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Mellanox Network Adapter and Software Management (CIM) For VMware ESX5x Platforms

2.0.0.0

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About this Manual

The purpose of this document is to provide information for Common Information Model (CIM) Provider for Mellanox ConnectIB®, ConnectX3Pro®, ConnectX®-3 and ConnectX®-2 based HCA's. CIM providers use a standard way to receive adapter software identity information, apply firmware and get diagnostic information and more.

1 Overview

Distributed enterprise computing has drastically changed the way users work. It allows people to access various types of data anytime and anywhere. This can be achieved by using a technology which can provide optimal management for most of the entities in the enterprise network and can co-exist with the existing technologies.

The Common Information Model (CIM) is an open standard that defines how managed elements in an IT environment are represented as a common set of objects and relationships between them. This is intended to allow consistent management of these managed elements, independent of their manufacturer or provider. CIM provides a unified method for managing an enterprise network without requiring an overhaul of the existing network management infrastructure.

CIM not only represents managed elements and management information, but also provides means to actively control and manage these elements using any standard CIM-based management software. The CIM standard is defined and published by the Distributed Management Task Force (DMTF). A related standard is Web-Based Enterprise Management (WBEM, also defined by DMTF) which defines a particular implementation of CIM, including protocols for discovering and accessing such CIM implementations.

CIM Providers allow adapters management using any standard CIM-based management software and API.

2 Requirements

2.1 Hardware

Table 1: Supported Mellanox HCAs and Firmware

Model	Firmware version
ConnectX-3 Pro	2.31.5050 and above
ConnectX-3	2.31.5050 and above
ConnectX-2	2.9.1100 and above

For the latest firmware versions, visit: http://www.mellanox.com/page/vmware_matrix or <http://www.mellanox.com/supportdownloader>

2.2 Software

Table 2: Required Mellanox Software

Model	Minimum Firmware version
net-mst	3.5.1-7
net-mlx4-core (inbox in ESX5.5)	1.9.7.0
net-mlx4-en (inbox in ESX5.5)	1.9.7.0

For the latest MST versions, visit:

http://www.mellanox.com/page/products_dyn?product_family=131&mtag=common_information_model

For the latest driver versions, visit:

http://www.mellanox.com/page/products_dyn?product_family=36&mtag=vmware_drivers

3 Installation and Configuration

3.1 Installing CIM Provider

➤ *To install CIM Provider:*

1. Download the CIM package from the Mellanox website.
www.mellanox.com → Products → Adapter IB/VPI SW → Common Information Model
2. Copy the VIB or offline bundle to the ESX server or any accessible to the ESX console shell.

In the process bellow, the location is in '/tmp'.

The example uses the Linux 'scp' utility to copy the file from a local system to an ESX server located at 10.10.10.10:

```
scp vmware-esx-provider-mlnxprovider.vib root@10.10.10.10:/tmp
scp net-mst-3.5.1.7-1OEM.550.0.0.1331820.x86_64.vib
root@10.10.10.10:/tmp
```

3. Install the CIM package.

```
esxcli software vib install -v {VIBFILE}
```

or

```
esxcli software vib install -d {OFFLINE_BUNDLE}
```

Examples:

```
esxcli software vib install -v /tmp/vmware-esx-provider-mlnxprovider.vib
```

and

```
esxcli software vib install -v /tmp/
net-mst-3.5.1.7-1OEM.550.0.0.1331820.x86_64.vib
```



NOTE: The Dependent MST nodule is Partner certified therefore you may need to change the host acceptance level.

To do this, use the following command: `esxcli software acceptance set --level=<level>`.

3.2 VUM Installation

The VMware Update Manager (VUM) is a plugin for the Virtual Center Server (vCenter Server). VUM UI is used to install a VIB by importing the associated offline bundle package (a ZIP file that contains the VIB and metadata). Afterwards, create an add-on baseline and remediate the host(s) with this baseline.

Please see the vCenter Server documentation for more details on VUM.

3.3 Configuring CIM Provider



NOTE: We recommend loading the MST module at startup from init.

1. Load and run the mst module.

```
vmkload_mod mst
```

2. Check the mst module status by using the Mellanox CIM Provider from any CIM client.

For example:

```
wbemcli ei https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_MstService
```

3.3.1 CIM Namespace

Mellanox CIM Provider supports the following namespace:

- mlnx/cimv2
- root/cimv2

4 Using the Mellanox Provider

Mellanox Provider is CMPI based and on the VMware platforms (ESX5x) it is registered to SFCB (Small Foot Print Broker) CIMOM.

In this section we are using sblim wbemcli, but any standard CIM client and API can be used.

CIM Define the following operation:

- GetInstance
- Associators
- AssociatorNames
- References
- ReferenceNames
- EnumerateInstances
- Enumerat
- EnumerateInstanceNames
- InvokeMethod

In this section we will demonstrate the usage of those operations as common tasks.

In all the examples presented throughout this section, the following data will be used:

- username - “root”
- password - “mypass”
- IP ESX host address - “1.1.1.1”

4.1 Firmware Burning

Class MLNX_FWInstallationService extend CIM_SoftwareInstallationService Implemented Method InstallFromURI.

➤ **To burn firmware:**

1. Verify the installed firmware version and PSID on all Mellanox HCAs

Example:

```
wbemcli ei https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_
FirmwareIdentity
```

or

```
wbemcli ei https://root:mypass@1.1.1.1:5989/mlnx/cimv2:CIM\_SoftwareIdentity
```

2. Download the required firmware from the Mellanox site according to the received PSID.
3. Get the installation target.

Enumerate the MLNX_PCIDevice to get the target PCIDevice ref object.

Examples:

```
wbemcli ei https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_PCIDevice
```

or

```
wbemcli ein https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_PCIDevice
```

or

```
wbemcli ein https://root:mypass@1.1.1.1:5989/mlnx/cimv2:CIM_PCIDevice
```

4. Install/Update specific firmware file on the Mellanox device.

Supplied Arguments:

- **URI:** path to mellanox firmware bin or firmware directory (if directory, the Provider selects the newest firmware version available for the target device)
- **Target:** Reference to PCIDevice instance
- **InstallOptions:**
 - 3 – force Install
 - 4 – Install
 - 5 - Update

Examples:

```
wbemcli -noverify cm https://
root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_FWInstallationService
InstallFromURI.URI="/tmp/cx3_2_30_8000.bin",Target='10.10.10.10:5989/mlnx
/cimv2:MLNX_PCIDevice.DeviceID="0000:07:00.0"',InstallOptions=3,4
```

or

```
wbemcli -noverify cm https://
root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_FWInstallationService
InstallFromURI.URI="/tmp",Target='10.10.10.10:5989/mlnx/cimv2:MLNX_PCIDev
ice.DeviceID="0000:07:00.0"',InstallOptions=3,4
```

If the force option is not needed the you can run the method without the InstallOptions:

```
wbemcli -noverify cm https://
root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_FWInstallationService
InstallFromURI.URI="/tmp",Target='10.10.10.10:5989/mlnx/cimv2:MLNX_PCIDev
ice.DeviceID="0000:07:00.0"'
```

4.2 Get Network Interface Information

- Enumerate all Mellanox related network interface:

```
wbemcli -ei https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_NetAdapter
```

Or for InfiniBand ports

```
wbemcli -ei https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_IBPort
```

- Get Ethernet port statistics using association:

```
wbemcli ai -ac MLNX_NetAdapterElementStatisticalData
https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_NetAdapter.DeviceID="vmn
ic5"
```

- Get InfiniBand port counters using association:

```
wbemcli ai -ac MLNX_IBPortCounters
https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_IBPort.DeviceID="HCA 1"
```

- Using reference:

```
wbemcli rin -arc MLNX_NetAdapterControlledBy
https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_NetAdapter.DeviceID="vmani_ib3"
wbemcli ri -arc MLNX_NetAdapterControlledBy
https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_NetAdapter.DeviceID="vmani_ib3"
```

4.3 Get Physical Card Information

- Get card part number, serial number and other card info by issue:

```
wbemcli -ei https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_Card
```

- Get specific card instance, issue:

```
wbemcli -noverify gi https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_Card.Tag="0000:04:00.0" -nl
```

- Reference of mellanox HCA/NIC the PCI device:

```
wbemcli ri -arc MLNX_PCIDeviceRealizes
'https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_Card.Tag="0000:04:00.0"
```

4.4 Run Firmware and HCA Diagnostic

- Validate and test a card and firmware:

```
wbemcli -noverify cm
https://root:mypass@1.1.1.1:5989/mlnx/cimv2:MLNX_FirmwareDiagnosticTest
RunDiagnosticService.ManagedElement=1.1.1.1:5989/mlnx/cimv2:MLNX_PCIDevice.DeviceID="0000:07:00.0"
```

The diagnostics log is located on the host machine at

/scratch/log/mlnxprovider_diag.log, You can retrieve log record and info using DiagnosticLog class.

4.5 General Queries

This section describes general command to help you learn about Mellanox provider offering and capabilities.

- Get all supported class in Mellanox namespace:

```
wbemcli -noverify ecn https://root:pswr@10.134.73.1:5989/mlnx/cimv2 -nl
```

- Get a class schema in order to understand the class capabilities and relationship with other class:

```
wbemcli -noverify gcd https://root:pswr@10.134.73.1:5989/mlnx/cimv2:<class name>
```



NOTE: Mellanox CIM provider was implemented according to DMTF profiles. Read and learn the Profiles listed in this document to get the full benefits of Mellanox CIM provider.

5 CIM Profiles

5.1 Supported CIM Profiles

- DSP 1033 1.0.0 - Registered Profile
- DSP 1011 1.0.2 - Physical Asset Profile
- DSP 1023 1.0.1 - Software Inventory Profile
- DSP 1025 1.0.0 - Software Update Profile
- DSP 1014 1.0.1 - Ethernet Port Profile
- DSP 1035 1.0.2 - Host LAN Network Port Profile
- DSP 1010 2.0.0 - Record Log Profile
- DSP 1002 2.0.0 - Diagnostics Profile

5.1.1 Service Location Protocol (SLP)

Mellanox CIM Provider support SLP which can be used to get the supported profiles.

5.2 Profile Registration

The Profile Registration describes the necessary properties and methods to represent profile and profile versioning implementation conformance. Profile Registration defines the classes used to describe the DMTF profile registration and the version information of the profiles advertised as implemented for a managed system and components of the system.

This profile specifies how to identify unambiguously the classes, properties, methods, and values that must be instantiated to represent the profile name, version, and owning organization information that is modeled using the DMTF CIM Schema.

The Profile Registration describes the registration and versioning of Common Information Model (CIM) profiles that are implemented by CIM-based system and component-management instrumentation.

5.3 Software Inventory Profile

The Software Inventory Profile describes the CIM schema elements required to provide an inventory of installed BIOS, firmware, drivers, and related software in a managed system.

This profile also describes the CIM schema elements required to represent the software that can be installed on a managed system.

The following Network Adapter SW that presented by this profile is:

- Firmware SW
- Driver SW
- CIM Provider SW

5.4 Software Update Profile

The Software Update Profile describes the classes, associations, properties, and methods used to support the installation and update of Mellanox firmware.

The profile defines relationship between a managed element and the installation service that represents the availability of software installation and update functionality for a managed element.

CIM_SoftwareInstallationService is a central class of this profile.

Following use case are supported:

- Find Software Installation Services that Can Install or Update Software
- Find Software Available for Installation
- Find the Software Installation Services compatible with a Software Identity
- Determine Whether Installing a Software Identity Requires a Reboot
- Install or Update Software on a Managed Element Using URI.

Current Implementation support 3 options for firmware update:

- Install – Install newer Firmware.
- Update - Update newer Firmware.
- Force – Install or Update same or older Firmware. This option should be combined with the Install or Update options.

5.5 PCI Device Profile

Logical PCI devices in the computer system are represented using CIM_PCIDevice.

The PCI Device Profile adding the capability to represent PCI devices for manageability, including PCI, PCI-X, PCI Express, bridge and switch devices.

The PCI device as a logical device is modeled as referencing the physical package for physical asset information and profile versioning for the schema implementation version information.

CIM_PCIDevice implement the properties according the Profile definition.

CIM_ConcreteIdentity is used to associate an instance of CIM_LogicalDevice (EthernetPort/IBPort) with an instance of CIM_PCIDevice of which the CIM_LogicalDevice instance represents an alternate aspect of the PCI device.

5.6 Physical Asset Profile

The Physical Asset Profile adding the capability to describe the physical aspects of logical elements that the implementation is instantiating.

This profile also describes the relationship between the physical elements and the profile's registration for the schema implementation and version information.

5.7 Ethernet Port Profile

The Ethernet Port Profile adding the capability to represent an Ethernet port, its associated controller, and Ethernet interfaces. Associations with the port's physical aspects and profile-implementation version information are also modeled in this profile. This profile specialize the Host LAN Network Port Profile.

CIM_EthernetPort is central class of this profile. The CIM_EthernetPort class represents the Ethernet port

The CIM_LANEndpoint class represents an access point at the data-link layer, identified by a MAC address to which the Ethernet port will respond on the network.

Mellanox provider is implemented to recognize both Ethernet and IPoIB interfaces.

Infiniband Ports are implemented align this Profile were the center class is IBPort.

5.8 Host LAN Port Profile

The Host LAN Network Port Profile is adding the capability to represent a network port that provides a LAN interface to a host system, its associated controller, and network interfaces.

This profile includes a specification of the network port, associated controller, associated network endpoint, and the realization of the connection in a physical connector.

This profile is not directly implemented, but by other profile that specialize it (i.e. CIM_EthernetPort)

CIM_NetworkPort is a central class of this profile.

5.9 Diagnostics CDMv2 Profile

Diagnostics (CDMv2) profile purpose is to ensure interoperability in the use of Web-Based Enterprise Management (WBEM) services for a diagnostics.

The goal of the Common Diagnostic Model (CDM) is to define industry-standard building blocks, based on and consistent with the DMTF CIM, that enables seamless integration of vendor-supplied diagnostic services into system and SAN management frameworks.

The CDM is an architecture and methodology for exposing system diagnostic instrumentation through the CIM standard interfaces.

A primary objective of the CDM is to standardize the interfaces that diagnostic developers create for their OS-Present Diagnostics in the operating environment, making the diagnostics accessible to all applications that query CIM for diagnostic data or register with CIM to execute diagnostic methods and receive results.

Current supported diagnostics are implemented on the driver level. There is no option to change the settings. But the diagnostic framework is implemented to enable adding external diagnostics tools and scripts. The log files are save at the provider root path.

Current implementation support HCA and firmware validation.

6 CIM Schemas

Table 3: Implemented CIM Schemas

Mellanox	Extend DMTF
MLNX_NetAdapterRealizes	CIM_Realizes
MLNX_CardElementCapabilities	CIM_ElementCapabilities
MLNX_FWInstServiceConformsToProfile	CIM_ElementConformsToProfile
MLNX_FirmwareDiagnosticElementCapabilities	CIM_ElementCapabilities
MLNX_FWInstServiceRegisteredProfile	CIM_RegisteredProfile
MLNX_ElementFirmwareIdentity	CIM_ElementSoftwareIdentity
MLNX_PhysicalConnector	CIM_PhysicalConnector
MLNX_DiagnosticRecordLogConformsToProfile	CIM_ElementConformsToProfile
MLNX_DiagnosticRecordLogRegisteredProfile	CIM_RegisteredProfile
MLNX_SoftwareIdentity	CIM_SoftwareIdentity
MLNX_IBPortIndication	CIM_AlertIndication
MLNX_NetAdapter	CIM_EthernetPort
MLNX_IBPortCounters	CIM_NetworkPortStatistics
MLNX_FWInstallationService	CIM_SoftwareInstallationService
MLNX_NetAdapterSystemDevice	CIM_SystemDevice
MLNX_DeviceSAPIImplementation	CIM_DeviceSAPIImplementation
MLNX_FirmwareIdentity	CIM_SoftwareIdentity
MLNX_PortController	CIM_PortController
MLNX_HostLanNetworkPortConformsToProfile	CIM_ElementConformsToProfile
MLNX_FirmwareIdentityConformsToProfile	CIM_ElementConformsToProfile
MLNX_HostLanNetworkPortRegisteredProfile	CIM_RegisteredProfile
MLNX_UnitaryComputerSystem	CIM_UnitaryComputerSystem
MLNX_FirmwareDiagnosticConformsToProfile	CIM_ElementConformsToProfile
MLNX_FirmwareDiagnosticSettingData	CIM_DiagnosticSettingData
MLNX_FirmwareDiagnosticTest	CIM_DiagnosticTest
MLNX_PhysicalConnectorRealizes	CIM_Realizes
MLNX_PortControllerRealizes	CIM_Realizes
MLNX_FirmwareIdentityRegisteredProfile	CIM_RegisteredProfile
MLNX_FirmwareDiagnosticAffectsElement	CIM_ServiceAffectsElement
MLNX_MstService	CIM_Service
MLNX_Card	CIM_Card
MLNX_FirmwareDiagnosticRegisteredProfile	CIM_RegisteredProfile
MLNX_InstalledFirmwareIdentity	CIM_InstalledSoftwareIdentity

Mellanox	Extend DMTF
MLNX_NetAdapterConformsToProfile	CIM_ElementConformsToProfile
MLNX_SoftwareIdentityConformsToProfile	CIM_ElementConformsToProfile
MLNX_HostedAccessPoint	CIM_HostedAccessPoint
MLNX_SoftwareIdentityRegisteredProfile	CIM_RegisteredProfile
MLNX_PCIDeviceConformsToProfile	CIM_ElementConformsToProfile
MLNX_NetAdapterControlledBy	CIM_ControlledBy
MLNX_FWInstallationServiceCapabilities	CIM_SoftwareInstallationServiceCapabilities
MLNX_FirmwareDiagnosticAvailableService	CIM_AvailableDiagnosticService
MLNX_IBPortElementStatisticalData	CIM_ElementStatisticalData
MLNX_FWElementCapabilities	CIM_ElementCapabilities
MLNX_NetAdapterRegisteredProfile	CIM_RegisteredProfile
MLNX_PCIDeviceRegisteredProfile	CIM_RegisteredProfile
MLNX_CardCapabilities	CIM_PhysicalAssetCapabilities
MLNX_FirmwareDiagnosticUseOfLog	CIM_UseOfLog
MLNX_FirmwareDiagnosticLog	CIM_DiagnosticLog
MLNX_IBPortRealizes	CIM_Realizes
MLNX_FWServiceAffectsElement	CIM_ServiceAffectsElement
MLNX_FWInstHostedService	CIM_HostedService
MLNX_IBPortControlledBy	CIM_ControlledBy
MLNX_NetAdapterEthStatistics	CIM_NetworkPortStatistics
MLNX_FirmwareDiagnosticHostedService	CIM_HostedService
MLNX_PCIDevice	CIM_PCIDevice
MLNX_IBPort	CIM_NetworkPort
MLNX_FirmwareDiagnosticElementSettingData	CIM_ElementSettingData
MLNX_FirmwareDiagnosticServiceCapabilities	CIM_DiagnosticServiceCapabilities
MLNX_FirmwareDiagnosticLogCapabilities	CIM_RecordLogCapabilities
MLNX_FirmwareDiagnosticLogElementCapabilities	CIM_ElementCapabilities
MLNX_PCIDeviceRealizes	CIM_Realizes
MLNX_LANEndpoint	CIM_LANEndpoint
MLNX_Container	CIM_Container
MLNX_ElementSoftwareIdentity	CIM_ElementSoftwareIdentity
MLNX_NetAdapterElementStatisticalData	CIM_ElementStatisticalData
MLNX_PhysicalAssetConformsToProfile	CIM_ElementConformsToProfile
MLNX_PhysicalAssetRegisteredProfile	CIM_RegisteredProfile

