIB Configuration

➢ ***To modify the IPoIB configuration after installation, perform the following steps:***

Step 1. Open Device Manager and expand Network Adapters in the device display pane.

Step 2. Right-click the Mellanox IPoIB Adapter entry and left-click Properties.

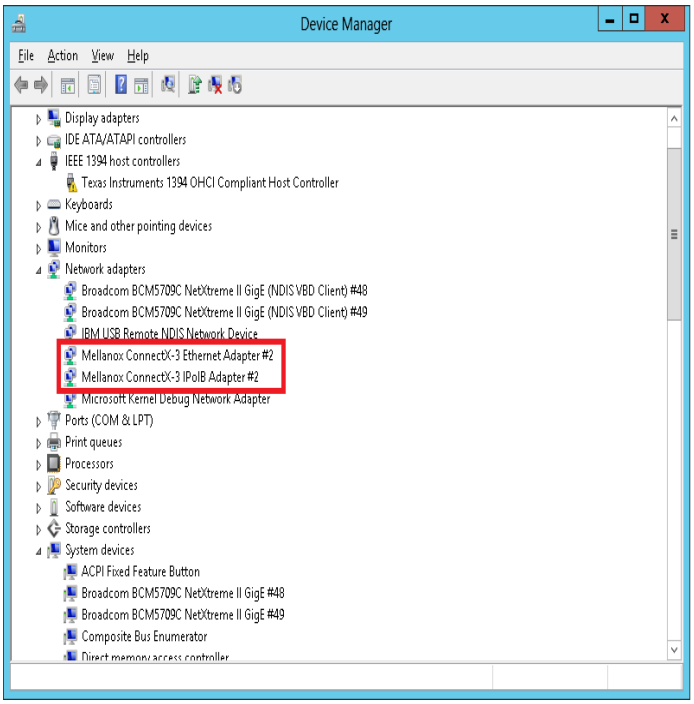
Step 3. Click the Advanced tab and modify the desired properties.

The IPoIB network interface is automatically restarted once you finish modifying IPoIB parameters. Consequently, it might affect any running traffic.

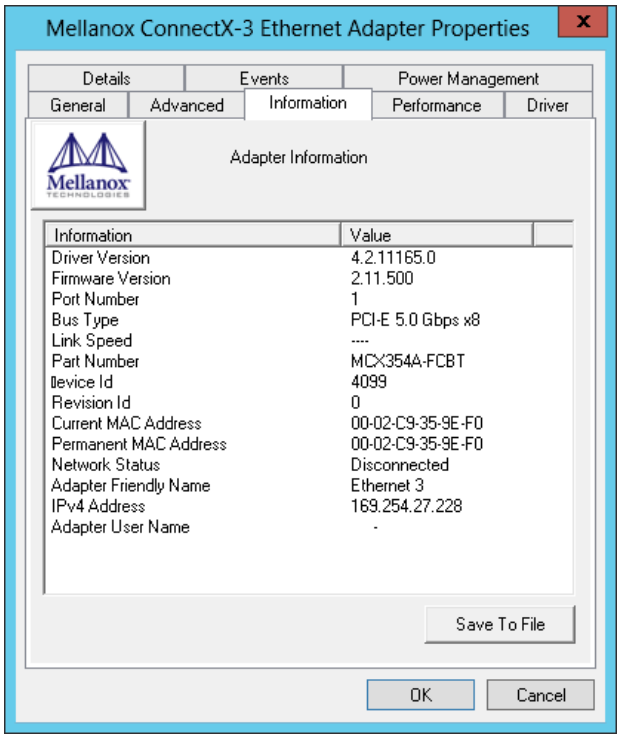
5.1.2 Displaying Adapter Related Information

To display a summary of network adapter software, firmware- and hardware-related information such as driver version, firmware version, bus interface, adapter identity, and network port link information, perform the following steps:

Step 1. Display the Device Manager.



Step 2. Select the Information tab from the Properties sheet.

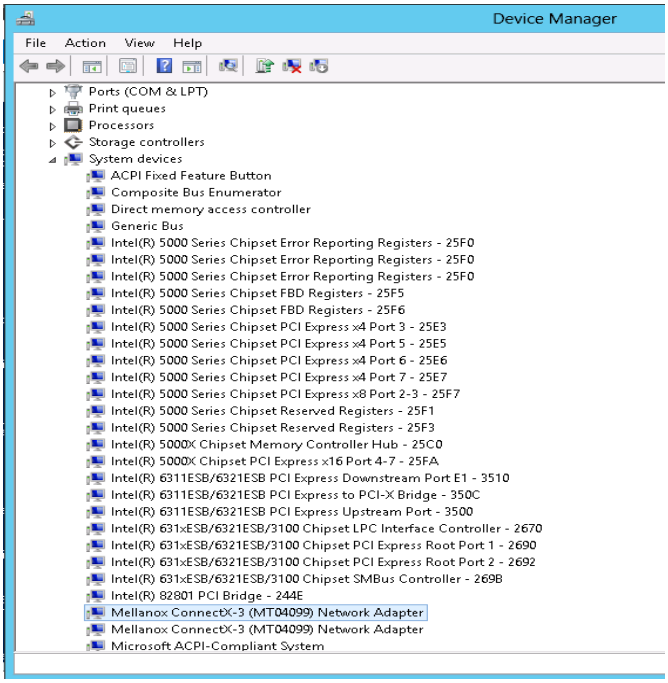


To save this information for debug purposes, click **Save to File** and provide the output file name.

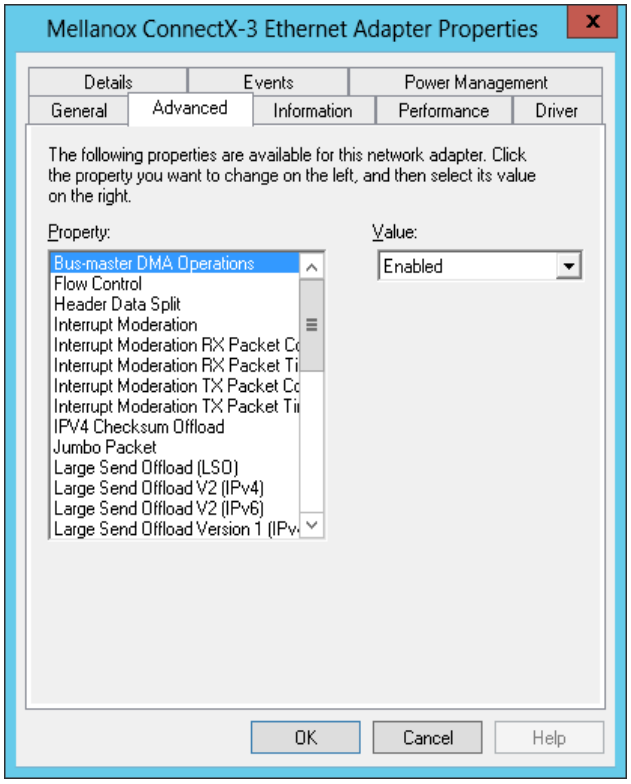
5.2 Configuring the Ethernet Driver

The following steps describe how to configure advanced features.

Step 1. Display the Device Manager.



Step 2. Right-click a Mellanox network adapter (under "Network adapters" list) and left-click Properties. Select the Advanced tab from the Properties sheet.



Step 3. Modify configuration parameters to suit your system.

Please note the following:

a. For help on a specific parameter/option, check the help button at the bottom of the dialog.

b. If you select one of the entries Off-load Options, Performance Options, or Flow Control Options, you'll need to click the Properties button to modify parameters via a pop-up dialog.

5.3 Configuring Quality of Service (QoS)

Prior to configuring Quality of Service, you must install Data Center Bridging using one of the following methods:

➢ ***To install the Data Center Bridging using the Server Manager:***

Step 1. Open the 'Server Manager'.

Step 2. Select 'Add Roles and Features'.

Step 3. Click Next.

Step 4. Select 'Features' on the left panel

Step 5. Check the 'Data Center Bridging' checkbox.

Step 6. Click 'Install'.

➢ ***To install the Data Center Bridging using PowerShell:***

Step 1. Enable Data Center Bridging (DCB).

```
PS $ Install-WindowsFeature Data-Center-Bridging
```

➢ ***To configure QoS on the host:***

The procedure below is not saved after you reboot your system. Hence, we recommend you create a script using the steps below and run it on the local machine.
Please see the procedure below on how to add the script to the local machine startup scripts.

Step 1. Change the Windows PowerShell execution policy.

```
PS $ Set-ExecutionPolicy AllSigned
```

Step 2. Remove the entire previous QoS configuration.

```
PS $ Remove-NetQosTrafficClass
PS $ Remove-NetQosPolicy -Confirm:$False
```

Step 3. Set the DCBX Willing parameter to false as Mellanox drivers do not support this feature.

```
PS $ set-NetQosDcbxSetting -Willing 0
```

Step 4. Create a Quality of Service (QoS) policy and tag each type of traffic with the relevant priority.

In this example we used TCP/UDP priority 1, ND/NDK priority 3.

```
PS $ New-NetQosPolicy "SMB" -store Activestore -NetDirectPortMatchCondition 445 -
PriorityValue8021Action 3
PS $ New-NetQosPolicy "DEFAULT" -store Activestore -Default -PriorityValue8021Action 3
PS $ New-NetQosPolicy "TCP" -store Activestore -IPProtocolMatchCondition TCP -
PriorityValue8021Action 1
PS $ New-NetQosPolicy "UDP" -store Activestore -IPProtocolMatchCondition UDP -
PriorityValue8021Action 1
```

Step 5. [Optional] If VLANs are used, mark the egress traffic with the relevant VlanID.
The NIC is referred as "Ethernet 4" in the examples below.

```
PS $ Set-NetAdapterAdvancedProperty -Name "Ethernet 4" -RegistryKeyword "VlanID" -RegistryValue
"55"
```

Step 6. [Optional] Configure the IP address for the NIC.

If DHCP is used, the IP address will be assigned automatically.

```
PS $ Set-NetIPInterface -InterfaceAlias "Ethernet 4" -DHCP Disabled
PS $ Remove-NetIPAddress -InterfaceAlias "Ethernet 4" -AddressFamily IPv4 -Confirm:$false
PS $ New-NetIPAddress -InterfaceAlias "Ethernet 4" -IPAddress 192.168.1.10 -PrefixLength 24 -Type
Unicast
```

Step 7. [Optional] Set the DNS server (assuming its IP address is 192.168.1.2).

```
PS $ Set-DnsClientServerAddress -InterfaceAlias "Ethernet 4" -ServerAddresses 192.168.1.2
```

After establishing the priorities of ND/NDK traffic, the priorities must have PFC enabled on them.

Step 8. Disable Priority Flow Control (PFC) for all other priorities except for 3.

```
PS $ Disable-NetQosFlowControl 0,1,2,4,5,6,7
```

Step 9. Enable QoS on the relevant interface.

```
PS $ Enable-NetAdapterQos -InterfaceAlias "Ethernet 4"
```

Step 10. Enable PFC on priority 3.

```
PS $ Enable-NetQosFlowControl -Priority 3
```

➢ ***To add the script to the local machine startup scripts:***

Step 1. From the PowerShell invoke.

```
gpedit.msc
```

Step 2. In the pop-up window, under the 'Computer Configuration' section, perform the following:

1. Select Windows Settings
2. Select Scripts (Startup/Shutdown)
3. Double click Startup to open the Startup Properties
4. Click Add
5. Browse for the script's location.
6. Click OK

6 Performance Tuning

This section describes how to modify Windows registry parameters in order to improve performance.

Please note that modifying the registry incorrectly might lead to serious problems, including the loss of data, system hang, and you may need to reinstall Windows. As such it is recommended to back up the registry on your system before implementing recommendations included in this section. If the modifications you apply lead to serious problems, you will be able to restore the original registry state. For more details about backing up and restoring the registry, please visit www.microsoft.com.

6.1 General Performance Optimization and Tuning

To achieve the best performance for Windows, you may need to modify some of the Windows registries.

6.1.1 Registry Tuning

The registry entries that may be added/changed by this "General Tuning" procedure are:

Under HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters:

- Disable TCP selective acks option for better cpu utilization:

```
SackOpts, type REG_DWORD, value set to 0.
```

Under HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\AFD\Parameters:

- Enable fast datagram sending for UDP traffic:

```
FastSendDatagramThreshold, type REG_DWORD, value set to 64K.
```

Under HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Ndis\Parameters:

- Set RSS parameters:

```
RssBaseCpu, type REG_DWORD, value set to 1.
```

6.1.2 Enable RSS

Enabling Receive Side Scaling (RSS) is performed by means of the following command:

```
"netsh int tcp set global rss = enabled"
```

6.1.3 Tuning the IPoIB Network Adapter

The IPoIB Network Adapter tuning can be performed either during installation by modifying some of Windows registries as explained in Section 6.1.1, "Registry Tuning", on page 46. or can be set post-installation manually.

➢ ***To improve the network adapter performance, activate the performance tuning tool as follows:***

Step 1. Start the "Device Manager" (open a command line window and enter: devmgmt.msc).

Step 2. Open "Network Adapters".

Step 3. Select Mellanox IPoIB adapter, right click and select Properties.

Step 4. Select the "Performance tab".

Step 5. Choose one of the tuning scenarios:

- Single port traffic - Improves performance for running single port traffic each time.
- Dual port traffic - Improves performance for running traffic on both ports simultaneously.
- Forwarding traffic - Improves performance for running scenarios that involve both ports (for example: via IXIA)
- Multicast traffic - Improves performance when the main traffic runs on multicast.

Step 6. Click on “Run Tuning” button.

Clicking the “Run Tuning” button changes several registry entries (described below), and checks for system services that may decrease network performance. It also generates a log including the applied changes.

Users can view this log to restore the previous values. The log path is:

```
%HOMEDRIVE%\Windows\System32\LogFiles\PerformanceTunning.log
```

This tuning is required to be performed only once after the installation is completed, and on one adapter only (as long as these entries are not changed directly in the registry, or by some other installation or script).

A reboot may be required for the changes to take effect.

6.1.4 Tuning the Ethernet Network Adapter

The Ethernet Network Adapter general tuning can be performed during installation by modifying some of Windows registries as explained in section "Registry Tuning" on page 32. Specific scenarios tuning can be set post-installation manually.

➢ ***To improve the network adapter performance, activate the performance tuning tool as follows:***

Step 1. Start the "Device Manager" (open a command line window and enter: devmgmt.msc).

Step 2. Open "Network Adapters".

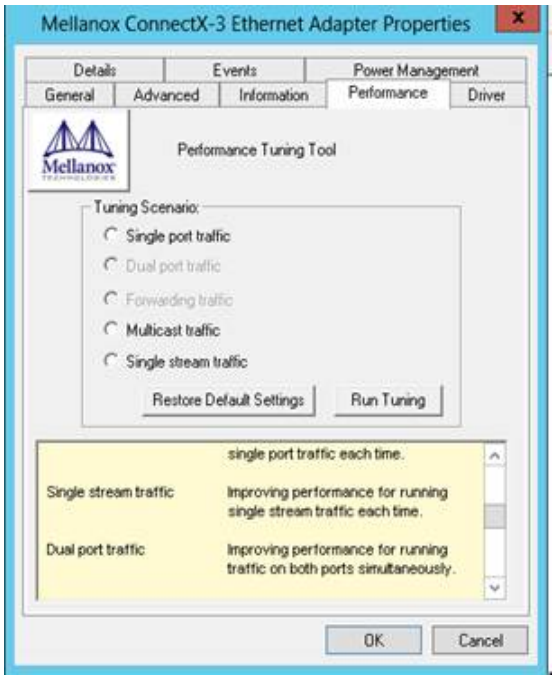
Step 3. Select Mellanox Ethernet adapter, right click and select Properties.

Step 4. Select the "Performance tab".

Step 5. Choose one of the tuning scenarios:

- Single port traffic - Improves performance for running single port traffic each time.
- Single stream traffic - Optimizes tuning for applications with single connection.
- Dual port traffic - Improves performance for running traffic on both ports simultaneously.
- Forwarding traffic - Improves performance for running scenarios that involve both ports (for example: via IXIA)
- Multicast traffic - Improves performance when the main traffic runs on multicast.

7. Click on “Run Tuning” button.



Clicking the "Run Tuning" button activates the general tuning as explained above and changes several driver registry entries for the current adapter and its sibling device once the sibling is an Ethernet device as well. It also generates a log including the applied changes.

Users can view this log to restore the previous values. The log path is:

```
%HOMEDRIVE%\Windows\System32\LogFiles\PerformanceTunning.log
```

This tuning is required to be performed only once after the installation is completed, and on one adapter only (as long as these entries are not changed directly in the registry, or by some other installation or script).

Please note that a reboot may be required for the changes to take effect.

6.1.4.1 Performance Tuning Tool Application

You can also activate the performance tuning through a script called perf_tuning.exe. This script has 4 options, which include the 3 scenarios described above and an additional manual tuning through which you can set the RSS base and number of processors for each Ethernet adapter. The adapters you wish to tune are supplied to the script by their name according to the “Network Connections”.

Synopsys

```
perf_tuning.exe -s -c1 <first connection name> [-c2 <second connection name>]
perf_tuning.exe -d -c1 <first connection name> -c2 <second connection name>
perf_tuning.exe -f -c1 <first connection name> -c2 <second connection name>
perf_tuning.exe -m -c1 <first connection name> -b <base RSS processor number> -n
<number of RSS processors>
perf_tuning -st -c1 <first connection name> [-c2 <second connection name>]
```

Options

Flag	Description
-s	Single port traffic scenario. This option can be followed by one or two connection names. The tuning will restore the default settings on the second connection and performed on the first connection. This option automatically sets: • SendCompletionMethod = 0 • RecvCompletionMethod = 2 • *ReceiveBuffers = 1024 • In Operating Systems support NDIS6.3: RssProfile = 4 Additionally, this option chooses the best processors to assign to: • DefaultRecvRingProcessor • TxInterruptProcessor • TxForwardingProcessor • In Operating Systems support NDIS6.2: RssBaseProcNumber MaxRssProcessors • In Operating Systems support NDIS6.3: NumRSSQueues RssMaxProcNumber
-d	Dual port traffic scenario. This option must be followed by two connection names. The tuning in this case is code-pendent. This option automatically sets: • SendCompletionMethod = 0 • RecvCompletionMethod = 2 • *ReceiveBuffers = 1024 • In Operating Systems support NDIS6.3: RssProfile = 4 Additionally, this option chooses the best processors to assign to: • DefaultRecvRingProcessor • TxForwardingProcessor • In Operating Systems support NDIS6.2: RssBaseProcNumber MaxRssProcessors • In Operating Systems support NDIS6.3: NumRSSQueues RssMaxProcNumber

Flag	Description
-f	Forwarding traffic scenario. This option must be followed by two connection names. The tuning in this case is code-pendent. This option automatically sets: • SendCompletionMethod = 1 • RecvCompletionMethod = 0 • *ReceiveBuffers = 4096 • UseRSSForRawIP = 0 • UseRSSForUDP = 0 Additionally, this option chooses the best processors to assign to: • DefaultRecvRingProcessor • TxInterruptProcessor • TxForwardingProcessor • In Operating Systems support NDIS6.2: RssBaseProcNumber MaxRssProcessors • In Operating Systems support NDIS6.3: NumRSSQueues RssMaxProcNumber
-m	Manual configuration This option must be followed by one connection name. This option assigns the provided base and number of CPUs to: • *RssBaseProcNumber • *MaxRssProcessors Additionally, this option assigns the following with processors inside the range: • DefaultRecvRingProcessor • TxInterruptProcessor
-r	Restore default settings. This option can be followed by one or two connection names. This option automatically sets the driver registry values back to their default values: • SendCompletionMethod = 0 - IPoIB; 1 - ETH • RecvCompletionMethod = 2 • *ReceiveBuffers = 1024 • UseRSSForRawIP = 1 • DefaultRecvRingProcessor = -1 • TxInterruptProcessor = -1 • TxForwardingProcessor = -1 • UseRSSForUDP = 1 • In Operating Systems support NDIS6.2: MaxRssProcessors = 8 • In Operating Systems support NDIS6.3: NumRSSQueues = 8
-c1	Specifies first connection name. See examples
-c2	Specifies second connection name. See examples
-b	Specifies base RSS processor number. See examples. Used for manual option (-m) only.
-n	Specifies number of RSS processors. See examples. Used for manual option (-m) only.

Flag	Description
-st	Single stream traffic scenario. This option must be followed by one or two connection names for an Ethernet adapter. The tuning will restore the default settings on the second connection and performed on the first connection. This option automatically sets: • SendCompletionMethod = 0 • RecvCompletionMethod = 2 • *ReceiveBuffers = 1024 • In Operating Systems support NDIS6.3: RssProfile = 4 • Additionally, this option chooses the best processors to assign to: • DefaultRecvRingProcessor • TxInterruptProcessor • TxForwardingProcessor • In Operating Systems support NDIS6.2: RssBaseProcNumber MaxRssProcessors • In Operating Systems support NDIS6.3: NumRSSQueues RssMaxProcNumber

Examples

For example, if the adapter is represented by "Local Area Connection 6" and "Local Area Connection 7"

```
For single port stream tuning type:
perf_tuning.exe -s -c1 "Local Area Connection 6" -c2 "Local Area Connection 7"
or to set one adapter only:
perf_tuning.exe -s -c1 "Local Area Connection 6"
For single stream tuning type:
perf_tuning.exe -st -c1 "Local Area Connection 6" -c2 "Local Area Connection 7"
or to set one adapter only:
perf_tuning.exe -st -c1 "Local Area Connection 6"
For dual port streams tuning type:
perf_tuning.exe -d -c1 "Local Area Connection 6" -c2 "Local Area Connection 7"
For forwarding streams tuning type:
perf_tuning.exe -f -c1 "Local Area Connection 6" -c2 "Local Area Connection 7"
For manual tuning of the first adapter to use RSS on CPUs 0-3:
perf_tuning.exe -m -c1 "Local Area Connection 6" -b 0 -n 4
In order to restore defaults type:
perf_tuning.exe -r -c1 "Local Area Connection 6" -c2 "Local Area Connection 7"
```

6.2 Application Specific Optimization and Tuning

6.2.1 Ethernet Performance Tuning

The user can configure the Ethernet adapter by setting some registry keys. The registry keys may affect Ethernet performance.

➢ ***To improve performance, activate the performance tuning tool as follows:***

Step 1. Start the "Device Manager" (open a command line window and enter: devmgmt.msc).

Step 2. Open "Network Adapters".

Step 3. Right click the relevant Ethernet adapter and select Properties.

Step 4. Select the "Advanced" tab

Step 5. Modify performance parameters (properties) as desired.

6.2.1.1 Performance Known Issues

- On Intel I/OAT supported systems, it is highly recommended to install and enable the latest I/OAT driver (download from www.intel.com).
- With I/OAT enabled, sending 256-byte messages or larger will activate I/OAT. This will cause a significant latency increase due to I/OAT algorithms. On the other hand, throughput will increase significantly when using I/OAT.

6.2.2 IPoIB Performance Tuning

The user can configure the IPoIB adapter by setting some registry keys. The registry keys may affect IPoIB performance.

For the complete list of registry entries that may be added/changed by the performance tuning procedure, see MLNX_VPI_WinOF Registry Keys following the path below:

http://www.mellanox.com/page/products_dyn?product_family=32&mtag=windows_sw_drivers

➢ ***To improve performance, activate the performance tuning tool as follows:***

Step 1. Start the "Device Manager" (open a command line window and enter: devmgmt.msc).

Step 2. Open "Network Adapters".

Step 3. Right click the relevant IPoIB adapter and select Properties.

Step 4. Select the "Advanced" tab

Step 5. Modify performance parameters (properties) as desired.

6.3 Tunable Performance Parameters

The following is a list of key parameters for performance tuning.

- **Jumbo Packet**

  The maximum available size of the transfer unit, also known as the Maximum Transmission Unit (MTU). For IPoIB, the MTU should not include the size of the IPoIB header (=4B). For example, if the network adapter card supports a 4K MTU, the upper threshold for payload MTU is 4092B and not 4096B. The MTU of a network can have a substantial impact on performance. A 4K MTU size improves performance for short messages, since it allows the OS to coalesce many small messages into a large one.

  - Valid MTU values range for an Ethernet driver is between 614 and 9614.
  - Valid MTU values range for an IPoIB driver is between 1500 and 4092.

All devices on the same physical network, or on the same logical network, must have the same MTU.

- **Receive Buffers**

The number of receive buffers (default 1024).

- **Send Buffers**

  The number of sent buffers (default 2048).

- **Performance Options**

  Configures parameters that can improve adapter performance.

  - Interrupt Moderation

    Moderates or delays the interrupts' generation. Hence, optimizes network throughput and CPU utilization (default Enabled).

    - When the interrupt moderation is enabled, the system accumulates interrupts and sends a single interrupt rather than a series of interrupts. An interrupt is generated after receiving 5 packets or after 10ms from the first packet received. It improves performance and reduces CPU load however, it increases latency.
    - When the interrupt moderation is disabled, the system generates an interrupt each time a packet is received or sent. In this mode, the CPU utilization data rates increase, as the system handles a larger number of interrupts. However, the latency decreases as the packet is handled faster.

  - Receive Side Scaling (RSS Mode)

    Improves incoming packet processing performance. RSS enables the adapter port to utilize the multiple CPUs in a multi-core system for receiving incoming packets and steering them to the designated destination. RSS can significantly improve the number of transactions, the number of connections per second, and the network throughput.

    This parameter can be set to one of the following values:

    - Enabled (default): Set RSS Mode
    - Disabled: The hardware is configured once to use the Toeplitz hash function, and the indirection table is never changed.

    IOAT is not used while in RSS mode.

  - Receive Completion Method

    Sets the completion methods of the received packets, and can affect network throughput and CPU utilization.

    - **Polling Method**

      Increases the CPU utilization as the system polls the received rings for the incoming packets. However, it may increase the network performance as the incoming packet is handled faster.

    - **Interrupt Method**

      Optimizes the CPU as it uses interrupts for handling incoming messages. However, in certain scenarios it can decrease the network throughput.

    - **Adaptive (Default Settings)**

      A combination of the interrupt and polling methods dynamically, depending on traffic type and network usage. Choosing a different setting may improve network and/or system performance in certain configurations.

  - Interrupt Moderation RX Packet Count

    Number of packets that need to be received before an interrupt is generated on the receive side (default 5).

- Interrupt Moderation RX Packet Time

  Maximum elapsed time (in usec) between the receiving of a packet and the generation of an interrupt, even if the moderation count has not been reached (default 10).

- Rx Interrupt Moderation Type

  Sets the rate at which the controller moderates or delays the generation of interrupts making it possible to optimize network throughput and CPU utilization. The default setting (Adaptive) adjusts the interrupt rates dynamically depending on the traffic type and network usage. Choosing a different setting may improve network and system performance in certain configurations.

- Send completion method

  Sets the completion methods of the Send packets and it may affect network throughput and CPU utilization.

- Interrupt Moderation TX Packet Count

  Number of packets that need to be sent before an interrupt is generated on the send side (default 0).

- Interrupt Moderation TX Packet Time

  Maximum elapsed time (in usec) between the sending of a packet and the generation of an interrupt even if the moderation count has not been reached (default 0).

- **Offload Options**

  Allows you to specify which TCP/IP offload settings are handled by the adapter rather than the operating system.

  Enabling offloading services increases transmission performance as the offload tasks are performed by the adapter hardware rather than the operating system. Thus, freeing CPU resources to work on other tasks.

  - IPv4 Checksums Offload

    Enables the adapter to compute IPv4 checksum upon transmit and/or receive instead of the CPU (default Enabled).

  - TCP/UDP Checksum Offload for IPv4 packets

    Enables the adapter to compute TCP/UDP checksum over IPv4 packets upon transmit and/or receive instead of the CPU (default Enabled).

  - TCP/UDP Checksum Offload for IPv6 packets

    Enables the adapter to compute TCP/UDP checksum over IPv6 packets upon transmit and/or receive instead of the CPU (default Enabled).

  - Large Send Offload (LSO)

    Allows the TCP stack to build a TCP message up to 64KB long and sends it in one call down the stack. The adapter then re-segments the message into multiple TCP packets for transmission on the wire with each pack sized according to the MTU. This option offloads a large amount of kernel processing time from the host CPU to the adapter.

- **IB Options**

  Configures parameters related to InfiniBand functionality.

  - SA Query Retry Count

    Sets the number of SA query retries once a query fails. The valid values are 1 - 64 (default 10).

  - SA Query Timeout

    Sets the waiting timeout (in millisecond) of an SA query completion. The valid values are 500 - 60000 (default 1000 ms).

6.4 Adapter Proprietary Performance Counters

Proprietary Performance Counters are used to provide information on Operating System, application, service or the drivers' performance. Counters can be used for different system debugging purposes, help to determine system bottlenecks and fine-tune system and application performance. The Operating System, network, and devices provide counter data that the application can consume to provide users with a graphical view of the system’s performance quality. WinOF counters hold the standard Windows CounterSet API that includes:

- Network Interface
- RDMA activity
- SMB Direct Connection

6.4.1 Supported Standard Performance Counters

6.4.1.1 Proprietary Mellanox Adapter Traffic Counters

Proprietary Mellanox adapter traffic counter set consists of global traffic statistics which gather information from ConnectX®-3 and ConnectX®-3 Pro network adapters, and includes traffic statistics, and various types of error and indications from both the Physical Function and Virtual Function.

Table 8 - Mellanox Adapter Traffic Counters

Mellanox Adapter Traffic Counters	Description
Bytes IN	
Bytes Received	Shows the number of bytes received by the adapter. The counted bytes include framing characters.
Bytes Received/Sec	Shows the rate at which bytes are received by the adapter. The counted bytes include framing characters.
Packets Received	Shows the number of packets received by ConnectX-3 and ConnectX-3Pro network interface.
Packets Received/Sec	Shows the rate at which packets are received by ConnectX-3 and ConnectX-3Pro network interface.
Bytes/ Packets OUT	
Bytes Sent	Shows the number of bytes sent by the adapter. The counted bytes include framing characters.
Bytes Sent/Sec	Shows the rate at which bytes are sent by the adapter. The counted bytes include framing characters.
Packets Sent	Shows the number of packets sent by ConnectX-3 and ConnectX-3Pro network interface.
Packets Sent/Sec	Shows the rate at which packets are sent by ConnectX-3 and ConnectX-3Pro network interface.
Bytes' TOTAL	
Bytes Total	Shows the total of bytes handled by the adapter. The counted bytes include framing characters.
Bytes Total/Sec	Shows the total rate of bytes that are sent and received by the adapter. The counted bytes include framing characters.
Packets Total	Shows the total of packets handled by ConnectX-3 and ConnectX-3Pro network interface.
Packets Total/Sec	Shows the rate at which packets are sent and received by ConnectX-3 and ConnectX-3Pro network interface.
Control Packets	The total number of successfully received control frames
ERRORS, DROP, AND MISC. INDICATIONS	

Table 8 - Mellanox Adapter Traffic Counters

Mellanox Adapter Traffic Counters	Description
Packets Outbound Errors	Shows the number of outbound packets that could not be transmitted because of errors.
Packets Outbound Discarded	Shows the number of outbound packets to be discarded even though no errors had been detected to prevent transmission. One possible reason for discarding packets could be to free up buffer space.
Packets Received Errors	Shows the total number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
Packets Received with Frame Length Error	Shows the number of inbound packets that contained error where the frame has length error. Packets received with frame length error are a subset of packets received errors.
Packets Received with Symbol Error	Shows the number of inbound packets that contained symbol error or an invalid block. Packets received with symbol error are a subset of packets received errors.
Packets Received with Bad CRC Error	Shows the number of inbound packets that failed the CRC check. Packets received with bad CRC error are a subset of packets received errors.
Packets Received Discarded	Shows the number of inbound packets that were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.

6.4.1.2 Proprietary Mellanox Adapter Diagnostics Counters

Proprietary Mellanox adapter diagnostics counter set consists of the NIC diagnostics. These counters collect information from ConnectX®-3 and ConnectX®-3 Pro firmware flows.

Table 9 - Mellanox Adapter Diagnostics Counters

Mellanox Adapter Diagnostics Counters	Description
Requester length errors	Number of local length errors when the local machine generates outbound traffic.
Responder length errors	Number of local length errors when the local machine receives inbound traffic.
Requester QP operation errors	Number of local QP operation errors when the local machine generates outbound traffic.
Responder QP operation errors	Number of local QP operation errors when the local machine receives inbound traffic.
Requester protection errors	Number of local protection errors when the local machine generates outbound traffic.
Responder protection errors	Number of local protection errors when the local machine receives inbound traffic.

Table 9 - Mellanox Adapter Diagnostics Counters

Mellanox Adapter Diagnostics Counters	Description
Requester CQE errors	Number of local CQE with errors when the local machine generates outbound traffic.
Responder CQE errors	Number of local CQE with errors when the local machine receives inbound traffic.
Requester Invalid request errors	Number of remote invalid request errors when the local machine generates outbound traffic, i.e. NAK was received indicating that the other end detected invalid OpCode request.
Responder Invalid request errors	Number of remote invalid request errors when the local machine receives inbound traffic.
Requester Remote access errors	Number of remote access errors when the local machine generates outbound traffic, i.e. NAK was received indicating that the other end detected wrong rkey.
Responder Remote access errors	Number of remote access errors when the local machine receives inbound traffic, i.e. the local machine received RDMA request with wrong rkey.
Requester RNR NAK	Number of RNR (Receiver Not Ready) NAKs received when the local machine generates outbound traffic.
Responder RNR NAK	Number of RNR (Receiver Not Ready) NAKs sent when the local machine receives inbound traffic.
Requester out of order sequence NAK	Number of Out of Sequence NAK received when the local machine generates outbound traffic, i.e. the number of times the local machine received NAKs indicating OOS on the receiving side.
Responder out of order sequence received	Number of Out of Sequence packet received when the local machine receives inbound traffic, i.e. the number of times the local machine received messages that are not consecutive.
Requester resync	Number of resync operations when the local machine generates outbound traffic.
Responder resync	Number of resync operations when the local machine receives inbound traffic.
Requester Remote operation errors	Number of remote operation errors when the local machine generates outbound traffic, i.e. NAK was received indicating that the other end encountered an error that prevented it from completing the request.
Requester transport retries exceeded errors	Number of transport retries exceeded errors when the local machine generates outbound traffic.
Requester RNR NAK retries exceeded errors	Number of RNR (Receiver Not Ready) NAKs retries exceeded errors when the local machine generates outbound traffic.
Bad multicast received	Number of bad multicast packet received.

Table 9 - Mellanox Adapter Diagnostics Counters

Mellanox Adapter Diagnostics Counters	Description
Discarded UD packets	Number of UD packets silently discarded on the receive queue due to lack of receives descriptor.
Discarded UC packets	Number of UC packets silently discarded on the receive queue due to lack of receives descriptor.
CQ overflows	Number of CQ overflows. **NOTE:** this value is evaluated for the entire NIC since there are cases where CQ might be associated with both ports (i.e. the value on all ports is identical).
EQ overflows	Number of EQ overflows. **NOTE:** this value is evaluated for the entire NIC since there are cases where EQ might be associated with both ports (i.e. the value on all ports is identical).
Bad doorbells	Number of bad DoorBells
Responder duplicate request received (pending firmware implementation).	Number of duplicate requests received when the local machine receives inbound traffic.
Requester time out received (pending firmware implementation).	Number of time out received when the local machine generates outbound traffic.

6.4.1.3 Proprietary Mellanox QoS Counters

Proprietary Mellanox QoS counter set consists of flow statistics per (VLAN) priority. Each QoS policy is associated with a priority. The counter presents the priority's traffic, pause statistic.

Table 10 - Mellanox QoS Counters

Mellanox QoS Counters	Description
Bytes/ Packets IN	
Bytes Received	The number of bytes received that are covered by this priority. The counted bytes include framing characters (modulo 2^64).
Bytes Received/Sec	The number of bytes received per second that are covered by this priority. The counted bytes include framing characters.
Packets Received	The number of packets received that are covered by this priority (modulo 2^64).
Packets Received/Sec	The number of packets received per second that are covered by this priority.
Bytes/ Packets OUT	
Bytes Sent	The number of bytes sent that are covered by this priority. The counted bytes include framing characters (modulo 2^64).

Table 10 - Mellanox QoS Counters

Mellanox QoS Counters	Description
Bytes Sent/Sec	The number of bytes sent per second that are covered by this priority. The counted bytes include framing characters.
Packets Sent	The number of packets sent that are covered by this priority (modulo 2^64).
Packets Sent/Sec	The number of packets sent per second that are covered by this priority.
Bytes and Packets' TOTAL	
Bytes Total	The total number of bytes that are covered by this priority. The counted bytes include framing characters (modulo 2^64).
Bytes Total/Sec	The total number of bytes per second that are covered by this priority. The counted bytes include framing characters.
Packets Total	The total number of packets that are covered by this priority (modulo 2^64).
Packets Total/Sec	The total number of packets per second that are covered by this priority.
PAUSE INDICATION	
Per prio sent pause frames	The number of pause frames that were sent to priority i. The untagged instance indicates global pause that were sent.
Per prio sent pause duration	The total duration in microseconds of pause that was sent to the other end to freeze the transmission on priority i.
Per prio rcv pause frames	The number of pause frames that were received for priority i. The untagged instance indicates global pause that were received
Per prio rcv pause duration	The total duration in microseconds of pause that was requested by the other end to freeze transmission on priority i.

7 OpenSM - Subnet Manager

OpenSM v3.3.11 is an InfiniBand Subnet Manager. In order to operate one host machine or more in the InfiniBand cluster., at least one Subnet Manger is required in the fabric.

Please use the embedded OpenSM in the WinOF package for testing purpose in small cluster. Otherwise, we recommend using OpenSM from FabricIT EFM™ or UFM® or MLNX-OS®.

OpenSM can run as a Windows service and can be started manually from the following directory: <installation_directory>\tools. OpenSM as a service will use the first active port, unless it receives a specific GUID.

OpenSM can be registered as a service from either the Command Line Interface (CLI) or the PowerShell.

The following are commands used from the CLI:

- ***To register it as a service execute the OpenSM service:***

```
sc create OpenSM binPath= "c:\Program Files\Mellanox\MLNX_VPI\IB\Tools\opensm.exe
-service" start= auto
```

- ***To start OpenSM as a service:***

```
sc start OpenSM
```

- ***To run OpenSM manually:***

```
opensm.exe
```

  For additional run options, enter: "`opensm.exe -h`"

The following are commands used from the PowerShell:

- ***To register it as a service execute the OpenSM service:***

```
New-Service -Name "OpenSM" -BinaryPathName "`"C:\Program Files\Mella-
nox\MLNX_VPI\IB\Tools\opensm.exe`" --service -L 128" -DisplayName "OpenSM" -
Description "OpenSM for IB subnet" -StartupType Automatic
```

- ***To start OpenSM as a service run:***

```
Start-Service OpenSM1
```

Notes

- For long term running, please avoid using the '-v' (verbosity) option to avoid exceeding disk quota.
- Running OpenSM on multiple servers may lead to incorrect OpenSM behavior.

  Please do not run more than two instances of OpenSM in the subnet.

8 InfiniBand Fabric

8.1 Network Direct Interface

The Network Direct Interface (NDI) architecture provides application developers with a networking interface that enables zero-copy data transfers between applications, kernel-bypass I/O generation and completion processing, and one-sided data transfer operations.

NDI is supported by Microsoft and is the recommended method to write InfiniBand application. NDI exposes the advanced capabilities of the Mellanox networking devices and allows applications to leverage advances of InfiniBand.

For further information please refer to:

http://msdn.microsoft.com/en-us/library/cc904397(v=vs.85).aspx

8.2 part_man - Virtual IPoIB Port Creation Utility

part_man is used to add/remove virtual IPoIB ports. Currently, each Mellanox IPoIB port can have a single virtual IPoIB only which is created with a default PKey value of 0xffff.

➢ ***Usage***

```
part_man.exe [-v] <show|add|rem> ["Local area connection #"]  [name]
```

- -v: increases verbosity level.
- Show: shows the currently configured virtual ipoib ports.
- Add: adds new virtual IPoIB port. Where add should be used with interface name, as it appears in Network connection in the control panel.
- Name: any printable name without quotations marks (“ ”), commas, and starting with i.
- Rem: removes existing virtual IPoIB port. Therefore, it requires running it with Show, then copy the parameters.

➢ ***Example***

Adding and removing virtual port:

```
part_man add "Ethernet 4" ipoib_4_1
Done...
Part_man show
Ethernet 6                      ipoib_4_1
part_man rem "Ethernet 6"  ipoib_4_1
Done
```

8.3 InfiniBand Fabric Diagnostic Utilities

The diagnostic utilities described in this chapter provide means for debugging the connectivity and status of InfiniBand (IB) devices in a fabric.

8.3.1 Utilities Usage

This section first describes common configuration, interface, and addressing for all the tools in the package. Then it provides detailed descriptions of the tools themselves including: operation, synopsis and options descriptions, error codes, and examples.

8.3.1.1 Common Configuration, Interface and Addressing

Topology File (Optional)

An InfiniBand fabric is composed of switches and channel adapter (HCA/TCA) devices. To identify devices in a fabric (or even in one switch system), each device is given a GUID (a MAC equivalent). Since a GUID is a non-user-friendly string of characters, it is better to alias it to a meaningful, user-given name. For this objective, the IB Diagnostic Tools can be provided with a "topology file", which is an optional configuration file specifying the IB fabric topology in user-given names.

For diagnostic tools to fully support the topology file, the user may need to provide the local system name (if the local hostname is not used in the topology file).

To specify a topology file to a diagnostic tool use one of the following two options:

1. On the command line, specify the file name using the option '`-t <topology file name>`'
2. Define the environment variable IBDIAG_TOPO_FILE

To specify the local system name to a diagnostic tool, use one of the following two options:

1. On the command line, specify the system name using the option '`-s <local system name>`'
2. Define the environment variable IBDIAG_SYS_NAME

8.3.1.2 IB Interface Definition

The diagnostic tools installed on a machine connect to the IB fabric by means of an HCA port through which they send MADs. To specify this port to an IB diagnostic tool use one of the following options:

1. On the command line, specify the port number using the option '-p <local port number>' (see below)
2. Define the environment variable IBDIAG_PORT_NUM

In case more than one HCA device is installed on the local machine, it is necessary to specify the device's index to the tool as well. For this use on of the following options:

1. On the command line, specify the index of the local device using the following option: '-i <index of local device>'
2. Define the environment variable IBDIAG_DEV_IDX

8.3.1.3 Addressing

This section applies to the `ibdiagpath` tool only. A tool command may require defining the destination device or port to which it applies.

The following addressing modes can be used to define the IB ports:

- Using a Directed Route to the destination: (Tool option '-d')

  This option defines a directed route of output port numbers from the local port to the destination.

- Using port LIDs: (Tool option '-l'):

  In this mode, the source and destination ports are defined by means of their LIDs. If the fabric is configured to allow multiple LIDs per port, then using any of them is valid for defining a port.

- Using port names defined in the topology file: (Tool option '-n')

  This option refers to the source and destination ports by the names defined in the topology file. (Therefore, this option is relevant only if a topology file is specified to the tool.) In this mode, the tool uses the names to extract the port LIDs from the matched topology, then the tool operates as in the '-l' option.

8.3.2 ibdiagnet

```
ibdiagnet [-c <count>] [-v] [-r] [-o <out-dir>]
    [-t <topo-file>] [-s <sys-name>] [-i <dev-index>] [-p <port-num>]
    [-pm] [-pc] [-P <<PM counter>=<Trash Limit>>]
    [-lw <1x|4x|12x>] [-ls <2.5|5|10>]
    [-skip <dup_guids|zero_guids|pm|logical_state>]
```

8.3.2.1 ibdiagnet Options

Table 11 - ibdiagnet Options

Flag	Description
-c <count>	Min number of packets to be sent across each link (default = 10
-v	Enable verbose mode
-r	Provides a report of the fabric qualities
-o <out-dir>	Specifies the directory where the output files will be placed (default = /tmp)
-t <topo-file>	Specifies the topology file name
-s <sys-name>	Specifies the local system name. Meaningful only if a topology file is specified
-i <dev-index>	Specifies the index of the device of the port used to connect to the IB fabric (in case of multiple devices on the local system)
-p <port-num>	Specifies the local device's port num used to connect to the IB fabric
-pm	Dump all the fabric links, pm Counters into ibdiagnet.pm
-pc	Reset all the fabric links pmCounters
-P <PM=<Trash>>	If any of the provided pm is greater than its provided value, print it to screen
-lw <1x|4x|12x>	Specifies the expected link width
-ls <2.5|5|10>	Specifies the expected link speed
-skip <skip-option(s)>	Skip the executions of the selected checks. Skip options (one or more can be specified): dup_guids zero_guids pm logical_state part ipoib all

8.3.2.2 ibdiagnet Output Files

Table 12 - ibdiagnet Output Files

Output File	Description
ibdiagnet.log	A dump of all the application reports generate according to the provided flags
ibdiagnet.lst	List of all the nodes, ports and links in the fabric
ibdiagnet.fdbs	A dump of the unicast forwarding tables of the fabric switches
ibdiag-net.mcfdbs	A dump of the multicast forwarding tables of the fabric switches
ibdiag-net.masks	In case of duplicate port/node Guids, these file include the map between masked Guid and real Guids
ibdiagnet.sm	List of all the SM (state and priority) in the fabric
ibdiagnet.pm	A dump of the pm Counters values, of the fabric links
ibdiagnet.pkey	A dump of the existing partitions and their member host ports
ibdiagnet.mcg	A dump of the multicast groups, their properties and member host ports
ibdiagnet.db	A dump of the internal subnet database. This file can be loaded in later runs using the -load_db option

In addition to generating the files above, the discovery phase also checks for duplicate node/port GUIDs in the IB fabric. If such an error is detected, it is displayed on the standard output. After the discovery phase is completed, directed route packets are sent multiple times (according to the -c option) to detect possible problematic paths on which packets may be lost. Such paths are explored, and a report of the suspected bad links is displayed on the standard output.

After scanning the fabric, if the `-r` option is provided, a full report of the fabric qualities is displayed. This report includes:

- SM report
- Number of nodes and systems
- Hop-count information: maximal hop-count, an example path, and a hop-count histogram
- All CA-to-CA paths traced
- Credit loop report
- mgid-mlid-HCAs multicast group and report
- Partitions report
- IPoIB report

In case the IB fabric includes only one CA, then CA-to-CA paths are not reported. Furthermore, if a topology file is provided, ibdiagnet uses the names defined in it for the output reports.

8.3.2.3 ibdiagnet Error Codes

```
1 - Failed to fully discover the fabric
2 - Failed to parse command line options
3 - Failed to interact with IB fabric
4 - Failed to use local device or local port
5 - Failed to use Topology File
6 - Failed to load required Package
```

8.3.3 ibportstate

Enables querying the logical (link) and physical port states of an InfiniBand port. It also allows adjusting the link speed that is enabled on any InfiniBand port.

If the queried port is a *switch* port, then ibportstate can be used to

- Disable, enable or reset the port
- Validate the port's link width and speed against the peer port

8.3.3.1 ibportstate Applicable Hardware

All InfiniBand devices.

8.3.3.2 ibportstate Synopsis

```
ibportstate [-d] [-e] [-v] [-V] [-D] [-L] [-G] [-s <smlid>] \            [-C
<ca_name>] [-P <ca_port>] [-u] [-t <timeout_ms>]       \                [<dest
dr_path|lid|guid>] <portnum> [<op> [<value>]]
```

8.3.3.3 ibportstate Options

The table below lists the various flags of the command.

Table 13 - ibportstate Flags and Options

Flag	Description
-h/--help	Print the help menu
-d/--debug	Raise the IB debug level. May be used several times for higher debug levels (-ddd or -d -d -d)
-e/--errors	Show send and receive errors (timeouts and others)
-v/--verbose	Increase verbosity level. May be used several times for additional verbosity (-vvv or -v -v -v)
-V/--version	Show version info
-D/--Direct	Use directed path address arguments. The path is a comma separated list of out ports. Examples: '0' – self port '0,1,2,1,4' – out via port 1, then 2, ...
-L/--Lid	Use Lid address argument

Table 13 - ibportstate Flags and Options (Continued)

Flag	Description
-G/--Guid	Use GUID address argument. In most cases, it is the Port GUID. Example: '0x08f1040023'
-s/--sm_port	Use <smlid> as the target lid for SM/SA queries
-C/--Ca	Use the specified channel adapter or router
-P/--Port	Use the specified port
-u/--usage	Usage message
-t/--timeout	Override the default timeout for the solicited MADs [msec]
<dest dr_path | lid | guid>	Destination's directed path, LID, or GUID.
<portnum>	Destination's port number
<op> [<value>]	Define the allowed port operations: enable, disable, reset, speed, and query

In case of multiple channel adapters (CAs) or multiple ports without a CA/port being specified, a port is chosen by the utility according to the following criteria:

1. The first ACTIVE port that is found.
2. If not found, the first port that is UP (physical link state is LinkUp).

Examples

1. Query the status of Port 1 of CA mlx4_0 (using ibstatus) and use its output (the LID – 3 in this case) to obtain additional link information using ibportstate.

```
> ibstat
CA type: MT4099
Number of ports: 2
Firmware version: 2.11.536
Hardware version: 0
Node GUID: 0x0002c903002e6670
System image GUID: 0x0002c903002e6673
Port 1:
Physical state: Disabled
Rate: 10
Base lid: 4
LMC: 0
SM lid: 2
Capability mask: 0x0251486a
Port GUID: 0x0002c903002e6671
Link layer: InfiniBand

> ibportstate -C mlx4_0 4 1 query
PortInfo:
# Port info: Lid 3 port 1
LinkState:.....................Initialize
PhysLinkState:.................LinkUp
LinkWidthSupported:.............1X or 4X
```

```
LinkWidthEnabled:.............1X or 4X
LinkWidthActive:..............4X
LinkSpeedSupported:...........2.5 Gbps or 5.0 Gbps
LinkSpeedEnabled:.............2.5 Gbps or 5.0 Gbps
LinkSpeedActive:..............5.0 Gbps
```

2. Query the status of two channel adapters using directed paths.

```
>  ibportstate -C mlx4_0 -D 0 1
PortInfo:
# Port info: DR path slid 65535; dlid 65535; 0 port 1
LinkState:....................Initialize
PhysLinkState:................LinkUp
LinkWidthSupported:...........1X or 4X
LinkWidthEnabled:.............1X or 4X
LinkWidthActive:..............4X
LinkSpeedSupported:...........2.5 Gbps or 5.0 Gbps
LinkSpeedEnabled:.............2.5 Gbps or 5.0 Gbps
LinkSpeedActive:..............5.0 Gbps

>  ibportstate -C mthca0 -D 0 1
PortInfo:
# Port info: DR path slid 65535; dlid 65535; 0 port 1
LinkState:....................Down
PhysLinkState:................Polling
LinkWidthSupported:...........1X or 4X
LinkWidthEnabled:.............1X or 4X
LinkWidthActive:..............4X
LinkSpeedSupported:...........2.5 Gbps
LinkSpeedEnabled:.............2.5 Gbps
LinkSpeedActive:..............2.5 Gbps
```

3. Change the speed of a port.

```
# First query for current configuration
>  ibportstate -C mlx4_0 -D 0 1
PortInfo:
# Port info: DR path slid 65535; dlid 65535; 0 port 1
LinkState:....................Initialize
PhysLinkState:................LinkUp
LinkWidthSupported:...........1X or 4X
LinkWidthEnabled:.............1X or 4X
LinkWidthActive:..............4X
LinkSpeedSupported:...........2.5 Gbps or 5.0 Gbps
LinkSpeedEnabled:.............2.5 Gbps or 5.0 Gbps
LinkSpeedActive:..............5.0 Gbps

# Now change the enabled link speed
>  ibportstate -C mlx4_0 -D 0 1 speed 2
ibportstate -C mlx4_0 -D 0 1 speed 2
Initial PortInfo:
# Port info: DR path slid 65535; dlid 65535; 0 port 1
```

```
LinkSpeedEnabled:.............2.5 Gbps

After PortInfo set:
# Port info: DR path slid 65535; dlid 65535; 0 port 1
LinkSpeedEnabled:.............5.0 Gbps (IBA extension)

# Show the new configuration
>  ibportstate -C mlx4_0 -D 0 1
PortInfo:
# Port info: DR path slid 65535; dlid 65535; 0 port 1
LinkState:.....................Initialize
PhysLinkState:.................LinkUp
LinkWidthSupported:............1X or 4X
LinkWidthEnabled:.............1X or 4X
LinkWidthActive:..............4X
LinkSpeedSupported:............2.5 Gbps or 5.0 Gbps
LinkSpeedEnabled:.............5.0 Gbps (IBA extension)
LinkSpeedActive:..............5.0 Gbps
```

8.3.4 ibroute

Uses SMPs to display the forwarding tables for unicast (LinearForwardingTable or LFT) or multicast (MulticastForwardingTable or MFT) for the specified switch LID and the optional lid (mlid) range. The default range is all valid entries in the range of 1 to FDBTop.

8.3.4.1 ibroute Applicable Hardware

InfiniBand switches.

8.3.4.2 ibroute Synopsis

```
ibroute [-h] [-d] [-v] [-V] [-a] [-n] [-D] [-G] [-M] [-L] [-e] [-u] [-s <smlid>] \
[-C <ca_name>] [-P <ca_port>] [-t <timeout_ms>] \      [<dest dr_path|lid|guid>
[<startlid> [<endlid>]]]
```

8.3.4.3 ibroute Options

The table below lists the various ibroute flags of the command.

Table 14 - ibroute Flags and Options

Flag	Description
-h/--help	Print the help menu
-d/--debug	Raise the IB debug level. May be used several times for higher debug levels (-ddd or -d -d -d)
-a/--all	Show all LIDs in range, including invalid entries
-v/--verbose	Increase verbosity level. May be used several times for additional verbosity (-vvv or -v -v -v)
-V/--version	Show version info

Table 14 - ibroute Flags and Options

Flag	Description
-n/--no_dests	Do not try to resolve destinations
-D/--Direct	Use directed path address arguments. The path is a comma separated list of out ports. Examples: ‘0’ – self port ‘0,1,2,1,4’ – out via port 1, then 2, ...
-G/--Guid	Use GUID address argument. In most cases, it is the Port GUID. Example: ‘0x08f1040023’
-M/--Multicast	Show multicast forwarding tables. The parameters <startlid> and <endlid> specify the MLID range.
-L/--Lid	Use Lid address argument
-u/--usage	Usage message
-e/--errors	Show send and receive errors (timeouts and others)
-s/--sm_port <smlid>	Use <smlid> as the target LID for SM/SA queries
-C/--Ca <ca_name>	Use the specified channel adapter or router
-P/--Port <ca_port>	Use the specified port
-t/--timeout<timeout_ms>	Override the default timeout for the solicited MADs [msec]
<dest dr_path | lid | guid>	Destination’s directed path, LID, or GUID
<startlid>	Starting LID in an MLID range
<endlid>	Ending LID in an MLID range

Examples

1. Dump all Lids with valid out ports of the switch with Lid 2.

```
> ibroute 2
Unicast lids [0x0-0x8] of switch Lid 2 guid 0x0002c902fffff00a (MT47396 Infiniscale-
III Mellanox Technologies):
  Lid  Out   Destination
       Port     Info
0x0002 000 : (Switch portguid 0x0002c902fffff00a: 'MT47396 Infiniscale-III Mellanox
Technologies')
0x0003 021 : (Switch portguid 0x000b8cffff004016: 'MT47396 Infiniscale-III Mellanox
Technologies')
0x0006 007 : (Channel Adapter portguid 0x0002c90300001039: 'sw137 HCA-1')
0x0007 021 : (Channel Adapter portguid 0x0002c9020025874a: 'sw157 HCA-1')
0x0008 008 : (Channel Adapter portguid 0x0002c902002582cd: 'sw136 HCA-1')
5 valid lids dumped
```

2. Dump all Lids in the range 3 to 7 with valid out ports of the switch with Lid 2.

```
> ibroute 2 3 7
```

```
Unicast lids [0x3-0x7] of switch Lid 2 guid 0x0002c902fffff00a (MT47396 Infiniscale-
III Mellanox Technologies):
  Lid  Out   Destination
       Port     Info
0x0003 021 : (Switch portguid 0x000b8cffff004016: 'MT47396 Infiniscale-III Mellanox
Technologies')
0x0006 007 : (Channel Adapter portguid 0x0002c90300001039: 'sw137 HCA-1')
0x0007 021 : (Channel Adapter portguid 0x0002c9020025874a: 'sw157 HCA-1')
3 valid lids dumped
```

3. Dump all Lids with valid out ports of the switch with portguid `0x000b8cffff004016`.

```
> ibroute -G 0x000b8cffff004016
Unicast lids [0x0-0x8] of switch Lid 3 guid 0x000b8cffff004016 (MT47396 Infiniscale-
III Mellanox Technologies):
  Lid  Out   Destination
       Port     Info
0x0002 023 : (Switch portguid 0x0002c902fffff00a: 'MT47396 Infiniscale-III Mellanox
Technologies')
0x0003 000 : (Switch portguid 0x000b8cffff004016: 'MT47396 Infiniscale-III Mellanox
Technologies')
0x0006 023 : (Channel Adapter portguid 0x0002c90300001039: 'sw137 HCA-1')
0x0007 020 : (Channel Adapter portguid 0x0002c9020025874a: 'sw157 HCA-1')
0x0008 024 : (Channel Adapter portguid 0x0002c902002582cd: 'sw136 HCA-1')
5 valid lids dumped
```

4. Dump all non-empty mlids of switch with Lid 3.

```
> ibroute -M 3
Multicast mlids [0xc000-0xc3ff] of switch Lid 3 guid 0x000b8cffff004016 (MT47396
Infiniscale-III Mellanox Technologies):
            0                   1                   2
     Ports: 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4
 MLid
0xc000                                              x
0xc001                                              x
0xc002                                              x
0xc003                                              x
0xc020                  x
0xc021                  x
0xc022                  x
0xc023                  x
0xc024                  x
0xc040                  x
0xc041                  x
0xc042                  x
12 valid mlids dumped
```

8.3.5 ibdump

The ibdump tool dumps InfiniBand, Ethernet and all RoCE versions' traffic that flows to and from Mellanox ConnectX®-3/ConnectX®-3 Pro NIC's ports. It provides a similar functionality to the tcpdump tool on a 'standard' Ethernet port. The ibdump tool generates packet dump file in

.pcap format. This file can be loaded by the Wireshark tool (www.wireshark.org) for graphical traffic analysis.

This provides the ability to analyze network behavior and performance, and to debug applications that send or receive RDMA network traffic. Run "ibdump -h" to display a help message which details the tools options.

8.3.5.1 ibdump Synopsis

```
- ibdump
```

8.3.5.2 ibdump Options

The table below lists the various ibdump flags of the command.

Table 15 - ibdump Flags and Options

Flag	Description
-d, --ib-dev=<dev>	Use RDMA device <dev> (default first device found) The relevant devices can be listed by running the 'ibv_devinfo' command.
-i, --ib-port=<port>	Use port <port> of IB device (default 1)
-w, --write=<file>	Dump file name (default "sniffer.pcap") '-' stands for stdout - enables piping to tcpdump or tshark.
-o, --output=<file>	Alias for the '-w' option. Do not use - for backward compatibility
-b, --max-burst=<log2 burst>	log2 of the maximal burst size that can be captured with no packets loss. Each entry takes ~ MTU bytes of memory (default 12 - 4096 entries)
-s, --silent	Do not print progress indication.
--mem-mode <size>	When specified, packets are written to file only after the capture is stopped. It is faster than default mode (less chance for packet loss), but takes more memory. In this mode, ibdump stops after <size> bytes are captured
--decap	Decapsulate port mirroring headers. Should be used when capturing RSPAN traffic.
-h, --help	Display this help screen.
-v, --version	Print version information.

8.3.6 smpquery

Provides a basic subset of standard SMP queries to query Subnet management attributes such as node info, node description, switch info, and port info.

8.3.6.1 smpquery Applicable Hardware

All InfiniBand devices.

8.3.6.2 smpquery Synopsys

```
smpquery [-h] [-d] [-e] [-c] [-v] [-D] [-G] [-s <smlid>] [-L] [-u] [-V]         [-C
<ca_name>] [-P <ca_port>] [-t <timeout_ms>]     [--node-name-map <node-name-map>]
<op> <dest dr_path|lid|guid> [op params]
```

8.3.6.3 smpquery Options

The table below lists the various flags of the command.

Table 16 - smpquery Flags and Options

Flag	Description
-h/--help	Print the help menu
-d/--debug	Raise the IB debug level. May be used several times for higher debug levels (-ddd or -d -d -d)
-e/--errors	Show send and receive errors (timeouts and others)
-v/--verbose	Increase verbosity level. May be used several times for additional verbosity (-vvv or -v -v -v)
-D/--Direct	Use directed path address arguments. The path is a comma separated list of out ports. Examples: ‘0’ – self port ‘0,1,2,1,4’ – out via port 1, then 2, ...
-G/--Guid	Use GUID address argument. In most cases, it is the Port GUID. Example: ‘0x08f1040023’
-s/--sm_port <smlid>	Use <smlid> as the target LID for SM/SA queries
-V/--version	Show version info
-L/--Lid	Use Lid address argument
-c/--combined	Use combined route address argument
-u/--usage	Usage message
-C/--Ca <ca_name>	Use the specified channel adapter or router
-P/--Port <ca_port>	Use the specified port
-t/--timeout <timeout_ms>	Override the default timeout for the solicited MADs [msec]
<op>	Supported operations: • NodeInfo (NI) <addr> • NodeDesc (ND) <addr> • PortInfo (PI) <addr> [<portnum>] • SwitchInfo (SI) <addr> • PKeyTable (PKeys) <addr> [<portnum>] • SL2VLTable (SL2VL) <addr> [<portnum>] • VLArbitration (VLArb) <addr> [<portnum>] • GUIDInfo (GI) <addr>

Table 16 - smpquery Flags and Options

Flag	Description
<dest dr_path | lid | guid>	Destination's directed path, LID, or GUID
--node-name-map <file>	Node name map file
-x/--extended	Use extended speeds

Examples

1. Query PortInfo by LID, with port modifier.

```
> smpquery portinfo 1 1
# Port info: Lid 1 port 1
Mkey:.........................0x0000000000000000
GidPrefix:....................0xfe80000000000000
Lid:..........................0x0001
SMLid:........................0x0001
CapMask:......................0x251086a
                              IsSM
                              IsTrapSupported
                              IsAutomaticMigrationSupported
                              IsSLMappingSupported
                              IsSystemImageGUIDsupported
                              IsCommunicatonManagementSupported
                              IsVendorClassSupported
                              IsCapabilityMaskNoticeSupported
                              IsClientRegistrationSupported
DiagCode:.....................0x0000
MkeyLeasePeriod:..............0
LocalPort:....................1
LinkWidthEnabled:.............1X or 4X
LinkWidthSupported:...........1X or 4X
LinkWidthActive:..............4X
LinkSpeedSupported:...........2.5 Gbps or 5.0 Gbps
LinkState:....................Active
PhysLinkState:................LinkUp
LinkDownDefState:.............Polling
ProtectBits:..................0
LMC:..........................0
LinkSpeedActive:..............5.0 Gbps
LinkSpeedEnabled:.............2.5 Gbps or 5.0 Gbps
NeighborMTU:..................2048
SMSL:.........................0
VLCap:........................VL0-7
InitType:.....................0x00
VLHighLimit:..................4
VLArbHighCap:.................8
VLArbLowCap:..................8
InitReply:....................0x00
```

```
MtuCap:.....2048
VLStallCount:.....0
HoqLife:.....31
OperVLs:.....VL0-3
PartEnforceInb:.....0
PartEnforceOutb:.....0
FilterRawInb:.....0
FilterRawOutb:.....0
MkeyViolations:.....0
PkeyViolations:.....0
QkeyViolations:.....0
GuidCap:.....128
ClientReregister:.....0
SubnetTimeout:.....18
RespTimeVal:.....16
LocalPhysErr:.....8
OverrunErr:.....8
MaxCreditHint:.....0
RoundTrip:.....0
```

2. Query SwitchInfo by GUID.

```
> smpquery -G switchinfo 0x000b8cffff004016
# Switch info: Lid 3
LinearFdbCap:.....49152
RandomFdbCap:.....0
McastFdbCap:.....1024
LinearFdbTop:.....8
DefPort:.....0
DefMcastPrimPort:.....0
DefMcastNotPrimPort:.....0
LifeTime:.....18
StateChange:.....0
LidsPerPort:.....0
PartEnforceCap:.....32
InboundPartEnf:.....1
OutboundPartEnf:.....1
FilterRawInbound:.....1
FilterRawOutbound:.....1
EnhancedPort0:.....0
```

3. Query NodeInfo by direct route.

```
> smpquery -D nodeinfo 0
# Node info: DR path slid 65535; dlid 65535; 0
BaseVers:.....1
ClassVers:.....1
NodeType:.....Channel Adapter
NumPorts:.....2
SystemGuid:.....0x0002c9030000103b
Guid:.....0x0002c90300001038
PortGuid:.....0x0002c90300001039
```

```
PartCap:.....128
DevId:.....0x634a
Revision:.....0x000000a0
LocalPort:.....1
VendorId:.....0x0002c9
```

8.3.7 perfquery

Queries InfiniBand ports' performance and error counters. Optionally, it displays aggregated counters for all ports of a node. It can also reset counters after reading them or simply reset them.

8.3.7.1 perfquery Applicable Hardware

All InfiniBand devices.

8.3.7.2 perfquery Synopsys

```
perfquery [-h] [-d] [-G] [--xmtsl, -X] [--xmtdisc, -D] [--rcvsl, -S] [--rcverr, -E]
[--smplctl, -c] [-a] [--Lid, -L] [--sm_port, -s <lid>] [--errors, -e] [--verbose, -
v] [--usage, -u][-l] [-r] [-C <ca_name>] [-P <ca_port>] [-R][-t <timeout_ms>] [-V]
[<lid|guid> [[port][reset_mask]]]
```

The table below lists the various flags of the command.

Table 17 - perfquery Flags and Options

Flag	Description
--help, -h	Print the help menu
--debug, -d	Raise the IB debug level. May be used several times for higher debug levels (-ddd or -d -d -d)
--Guid,-G	Use GUID address argument. In most cases, it is the Port GUID. Example: '0x08f1040023'
--xmtsl, -X	Show Xmt SL port counters
--rcvsl, -S	Show Rcv SL port counters
--xmtdisc, -D	Show Xmt Discard Details
--rcverr, -E	Show Rcv Error Details
--smplctl, -c	Show samples control
--all_ports, -a	Apply query to all ports
--Lid, -L	Use LID address argument
--sm_port, -s <lid>	SM port lid
--errors, -e	Show send and receive errors
--verbose, -v	Increase verbosity level
--usage, -u	Usage message

Table 17 - perfquery Flags and Options

Flag	Description
--loop_ports, -l	Loop ports
--reset_after_read, -r	Reset the counters after reading them
--Ca, -C <ca_name>	Use the specified channel adapter or router
--Port, -P <ca_port>	Use the specified port
--Reset_only, -R	Reset the counters
--timeout, -t <timeout_ms>	Override the default timeout for the solicited MADs [msec]
--version, -V	Show version info
<lid | guid> [[port][reset_mask]]	LID or GUID
--extended, -x	show extended port counters
--extended_speeds, -T	show port extended speeds counters
--oprcvcounters	show Rcv Counters per Op code
--flowctlcounters	show flow control counters
--vloppackets	show packets received per Op code per VL
--vlopdata	show data received per Op code per VL
--vlxmitflowctlerrors	show flow control update errors per VL
--vlxmitcounters	show ticks waiting to transmit counters per VL
--swportvlcong	show sw port VL congestion
--rcvcc	show Rcv congestion control counters
--slrcvfecn	show SL Rcv FECN counters
--slrcvbecn	show SL Rcv BECN counters
--xmitcc	show Xmit congestion control counters
--vlxmittimecc	show VL Xmit Time congestion control counters

Examples

```
perfquery -r 32 1   # read performance counters and reset
perfquery -e -r 32 1# read extended performance counters and reset
perfquery -R 0x20 1 # reset performance counters of port 1 only
perfquery -e -R 0x20 1# reset extended performance counters of port 1 only
perfquery -R -a 32  # reset performance counters of all ports
perfquery -R 32 2 0x0fff# reset only error counters of port 2
perfquery -R 32 2 0xf000# reset only non-error counters of port 2
```

1. Read local port's performance counters.

```
> perfquery
```

```
# Port counters: Lid 6 port 1
PortSelect:.....................1
CounterSelect:..................0x1000
SymbolErrors:...................0
LinkRecovers:...................0
LinkDowned:.....................0
RcvErrors:......................0
RcvRemotePhysErrors:............0
RcvSwRelayErrors:...............0
XmtDiscards:....................0
XmtConstraintErrors:............0
RcvConstraintErrors:............0
LinkIntegrityErrors:............0
ExcBufOverrunErrors:............0
VL15Dropped:....................0
XmtData:........................55178210
RcvData:........................55174680
XmtPkts:........................766366
RcvPkts:........................766315
```

2. Read performance counters from LID 2, all ports.

```
> smpquery -a 2
# Port counters: Lid 2 port 255
PortSelect:.....................255
CounterSelect:..................0x0100
SymbolErrors:...................65535
LinkRecovers:...................255
LinkDowned:.....................16
RcvErrors:......................657
RcvRemotePhysErrors:............0
RcvSwRelayErrors:...............70
XmtDiscards:....................488
XmtConstraintErrors:............0
RcvConstraintErrors:............0
LinkIntegrityErrors:............0
ExcBufOverrunErrors:............0
VL15Dropped:....................0
XmtData:........................129840354
RcvData:........................129529906
XmtPkts:........................1803332
RcvPkts:........................1799018
```

3. Read then reset performance counters from LID 2, port 1.

```
> perfquery  -r 2 1
# Port counters: Lid 2 port 1
PortSelect:.....................1
CounterSelect:..................0x0100
SymbolErrors:...................0
LinkRecovers:...................0
LinkDowned:.....................0
```

```
RcvErrors:.....0
RcvRemotePhysErrors:.....0
RcvSwRelayErrors:.....0
XmtDiscards:.....3
XmtConstraintErrors:.....0
RcvConstraintErrors:.....0
LinkIntegrityErrors:.....0
ExcBufOverrunErrors:.....0
VL15Dropped:.....0
XmtData:.....0
RcvData:.....0
XmtPkts:.....0
RcvPkts:.....0
```

8.3.8 ibping

ibping uses vendor MADs to validate connectivity between IB nodes. On exit, (IP) ping like output is shown. ibping is run as client/server, however the default is to run it as a client. Note also that in addition to ibping, a default server is implemented within the kernel.

8.3.8.1 ibping Synopsys

```
ibping  [-d(ebug)]  [-e(rr_show)]  [-v(erbose)] [-G(uid)] [-C ca_name] [-P ca_port]
[-s smlid] [-t(imeout)timeout_ms] [-V(ersion)] [-L(id)][-u(sage)] [-c ping_count] [-
f(lood)] [-o oui] [-S(erver)] [-h(elp)] <dest lid | guid>
```

8.3.8.2 ibping Options

The table below lists the various flags of the command.

Table 18 - ibping Flags and Options

Flag	Description
--count, -c <num>	Stops after count packets
-f, (--flood)	Floods destination: send packets back to back without delay
-o, (--oui)	Uses specified OUI number to multiplex vendor mads
--Server, -S	Starts in server mode (do not return)
--debug, -d/-ddd/ -d -d -d	Raises the IB debugging level
--errors, -e	Shows send and receive errors (timeouts and others)
--help, -h	Shows the usage message
--verbose, -v/-vvv/-v -v -v	Increases the application verbosity level
--version, -V	Shows the version info
--Lid, -L	Use LID address argument
--usage, -u	Usage message

Table 18 - ibping Flags and Options

Flag	Description
--Guid, -G	Uses GUID address argument. In most cases, it is the Port GUID. For example: "0x08f1040023"
--sm_port, -s <smlid>	Uses 'smlid' as the target lid for SM/SA queries
--Ca, -C <ca_name>	Uses the specified ca_name
--Port, -P <ca_port>	Uses the specified ca_port
--timeout, -t <timeout_ms>	Overrides the default timeout for the solicited mads

8.3.9 ibnetdiscover

ibnetdiscover performs IB subnet discovery and outputs a readable topology file. GUIDs, node types, and port numbers are displayed as well as port LIDs and NodeDescriptions. All nodes (and links) are displayed (full topology). Optionally, this utility can be used to list the current connected nodes by node-type. The output is printed to standard output unless a topology file is specified.

8.3.9.1 ibnetdiscover Synopsys

```
ibnetdiscover [-d(ebug)] [-e(rr_show)] [-v(erbose)] [-s(how)] [-l(ist)] [-
g(rouping)] [-H(ca_list)][-S(witch_list)] [-R(outer_list)] [-C ca_name] [-P
ca_port] [-t(imeout) timeout_ms] [-V(ersion)] [--outstanding_smps -o <val>] [-
u(sage)] [--node-name-map <node-name-map>] [--cache <filename>] [--load-cache
<filename>] [-p(orts)] [-m(ax_hops)]
[-h(elp)] [<topology-file>]
```

8.3.9.2 ibnetdiscover Options

The table below lists the various flags of the command.

Most OpenIB diagnostics take the following common flags. The exact list of supported flags per utility can be found in the usage message and can be shown using the util_name -h syntax.

Table 19 - ibnetdiscover Flags and Options

Flag	Description
-l, --list	Lists of connected nodes
-g, --grouping	Shows grouping. Grouping correlates InfiniBand nodes by different vendor specific schemes. It may also show the switch external ports correspondence.
-H, --Hca_list	Lists of connected CAs
-S, --Switch_list	Lists of connected switches
-R, --Router_list	Lists of connected routers
-s, --show	Shows progress information during discovery

Table 19 - ibnetdiscover Flags and Options

Flag	Description
--node-name-map <node-name-map>	Specifies a node name map. The node name map file maps GUIDs to more user friendly names. See "Topology File Format" on page 82.
--cache <filename>	Caches the ibnetdiscover network data in the specified filename. This cache may be used by other tools for later analysis
--load-cache <filename>	Loads and use the cached ibnetdiscover data stored in the specified filename. May be useful for outputting and learning about other fabrics or a previous state of a fabric
--diff <filename>	Loads cached ibnetdiscover data and do a diff comparison to the current network or another cache. A special diff output for ibnetdiscover output will be displayed showing differences between the old and current fabric. By default, the following are compared for differences: switches, channel adapters, routers, and port connections
--diffcheck <key(s)>	Specifies what diff checks should be done in the --diff option above. Comma separate multiple diff check key(s). The available diff checks are: sw = switches, ca = channel adapters, router = routers, port = port connections, lid = lids, nodedesc = node descriptions. Note that port, lid, and nodedesc are checked only for the node types that are specified (e.g. sw, ca, router). If port is specified alongside lid or nodedesc, remote port lids and node descriptions will also be compared
-p, --ports	Obtains a ports report which is a list of connected ports with relevant information (like LID, port-num, GUID, width, speed, and NodeDescription)
-m, --max_hops	Reports max hops discovered
--debug, -d/-ddd/ -d -d -d	Raises the IB debugging level
--errors, -e	Shows send and receive errors (timeouts and others)
--help, -h	Shows the usage message
--verbose,-v/-vv/ -v -v -v	Increases the application verbosity level
--version, -V	Shows the version info
--outstanding_smps -o <val>	Specifies the number of outstanding SMPs which should be issued during the scan
-usage, -u	Usages message
--Ca, -C <ca_name>	Uses the specified ca_name
--Port, -P <ca_port>	Uses the specified ca_port
--timeout, -t <timeout_ms>	Overrides the default timeout for the solicited mads
--full, -f	Shows full information (ports' speed and width)
--show, -s	Shows more information

8.3.9.3 Topology File Format

The topology file format is largely intuitive. Most identifiers are given textual names like vendor ID (vendid), device ID (device ID), GUIDs of various types (sysimgguid, caguid, switchguid, etc.). PortGUIDs are shown in parentheses (). For switches, this is shown on the switchguid line. For CA and router ports, it is shown on the connectivity lines. The IB node is identified followed by the number of ports and the node GUID. On the right of this line is a comment (#) followed by the NodeDescription in quotes. If the node is a switch, this line also contains whether switch port 0 is base or enhanced, and the LID and LMC of port 0. Subsequent lines pertaining to this node show the connectivity. On the left is the port number of the current node. On the right is the peer-node (node at other end of link). It is identified in quotes with nodetype followed by - followed by NodeGUID with the port number in square brackets. Further on the right is a comment (#). What follows the comment is dependent on the node type. If it is a switch node, it is followed by the NodeDescription in quotes and the LID of the peer node. If it is a CA or router node, it is followed by the local LID and LMC and then followed by the NodeDescription in quotes and the LID of the peer node. The active link width and speed are then appended to the end of this output line.

Example

```
# Topology file: generated on Tue Jun  5 14:15:10 2007
#
# Max of 3 hops discovered
# Initiated from node 0008f10403960558 port 0008f10403960559
```

Non-Chassis Nodes

When grouping is used, InfiniBand nodes are organized into chasses which are numbered. Nodes which cannot be determined to be in a chassis are displayed as "Non-Chassis Nodes". External ports are also shown on the connectivity lines.

```
vendid=0x8f1
devid=0x5a06
sysimgguid=0x5442ba00003000
switchguid=0x5442ba00003080(5442ba00003080)
Switch  24 "S-005442ba00003080"         # "ISR9024 Voltaire" base port 0 lid 6 lmc 0
[22]    "H-0008f10403961354"[1](8f10403961355)        # "MT23108 InfiniHost Mellanox
Technologies" lid 4 4xSDR
[10]    "S-0008f10400410015"[1]         # "SW-6IB4 Voltaire" lid 3 4xSDR
[8]     "H-0008f10403960558"[2](8f1040396055a)        # "MT23108 InfiniHost Mellanox
Technologies" lid 14 4xSDR
[6]     "S-0008f10400410015"[3]         # "SW-6IB4 Voltaire" lid 3 4xSDR
[12]    "H-0008f10403960558"[1](8f10403960559)        # "MT23108 InfiniHost Mellanox
Technologies" lid 10 4xSDR
vendid=0x8f1
devid=0x5a05
switchguid=0x8f10400410015(8f10400410015)
Switch  8 "S-0008f10400410015"          # "SW-6IB4 Voltaire" base port 0 lid 3 lmc 0
[6]     "H-0008f10403960984"[1](8f10403960985)        # "MT23108 InfiniHost Mellanox
Technologies" lid 16 4xSDR
[4]     "H-005442b100004900"[1](5442b100004901)       # "MT23108 InfiniHost Mellanox
Technologies" lid 12 4xSDR
[1]     "S-005442ba00003080"[10]               # "ISR9024 Voltaire" lid 6 1xSDR
```

```
[3]     "S-005442ba00003080"[6]         # "ISR9024 Voltaire" lid 6 4xSDR
vendid=0x2c9
devid=0x5a44
caguid=0x8f10403960984
Ca      2 "H-0008f10403960984"          # "MT23108 InfiniHost Mellanox Technologies"
[1](8f10403960985)     "S-0008f10400410015"[6]         # lid 16 lmc 1 "SW-6IB4 Vol-
taire" lid 3 4xSDR
vendid=0x2c9
devid=0x5a44
caguid=0x5442b100004900
Ca      2 "H-005442b100004900"          # "MT23108 InfiniHost Mellanox Technologies"
[1](5442b100004901)     "S-0008f10400410015"[4]         # lid 12 lmc 1 "SW-6IB4 Vol-
taire" lid 3 4xSDR
vendid=0x2c9
devid=0x5a44
caguid=0x8f10403961354
Ca      2 "H-0008f10403961354"          # "MT23108 InfiniHost Mellanox Technologies"
[1](8f10403961355)     "S-005442ba00003080"[22]              # lid 4 lmc 1 "ISR9024
Voltaire" lid 6 4xSDR
vendid=0x2c9
devid=0x5a44
caguid=0x8f10403960558
Ca      2 "H-0008f10403960558"          # "MT23108 InfiniHost Mellanox Technologies"
[2](8f1040396055a)     "S-005442ba00003080"[8]         # lid 14 lmc 1 "ISR9024 Vol-
taire" lid 6 4xSDR
[1](8f10403960559)     "S-005442ba00003080"[12]             # lid 10 lmc 1 "ISR9024
Voltaire" lid 6 1xSDR
```

Node Name Map File Format

The node name map is used to specify user friendly names for nodes in the output. GUIDs are used to perform the lookup.

```
# comment
<guid> "<name>"
```

Example

```
# IB1
# Line cards
0x0008f104003f125c "IB1 (Rack 11 slot 1   ) ISR9288/ISR9096 Voltaire sLB-24D"
0x0008f104003f125d "IB1 (Rack 11 slot 1   ) ISR9288/ISR9096 Voltaire sLB-24D"
0x0008f104003f10d2 "IB1 (Rack 11 slot 2   ) ISR9288/ISR9096 Voltaire sLB-24D"
0x0008f104003f10d3 "IB1 (Rack 11 slot 2   ) ISR9288/ISR9096 Voltaire sLB-24D"
0x0008f104003f10bf "IB1 (Rack 11 slot 12  ) ISR9288/ISR9096 Voltaire sLB-24D"
# Spines
0x0008f10400400e2d "IB1 (Rack 11 spine 1   ) ISR9288 Voltaire sFB-12D"
0x0008f10400400e2e "IB1 (Rack 11 spine 1   ) ISR9288 Voltaire sFB-12D"
0x0008f10400400e2f "IB1 (Rack 11 spine 1   ) ISR9288 Voltaire sFB-12D"
0x0008f10400400e31 "IB1 (Rack 11 spine 2   ) ISR9288 Voltaire sFB-12D"
0x0008f10400400e32 "IB1 (Rack 11 spine 2   ) ISR9288 Voltaire sFB-12D"
# GUID   Node Name
0x0008f10400411a08 "SW1  (Rack  3) ISR9024 Voltaire 9024D"
0x0008f10400411a28 "SW2  (Rack  3) ISR9024 Voltaire 9024D"
0x0008f10400411a34 "SW3  (Rack  3) ISR9024 Voltaire 9024D"
0x0008f104004119d0 "SW4  (Rack  3) ISR9024 Voltaire 9024D"
```

8.3.10 ibtracert

ibtracert uses SMPs to trace the path from a source GID/LID to a destination GID/LID. Each hop along the path is displayed until the destination is reached or a hop does not respond. By using the -m option, multicast path tracing can be performed between source and destination nodes.

8.3.10.1 ibtracert Synopsys

```
ibtracert  [-d(ebug)]  [-v(erbose)]  [-D(irect)] [-L(id)] [-e(rrors)] [-u(sage)] [-
G(uids)] [-f(orce)] [-n(o_info)] [-m mlid] [-s smlid] [-C ca_name][-P ca_port] [-
t(imeout) timeout_ms]  [-V(ersion)]  [--node-name--map  <node-name-map>]  [-h(elp)]
[<dest dr_path|lid|guid> [<startlid> [<endlid>]]
```

8.3.10.2 ibtracert Options

The table below lists the various flags of the command.

Most OpenIB diagnostics take the following common flags. The exact list of supported flags per utility can be found in the usage message and can be shown using the util_name -h syntax.

Table 20 - ibtracert Flags and Options

Flag	Description
--force, -f	Force
-n, --no_info	Simple format; do not show additional information
--mlid, -m <mlid>	Shows the multicast trace of the specified mlid
--node-name-map <node-name-map>	Specifies a node name map. The node name map file maps GUIDs to more user friendly names. See "Topology File Format" on page 82.
--debug, -d/-ddd/-d -d -d	Raises the IB debugging level

Table 20 - ibtracert Flags and Options

Flag	Description
--Lid, -L	Uses LID address argument
--errors, -e	Shows send and receive errors
--usage, -u	Usage message
--Guid, -G	Uses GUID address argument. In most cases, it is the Port GUID. Example: "0x08f1040023"
--sm_port, -s <smlid>	Uses 'smlid' as the target lid for SM/SA queries
--help, -h	Shows the usage message
-verbose, -v/-vv/-v -v -v	Increases the application verbosity level
--version, -V	Shows the version info
--Ca, -C <ca_name>	Uses the specified ca_name
--Port, -P <ca_port>	Uses the specified ca_port
--timeout, -t <timeout_ms>	Overrides the default timeout for the solicited mads

Examples

- Unicast examples

```
ibtracert 4 16              # show path between lids 4 and 16
ibtracert -n 4 16           # same, but using simple output format
ibtracert -G 0x8f1040396522d 0x002c9000100d051  # use guid addresses
```

- Multicast example

```
ibtracert -m 0xc000 4 16    # show multicast path of mlid 0xc000 between lids 4 and
16
```

8.3.11 sminfo

Optionally sets and displays the output of a sminfo query in a readable format. The target SM is the one listed in the local port info, or the SM specified by the optional SM lid or by the SM direct routed path.

Using sminfo for any purposes other than simple query may result in a malfunction of the target SM.

8.3.11.1 sminfo Synopsys

```
sminfo  [-d(ebug)]  [-e(rr_show)]  [-s  state] [-p  prio] [-a activity] [-D(irect)]
[-L(id)] [-u(sage)] [-G(uid)]  [-C ca_name] [-P ca_port] [-t(imeout) timeout_ms] [-
V(ersion)] [-h(elp)] sm_lid | sm_dr_path [modifier]
```

8.3.11.2 sminfo Options

The table below lists the various flags of the command.

Most OpenIB diagnostics take the following common flags. The exact list of supported flags per utility can be found in the usage message and can be shown using the util_name -h syntax..

Table 21 - sminfo Flags and Options

Flag	Description
--state, -s	Sets SM state: • 0 - not active • 1 - discovering • 2 - standby • 3 - master
--priority, -p	Sets priority (0-15)
--activity, -a	Sets activity count
--debug, -d/-ddd/-d -d -d	Raises the IB debugging level
--Direct, -D	Uses directed path address arguments. The path is a comma separated list of out ports. Examples: • "0" # self port • "0,1,2,1,4" # out via port 1, then 2, ...
--Lid, -L	Uses LID address argument
--usage, -u	Usage message
--errors, -e	Shows send and receive errors (timeouts and others)
--Guid, -G	Uses GUID address argument. In most cases, it is the Port GUID. Example: "0x08f1040023"
--help, -h	Shows the usage message
-verbose, -v/-vv/-v -v -v	Increases the application verbosity level
--version, -V	Shows the version info
--Ca, -C <ca_name>	Uses the specified ca_name
--Port, -P <ca_port>	Uses the specified ca_port
--timeout, -t <timeout_ms>	Overrides the default timeout for the solicited mads

Examples

```
sminfo                  # local ports sminfo
sminfo 32               # show sminfo of lid 32
sminfo  -G 0x8f1040023  # same but using guid address
```

8.3.12 ibclearerrors

ibclearerrors is a script which clears the PMA error counters in PortCounters by either waking the InfiniBand subnet topology or using an already saved topology file.

8.3.12.1 ibclearerrors Synopsys

```
ibclearerrors [-h] [-N | -nocolor] [<topology-file> | -C ca_name -P ca_port -t(ime-
out) timeout_ms]
```

8.3.12.2 ibclearerrors Options

The table below lists the various flags of the command.

Table 22 - ibclearerrors Flags and Options

Flag	Description
-C <ca_name>	Use the specified ca_name
-P <ca_port>	Use the specified ca_port
-t <timeout_ms>	Override the default timeout for the solicited mads

8.3.13 ibstat

ibstat is a binary which displays basic information obtained from the local IB driver. Output includes LID, SMLID, port state, link width active, and port physical state.

8.3.13.1 ibstat Synopsys

```
ibstat [-d(ebug)] [-l(ist_of_cas)] [-s(hort)] [-p(ort_list)] [-V(ersion)] [-h]
<ca_name> [portnum]
```

8.3.13.2 ibstat Options

The table below lists the various flags of the command.

Most OpenIB diagnostics take the following common flags. The exact list of supported flags per utility can be found in the usage message and can be shown using the util_name -h syntax..

Table 23 - ibstat Flags and Options

Flag	Description
-l, --list_of_cas	List all IB devices
-s, --short	Short output
-p, --port_list	Show port list

Table 23 - ibstat Flags and Options

Flag	Description
ca_name	InfiniBand device name
portnum	Port number of InfiniBand device
--debug, -d/-ddd/-d -d -d	Raise the IB debugging level
--help, -h	Show the usage message
-verbose, -v/-vv/-v -v -v	Increase the application verbosity level
--version, -V	Show the version info
--usage, -u	usage message

Examples

```
ibstat            # display status of all ports on all IB devices
ibstat -l         # list all IB devices
ibstat -p         # show port guids
ibstat mthca0 2   # show status of port 2 of 'mthca0'
```

8.3.14 vstat

vstat is a binary which displays information on the HCA attributes.

- vstat synopsys is

```
vstat [-v] [-c] [-m] [-p N]
```

8.3.14.1 vstat Options

The table below lists the various flags of the command..

Table 24 - vstat Flags and Options

Flag	Description
-v	Verbose mode
-c	HCA error/statistic counters
-m	more verbose mode
-p N	repeat every N sec

8.3.15 osmtest

osmtest is a test program to validate InfiniBand subnet manager and administration (SM/SA). Default is to run all flows with the exception of the QoS flow. osmtest provides a test suite for opensm. osmtest has the following capabilities and testing flows:

- It creates an inventory file of all available Nodes, Ports, and PathRecords, including all their fields.

- It verifies the existing inventory, with all the object fields, and matches it to a pre-saved one.
- A Multicast Compliancy test.
- An Event Forwarding test.
- A Service Record registration test.
- An RMPP stress test.
- A Small SA Queries stress test.

It is recommended that after installing opensm, the user should run "osmtest -f c" to generate the inventory file, and immediately afterwards run "osmtest -f a" to test OpenSM.

Additionally, it is recommended to create the inventory when the IB fabric is stable, and occasionally run "osmtest -v" to verify that nothing has changed.

8.3.15.1 osmtest Synopsys

```
osmtest [-f(low) <c|a|v|s|e|f|m|q|t>] [-w(ait) <trap_wait_time>] [-d(ebug) <num-
ber>] [-m(ax_lid) <LID in hex>] [-g(uid)[=]<GUID in hex>] [-p(ort)] [-i(nventory)
<filename>] [-s(tress)] [-M(ulticast_Mode)] [-t(imeout) <milliseconds>] [-l | --
log_file] [-v] [-vf <flags>] [-h(elp)]
```

8.3.15.2 osmtest Options

The table below lists the various flags of the command.

Table 25 - osmtest Flags and Options

Flag	Description
-f, --flow	This option directs osmtest to run a specific flow. The following is the flow's description: • c = create an inventory file with all nodes, ports and paths • a = run all validation tests (expecting an input inventory) • v = only validate the given inventory file • s = run service registration, deregistration, and lease test • e = run event forwarding test • f = flood the SA with queries according to the stress mode • m = multicast flow • q = QoS info: dump VLArb and SLtoVL tables • t = run trap 64/65 flow (this flow requires running of external tool, default is all flows except QoS)
-w, --wait	This option specifies the wait time for trap 64/65 in seconds It is used only when running -f t - the trap 64/65 flow (default to 10 sec)
-d, --debug	This option specifies a debug option. These options are not normally needed. The number following -d selects the debug option to enable as follows: OPT Description --- ---------- -d0 - Ignore other SM nodes -d1 - Force single threaded dispatching -d2 - Force log flushing after each log message -d3 - Disable multicast support

Table 25 - osmtest Flags and Options

Flag	Description
-m, --max_lid	This option specifies the maximal LID number to be searched for during inventory file build (default to 100)
-g, --guid	This option specifies the local port GUID value with which OpenSM should bind. OpenSM may be bound to 1 port at a time. If GUID given is 0, OpenSM displays a list of possible port GUIDs and waits for user input. Without -g, OpenSM tries to use the default port
-p, --port	This option displays a menu of possible local port GUID values with which osmtest could bind
-i, --inventory	This option specifies the name of the inventory file Normally, osmtest expects to find an inventory file, which osmtest uses to validate real-time information received from the SA during testing If -i is not specified, osmtest defaults to the file osmtest.dat See -c option for related information
-s, --stress	This option runs the specified stress test instead of the normal test suite Stress test options are as follows: OPT Description --- ---------- -s1 - Single-MAD (RMPP) response SA queries -s2 - Multi-MAD (RMPP) response SA queries -s3 - Multi-MAD (RMPP) Path Record SA queries -s4 - Single-MAD (non RMPP) get Path Record SA queries Without -s, stress testing is not performed
-M, --Multicast_Mode	This option specify length of Multicast test: OPT Description --- ---------- -M1 - Short Multicast Flow (default) - single mode -M2 - Short Multicast Flow - multiple mode -M3 - Long Multicast Flow - single mode -M4 - Long Multicast Flow - multiple mode • Single mode - Osmtest is tested alone, with no other apps that interact with OpenSM MC • Multiple mode - Could be run with other apps using MC with OpenSM. Without -M, default flow testing is performed
-t	This option specifies the time in milliseconds used for transaction timeouts. Specifying -t 0 disables timeouts. Without -t, OpenSM defaults to a timeout value of 200 milliseconds.
-l, --log_file	This option defines the log to be the given file. By default the log goes to stdout.
-v	This option increases the log verbosity level. The -v option may be specified multiple times to further increase the verbosity level. See the -vf option for more information about. log verbosity.
-V	This option sets the maximum verbosity level and forces log flushing. The -V is equivalent to '-vf0xFF -d 2'. See the -vf option for more information about. log verbosity.

Table 25 - osmtest Flags and Options

Flag	Description
-vf	This option sets the log verbosity level. A flags field must follow the -D option. A bit set/clear in the flags enables/disables a specific log level as follows: BIT LOG LEVEL ENABLED ---- ---------- 0x01 - ERROR (error messages) 0x02 - INFO (basic messages, low volume) 0x04 - VERBOSE (interesting stuff, moderate volume) 0x08 - DEBUG (diagnostic, high volume) 0x10 - FUNCS (function entry/exit, very high volume) 0x20 - FRAMES (dumps all SMP and GMP frames) 0x40 - ROUTING (dump FDB routing information) 0x80 - currently unused. Without -vf, osmtest defaults to ERROR + INFO (0x3) Specifying -vf 0 disables all messages Specifying -vf 0xFF enables all messages (see -V) High verbosity levels may require increasing the transaction timeout with the -t option
-h, --help	Display this usage info then exit.

8.3.16 ibaddr

Displays the lid (and range) as well as the GID address of the port specified (by DR path, lid, or GUID) or the local port by default.

This utility can be used as simple address resolver.

8.3.16.1 ibaddr Synopsis

```
ibaddr [-d(ebug)] [-D(irect)] [-G(uid)] [-l(id_show)] [-g(id_show)] [-C
      ca_name] [-P ca_port] [-t(imeout)  timeout_ms]  [-V(ersion)]  [-h(elp)]
      [<lid | dr_path | guid>]
```

8.3.16.2 ibaddr Options

Table 26 - ibaddr Flags and Options

Flags	Description
-G, --Guid	shows lid range and gid for GUID address
-l, --lid_show	shows lid range only
-L, --Lid_show	shows lid range (in decimal) only
-g, --gid_show	shows gid address only

Table 26 - ibaddr Flags and Options

Flags	Description
Debugging Flags	**Description**
NOTE: Most OpenIB diagnostics take the following common flags. The exact list of supported flags per utility can be found in the usage message and can be shown using the util_name -h syntax.	
-d	Raises the IB debugging level. Can be used several times (-ddd or -d -d -d).
-e	shows send and receive errors (timeouts and others)
-h	shows the usage message
-v	Increases the application verbosity level. Can be used several times (-vv or -v -v -v)
-v	shows the version info.
Addressing Flags	**Description**
-D	Uses directed path address arguments. The path is a comma separated list of out ports. Examples: "0" # self port "0,1,2,1,4" # out via port 1, then 2, ...
-G	Uses GUID address argument. In most cases, it is the Port GUID. Example: "0x08f1040023"
-s <smlid>	Uses 'smlid' as the target lid for SM/SA queries.
Other Common Flags	**Description**
-C <ca_name>	Uses the specified ca_name.
-P <ca_port>	Uses the specified ca_port.
-t <timeout_ms>	Overrides the default timeout for the solicited mads.

8.3.16.3 Multiple CA/Multiple Port Support

When no IB device or port is specified, the port to use is selected by the following criteria:

1. The first port that is ACTIVE.
2. If not found, the first port that is UP (physical link up).

If a port and/or CA name is specified, the user request is attempted to be fulfilled, and will fail if it is not possible.

Examples

```
ibaddr                  # local port´s address
ibaddr 32               # show lid range and gid of lid 32
ibaddr -G 0x8f1040023   # same but using guid address
ibaddr -l 32         # show lid range only
ibaddr -L 32         # show decimal lid range only
ibaddr -g 32         # show gid address only
```

8.3.17 ibcacheedit

ibcacheedit allows users to edit an ibnetdiscover cache created through the --cache option in ibnetdiscover(8).

8.3.17.1 ibcacheedit Synopsis

```
ibcacheedit [--switchguid BEFOREGUID:AFTERGUID] [--caguid BEFORE:AFTER]
       [--sysimgguid                  BEFOREGUID:AFTERGUID]               [--port-
guid
       NODEGUID:BEFOREGUID:AFTERGUID] [-h(elp)] <orig.cache> <new.cache>
```

8.3.17.2 ibcacheedit Options

Table 27 - ibcacheedit Flags and Options

Flags	Description
--switchguid BEFOREGUID:AFTERGUID	Specifies a switchguid that should be changed. The before and after guid should be separated by a colon. On switches, port guids are identical to the switch guid, so port guids will be adjusted as well on switches.
--caguid BEFOREGUID:AFTERGUID	Specifies a caguid that should be changed. The before and after guid should be separated by a colon.
--sysimgguid BEFOREGUID:AFTERGUID	Specifies a sysimgguid that should be changed. The before and after guid should be separated by a colon.
--portguid NODEGUID:BEFOREGUID:AFTER-GUID	Specifies a portguid that should be changed. The node-guid of the port (e.g. switchguid or caguid) should be specified first, followed by a colon, the before port guid, another colon, then the after port guid. On switches, port guids are identical to the switch guid, so the switch guid will be adjusted as well on switches.
Debugging Flags	**Description**
NOTE: Most OpenIB diagnostics take the following common flags. The exact list of supported flags per util-ity can be found in the usage message and can be shown using the util_name -h syntax.	
-h	shows the usage message
-v	shows the version info.

8.3.18 iblinkinfo

iblinkinfo reports link info for each port in an IB fabric, node by node. Optionally, iblinkinfo can do partial scans and limit its output to parts of a fabric.

8.3.18.1 iblinkinfo Synopsis

```
[-hcdl -C <ca_name> -P <ca_port> -p -S <port_guid> -G <port_guid> -D
       <direct_route> --load-cache <filename>]
```

8.3.18.2 iblinkinfo Flags and Options

Table 28 - iblinkinfo Flags and Options

Flags	Description
-S <port_guid> -G <port_guid> --port-guid	Starts partial scan at the port specified by <port_guid> (hex format)
-D <direct_route>	Starts partial scan at the port specified by the direct route path.
-l	Prints all information for each link on one line. Default is to print a header with the node information and then a list for each port (useful for grep´ing output).
-d	Prints only nodes which have a port in the "Down" state.
-p	Prints additional port settings (<Life-Time>,<HoqLife>,<VLStall-Count>)
-C <ca_name>	Uses the specified ca_name for the search.
-P <ca_port>	Uses the specified ca_port for the search.
-R	(This option is obsolete and does nothing)
--load-cache <filename>	Loads and use the cached ibnetdiscover data stored in the specified filename. May be useful for outputting and learning about other fabrics or a previous state of a fabric. Cannot be used if user specifies a direct route path. See ibnetdiscover for information on caching ibnetdiscover output.
--diff <filename>	Loads cached ibnetdiscover data and do a diff comparison to the current network or another cache. A special diff output for iblinkinfo output will be displayed showing differences between the old and current fabric links. Be default, the following are compared for differences: port connections and port state. See ibnetdiscover for information on caching ibnetdiscover output.

Table 28 - iblinkinfo Flags and Options

Flags	Description
--diffcheck <key(s)>	Specifies what diff checks should be done in the--diffoption above. Comma separate multiple diff check key(s). The available diff checks are:port = port connections,state = port state, lid = lids, nodedesc = node descriptions. If port is specified alongside lid or nodedesc, remote port lids and node descriptions will also be compared.
--filterdownports <filename>	Filters downports indicated in a ibnetdiscover cache. If a port was previously indicated as down in the specified cache, and is still down, do not output it in the resulting output. This option may be particularly useful for environments where switches are not fully populated, thus much of the default iblinkinfo info is considered un-useful. See ibnetdiscover for information on caching ibnetdiscover output.

8.3.19 ibqueryerrors

The default behavior is to report the port error counters which exceed a threshold for each port in the fabric. The default threshold is zero (0). Error fields can also be suppressed entirely.

In addition to reporting errors on every port. ibqueryerrors can report the port transmit and receive data as well as report full link information to the remote port if available.

8.3.19.1 ibqueryerrors Synopsis

```
ibqueryerrors [options]
```

8.3.19.2 ibqueryerrors Options

Table 29 - ibqueryerrors Flags and Options

Flags	Description
-s <err1,err2,...>	Suppresses the errors listed in the comma separated list provided.
-c	Suppresses some of the common "side effect" counters. These counters usually do not indicate an error condition and can be usually be safely ignored.
-G <port_guid> -S <port_guid> --port-guid	Report results for the port specified. For switches results are printed for all ports not just switch port 0.
-S same as "-G"	Provided only for backward compatibility
-D <direct_route>	Reports results for the port specified. For switches results are printed for all ports not just switch port 0.

Table 29 - ibqueryerrors Flags and Options

Flags	Description
-r	Reports the port information. This includes LID, port, external port (if applicable), link speed setting, remote GUID, remote port, remote external port (if applicable), and remote node description information.
--data	Includes the optional transmit and receive data counters.
--threshold-file	Specifies an alternate threshold file. The default is: /opt/ufm/files/conf/infiniband-diags/error_thresholds
--switch	Prints data for switches only.
--ca	Prints data for CA's only.
--router	Prints data for routers only
--clear-errors-k	Clear error counters after read. -k and -K can be used together to clear both errors and counters.
--clear-counts -K	Clear data counters after read. CAUTION: clearing data counters will occur regardless of if they are printed or not. This is because data counters are only printed on ports which have errors. This means if a port has 0 errors and the -K option is specified the data counters will be cleared without any printed output.
-details	Includes receive error and transmits discard details
--load-cache <filename>	Loads and uses the cached ibnetdiscover data stored in the specified filename. May be useful for outputting and learning about other fabrics or a previous state of a fabric. Cannot be used if user specifies a direct route path. See ibnetdiscover for information on caching ibnetdiscover output.
-R	This option is obsolete (and has no effect).
-d	Raises the IB debugging level. May be used several times (-ddd or -d -d -d).
-e	Shows send and receive errors (time-outs and others)
-h	Shows the usage message
-v	Increases the application verbosity level. May be used several times (-vv or -v -v -v)
-C <ca_name>	Uses the specified ca_name.
-P <ca_port>	Uses the specified ca_port.

Table 29 - ibqueryerrors Flags and Options

Flags	Description
-t <timeout_ms>	Overrides the default timeout for the solicited mads.

8.3.19.3 ibqueryerrors Exit Status

If a failure to scan the fabric occurs return -1. If the scan succeeds without errors beyond thresholds return 0. If errors are found on ports beyond thresholds return 1.

8.3.19.4 ibqueryerrors Files

/opt/ufm/files/conf/infiniband-diags/error_thresholds

Define threshold values for errors. File format is simple "name=val".

Comments begin with '#'

Example:

```
# Define thresholds for error counters
                      SymbolErrorCounter=10
                      LinkErrorRecoveryCounter=10
                      VL15Dropped=100
```

8.3.20 ibsysstat

ibsysstat uses vendor MADs to validate connectivity between InfiniBand nodes and obtain other information about the InfiniBand node.ibsysstat is run as client/server. Default is to run as client.

8.3.20.1 ibsysstat Synopsis

```
ibsysstat  [-d(ebug)] [-e(rr_show)] [-v(erbose)] [-G(uid)] [-C ca_name]
[-P ca_port] [-s smlid] [-t(imeout) timeout_ms] [-V(ersion)]  [-o  oui]
[-S(erver)] [-h(elp)] <dest lid | guid> [<op>]
```

8.3.20.2 ibsysstat Options

Table 30 - ibsysstat Flags and Options

Flags	Description
ping	Verifies connectivity to server (default)
host	Obtains host information from server
cpu	Obtains cpu information from server
-o, --oui	Uses specified OUI number to multiplex vendor mads
-S, --Server	Starts in server mode (do not return)
Debugging Flags	**Description**

Table 30 - ibsysstat Flags and Options

Flags	Description
NOTE: Most OpenIB diagnostics take the following common flags. The exact list of supported flags per utility can be found in the usage message and can be shown using the util_name -h syntax.	
-d	Raises the IB debugging level. Can be used several times (-ddd or -d -d -d).
-e	Shows send and receive errors (timeouts and others)
-h	Shows the usage message
-v	Increases the application verbosity level. Can be used several times (-vv or -v -v -v).
-v	Shows the version info.
Addressing Flags	**Description**
-G	Uses GUID address argument. In most cases, it is the Port GUID. Example: "0x08f1040023"
-s <smlid>	Uses 'smlid' as the target lid for SM/SA queries.
Other Common Flags	**Description**
-C <ca_name>	Uses the specified ca_name.
-P <ca_port>	Uses the specified ca_port.
-t <timeout_ms>	Overrides the default timeout for the solicited mads.

8.3.20.3 Multiple CA/Multiple Port Support

When no IB device or port is specified, the port to use is selected by the following criteria:

1. The first port that is ACTIVE.
2. If not found, the first port that is UP (physical link up).

If a port and/or CA name is specified, the user request is attempted to be fulfilled, and will fail if it is not possible.

8.3.21 saquery

saquery issues the selected SA query. Node records are queried by default.

8.3.21.1 saquery Synopsis

```
saquery [-h] [-d] [-p] [-N] [--list | -D] [-S] [-I] [-L] [-l] [-G] [-O]
       [-U] [-c] [-s] [-g] [-m] [-x] [-C ca_name] [-P ca_port][--smkey
val]
       [-t(imeout)    <msec>] [--src-to-dst  <src:dst>]   [--sgid-to-dgid
       <sgid-dgid>]  [--node-name-map  <node-name-map>] [<name>  |  <lid>
|
       <guid>]
```

8.3.21.2 saquery Options

Table 31 - saquery Flags and Options

Flags	Description
-p	Gets PathRecord info.
-N	Gets NodeRecord info.
--list | -D	Gets NodeDescriptions of CAs only.
-S	Gets ServiceRecord info.
-I	Gets InformInfoRecord (subscription) info.
-L	Returns the Lids of the name specified
-l	Returns the unique Lid of the name specified
-G	Returns the Guids of the name specified
-O	Returns the name for the Lid specified
-U	Returns the name for the Guid specified
-C	Gets the SA's class port info
-s	Returns the PortInfoRecords with isSM or isSMdisabled capability mask bit on.
-g	Gets multicast group info
-m	Gets multicast member info. If a group is specified, limit the output to the group specified and print one line containing only the GUID and node description for each entry. Example: saquery -m 0xc000
-x	Gets LinkRecord info.
--src-to-dst	Gets a PathRecord for <src:dst> where src and dst are either node names or LIDs.
--sgid-to-dgid	Gets a PathRecord for sgid to dgid where both GIDs are in an IPv6 format acceptable to inet_pton(3).
-C <ca_name>	Uses the specified ca_name.
-P <ca_port>	Uses the specified ca_port.
--smkey <val>	Uses SM_Key value for the query. Will be used only with "trusted" queries. If non-numeric value (like'x') is specified then saquery will prompt for a value.

Table 31 - saquery Flags and Options

Flags	Description
-t, -timeout <msec>	Specifies SA query response timeout in milliseconds. Default is 100 milliseconds. You may want to use this option if IB_TIMEOUT is indicated.
--node-name-map <node-name-map>	Specifies a node name map.The node name map file maps GUIDs to more user friendly names. See ibnetdiscover(8) for node name map file format.Only used with the -O and -U options. • Supported query names (and aliases): ClassPortInfo (CPI) NodeRecord (NR) [lid] PortInfoRecord (PIR) [[lid]/[port]/[options]] SL2VLTableRecord (SL2VL) [[lid]/[in_port]/[out_port]] PKeyTableRecord (PKTR) [[lid]/[port]/[block]] VLArbitrationTableRecord (VLAR) [[lid]/[port]/[block]] InformInfoRecord (IIR) LinkRecord (LR) [[from_lid]/[from_port]] [[to_lid]/[to_port]] ServiceRecord (SR) PathRecord (PR) MCMemberRecord (MCMR) LFTRecord (LFTR) [[lid]/[block]] MFTRecord (MFTR) [[mlid]/[position]/[block]] GUIDInfoRecord (GIR) [[lid]/[block]]
-d	enables debugging.
-h	Shows help.

8.3.22 smpdump

smpdump is a general purpose SMP utility which gets SM attributes from a specified SMA. The result is dumped in hex by default.

8.3.22.1 smpdump Synopsis

```
smpdump             [-s(ring)]  [-D(irect)] [-C ca_name] [-P ca_port] [-
t(imeout)
       timeout_ms] [-V(ersion)] [-h(elp)] <dlid|dr_path> <attr> [mod]
```

8.3.22.2 smpdump Options

Table 32 - smpdump Flags and Options

Flags	Description
attr	IBA attribute ID for SM attribute
mod	IBA modifier for SM attribute
Debugging Flags	**Description**
NOTE: Most OpenIB diagnostics take the following common flags. The exact list of supported flags per utility can be found in the usage message and can be shown using the util_name -h syntax.	
-d	Raises the IB debugging level. Can be used several times (-ddd or -d -d -d).
-e	Shows send and receive errors (timeouts and others)
-h	Shows the usage message
-v	Increases the application verbosity level. Can be used several times (-vv or -v -v -v)
-V	Shows the version info.
Addressing Flags	**Description**
-D	Uses directed path address arguments. The path is a comma separated list of out ports. Examples: "0" # self port "0,1,2,1,4" # out via port 1, then 2, ...
-G	Uses GUID address argument. In most cases, it is the Port GUID. Example: "0x08f1040023"
-s <smlid>	Uses 'smlid' as the target lid for SM/SA queries.
Flags	**Description**
-C <ca_name>	Uses the specified ca_name.
-P <ca_port>	Uses the specified ca_port.
-t <timeout_ms>	Overrides the default timeout for the solicited mads.

8.3.22.3 Multiple CA/Multiple Port Support

When no IB device or port is specified, the port to use is selected by the following criteria:

1. The first port that is ACTIVE.
2. If not found, the first port that is UP (physical link up).

If a port and/or CA name is specified, the user request is attempted to be fulfilled, and will fail if it is not possible.

Examples

Direct Routed Examples:

```
smpdump -D 0,1,2,3,5 16 # NODE DESC
smpdump -D 0,1,2 0x15 2 # PORT INFO, port 2
```

LID Routed Examples:

```
smpdump 3 0x15 2          # PORT INFO, lid 3 port 2
smpdump 0xa0 0x11       # NODE INFO, lid 0xa0
```

8.4 InfiniBand Fabric Performance Utilities

The performance utilities described in this chapter are intended to be used as a performance micro-benchmark.

8.4.1 ib_read_bw

ib_read_bw calculates the BW of RDMA read between a pair of machines. One acts as a server and the other as a client. The client RDMA reads the server memory and calculate the BW by sampling the CPU each time it receive a successful completion. The test supports features such as Bidirectional, in which they both RDMA read from each other memory's at the same time, change of mtu size, tx size, number of iteration, message size and more. Read is available only in RC connection mode (as specified in IB spec).

8.4.1.1 ib_read_bw Synopsys

```
ib_read_bw [-i(b_port) ib_port] [-m(tu) mtu_size] [-s(ize) message_size] [-n
iteration_num] [-p(ort) PDT_port] [-b(idirectional)] [-o(uts) outstanding reads] [-
a(ll)] [-V(ersion)]
```

8.4.1.2 ib_read_bw Options

The table below lists the various flags of the command.

Table 33 - ib_read_bw Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-o, --outs=<num>	The number of outstanding read/atom(default 4)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)

Table 33 - ib_read_bw Flags and Options

Flag	Description
-b, --bidirectional	Measures bidirectional bandwidth (default unidirectional)
-V, --version	Displays version number
-g, --grh	Use GRH with packets (mandatory for RoCE)

8.4.2 ib_read_lat

ib_read_lat calculates the latency of RDMA read operation of message_size between a pair of machines. One acts as a server and the other as a client. They perform a ping pong benchmark on which one side RDMA reads the memory of the other side only after the other side have read his memory. Each of the sides samples the CPU clock each time they read the other side memory , in order to calculate latency. Read is availible only in RC connection mode (as specified in IB spec).

8.4.2.1 ib_read_lat Synopsys

```
ib_read_lat [-i(b_port) ib_port] [-m(tu) mtu_size] [-s(ize) message_size] [-t(x-
depth) tx_size] [-n iteration_num] [-p(ort) PDT_port] [-o(uts) outstanding reads] [-
a(ll)] [-V(ersion)] [-C report cycles] [-H report histogram] [-U report unsorted]
```

8.4.2.2 ib_read_lat Options

The table below lists the various flags of the command.

Table 34 - ib_read_lat Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-o, --outs=<num>	The number of outstanding read/atom(default 4)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-C, --report-cycles	Reports times in cpu cycle units (default microseconds)
-H, --report-histogram	Print out all results (default print summary only)
-U, --report-unsorted (implies -H)	Print out unsorted results (default sorted)
-V, --version	Displays version number

Table 34 - ib_read_lat Flags and Options

Flag	Description
-g, --grh	Use GRH with packets (mandatory for RoCE)

8.4.3 ib_send_bw

ib_send_bw calculates the BW of SEND between a pair of machines. One acts as a server and the other as a client. The server receive packets from the client and they both calculate the throughput of the operation. The test supports features such as Bidirectional, on which they both send and receive at the same time, change of mtu size, tx size, number of iteration, message size and more. Using the "-a" provides results for all message sizes.

8.4.3.1 ib_send_bw Synopsys

```
ib_send_bw [-i(b_port) ib_port]  [-c(onnection_type) RC\UC\UD] [-m(tu) mtu_size] [-
s(ize) message_size] [-t(x-depth) tx_size]              [-n iteration_num] [-p(ort)
PDT_port] [-b(idirectional)]           [-a(ll)] [-V(ersion)]
```

8.4.3.2 ib_send_bw Options

The table below lists the various flags of the command.

Table 35 - ib_send_bw Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-c, --connection=<RC/UC/UD>	Connection type RC/UC/UD (default RC)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-b, --bidirectional	Measures bidirectional bandwidth (default unidirectional)
-V, --version	Displays version number
-g, --grh	Use GRH with packets (mandatory for RoCE)

8.4.4 ib_send_lat

ib_send_lat calculates the latency of sending a packet in message_size between a pair of machines. One acts as a server and the other as a client. They perform a ping pong benchmark on

which you send packet only if you receive one. Each of the sides samples the CPU each time they receive a packet in order to calculate the latency.

8.4.4.1 ib_send_lat Synopsys

```
ib_send_lat [-i(b_port) ib_port]  [-c(onnection_type) RC\UC\UD] [-m(tu) mtu_size] [-
s(ize) message_size] [-t(x-depth) tx_size]              [-n iteration_num] [-p(ort)
PDT_port] [-a(ll)] [-V(ersion)]                         [-C report cycles] [-H
report histogram] [-U report unsorted]
```

8.4.4.2 ib_send_lat Options

The table below lists the various flags of the command.

Table 36 - ib_send_lat Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-c, --connection=<RC/UC/UD>	Connection type RC/UC/UD (default RC)
-s, --size=<size>	The size of message to exchange (default 65536)
-l, --signal	Signal completion on each msg
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-C, --report-cycles	Reports times in cpu cycle units (default microseconds)
-H, --report-histogram	Print out all results (default print summary only)
-U, --report-unsorted (implies -H)	Print out unsorted results (default sorted)
-V, --version	Displays version number
-g, --grh	Use GRH with packets (mandatory for RoCE)

8.4.5 ib_write_bw

ib_write_bw calculates the BW of RDMA write between a pair of machines. One acts as a server and the other as a client. The client RDMA writes to the server memory and calculate the BW by sampling the CPU each time it receive a successful completion. The test supports features such as Bidirectional, in which they both RDMA write to each other at the same time, change of mtu size, tx size, number of iteration, message size and more. Using the "-a" flag provides results for all message sizes.

8.4.5.1 ib_write_bw Synopsys

```
ib_write_bw [-q num of qps] [-c(onnection_type) RC\UC] [-i(b_port) ib_port] [-m(tu)
mtu_size] [-s(ize) message_size] [-t(x-depth) tx_size] [-n iteration_num] [-p(ort)
PDT_port] [-b(idirectional)]                          [-a(ll)] [-V(ersion)]
```

8.4.5.2 ib_write_bw Options

The table below lists the various flags of the command.

Table 37 - ib_write_bw Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-c, --connection=<RC/UC>	Connection type RC/UC (default RC)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-b, --bidirectional	Measures bidirectional bandwidth (default unidirectional)
-V, --version	Displays version number
-o, --post=<num of posts>	The number of posts for each qp in the chain (default tx_depth)
-q, --qp=<num of qp's>	The number of qp's(default 1)
-g, --grh	Use GRH with packets (mandatory for RoCE)

8.4.6 ib_write_lat

ib_write_lat calculates the latency of RDMA write operation of message_size between a pair of machines. One acts as a server and the other as a client. They perform a ping pong benchmark on which one side RDMA writes to the other side memory only after the other side wrote on his memory. Each of the sides samples the CPU clock each time they write to the other side memory, in order to calculate latency.

8.4.6.1 ib_write_lat Synopsys

```
ib_write_lat [-i(b_port) ib_port]  [-c(onnection_type) RC\UC] [-m(tu) mtu_size] [-
s(ize) message_size] [-t(x-depth) tx_size]              [-n iteration_num] [-p(ort)
PDT_port] [-a(ll)] [-V(ersion)]                         [-C report cycles] [-H
report histogram] [-U report unsorted]
```

8.4.6.2 ib_write_lat Options

The table below lists the various flags of the command.

Table 38 - ib_write_lat Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-c, --connection=<RC/UC>	Connection type RC/UC (default RC)
-s, --size=<size>	The size of message to exchange (default 65536)
-f, --freq=<dep>	How often the time stamp is taken
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-C, --report-cycles	Reports times in cpu cycle units (default microseconds)
-H, --report-histogram	Prints out all results (default print summary only)
-U, --report-unsorted (implies -H)	Prints out unsorted results (default sorted)
-V, --version	Displays version number
-g, --grh	Uses GRH with packets (mandatory for RoCE)

8.4.7 ibv_read_bw

This is a more advanced version of ib_read_bw and contains more flags and features than the older version and also improved algorithms. ibv_read_bw calculates the BW of RDMA read between a pair of machines. One acts as a server, and the other as a client. The client RDMA reads the server memory and calculate the BW by sampling the CPU each time it receive a successful completion. The test supports a large variety of features as described below, and has better performance than ib_read_bw in Nahalem systems. Read is available only in RC connection mode (as specified in the InfiniBand spec).

8.4.7.1 ibv_read_bw Synopsys

```
ibv_read_bw [-i(b_port) ib_port] [-d ib device] [-o(uts) outstanding reads] [-m(tu)
mtu_size] [-s(ize) message_size] [-t(x-depth) tx_size]  [-n iteration_num] [-p(ort)
PDT_port] [-u qp timeout]             [-S(l) sl type] [-x gid index] [-e(vents) use
events]             [-F CPU freq fail] [-b(idirectional)] [-a(ll)] [-V(ersion)]
```

8.4.7.2 ibv_read_bw Options

The table below lists the various flags of the command.

Table 39 - ibv_read_bw Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-o, --outs=<num>	The number of outstanding read/atom(default for ConnectX 16 (others 4)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-u, --qp-timeout=<timeout>	QP timeout. The timeout value is 4 usec * 2 ^(timeout), default 14
-S, --sl=<sl>	The service level (default 0)
-x, --gid-index=<index>	Test uses GID with GID index taken from command line (for RDMAoE index should be 0)
-b, --bidirectional	Measures bidirectional bandwidth (default unidirectional)
-V, --version	Displays version number
-g, --post=<num of posts>	The number of posts for each qp in the chain (default tx_depth)
-e, --events	Inactive during CQ events (default poll)
-F, --CPU-freq	The CPU frequency test. It is active even if the cpufreq_ondemand module is loaded
-R, --rdma_cm	Connect QPs with rdma_cm and run test on those QPs
-z, --com_rdma_cm	Communicate with rdma_cm module to exchange data - use regular QPs
-c, --connection=<RC/UC>	Connection type RC/UC (default RC)
-I, --inline_size=<size>	Max size of message to be sent in inline (default 0)

Table 39 - ibv_read_bw Flags and Options

Flag	Description
-Q, --cq-mod	Generate Cqe only after <--cq-mod> completion
-N, --no peak-bw	Cancel peak-bw calculation (default with peak)

8.4.8 ibv_read_lat

This is a more advanced version of ib_read_lat ,and contains more flags and features than the older version and also improved algorithms. ibv_read_lat calculates the latency of RDMA read operation of message_size between a pair of machines. One acts as a server and the other as a client. They perform a ping pong benchmark on which one side RDMA reads the memory of the other side only after the other side have read his memory. Each of the sides samples the CPU clock each time they read the other side memory, to calculate latency. Read is available only in RC connection mode (as specified in InfiniBand spec).

8.4.8.1 ibv_read_lat Synopsys

```
ibv_read_lat [-i(b_port) ib_port] [-m(tu) mtu_size] [-s(ize) message_size] [-t(x-
depth) tx_size] [-I(nline_size) inline size] [-u qp timeout] [-S(L) sl type] [-d
ib_device name] [-x gid index]                          [-n iteration_num] [-o(uts)
outstanding reads]                                      [-e(vents) use events] [-
p(ort) PDT_port] [-a(ll)] [-V(ersion)]                  [-C report cycles] [-H
report histogram] [-U report unsorted] [-F CPU freq fail]
```

8.4.8.2 ibv_read_lat Options

The table below lists the various flags of the command.

Table 40 - ibv_read_lat Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-o, --outs=<num>	The number of outstanding read/atom(default for ConnectX 16 (others 4)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-u, --qp-timeout=<timeout>	QP timeout. The timeout value is 4 usec * 2 ^(timeout), default 14
-S, --sl=<sl>	The service level (default 0)

Table 40 - ibv_read_lat Flags and Options

Flag	Description
-x, --gid-index=<index>	Test uses GID with GID index taken from command line (for RDMAoE index should be 0)
-C, --report-cycles	Reports times in cpu cycle units (default microseconds)
-H, --report-histogram	Prints out all results (default print summary only)
-U, --report-unsorted (implies -H)	Prints out unsorted results (default sorted)
-V, --version	Displays version number
-e, --events	Inactive during CQ events (default poll)
-F, --CPU-freq	The CPU frequency test. It is active even if the cpufreq_ondemand module is loaded
-R, --rdma_cm	Connects QPs with rdma_cm and run test on those QPs
-z, --com_rdma_cm	Communicates with rdma_cm module to exchange data - use regular QPs
-c, --connection=<RC/UC>	Connection type RC/UC (default RC)
-I, --inline_size=<size>	Max size of message to be sent in inline (default 400)

8.4.9 ibv_send_bw

This is a more advanced version of ib_send_bw and contains more flags and features than the older version and also improved algorithms. ibv_send_bw calculates the BW of SEND between a pair of machines. One acts as a server and the other as a client. The server receive packets from the client and they both calculate the throughput of the operation.The test supports a large variety of features as described below, and has better performance than ib_send_bw in Nehalem systems.

8.4.9.1 ibv_send_bw Synopsys

```
ibv_send_bw [-i(b_port) ib_port] [-d ib device]  [-c(onnection_type) RC\UC\UD] [-
m(tu) mtu_size] [-s(ize) message_size] [-t(x-depth) tx_size] [-r(x_dpeth) rx_size]
[-n iteration_num] [-p(ort) PDT_port]  [-I(nline_size) inline size] [-u qp timeout]
[-S(l) sl type]                        [-x gid index] [-e(vents) use events] [-
N(o_peak) use peak calc]                                [-F CPU freq fail] [-g num
of qps in mcast group] [-M mcast gid]  [-b(idirectional)] [-a(ll)] [-V(ersion)]
```

8.4.9.2 ibv_send_bw Options

The table below lists the various flags of the command.

Table 41 - ibv_send_bw Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)

Table 41 - ibv_send_bw Flags and Options

Flag	Description
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-c, --connection=<RC/UC/UD>	Connection type RC/UC/UD (default RC)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-u, --qp-timeout=<timeout>	QP timeout. The timeout value is 4 usec * 2 ^(timeout), default 14
-S, --sl=<sl>	The service level (default 0)
-x, --gid-index=<index>	Test uses GID with GID index taken from command line (for RDMAoE index should be 0)
-b, --bidirectional	Measures bidirectional bandwidth (default unidirectional)
-V, --version	Displays version number
-g, --post=<num of posts>	The number of posts for each qp in the chain (default tx_depth)
-e, --events	Inactive during CQ events (default poll)
-F, --CPU-freq	The CPU frequency test. It is active even if the cpufreq_ondemand module is loaded
-r, --rx-depth=<dep>	Makes rx queue bigger than tx (default 600)
-I, --inline_size=<size>	The maximum size of message to be sent in “inline mode” (default 0)
-N, --no peak-bw	Cancels peak-bw calculation (default with peak-bw)
-g, --mcg=<num_of_qps>	Sends messages to multicast group with <num_of_qps> qps attached to it.
-M, --MGID=<multicast_gid>	In case of multicast, uses <multicast_gid> as the group MGID. The format must be '255:1:X:X:X:X:X:X:X:X:X:X:X:X:X:X', where X is a value within [0,255]
-R, --rdma_cm	Connects QPs with rdma_cm and run test on those QPs
-z, --com_rdma_cm	Communicates with rdma_cm module to exchange data - use regular QPs
-Q, --cq-mod	Generates Cqe only after <--cq-mod> completion

8.4.10 ibv_send_lat

This is a more advanced version of ib_send_lat and contains more flags and features than the older version and also improved algorithms. ibv_send_lat calculates the latency of sending a packet in message_size between a pair of machines. One acts as a server and the other as a client.

They perform a ping pong benchmark on which you send packet only after you receive one. Each of the sides samples the CPU clock each time they receive a send packet, in order to calculate the latency.

8.4.10.1 ibv_send_lat Synopsys

```
ibv_send_lat [-i(b_port) ib_port]  [-c(onnection_type) RC\UC\UD] [-d ib_device name]
[-m(tu) mtu_size] [-s(ize) message_size]                [-t(x-depth) tx_size] [-
I(nline_size) inline size]                              [-u qp timeout] [-S(L) sl
type] [-x gid index]                                   [-e(events) use events] [-n
iteration_num]                                          [-g num of qps in mcast
group] [-p(ort) PDT_port] [-a(ll)]                      [-V(ersion)] [-C report
cycles] [-H report histogram]                           [-U report unsorted] [-F
CPU freq fail]
```

8.4.10.2 ibv_send_lat Options

The table below lists the various flags of the command.

Table 42 - ibv_send_lat Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-c, --connection=<RC/UC/UD>	Connection type RC/UC/UD (default RC)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-u, --qp-timeout=<timeout>	QP timeout. The timeout value is 4 usec * 2 ^(timeout), default 14
-S, --sl=<sl>	The service level (default 0)
-x, --gid-index=<index>	Test uses GID with GID index taken from command line (for RDMAoE index should be 0)
-C, --report-cycles	Reports times in cpu cycle units (default microseconds)
-H, --report-histogram	Print out all results (default print summary only)
-U, --report-unsorted (implies -H)	Print out unsorted results (default sorted)
-V, --version	Displays version number
-F, --CPU-freq	The CPU frequency test. It is active even if the cpufreq_ondemand module is loaded

Table 42 - ibv_send_lat Flags and Options

Flag	Description
-g, --post=<num of posts>	The number of posts for each qp in the chain (default tx_depth)
-I, --inline_size=<size>	The maximum size of message to be sent in “inline mode” (default 0)
-e, --events	Inactive during CQ events (default poll)
-g, --mcg=<num_of_qps>	Sends messages to multicast group with <num_of_qps> qps attached to it.
-M, --MGID=<multicast_gid>	In case of multicast, uses <multicast_gid> as the group MGID. The format must be '255:1:X:X:X:X:X:X:X:X:X:X:X:X:X:X', where X is a value within [0,255]. You must specify a different MGID on both sides to avoid loopback.
-R, --rdma_cm	Connect QPs with rdma_cm and run test on those QPs
-z, --com_rdma_cm	Communicate with rdma_cm module to exchange data - use regular QPs

8.4.11 ibv_write_bw

This is a more advanced version of ib_write_bw ,and contains more flags and features than the older version and also improved algorithms. ibv_write_bw calculates the BW of RDMA write between a pair of machines. One acts as a server and the other as a client. The client RDMA writes to the server memory and calculate the BW by sampling the CPU each time it receives a successful completion. The test supports a large variety of features as described below, and has better performance than ib_write_bw in Nehalem systems.

8.4.11.1 ibv_write_bw Synopsys

```
ibv_write_bw [-i(b_port) ib_port] [-d ib device]  [-c(onnection_type) RC\UC][-m(tu)
mtu_size] [-s(ize) message_size] [-t(x-depth) tx_size]  [-n iteration_num] [-p(ort)
PDT_port] [-I(nline_size) inline size]                  [-u qp timeout] [-S(l) sl
type] [-x gid index]                  [-e(vents) use events] [-N(o_peak) use peak
calc]                                                  [-F CPU freq fail] [-g num
of posts] [-q num of qps]                             [-b(idirectional)] [-a(ll)]
[-V(ersion)]
```

8.4.11.2 ibv_write_bw Options

The table below lists the various flags of the command.

Table 43 - ibv_write_bw Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)

Table 43 - ibv_write_bw Flags and Options

Flag	Description
-c, --connection=<RC/UC>	Connection type RC/UC(default RC)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-u, --qp-timeout=<timeout>	QP timeout. The timeout value is 4 usec * 2 ^(timeout), default 14
-S, --sl=<sl>	The service level (default 0)
-x, --gid-index=<index>	Test uses GID with GID index taken from command line (for RDMAoE index should be 0)
-b, --bidirectional	Measures bidirectional bandwidth (default unidirectional)
-V, --version	Displays version number
-g, --post=<num of posts>	The number of posts for each qp in the chain (default tx_depth)
-F, --CPU-freq	The CPU frequency test. It is active even if the cpufreq_ondemand module is loaded
-q, --qp=<num of qp's>	The number of qp's (default 1)
-I, --inline_size=<size>	The maximum size of message to be sent in “inline mode” (default 0)
-N, --no peak-bw	Cancels peak-bw calculation (default with peak-bw)
-R, --rdma_cm	Connect QPs with rdma_cm and run test on those QPs
-z, --com_rdma_cm	Communicate with rdma_cm module to exchange data - use regular QPs
-Q, --cq-mod	Generate Cqe only after <--cq-mod> completion

8.4.12 ibv_write_lat

This is a more advanced version of ib_write_lat and contains more flags and features than the older version and also improved algorithms. ibv_write_lat calculates the latency of RDMA write operation of message_size between a pair of machines. One acts as a server, and the other as a client. They perform a ping pong benchmark on which one side RDMA writes to the other side memory only after the other side wrote on his memory. Each of the sides samples the CPU clock each time they write to the other side memory to calculate latency.

8.4.12.1 ibv_write_lat Synopsis

```
ibv_write_lat [-i(b_port) ib_port]  [-c(onnection_type) RC\UC\UD][-m(tu) mtu_size]
[-s(ize) message_size] [-t(x-depth) tx_size]            [-I(nline_size) inline
size] [-u qp timeout] [-S(L) sl type]  [-d ib_device name] [-x gid index] [-n
iteration_num]                                          [-p(ort) PDT_port] [-a(ll)]
[-V(ersion)] [-C report cycles]                         [-H report histogram] [-U
report unsorted]
```

8.4.12.2 ibv_write_lat Options

The table below lists the various flags of the command.

Table 44 - ibv_write_lat Flags and Options

Flag	Description
-p, --port=<port>	Listens on/connect to port <port> (default 18515)
-d, --ib-dev=<dev>	Uses IB device <device guid> (default first device found)
-i, --ib-port=<port>	Uses port <port> of IB device (default 1)
-m, --mtu=<mtu>	The mtu size (default 1024)
-c, --connection=<RC/UC>	Connection type RC/UC (default RC)
-s, --size=<size>	The size of message to exchange (default 65536)
-a, --all	Runs sizes from 2 till 2^23
-t, --tx-depth=<dep>	The size of tx queue (default 100)
-n, --iters=<iters>	The number of exchanges (at least 2, default 1000)
-u, --qp-timeout=<timeout>	QP timeout. The timeout value is 4 usec * 2 ^(timeout), default 14
-S, --sl=<sl>	The service level (default 0)
-x, --gid-index=<index>	Test uses GID with GID index taken from command line (for RDMAoE index should be 0)
-C, --report-cycles	Reports times in cpu cycle units (default microseconds)
-H, --report-histogram	Print out all results (default print summary only)
-U, --report-unsorted (implies -H)	Print out unsorted results (default sorted)
-V, --version	Displays version number
-F, --CPU-freq	The CPU frequency test. It is active even if the cpufreq_ondemand module is loaded
-I, --inline_size=<size>	The maximum size of message to be sent in “inline mode” (default 0)
-R, --rdma_cm	Connects QPs with rdma_cm and run test on those QPs
-z, --com_rdma_cm	Communicates with rdma_cm module to exchange data - use regular QPs

8.4.13 nd_write_bw

This test is used for performance measuring of RDMA-Write requests in Microsoft Windows Operating Systems. nd_write_bw is performance oriented for RDMA-Write with maximum throughput, and runs over Microsoft's NetworkDirect standard. The level of customizing for the user is relatively high. User may choose to run with a customized message size, customized number of iterations, or alternatively, customized test duration time. nd_write_bw runs with all message sizes from 1B to 4MB (powers of 2), message inlining, CQ moderation.

8.4.13.1 nd_write_bw Synopsys

```
<running on specific single core>
Server side: start /b /affinity 0X1 nd_write_bw -s1048576 -D10 -S 11.137.53.1
Client side: start /b /wait /affinity 0X1 nd_write_bw -s1048576 -D10 -C 11.137.53.1
```

8.4.13.2 nd_write_bw Options

The table below lists the various flags of the command.

Table 45 - nd_write_bw Flags and Options

Flag	Description
-h	Shows the Help screen.
-v	Shows the version number.
-p	Connects to the port <port> <default 6830>.
-s <msg size>	Exchanges the message size with <default 65536B>, and it must not be combined with -a flag.
-a	Runs all the messages' sizes from 1B to 8MB, and it must not be combined with -s flag.
-n <num of iterations>	The number of exchanges (at least 2, the default is 100000)
-I <max inline size>	The maximum size of message to send inline. The default number is 128B.
-D <test duration in seconds>	Tests duration in seconds.
-f <margin time in seconds>	The margin time to avoid calculation, and it must be less than half of the duration time.
-Q	CQ-Moderation <value>. The default number is 100.
-S <server interface IP>	<server side only, must be last parameter>
-C <server interface IP>	<client side only, must be last parameter>

8.4.14 nd_write_lat

This test is used for performance measuring of RDMA-Write requests in Microsoft Windows Operating Systems. nd_write_lat is performance oriented for RDMA-Write with minimum

latency, and runs over Microsoft's NetworkDirect standard. The level of customizing for the user is relatively high. User may choose to run with a customized message size, customized number of iterations, or alternatively, customized test duration time. nd_write_lat runs with all message sizes from 1B to 4MB (powers of 2), message inlining, CQ moderation.

8.4.14.1 nd_write_lat Synopsys

```
<running on specific single core>
Server side: start /b /affinity 0X1 nd_write_lat -s1048576 -D10 -S 11.137.53.1
Client side: start /b /wait /affinity 0X1 nd_write_lat -s1048576 -D10 -C 11.137.53.1
```

8.4.14.2 nd_write_lat Options

The table below lists the various flags of the command.

Table 46 - nd_write_lat Options

Flag	Description
-h	Shows the Help screen.
-v	Shows the version number.
-p	Connects to the port <port> <default 6830>.
-s <msg size>	Exchanges the message size with <default 65536B>, and it must not be combined with -a flag.
-a	Runs all the messages' sizes from 1B to 8MB, and it must not be combined with -s flag.
-n <num of iterations>	The number of exchanges (at least 2, the default is 100000)
-I <max inline size>	The maximum size of message to send inline. The default number is 128B.
-D <test duration in seconds>	Tests duration in seconds.
-f <margin time in seconds>	The margin time to avoid calculation, and it must be less than half of the duration time.
-S <server interface IP>	<server side only, must be last parameter>
-C <server interface IP>	<client side only, must be last parameter>
-h	Shows the Help screen.

8.4.15 nd_read_bw

This test is used for performance measuring of RDMA-Read requests in Microsoft Windows Operating Systems. nd_read_bw is performance oriented for RDMA-Read with maximum throughput, and runs over Microsoft's NetworkDirect standard. The level of customizing for the user is relatively high. User may choose to run with a customized message size, customized number of iterations, or alternatively, customized test duration time. nd_read_bw runs with all message sizes from 1B to 4MB (powers of 2), message inlining, CQ moderation.

8.4.15.1 nd_read_bw Synopsys

```
<running on specific single core>
Server side: start /b /affinity 0X1 nd_read_bw -s1048576 -D10 -S 11.137.53.1
Client side: start /b /wait /affinity 0X1 nd_read_bw -s1048576 -D10 -C 11.137.53.1
```

8.4.15.2 nd_read_bw Options

The table below lists the various flags of the command.

Table 47 - nd_read_bw Options

Flags	Description
-h	Shows the Help screen.
-v	Shows the version number.
-p	Connects to the port <port> <default 6830>.
-s <msg size>	Exchanges the message size with <default 65536B>, and it must not be combined with -a flag.
-a	Runs all the messages' sizes from 1B to 8MB, and it must not be combined with -s flag.
-n <num of iterations>	The number of exchanges (at least 2, the default is 100000)
-I <max inline size>	The maximum size of message to send inline. The default number is 128B.
-D <test duration in seconds>	Tests duration in seconds.
-f <margin time in seconds>	The margin time to avoid calculation, and it must be less than half of the duration time.
-Q	CQ-Moderation <value>. The default number is 100.
-S <server interface IP>	<server side only, must be last parameter>
-C <server interface IP>	<client side only, must be last parameter>
-h	Shows the Help screen.

8.4.16 nd_read_lat

This test is used for performance measuring of RDMA-Read requests in Microsoft Windows Operating Systems. nd_read_lat is performance oriented for RDMA-Read with minimum latency, and runs over Microsoft's NetworkDirect standard. The level of customizing for the user is relatively high. User may choose to run with a customized message size, customized number of iterations, or alternatively, customized test duration time. nd_read_lat runs with all message sizes from 1B to 4MB (powers of 2), message inlining, CQ moderation.

8.4.16.1 nd_read_lat Synopsys

```
<running on specific single core>
Server side: start /b /affinity 0X1 nd_read_lat -s1048576 -D10 -S 11.137.53.1
Client side: start /b /wait /affinity 0X1 nd_read_lat -s1048576 -D10 -C 11.137.53.1
```

8.4.16.2 nd_read_lat Options

The table below lists the various flags of the command.

Table 48 - nd_read_lat Options

Flags	Description
-h	Shows the Help screen.
-v	Shows the version number.
-p	Connects to the port <port> <default 6830>.
-s <msg size>	Exchanges the message size with <default 65536B>, and it must not be combined with -a flag.
-a	Runs all the messages' sizes from 1B to 8MB, and it must not be combined with -s flag.
-n <num of iterations>	The number of exchanges (at least 2, the default is 100000)
-I <max inline size>	The maximum size of message to send inline. The default number is 128B.
-D <test duration in seconds>	Tests duration in seconds.
-f <margin time in seconds>	The margin time to avoid calculation, and it must be less than half of the duration time.
-S <server interface IP>	<server side only, must be last parameter>
-C <server interface IP>	<client side only, must be last parameter>
-h	Shows the Help screen.

8.4.17 nd_send_bw

This test is used for performance measuring of Send requests in Microsoft Windows Operating Systems. nd_send_bw is performance oriented for Send with maximum throughput, and runs over Microsoft's NetworkDirect standard. The level of customizing for the user is relatively high. User may choose to run with a customized message size, customized number of iterations, or alternatively, customized test duration time. nd_send_bw runs with all message sizes from 1B to 4MB (powers of 2), message inlining, CQ moderation.

8.4.17.1 nd_send_bw Synopsys

```
<running on specific single core>
Server side: start /b /affinity 0X1 nd_send_bw -s1048576 -D10 -S 11.137.53.1
Client side: start /b /wait /affinity 0X1 nd_send_bw -s1048576 -D10 -C 11.137.53.1
```

8.4.17.2 nd_send_bw Options

The table below lists the various flags of the command.

Table 49 - nd_send_bw Flags and Options

Flag	Description
-h	Shows the Help screen.
-v	Shows the version number.
-p	Connects to the port <port> <default 6830>.
-s <msg size>	Exchanges the message size with <default 65536B>, and it must not be combined with -a flag.
-a	Runs all the messages' sizes from 1B to 8MB, and it must not be combined with -s flag.
-n <num of iterations>	The number of exchanges (at least 2, the default is 100000)
-I <max inline size>	The maximum size of message to send inline. The default number is 128B.
-D <test duration in seconds>	Tests duration in seconds.
-f <margin time in seconds>	The margin time to avoid calculation, and it must be less than half of the duration time.
-Q	CQ-Moderation <value>. The default number is 100.
-S <server interface IP>	<server side only, must be last parameter>
-C <server interface IP>	<client side only, must be last parameter>

8.4.18 nd_send_lat

This test is used for performance measuring of Send requests in Microsoft Windows Operating Systems. nd_send_lat is performance oriented for Send with minimum latency, and runs over Microsoft's NetworkDirect standard. The level of customizing for the user is relatively high. User may choose to run with a customized message size, customized number of iterations, or alternatively, customized test duration time. nd_send_lat runs with all message sizes from 1B to 4MB (powers of 2), message inlining, CQ moderation.

8.4.18.1 nd_send_lat Synopsys

```
<running on specific single core>
Server side: start /b /affinity 0X1 nd_send_lat -s1048576 -D10 -S 11.137.53.1
Client side: start /b /wait /affinity 0X1 nd_send_lat -s1048576 -D10 -C 11.137.53.1
```

8.4.18.2 nd_send_lat Options

The table below lists the various flags of the command.

Table 50 - nd_send_lat Options

Flag	Description
-h	Shows the Help screen.
-v	Shows the version number.
-p	Connects to the port <port> <default 6830>.
-s <msg size>	Exchanges the message size with <default 65536B>, and it must not be combined with -a flag.
-a	Runs all the messages' sizes from 1B to 8MB, and it must not be combined with -s flag.
-n <num of iterations>	The number of exchanges (at least 2, the default is 100000)
-I <max inline size>	The maximum size of message to send inline. The default number is 128B.
-D <test duration in seconds>	Tests duration in seconds.
-f <margin time in seconds>	The margin time to avoid calculation, and it must be less than half of the duration time.
-S <server interface IP>	<server side only, must be last parameter>
-C <server interface IP>	<client side only, must be last parameter>
-h	Shows the Help screen.

8.4.19 NTttcp

NTttcp is a Windows base testing application that sends and receives TCP data between two or more endpoints. It is a Winsock-based port of the ttcp tool that measures networking performance bytes/second.

To download the latest version of NTttcp (5.28), please refer to Microsoft website following the link below:

http://gallery.technet.microsoft.com/NTttcp-Version-528-Now-f8b12769

This tool should be run from cmd only.

8.4.19.1 NTttcp Synopsys

```
Server: ntttcp_x64.exe -r -t 15 -m 16,*,<interface IP>
Client: ntttcp_x64.exe -s -t 15 -m 16,*,<same address as above>
```

8.4.19.2 NTttcp Options

The table below lists the various flags of the command.

Table 51 - NTttcp Options

Flags	Description
-s	Works as a sender
-r	Works as a receiver
-l	<Length of buffer> [default TCP: 64K, UDP: 128]
-n	<Number of buffers> [default: 20K]
-p	<port base> [default: 5001]
-sp	Synchronizes data ports, if used -p should be same on every instance
-a	<outstanding I/O> [default: 2]
-x	<PacketArray size> [default: 1]
-rb	<Receive buffer size> [default: 64K]
-sb	<Send buffer size>[default: 8K]
-u	UDP send/recv
-w	WSARecv/WSASend
-d	Verifies Flag
-t	<Runtime> in seconds.
-cd	<Cool-down> in seconds
-wu	<Warm-up> in seconds
-nic	<NIC IP> Use NIC with for sending data (sender only).
-m	<mapping> [mapping]

9 Software Development Kit

Software Development Kit (SDK) a set of development tools that allows the creation of InfiniBand applications for MLNX_VPI software package.

The SDK package contains, header files, libraries, and code examples.

To compile the examples provided with the SDK you must install Windows Driver Kit (WDK) version 8.1 and higher.

To open the SDK package you must run the sdk.exe file and get the complete list of files. SDK package can be found under <installation_directory>\IB\SDK

It is highly recommended to program the applications over the ND API and not over the IBAL API.

10 Troubleshooting

10.1 InfiniBand Troubleshooting

Issue 1. The InfiniBand interfaces are not up after the first reboot after the installation process is completed.

Suggestion: To troubleshoot this issue, follow the steps below:

1. Check that the InfiniBand driver is running on all nodes by using "`vstat`". The vstat utility located at <installation_directory>\tools, displays the status and capabilities of the network adaptor card(s).
2. On the command line, enter "vstat" (use -h for options) to retrieve information about one or more adapter ports. The field port_state will be equal to:
   - PORT_DOWN - when there is no InfiniBand cable ("no link");
   - PORT_INITIALIZED - when the port is connected to some other port ("physical link");
   - PORT_ACTIVE - when the port is connected and OpenSM is running ("logical link")
   - PORT_ARMED - when the port is connected to some other port ("physical link");
3. Run "`sminfo`" and verify that OpenSM is running.
   In case OpenSM is not running, please see OpenSM operation instructions in Section 7, "OpenSM - Subnet Manager", on page 61 above.
4. Verify the status of ports by using vstat: All connected ports should report "PORT_ACTIVE" state.

10.2 Ethernet Troubleshooting

Issue 1. The installation of Win OFED VPI for Windows fails with the following error message:

This installation package is not supported by this processor type. Contact your product vendor."

Suggestion: This message is printed if you have downloaded and attempted to install an incorrect driver version-- for example, if you are trying to install a 64-bit driver on a 32-bit machine (or vice versa).

Issue 2. The performance is low.

Suggestion: This can be due to non-optimal system configuration. See the section "Performance Tuning" to take advantage of Mellanox 40/10 GBit NIC performance.

Issue 3. The driver does not start.

Suggestion 1: This can happen due to an RSS configuration mismatch between the TCP stack and the Mellanox adapter. To confirm this scenario, open the event log and look under "System" for the "mlx4ethX" source. If found, enable RSS as follows:

1. Run the following command: "netsh int tcp set global rss = enabled".

Suggestion 2: This is a less recommended suggestion, and will cause low performance. To disable RSS on the adapter, run the following command: "netsh int tcp set global rss = no dynamic balancing".

Issue 4. The Ethernet driver fails to start. In the Event log, under the mlx4_bus source, the following error message appears: RUN_FW command failed with error -22

Suggestion: The error message indicates that the wrong firmware image has been programmed on the adapter card.

See Section 2,“Firmware Upgrade,” on page 15.

Issue 5. The Ethernet driver fails to start. A yellow sign appears near the "Mellanox ConnectX 10Gb Ethernet Adapter" in the Device Manager display.

Suggestion: This can happen due to a hardware error. Try to disable and re-enable "Mellanox ConnectX Adapter" from the Device Manager display.

Issue 6. No connectivity to a Fault Tolerance bundle while using network capture tools (e.g., Wireshark).

Suggestion: This can happen if the network capture tool captures the network traffic of the non-active adapter in the bundle. This is not allowed since the tool sets the packet filter to "promiscuous", thus causing traffic to be transferred on multiple interfaces. Close the network capture tool on the physical adapter card, and set it on the LBFO interface instead.

Issue 7. No Ethernet connectivity on 10Gb adapters after activating Performance Tuning (part of the installation).

Suggestion: This can happen due to adding a TcpWindowSize registry value. To resolve this issue, remove the value key under HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters\TcpWindowSize or set its value to 0xFFFF.

Issue 8. Packets are being lost.

Suggestion: This may occur if the port MTU has been set to a value higher than the maximum MTU supported by the switch.

Issue 9. Issue(s) not listed above.

The MLNX_EN for Windows driver records events in the system log of the Windows event system. Using the event log you'll be able to identify, diagnose, and predict sources of system problems.

Suggestion: To see the log of events, open System Event Viewer as follows:

1. Right click on My Computer, click Manage, and then click Event Viewer.

OR

1. Click start-->Run and enter "eventvwr.exe".
2. In Event Viewer, select the system log.

The following events are recorded:

- Mellanox ConnectX EN 10Gbit Ethernet Adapter <X> has been successfully initialized and enabled.
- Failed to initialize Mellanox ConnectX EN 10Gbit Ethernet Adapter.
- Mellanox ConnectX EN 10Gbit Ethernet Adapter <X> has been successfully initialized and enabled. The port's network address is <MAC Address>
- The Mellanox ConnectX EN 10Gbit Ethernet was reset.
- Failed to reset the Mellanox ConnectX EN 10Gbit Ethernet NIC. Try disabling then re-enabling the "Mellanox Ethernet Bus Driver" device via the Windows device manager.
- Mellanox ConnectX EN 10Gbit Ethernet Adapter <X> has been successfully stopped.
- Failed to initialize the Mellanox ConnectX EN 10Gbit Ethernet Adapter <X> because it uses old firmware version (<old firmware version>). You need to burn firmware version <new firmware version> or higher, and to restart your computer.

- Mellanox ConnectX EN 10Gbit Ethernet Adapter <X> device detected that the link connected to port <Y> is up, and has initiated normal operation.
- Mellanox ConnectX EN 10Gbit Ethernet Adapter <X> device detected that the link connected to port <Y> is down. This can occur if the physical link is disconnected or damaged, or if the other end-port is down.
- Mismatch in the configurations between the two ports may affect the performance. When Using MSI-X, both ports should use the same RSS mode. To fix the problem, configure the RSS mode of both ports to be the same in the driver GUI.
- Mellanox ConnectX EN 10Gbit Ethernet Adapter <X> device failed to create enough MSI-X vectors. The Network interface will not use MSI-X interrupts. This may affects the performance. To fix the problem, configure the number of MSI-X vectors in the registry to be at least <Y>.

10.3 Performance Troubleshooting

Issue 1. Windows Settings

Suggestion 1: In Windows 2012 and above, when a kernel debugger is configured (not necessarily physically connected), flow control is disabled unless the following registry key is set (reboot required after setting):

Registry Path: HKLM\SYSTEM\CurrentControlSet\Services\NDIS\Parameters

Type: REG_DWORD

Key name: AllowFlowControlUnderDebugger

Value: 1

Suggestion 2: Go to "Power Options" in the "Control Panel". Make sure "Maximum Performance" is set as the power scheme, reboot is needed.

Issue 2. General Diagnostic

Suggestion 1: Go to "Device Manager", locate the Mellanox adapter that you are debugging, right-click and go to "Information":

- PCI Gen 2: should appear as "PCI-E 5.0 GT/s
- PCI Gen 3: should appear as "PCI-E 8.0 GT/s"
- Link Speed: 40.0Gbps/10.0Gbps

Suggestion 2: To determine if the Mellanox NIC and PCI bus can achieve their maximum speed, it's best to run ib_send_bw in a loopback. On the same machine:

1. Run "start /b /affinity 0x1 ibv_write_bw"
2. Run "start /b /affinity 0x2 ibv_write_bw 127.0.0.1"
3. Repeat for port 2 with additional -p2, and for other cards if necessary.
4. On PCI Gen3 the expected result is around 5700MB/s

On PCI Gen2 the expected result is around 3300MB/s

Any number lower than that points to bad configuration or installation on the wrong PCI slot. Malfunctioning QoS settings and Flow Control can be the cause as well.

Suggestion 3: To determine the maximum speed between the two sides with the most basic test:

1. Run "ib_send_bw" on machine 1
2. Run "ib_send_bw <host1>" on machine 2 where <host1> is the hostname for machine 1.

3. Results appear in MB/s (Mega Bytes 2^20), and reflect the actual data that was transferred, excluding headers.
4. If these results are not as expected, the problem is most probably with one or more of the following:

- Old Firmware version.
- Misconfigured Flow-control: Global pause or PFC is configured wrong on the hosts, routers and-switches. See Section 3.7,“RDMA over Converged Ethernet (RoCE),” on page 30
- CPU/power options are not set to "Maximum Performance".

Issue 3. QoS and Flow-control

Flow control settings can greatly affect results. In order to see configured settings for all of the QoS options, open a PowerShell prompt and use "Get-NetAdapterQos"

To achieve maximum performance all of the following must exist:

1. All of the hosts, switches and routers should use the same matching flow control settings. If Global-pause is used, all devices must be configured for it. If PFC (Priority Flow-control) is used all devices must have matching settings for all priorities.
2. ETS settings that limit speed of some priorities will greatly affect the output results.
3. Make sure Flow-Control is enabled on the Mellanox Interfaces (enabled by default). Go to the device manager, right click the Mellanox interface go to "Advanced" and make sure Flow-control is enabled for both TX and RX.
4. To eliminate QoS and Flow-control as the performance degrading factor, set all devices to run with Global Pause and rerun the tests:

- Set Global pause on the switches, routers.
- Run "Disable-NetAdapterQos *" on all of the hosts in a PowerShell window.

11 Documentation

- Under <installation_directory>\Documentation:
  - License file
  - User Manual (this document)
  - MLNX_VPI_WinOF Installation Guide
  - MLNX_VPI_WinOF Release Notes
  - MLNX_VPI_WinOF Registry Keys

Appendix A: Windows MPI (MS-MPI)

A.1 Overview

Message Passing Interface (MPI) is meant to provide virtual topology, synchronization, and communication functionality between a set of processes.

With MPI you can run one process on several hosts.

- Windows MPI run over the following protocols:
  - Sockets (Ethernet)
  - Network Direct (ND)

A.1.1 Prerequisites

- Install HPC (Build: 4.0.3906.0).
- Validate traffic (ping) between the whole MPI Hosts.
- Every MPI client need to run smpd process which open the mpi channel.
- MPI Initiator Server need to run: mpiexec. If the initiator is also client it should also run smpd.

A.2 Running MPI

Step 1. Run the following command on each mpi client.

```
start smpd -d -p <port>
```

Step 2. Install ND provider on each MPI client in MPI ND.

Step 3. Run the following command on MPI server.

```
mpiexec.exe -p <smpd_port> -hosts <num_of_hosts> <hosts_ip_list>
-env MPICH_NETMASK <network_ip/subnet> -env
MPICH_ND_ZCOPY_THRESHOLD -1 -env MPICH_DISABLE_ND <0/1> -env
MPICH_DISABLE_SOCK <0/1> -affinity <process>
```

A.3 Directing MSMPI Traffic

Directing MPI traffic to a specific QoS priority may delayed due to:

- Except for NetDirectPortMatchCondition, the QoS powershell CmdLet for NetworkDirect traffic does not support port range. Therefore, NetwrokDirect traffic cannot be directed to ports 1-65536.
- The MSMPI directive to control the port range (namely: MPICH_PORT_RANGE 3000,3030) is not working for ND, and MSMPI chose a random port.

A.4 Running MSMPI on the Desired Priority

Step 1. Set the default QoS policy to be the desired priority (Note: this prio should be lossless all the way in the switches*)

Step 2. Set SMB policy to a desired priority only if SMD Traffic running.

Step 3. **[Recommended]** Direct ALL TCP/UDP traffic to a lossy priority by using the “IPProtocol-MatchCondition”.

TCP is being used for MPI control channel (smpd), while UDP is being used for other services such as remote-desktop.

Arista switches forwards the pcp bits (e.g. 802.1p priority within the vlan tag) from ingress to egress to enable any two End-Nodes in the fabric as to maintain the priority along the route.

In this case the packet from the sender goes out with priority X and reaches the far end-node with the same priority X.

The priority should be losslessin the switches

➢ ***To force MSMPI to work over ND and not over sockets, add the following in mpiexec command:***

```
-env MPICH_DISABLE_ND 0 -env MPICH_DISABLE_SOCK 1
```

A.5 Configuring MPI

Step 1. Configure all the hosts in the cluster with identical PFC (see the PFC example below).

Step 2. Run the WHCK ND based traffic tests to Check PFC (ndrping, ndping, ndrpingpong, ndpingpong).

Step 3. Validate PFC counters, during the run-time of ND tests, with “Mellanox Adapter QoS Counters” in the perfmon.

Step 4. Install the same version of HPC Pack in the entire cluster.
NOTE: Version mismatch in HPC Pack 2012 can cause MPI to hung.

Step 5. Validate the MPI base infrastructure with simple commands, such as `“hostname”`.

A.5.1 PFC Example

In the example below, ND and NDK go to priority 3 that configures no-drop in the switches. The TCP/UDP traffic directs ALL traffic to priority 1.

- Install dcbx, and remove any previous settings
- Install-WindowsFeature Data-Center-Bridging
- Remove-NetQosTrafficClass
- Remove-NetQosPolicy -Confirm:$False
- Set-NetQosDcbxSetting -Willing 0
- New-NetQosPolicy “SMB" -NetDirectPortMatchCondition 445 -PriorityValue8021Action 3
- New-NetQosPolicy “DEFAULT" -Default -PriorityValue8021Action 3
- New-NetQosPolicy “TCP" -IPProtocolMatchCondition TCP -PriorityValue8021Action1

- New-NetQosPolicy “UDP" -IPProtocolMatchCondition UDP -PriorityValue8021Action 1
- Enable-NetQosFlowControl 3
- Disable-NetQosFlowControl 0,1,2,4,5,6,7
- Enable-netadapterqos -Name

A.5.2 Running MPI Command Examples

- Running MPI pallas test over ND.

```
mpiexec.exe -p 19020 -hosts 4 11.11.146.101 11.21.147.101 11.21.147.51
11.11.145.101 -env MPICH_NETMASK 11.0.0.0/
255.0.0.0 -env MPICH_ND_ZCOPY_THRESHOLD -1 -env MPICH_DISABLE_ND 0 -env
MPICH_DISABLE_SOCK 1 -affinity c:\\test1.exe
```

- Running MPI pallas test over ETH.

```
exempiexec.exe -p 19020 -hosts 4 11.11.146.101 11.21.147.101 11.21.147.51
11.11.145.101 -env MPICH_NETMASK 11.0.0.0/
255.0.0.0 -env MPICH_ND_ZCOPY_THRESHOLD -1 -env MPICH_DISABLE_ND 1 -env
MPICH_DISABLE_SOCK 0 -affinity c:\\test1.exe
```

Appendix B: NVGRE Configuration Scrips Examples

The setup is as follow for both examples below:

```
 Hypervisor mtlae14 = "Port1", 192.168.20.114/24
      VM on mtlae14 = mtlae14-005, 172.16.14.5/16, Mac 00155D720100
      VM on mtlae14 = mtlae14-006, 172.16.14.6/16, Mac 00155D720101
 Hypervisor mtlae15 = "Port1", 192.168.20.115/24
      VM on mtlae15 = mtlae15-005, 172.16.15.5/16, Mac 00155D730100
      VM on mtlae15 = mtlae15-006, 172.16.15.6/16, Mac 00155D730101
```

B.1 Adding NVGRE Configuration to Host 14 Example

The following is an example of adding NVGRE to Host 14.

```
 # On both sides
 # vSwitch create command

 # Note, that vSwitch configuration is persistent, no need to configure it after each
reboot

 New-VMSwitch "VSwMLNX" -NetAdapterName "Port1" -AllowManagementOS $true

 # Shut down VMs
 Stop-VM -Name "mtlae14-005" -Force -Confirm
 Stop-VM -Name "mtlae14-006" -Force -Confirm
 # Connect VM to vSwitch (maybe you have to switch off VM before), doing manual does also
work
 # Connect-VMNetworkAdapter -VMName " mtlae14-005" -SwitchName "VSwMLNX"
 Add-VMNetworkAdapter -VMName "mtlae14-005" -SwitchName "VSwMLNX" -StaticMacAddress
"00155D720100"
 Add-VMNetworkAdapter -VMName "mtlae14-006" -SwitchName "VSwMLNX" -StaticMacAddress
"00155D720101"
 # -------  The commands from Step 2 - 4 are not persistent, Its suggested to create
script is running after each OS reboot

 # Step 2. Configure a Subnet Locator and Route records on each Hyper-V Host (Host 1 and
Host 2) mtlae14 & mtlae15
 New-NetVirtualizationLookupRecord -CustomerAddress 172.16.14.5 -ProviderAddress
192.168.20.114 -VirtualSubnetID 5001 -MACAddress "00155D720100" -Rule "TranslationMetho-
dEncap"
 New-NetVirtualizationLookupRecord -CustomerAddress 172.16.14.6 -ProviderAddress
192.168.20.114 -VirtualSubnetID 5001 -MACAddress "00155D720101" -Rule "TranslationMetho-
dEncap"
 New-NetVirtualizationLookupRecord -CustomerAddress 172.16.15.5 -ProviderAddress
192.168.20.115 -VirtualSubnetID 5001 -MACAddress "00155D730100" -Rule "TranslationMetho-
dEncap"
 New-NetVirtualizationLookupRecord -CustomerAddress 172.16.15.6 -ProviderAddress
192.168.20.115 -VirtualSubnetID 5001 -MACAddress "00155D730101" -Rule "TranslationMetho-
dEncap"
 # Add customer route
 New-NetVirtualizationCustomerRoute -RoutingDomainID "{11111111-2222-3333-4444-
000000005001}" -VirtualSubnetID "5001" -DestinationPrefix "172.16.0.0/16" -NextHop
"0.0.0.0" -Metric 255
```

```
 # Step 3. Configure the Provider Address and Route records on Hyper-V Host 1 (Host 1
Only) mtlae14
 $NIC = Get-NetAdapter "Port1"
 New-NetVirtualizationProviderAddress -InterfaceIndex $NIC.InterfaceIndex -Pro-
viderAddress 192.168.20.114 -PrefixLength 24
 New-NetVirtualizationProviderRoute -InterfaceIndex $NIC.InterfaceIndex -Destination-
Prefix "0.0.0.0/0" -NextHop 192.168.20.1
 # Step 5. Configure the Virtual Subnet ID on the Hyper-V Network Switch Ports for each
Virtual Machine on each Hyper-V Host (Host 1 and Host 2)
 # Run the command below for each VM on the host the VM is running on it, i.e. the for
mtlae14-005, mtlae14-006 on
 # host 192.168.20.114 and for VMs mtlae15-005, mtlae15-006 on host 192.168.20.115
 # mtlae14 only
 Get-VMNetworkAdapter -VMName mtlae14-005 | where {$_.MacAddress -eq "00155D720100"} |
Set-VMNetworkAdapter -VirtualSubnetID 5001
 Get-VMNetworkAdapter -VMName mtlae14-006 | where {$_.MacAddress -eq "00155D720101"} |
Set-VMNetworkAdapter -VirtualSubnetID 5001
```

B.2 Adding NVGRE Configuration to Host 15 Example

The following is an example of adding NVGRE to Host 15.

```
 # On both sides
 # vSwitch create command

 # Note, that vSwitch configuration is persistent, no need to configure it after each
reboot

 New-VMSwitch "VSwMLNX" -NetAdapterName "Port1" -AllowManagementOS $true

 # Shut down VMs
 Stop-VM -Name "mtlae15-005" -Force -Confirm
 Stop-VM -Name "mtlae15-006" -Force -Confirm
 # Connect VM to vSwitch (maybe you have to switch off VM before), doing manual does also
work
 # Connect-VMNetworkAdapter -VMName " mtlae14-005" -SwitchName "VSwMLNX"
 Add-VMNetworkAdapter -VMName "mtlae15-005" -SwitchName "VSwMLNX" -StaticMacAddress
"00155D730100"
 Add-VMNetworkAdapter -VMName "mtlae15-006" -SwitchName "VSwMLNX" -StaticMacAddress
"00155D730101"
```

```
 # -------  The commands from Step 2 - 4 are not persistent, Its suggested to create
script is running after each OS reboot

 # Step 2. Configure a Subnet Locator and Route records on each Hyper-V Host (Host 1 and
Host 2) mtlae14 & mtlae15
 New-NetVirtualizationLookupRecord -CustomerAddress 172.16.14.5 -ProviderAddress
192.168.20.114 -VirtualSubnetID 5001 -MACAddress "00155D720100" -Rule "TranslationMetho-
dEncap"
 New-NetVirtualizationLookupRecord -CustomerAddress 172.16.14.6 -ProviderAddress
192.168.20.114 -VirtualSubnetID 5001 -MACAddress "00155D720101" -Rule "TranslationMetho-
dEncap"
 New-NetVirtualizationLookupRecord -CustomerAddress 172.16.15.5 -ProviderAddress
192.168.20.115 -VirtualSubnetID 5001 -MACAddress "00155D730100" -Rule "TranslationMetho-
dEncap"
 New-NetVirtualizationLookupRecord -CustomerAddress 172.16.15.6 -ProviderAddress
192.168.20.115 -VirtualSubnetID 5001 -MACAddress "00155D730101" -Rule "TranslationMetho-
dEncap"
 # Add customer route
 New-NetVirtualizationCustomerRoute -RoutingDomainID "{11111111-2222-3333-4444-
000000005001}" -VirtualSubnetID "5001" -DestinationPrefix "172.16.0.0/16" -NextHop
"0.0.0.0" -Metric 255
 # Step 4. Configure the Provider Address and Route records on Hyper-V Host 2 (Host 2
Only) mtlae15
 $NIC = Get-NetAdapter "Port1"
 New-NetVirtualizationProviderAddress -InterfaceIndex $NIC.InterfaceIndex -Pro-
viderAddress 192.168.20.115 -PrefixLength 24
 New-NetVirtualizationProviderRoute -InterfaceIndex $NIC.InterfaceIndex -Destination-
Prefix "0.0.0.0/0" -NextHop 192.168.20.1
 # Step 5. Configure the Virtual Subnet ID on the Hyper-V Network Switch Ports for each
Virtual Machine on each Hyper-V Host (Host 1 and Host 2)
 # Run the command below for each VM on the host the VM is running on it, i.e. the for
mtlae14-005, mtlae14-006 on
 # host 192.168.20.114 and for VMs mtlae15-005, mtlae15-006 on host 192.168.20.115
 # mtlae15 only
 Get-VMNetworkAdapter -VMName mtlae15-005 | where {$_.MacAddress -eq "00155D730100"} |
Set-VMNetworkAdapter -VirtualSubnetID 5001
 Get-VMNetworkAdapter -VMName mtlae15-006 | where {$_.MacAddress -eq "00155D730101"} |
Set-VMNetworkAdapter -VirtualSubnetID 5001
```