

**Intel® Ethernet Adapters and Devices  
User Guide**


# Overview

Welcome to the *User's Guide* for Intel® Ethernet Adapters and devices. This guide covers hardware and software installation, setup procedures, and troubleshooting tips for Intel network adapters, connections, and other devices.

## Installing the Network Adapter

If you are installing a network adapter, follow this procedure from step 1.

If you are upgrading the driver software, start with step 4.

 **NOTE:** If you update the firmware, you must update the driver software to the same family version.

1. Review [system requirements](#).
2. [Insert the PCI Express Adapter](#), [Mezzanine Card](#), or [Network Daughter Card](#) into your server.
3. Carefully connect the network [copper cable\(s\)](#), [fiber cable\(s\)](#), or [direct attach cables](#)
4. Install the network drivers and other software
  - [Windows Instructions](#)
  - [Linux Instructions](#)
5. [Testing the Adapter](#).

## Intended Audience

This document is intended for information technology professionals with a high level of knowledge, experience, and competency in Ethernet networking technology.

## Before You Begin

### Supported Devices

#### Supported 40 Gigabit Network Adapters

- Intel® Ethernet 40G 2P XL710 QSFP+ rNDC
- Intel® Ethernet Converged Network Adapter XL710-Q2

 **NOTE:**

- The total throughput supported by an Intel 710 Series based adapter is 40 Gb/s, even when connected via two 40 Gb/s connections.
- In order for an adapter based on the XL710 controller to reach its full potential, you must install it in a PCIe Gen3 x8 slot. Installing it in a shorter slot, or a Gen2 or Gen1 slot, will limit the throughput of the adapter.

#### Supported 25 Gigabit Network Adapters

- Intel® Ethernet 25G 2P XXV710 Mezz
- Intel® Ethernet 25G 2P XXV710 Adapter

#### Supported 10 Gigabit Network Adapters

- Intel® Ethernet 10G 2P X520 Adapter
- Intel® Ethernet 10G X520 LOM
- Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
- Intel® Ethernet 10G 2P X540-t Adapter
- Intel® Ethernet 10G 2P X550-t Adapter
- Intel® Ethernet 10G 4P X550 rNDC
- Intel® Ethernet 10G 4P X550/I350 rNDC
- Intel® Ethernet 10G 4P X540/I350 rNDC
- Intel® Ethernet 10G 4P X520/I350 rNDC
- Intel® Ethernet 10G 2P X520-k bNDC

- Intel® Ethernet 10G 4P X710-k bNDC
- Intel® Ethernet 10G 2P X710-k bNDC
- Intel® Ethernet 10G X710-k bNDC
- Intel® Ethernet Converged Network Adapter X710
- Intel® Ethernet Converged Network Adapter X710-T
- Intel® Ethernet 10G 4P X710/I350 rNDC
- Intel® Ethernet 10G 4P X710 SFP+ rNDC
- Intel® Ethernet 10G X710 rNDC
- Intel® Ethernet Server Adapter X710-DA2 for OCP



**NOTE:** The first port of Intel 710 Series based adapters will display the correct branding string. All other ports on the same device will display a generic branding string.

#### Supported Gigabit Network Adapters and Devices

- Intel® Gigabit 2P I350-t Adapter
- Intel® Gigabit 4P I350-t Adapter
- Intel® Gigabit 4P X550/I350 rNDC
- Intel® Gigabit 4P I350-t rNDC
- Intel® Gigabit 4P X540/I350 rNDC
- Intel® Gigabit 4P X520/I350 rNDC
- Intel® Gigabit 4P I350-t Mezz
- Intel® Gigabit 4P X710/I350 rNDC
- Intel® Gigabit 4P I350 bNDC
- Intel® Ethernet Connection I354 1.0 GbE Backplane
- Intel® Gigabit 2P I350-t LOM
- Intel® Gigabit I350-t LOM
- Intel® Gigabit 2P I350 LOM

## Supported Operating Systems

### Supported Intel® 64 Architecture Operating Systems

- Microsoft\* Windows Server\* 2012 R2
- Microsoft Windows Server 2016
- Microsoft Windows Server 2016 Nano Server
- Microsoft Windows Server 2019
- VMWare\* ESXi\* 6.5 U2 ‡
- VMWare\* ESXi\* 6.7 U1
- Red Hat\* Enterprise Linux\* (RHEL) 6.10
- Red Hat\* Enterprise Linux\* (RHEL) 7.5
- Novell\* SUSE\* Linux Enterprise Server (SLES) 15

‡ If you upgrade to VMWare ESXi 6.5 U1 or later, you must use native mode drivers (available in the latest driver software package) instead of VMKLinux legacy mode drivers.

## Hardware Compatibility

Before installing the adapter, check your system for the following:

- The latest BIOS for your system
- One open PCI Express slot (see the [specifications of your card](#) for slot compatibility)


## Cabling Requirements

Please see the section [Connecting Network Cables](#).

# Installation Overview

## Installing the Adapter

1. Turn off the computer and unplug the power cord.
2. Remove the computer cover and the adapter slot cover from the slot that matches your adapter.
3. Insert the adapter edge connector into the slot and secure the bracket to the chassis.
4. Replace the computer cover, then plug in the power cord.


 **NOTE:** For information on identifying PCI Express slots that support your adapters, see your Dell EMC system guide.

## Install Drivers and Software

### Windows\* Operating Systems

You must have administrative rights to the operating system to install the drivers.

1. Download the latest drivers from the [support website](#) and transfer them to the system.
2. If the Found New Hardware Wizard screen is displayed, click **Cancel**.
3. Double-click the downloaded file.
4. Select **Install** from the Dell Update Package screen.
5. Follow the instructions in the install wizard. Be sure to select Intel PROSet for installation.

 **NOTE:** Be sure to select the "iSCSI using Data Center Bridging" install option for systems that have an NPAR capable device installed.

### Installing Linux\* Drivers from Source Code

1. Download and expand the base driver tar file.
2. Compile the driver module.
3. Install the module using the modprobe command.
4. Assign an IP address using the ifconfig command.

Please refer to the [Linux section](#) of this guide for more specific information.

### Other Operating Systems

To install other drivers, visit the Customer Support web site: <http://www.support.dell.com>.

## Optimizing Performance

You can configure Intel network adapter advanced settings to help optimize server performance.

The examples below provide guidance for three server usage models:

- [Optimized for quick response and low latency](#) – useful for video, audio, and High Performance Computing Cluster (HPCC) servers
- [Optimized for throughput](#) – useful for data backup/retrieval and file servers
- [Optimized for CPU utilization](#) – useful for application, web, mail, and database servers

#### **NOTES:**

- The recommendations below are guidelines and should be treated as such. Additional factors such as installed applications, bus type, network topology, and operating system also affect system performance.
- These adjustments should be performed by a highly skilled network administrator. They are not guaranteed to improve performance. Not all settings shown here may be available through network driver configuration, operating system or system BIOS. Linux users, see the README file in the Linux driver package for Linux-specific performance enhancement details.
- When using performance test software, refer to the documentation of the application for optimal results.

## General Optimization

- Install the adapter in an appropriate slot.
  - 📌 **NOTE:** Some PCIe x8 slots are actually configured as x4 slots. These slots have insufficient bandwidth for full line rate with some dual port devices. The driver can detect this situation and will write the following message in the system log: "PCI-Express bandwidth available for this card is not sufficient for optimal performance. For optimal performance a x8 PCI-Express slot is required." If this error occurs, moving your adapter to a true x8 slot will resolve the issue.
- In order for an Intel® 710 Series Network Adapter to reach its full potential, you must install it in a PCIe Gen3 x8 slot. Installing it in a shorter slot, or a Gen2 or Gen1 slot, will impact the throughput the adapter can attain.
- Use the proper cabling for your device.
- Enable Jumbo Packets, if your other network components can also be configured for it.
- Increase the number of TCP and Socket resources from the default value. For Windows based systems, we have not identified system parameters other than the TCP Window Size which significantly impact performance.
- Increase the allocation size of Driver Resources (transmit/receive buffers). However, most TCP traffic patterns work best with the transmit buffer set to its default value, and the receive buffer set to its minimum value.
- When passing traffic on multiple network ports using an I/O application that runs on most or all of the cores in your system, consider setting the CPU Affinity for that application to fewer cores. This should reduce CPU utilization and in some cases may increase throughput for the device. The cores selected for CPU Affinity must be local to the affected network device's Processor Node/Group. You can use the PowerShell command `Get-NetAdapterRSS` to list the cores that are local to a device. You may need to increase the number of cores assigned to the application to maximize throughput. Refer to your operating system documentation for more details on setting the CPU Affinity.
- If you have multiple 10 Gbps (or faster) ports installed in a system, the RSS queues of each adapter port can be adjusted to use non-overlapping sets of processors within the adapter's local NUMA Node/Socket. Change the RSS Base Processor Number for each adapter port so that the combination of the base processor and the max number of RSS processors settings ensure non-overlapping cores.
  1. Identify the adapter ports to be adjusted and inspect at their `RssProcessorArray` using the `Get-NetAdapterRSS` PowerShell cmdlet.
  2. Identify the processors with NUMA distance 0. These are the cores in the adapter's local NUMA Node/Socket and will provide the best performance.
  3. Adjust the RSS Base processor on each port to use a non-overlapping set of processors within the local set of processors. You can do this manually or using the following PowerShell command:

```
Set-NetAdapterAdvancedProperty -Name <Adapter Name> -DisplayName "RSS Base Processor Number" -DisplayValue <RSS Base Proc Value>
```
  4. Use the `Get-NetAdapterAdvancedProperty` cmdlet to check that the right values have been set:

```
Get-NetAdapterAdvancedProperty -Name <Adapter Name>
```

For Example: For a 4 port adapter with Local processors 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, and 'Max RSS processor' of 8, set the RSS base processors to 0, 8, 16 and 24.

## Optimized for quick response and low latency

- Minimize or disable Interrupt Moderation Rate.
- Disable Offload TCP Segmentation.
- Disable Jumbo Packets.
- Increase Transmit Descriptors.
- Increase Receive Descriptors.
- Increase RSS Queues.

## Optimized for throughput

- Enable Jumbo Packets.
- Increase Transmit Descriptors.
- Increase Receive Descriptors.
- On systems that support NUMA, set the Preferred NUMA Node on each adapter to achieve better scaling across NUMA nodes.

## Optimized for CPU utilization

- Maximize Interrupt Moderation Rate.
- Keep the default setting for the number of Receive Descriptors; avoid setting large numbers of Receive Descriptors.
- Decrease RSS Queues.
- In Hyper-V environments, decrease the Max number of RSS CPUs.

## Remote Storage

The remote storage features allow you to access a SAN or other networked storage using Ethernet protocols. This includes Data Center Bridging (DCB), iSCSI over DCB, and Fibre Channel over Ethernet (FCoE).

## DCB (Data Center Bridging)

Data Center Bridging (DCB) is a collection of standards-based extensions to classical Ethernet. It provides a lossless data center transport layer that enables the convergence of LANs and SANs onto a single unified fabric.

Furthermore, DCB is a configuration Quality of Service implementation in hardware. It uses the VLAN priority tag (802.1p) to filter traffic. That means that there are 8 different priorities that traffic can be filtered into. It also enables priority flow control (802.1Qbb) which can limit or eliminate the number of dropped packets during network stress. Bandwidth can be allocated to each of these priorities, which is enforced at the hardware level (802.1Qaz).

Adapter firmware implements LLDP and DCBX protocol agents as per 802.1AB and 802.1Qaz respectively. The firmware based DCBX agent runs in willing mode only and can accept settings from a DCBX capable peer. Software configuration of DCBX parameters via dcbtool/ldptool are not supported.



**NOTE:** On X710 based devices running Microsoft Windows, Data Center Bridging (DCB) is only supported on firmware version 17.0.12 and newer. Older NVM versions must be updated before the adapter is capable of DCB support in Windows.

## Supported Devices

The following adapters support remote storage using iSCSI over DCB and FCoE over DCB

- Intel® Ethernet 10G 2P X520 Adapter
- Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
- Intel® Ethernet 4P X520/I350 rNDC
- Intel® Ethernet 10G X520 LOM
- Intel® Ethernet 10G 2P X520-k bNDC
- Intel® Ethernet 10G 2P X540-t Adapter
- Intel® Ethernet 10G 4P X540/I350 rNDC (I350 ports only)
- Intel® Ethernet 10G 2P X550-t Adapter
- Intel® Ethernet 10G 4P X550 rNDC<sup>‡</sup>
- Intel® Ethernet 10G 4P X550/I350 rNDC<sup>‡</sup>
- Intel® Ethernet 10G 4P X710-k bNDC<sup>‡</sup>
- Intel® Ethernet 10G 2P X710-k bNDC<sup>‡</sup>
- Intel® Ethernet 10G X710-k bNDC<sup>‡</sup>
- Intel® Ethernet Converged Network Adapter X710<sup>‡</sup>
- Intel® Converged Network Adapter X710-T<sup>‡</sup>
- Intel® Ethernet 10G 4P X710/I350 rNDC<sup>‡</sup>
- Intel® Ethernet 10G 4P X710 SFP+ rNDC<sup>‡</sup>
- Intel® Ethernet 10G X710 rNDC<sup>‡</sup>
- Intel® Ethernet Server Adapter X710-DA2 for OCP<sup>‡</sup>
- Intel® Ethernet 25G 2P XXV710 Adapter<sup>‡</sup>
- Intel® Ethernet 25G 2P XXV710 Mezz<sup>‡</sup>
- Intel® Ethernet 40G 2P XL710 QSFP+ rNDC<sup>‡</sup>
- Intel® Ethernet Converged Network Adapter XL710-Q2<sup>‡</sup>

‡ This device does not support FCoE over DCB.



**NOTE:** When an Intel® 710 Series based adapter is in NPar mode, you can only configure DCB through the System Setup/BIOS.

## iSCSI Over DCB

Intel® Ethernet adapters support iSCSI software initiators that are native to the underlying operating system. In the case of Windows, the Microsoft iSCSI Software Initiator, enables connection of a Windows host to an external iSCSI storage array using an Intel Ethernet adapter.

In the case of Open Source distributions, virtually all distributions include support for an Open iSCSI Software Initiator and Intel® Ethernet adapters will support them. Please consult your distribution documentation for additional configuration details on their particular Open iSCSI initiator.

Intel® 82599 and X540-based adapters support iSCSI within a Data Center Bridging cloud. Used in conjunction with switches and targets that support the iSCSI/DCB application TLV, this solution can provide guaranteed minimum bandwidth for iSCSI traffic between the host and target. This solution enables storage administrators to segment iSCSI traffic from LAN traffic, similar to how they can currently segment FCoE from LAN traffic. Previously, iSCSI traffic within a DCB supported environment was treated as LAN traffic by switch vendors. Please consult your switch and target vendors to ensure that they support the iSCSI/DCB application TLV.

## Intel® Ethernet FCoE (Fibre Channel over Ethernet)

Fibre Channel over Ethernet (FCoE) is the encapsulation of standard Fibre Channel (FC) protocol frames as data within standard Ethernet frames. This link-level encapsulation, teamed with an FCoE-aware Ethernet-to-FC gateway, acts to extend an FC fabric to include Ethernet-based host connectivity. The FCoE specification focuses on encapsulation of FC frames specific to storage class traffic, as defined by the Fibre Channel FC-4 FCP specification.



### NOTES:

- FCoE is no longer supported and is no longer being tested. Installing drivers from Release 23.2 or later may cause FCoE to behave unexpectedly or cease functioning.
- Support for new operating systems will not be added to FCoE. The last operating system versions that support FCoE are as follows:
  - Microsoft\* Windows Server\* 2012 R2
  - SLES 11 SP4
  - VMware\* ESX 6.0 U3

## Jumbo Frames

The base driver supports FCoE mini-Jumbo Frames (2.5k bytes) independent of the LAN Jumbo Frames setting.

## FCoE VN to VN (VN2VN) Support

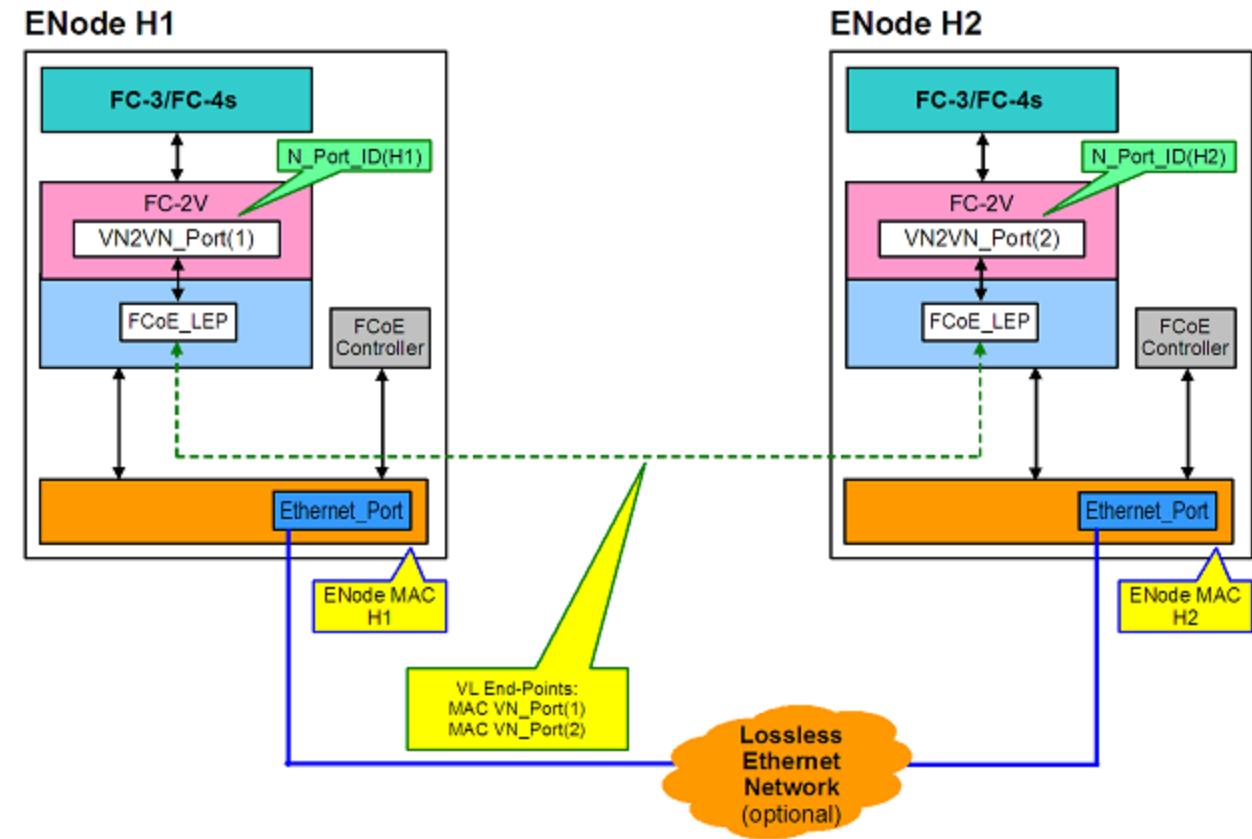
FCoE VN to VN, also called VN2VN, is a standard for connecting two end-nodes (ENodes) directly using FCoE. An ENode can create a VN2VN virtual link with another remote ENode by not connecting to FC or FCoE switches (FCFs) in between, so neither port zoning nor advance fibre channel services is required. The storage software controls access to, and security of, LUNs using LUN masking. The VN2VN fabric may have a lossless Ethernet switch between the ENodes. This allows multiple ENodes to participate in creating more than one VN2VN virtual link in the VN2VN fabric. VN2VN has two operational modes: Point to Point (PT2PT) and Multipoint.



**NOTE:** The mode of operation is used only during initialization.

## Point to Point (PT2PT) Mode

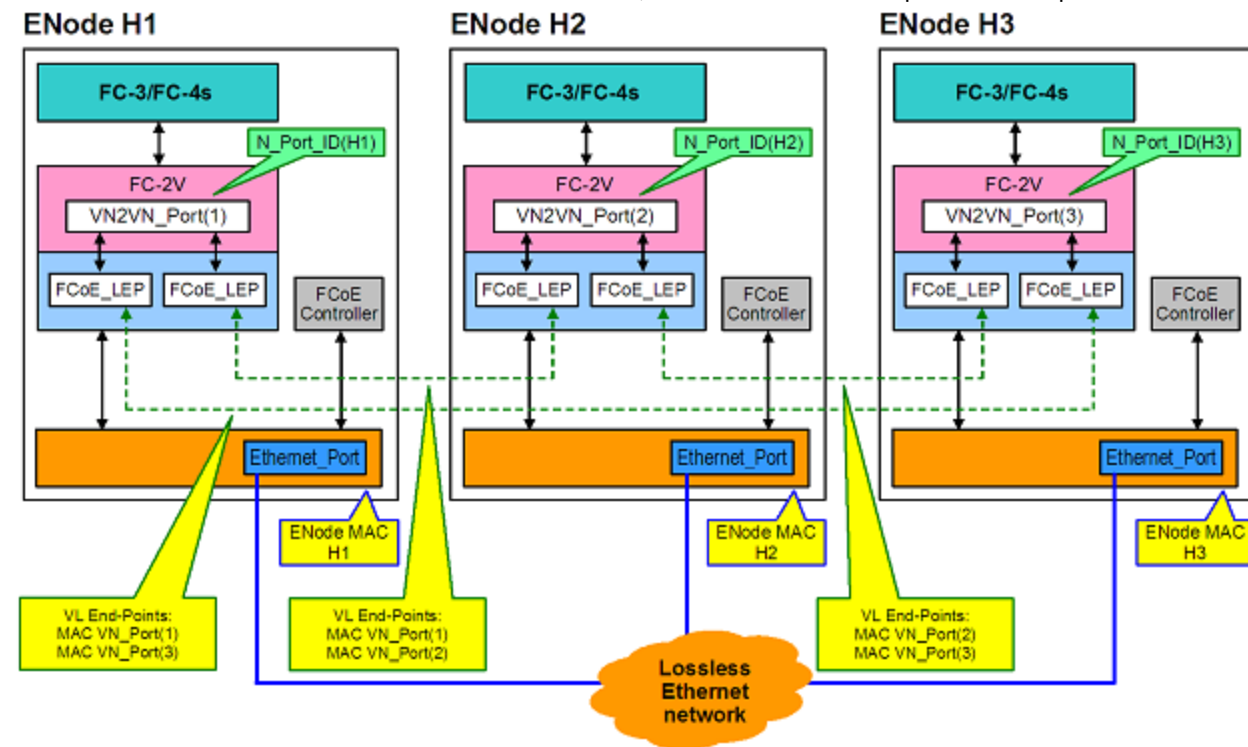
In Point to Point mode, there are only two ENodes, and they are connected either directly or through a lossless Ethernet switch:





## MultiPoint Mode

If more than two ENodes are detected in the VN2VN fabric, then all nodes should operate in Multipoint mode:



## Enabling VN2VN in Microsoft Windows

To enable VN2VN in Microsoft Windows:

1. Start Windows Device Manager.
2. Open the appropriate FCoE miniport property sheet (generally under Storage controllers) and click on the Advanced tab.
3. Select the VN2VN setting and choose "Enable."

## Remote Boot

Remote Boot allows you to boot a system using only an Ethernet adapter. You connect to a server that contains an operating system image and use that to boot your local system.

## Intel® Boot Agent

The Intel® Boot Agent is a software product that allows your networked client computer to boot using a program code image supplied by a remote server. Intel Boot Agent complies with the Pre-boot eXecution Environment (PXE) Version 2.1 Specification. It is compatible with legacy boot agent environments that use BOOTP protocol.

## Supported Devices

You can use BootUtil to enable the flash ROM on most Intel server adapters. However, for the following adapters, PXE is enabled through the uEFI environment (HII interface) and Bootutil cannot be used to update the boot image. Bootutil can be used to change the remote boot options when the server is set to legacy boot mode in the BIOS. If booting in EFI mode, the server BIOS will handle the boot mode changes. Updating the adapter is handled by the appropriate Dell update package.

- Intel® Gigabit 2P I350-t Adapter
- Intel® Gigabit 4P I350-t Adapter
- Intel® Gigabit 4P I350-t rNDC

- Intel® Gigabit 2P I350-t LOM
- Intel® Gigabit I350-t LOM
- Intel® Gigabit 2P I350 LOM
- Intel® Gigabit 4P I350-t Mezz
- Intel® Ethernet 10G 2P X520 Adapter
- Intel® Ethernet 10G 2P X520-k bNDC
- Intel® Ethernet 4P X520/I350 rNDC
- Intel® Gigabit 4P I350 bNDC
- Intel® Ethernet 10G X520 LOM
- Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
- Intel® Ethernet 10G 2P X540-t Adapter
- Intel® Ethernet 10G 4P X540/I350 rNDC
- Intel® Ethernet 10G 2P X550-t Adapter
- Intel® Ethernet 10G 4P X550 rNDC
- Intel® Ethernet 10G 4P X550/I350 rNDC
- Intel® Ethernet Converged Network Adapter X710
- Intel® Ethernet 10G 4P X710-k bNDC
- Intel® Ethernet 10G 2P X710-k bNDC
- Intel® Ethernet 10G X710-k bNDC
- Intel® Ethernet 10G 4P X710/I350 rNDC
- Intel® Ethernet 10G 4P X710 SFP+ rNDC
- Intel® Ethernet 10G X710 rNDC
- Intel® Converged Network Adapter X710-T
- Intel® Ethernet Server Adapter X710-DA2 for OCP
- Intel® Ethernet 25G 2P XXV710 Adapter
- Intel® Ethernet 25G 2P XXV710 Mezz
- Intel® Ethernet Converged Network Adapter XL710-Q2
- Intel® Ethernet 40G 2P XL710 QSFP+ rNDC

## Intel® Ethernet iSCSI Boot

Intel® Ethernet iSCSI Boot provides the capability to boot a client system from a remote iSCSI disk volume located on an iSCSI-based Storage Area Network (SAN).

### Supported Devices

- Intel® Gigabit 2P I350-t Adapter
- Intel® Gigabit 4P I350-t Adapter
- Intel® Gigabit 4P I350-t rNDC
- Intel® Gigabit 4P I350 bNDC
- Intel® Gigabit 2P I350-t LOM
- Intel® Gigabit I350-t LOM
- Intel® Gigabit 2P I350 LOM
- Intel® Gigabit 4P I350-t Mezz
- Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
- Intel® Ethernet 10G 2P X520 Adapter
- Intel® Ethernet 10G 2P X520-k bNDC
- Intel® Ethernet 10G X520 LOM
- Intel® Ethernet 4P X520/I350 rNDC
- Intel® Ethernet 10G 2P X540-t Adapter
- Intel® Ethernet 10G 4P X540/I350 rNDC
- Intel® Ethernet 10G 2P X550-t Adapter
- Intel® Ethernet Converged Network Adapter XL710-Q2
- Intel® Ethernet 10G 4P X550 rNDC
- Intel® Ethernet 10G 4P X550/I350 rNDC
- Intel® Ethernet Converged Network Adapter X710
- Intel® Ethernet 10G 2P X710-k bNDC
- Intel® Ethernet 10G 4P X710-k bNDC

- Intel® Ethernet 10G X710-k bNDC
- Intel® Ethernet 10G 4P X710/I350 rNDC
- Intel® Ethernet 10G 4P X710 SFP+ rNDC
- Intel® Ethernet 10G X710 rNDC
- Intel® Converged Network Adapter X710-T
- Intel® Ethernet Server Adapter X710-DA2 for OCP
- Intel® Ethernet 25G 2P XXV710 Adapter
- Intel® Ethernet 25G 2P XXV710 Mezz
- Intel® Ethernet 40G 2P XL710 QSFP+ rNDC

## Intel® Ethernet FCoE Boot

Intel® Ethernet FCoE Boot provides the capability to boot a client system from a remote disk volume located on an Fibre Channel Storage Area Network (SAN).

## Using Intel® PROSet for Windows Device Manager

There are two ways to navigate to the FCoE properties in Windows Device Manager: by using the "Data Center" tab on the adapter property sheet or by using the Intel® "Ethernet Virtual Storage Miniport Driver for FCoE Storage Controllers" property sheet.

## Supported Devices

Intel® FCoE is supported on the following Intel® Network Adapters:

- Intel® Ethernet 10G 2P X520 Adapter
- Intel® Ethernet 10G 2P X520-k bNDC
- Intel® Ethernet 4P X520/I350 rNDC
- Intel® Ethernet 10G X520 LOM
- Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
- Intel® Ethernet 10G 2P X540-t Adapter
- Intel® Ethernet 10G 4P X540/I350 rNDC (X540 ports only)
- Intel® Ethernet 10G 2P X550-t Adapter



### NOTES:

- When using FCoE Boot with an Intel networking adapter, a Brocade Host Bus Adapter (HBA) must not be installed in the system.
- Not all operating systems are supported on all adapters.

## Virtualization Support

Virtualization makes it possible for one or more operating systems to run simultaneously on the same physical system as virtual machines. This allows you to consolidate several servers onto one system, even if they are running different operating systems. Intel® Network Adapters work with, and within, virtual machines with their standard drivers and software.



### NOTES:

- Some virtualization options are not available on some adapter/operating system combinations.
- The jumbo frame setting inside a virtual machine must be the same, or lower than, the setting on the physical port.
- When you attach a Virtual Machine to a tenant overlay network through the Virtual NIC ports on a Virtual Switch, the encapsulation headers increase the Maximum Transmission Unit (MTU) size on the virtual port. The Encapsulation Overhead feature automatically adjusts the physical port's MTU size to compensate for this increase.
- See [http://www.intel.com/technology/advanced\\_comm/virtualization.htm](http://www.intel.com/technology/advanced_comm/virtualization.htm) for more information on using Intel Network Adapters in virtualized environments.

## Using Intel® Network Adapters in a Microsoft\* Hyper-V\* Environment

When a Hyper-V Virtual NIC (vNIC) interface is created in the parent partition, the vNIC takes on the MAC address of the underlying physical NIC. The same is true when a vNIC is created on a team or VLAN. Since the vNIC uses the MAC address of the underlying interface, any operation that changes the MAC address of the interface (for example, setting LAA on the interface, changing the primary adapter on a team, etc.), will cause the vNIC to lose connectivity. In order to prevent this loss of connectivity, Intel® PROSet will not allow you to change settings that change the MAC address.

### NOTES:

- If Fibre Channel over Ethernet (FCoE)/Data Center Bridging (DCB) is present on the port, configuring the device in Virtual Machine Queue (VMQ) + DCB mode reduces the number of VMQ vPorts available for guest OSes. This does not apply to Intel® Ethernet Controller X710 based devices.
- When sent from inside a virtual machine, LLDP and LACP packets may be a security risk. The Intel® Virtual Function driver blocks the transmission of such packets.
- The Virtualization setting on the Advanced tab of the adapter's Device Manager property sheet is not available if the Hyper-V role is not installed.
- Prior to configuring the Microsoft\* Hyper-V features, the Intel® NIC drivers must be installed by the Dell EMC Update Package. If the Microsoft\* Hyper-V feature is configured on an unsupported NIC partition on Intel® X710 devices prior to executing the Dell EMC Update Package to install Intel® NIC Drivers, the driver installation may not complete. To recover, you must uninstall Microsoft\* Hyper-V, uninstall 'Intel® Network Connections' from 'Programs and Features', and execute the Dell EMC Update Package to install Intel® NIC Drivers.

## The Virtual Machine Switch

The virtual machine switch is part of the network I/O data path. It sits between the physical NIC and the virtual machine NICs and routes packets to the correct MAC address. Enabling Virtual Machine Queue (VMQ) offloading in Intel® PROSet will automatically enable VMQ in the virtual machine switch. For driver-only installations, you must manually enable VMQ in the virtual machine switch.

## Using ANS VLANs

If you create ANS VLANs in the parent partition, and you then create a Hyper-V Virtual NIC interface on an ANS VLAN, then the Virtual NIC interface **\*must\*** have the same VLAN ID as the ANS VLAN. Using a different VLAN ID or not setting a VLAN ID on the Virtual NIC interface will result in loss of communication on that interface.

Virtual Switches bound to an ANS VLAN will have the same MAC address as the VLAN, which will have the same address as the underlying NIC or team. If you have several VLANs bound to a team and bind a virtual switch to each VLAN, all of the virtual switches will have the same MAC address. Clustering the virtual switches together will cause a network error in Microsoft's cluster validation tool. In some cases, ignoring this error will not impact the performance of the cluster. However, such a cluster is not supported by Microsoft. Using Device Manager to give each of the virtual switches a unique address will resolve the issue. See the Microsoft TechNet article [Configure MAC Address Spoofing for Virtual Network Adapters](#) for more information.

Virtual Machine Queues (VMQ) and SR-IOV cannot be enabled on a Hyper-V Virtual NIC interface bound to a VLAN configured using the VLANs tab in Windows Device Manager.

## Using an ANS Team or VLAN as a Virtual NIC

If you want to use a team or VLAN as a virtual NIC you must follow these steps:

### NOTES:

- This applies only to virtual NICs created on a team or VLAN. Virtual NICs created on a physical adapter do not require these steps.
  - Receive Load Balancing (RLB) is not supported in Hyper-V. Disable RLB when using Hyper-V.
1. Use Intel® PROSet to create the team or VLAN.
  2. Open the Network Control Panel.
  3. Open the team or VLAN.
  4. On the General Tab, uncheck all of the protocol bindings and click OK.

5. Create the virtual NIC. (If you check the "Allow management operating system to share the network adapter." box you can do the following step in the parent partition.)
6. Open the Network Control Panel for the Virtual NIC.
7. On the General Tab, check the protocol bindings that you desire.



**NOTE:** This step is not required for the team. When the Virtual NIC is created, its protocols are correctly bound.

## Command Line for Microsoft Windows Server\* Core

Microsoft Windows Server\* Core does not have a GUI interface. If you want to use an ANS Team or VLAN as a Virtual NIC, you must use [Microsoft\\* Windows PowerShell\\*](#) to set up the configuration. Use Windows PowerShell to create the team or VLAN.

The following is an example of how to set up the configuration using Microsoft\* Windows PowerShell\*.

1. Get all the adapters on the system and store them into a variable.

```
$a = Get-IntelNetAdapter
```

2. Create a team by referencing the indexes of the stored adapter array.

```
New-IntelNetTeam -TeamMembers $a[1], $a[2] -TeamMode  
VirtualMachineLoadBalancing -TeamName "Team1"
```

## Virtual Machine Queue Offloading

Enabling VMQ offloading increases receive and transmit performance, as the adapter hardware is able to perform these tasks faster than the operating system. Offloading also frees up CPU resources. Filtering is based on MAC and/or VLAN filters. For devices that support it, VMQ offloading is enabled in the host partition on the adapter's Device Manager property sheet, under Virtualization on the Advanced Tab.

Each Intel® Ethernet Adapter has a pool of virtual ports that are split between the various features, such as VMQ Offloading, SR-IOV, Data Center Bridging (DCB), and Fibre Channel over Ethernet (FCoE). Increasing the number of virtual ports used for one feature decreases the number available for other features. On devices that support it, enabling DCB reduces the total pool available for other features to 32. Enabling FCoE further reduces the total pool to 24.



**NOTE:** This does not apply to devices based on the Intel® Ethernet X710 or XL710 controllers.

[Intel PROSet](#) displays the number of virtual ports available for virtual functions under Virtualization properties on the device's Advanced Tab. It also allows you to set how the available virtual ports are distributed between VMQ and SR-IOV.

## Teaming Considerations

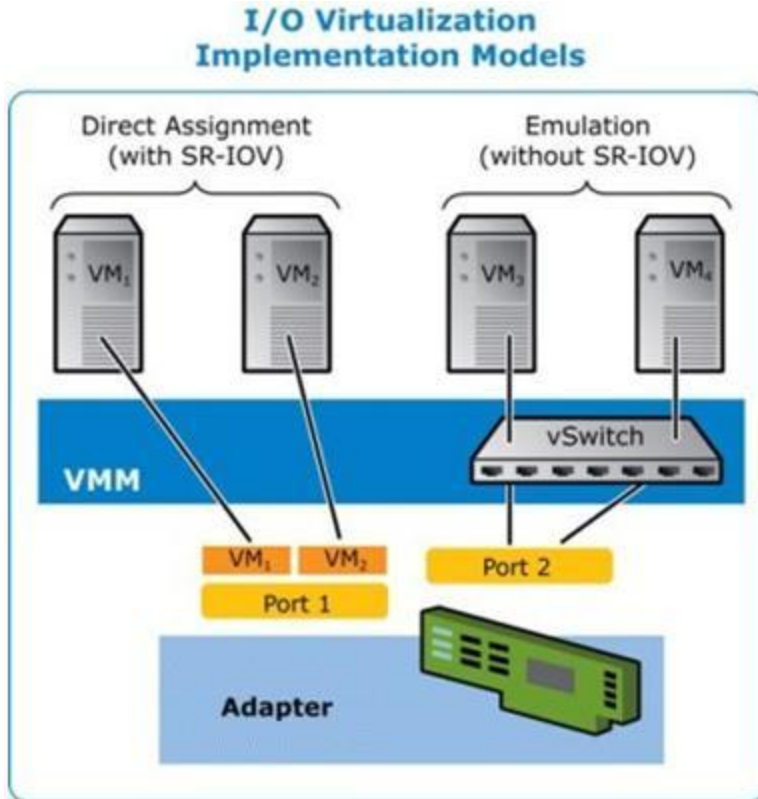
- If VMQ is not enabled for all adapters in a team, VMQ will be disabled for the team.
- If an adapter that does not support VMQ is added to a team, VMQ will be disabled for the team.
- Virtual NICs cannot be created on a team with Receive Load Balancing enabled. Receive Load Balancing is automatically disabled if you create a virtual NIC on a team.
- If a team is bound to a Hyper-V virtual NIC, you cannot change the Primary or Secondary adapter.

## Virtual Machine Multiple Queues

Virtual Machine Multiple Queues (VMMQ) enables Receive Side Scaling (RSS) for virtual ports attached to a physical port. This allows RSS to be used with SR-IOV and inside a VMQ virtual machine, and offloads the RSS processing to the network adapter. RSS balances receive traffic across multiple CPUs or CPU cores. This setting has no effect if your system has only one processing unit.

## SR-IOV Overview

Single Root IO Virtualization (SR-IOV) is a PCI SIG specification allowing PCI Express devices to appear as multiple separate physical PCI Express devices. SR-IOV allows efficient sharing of PCI devices among Virtual Machines (VMs). It manages and transports data without the use of a hypervisor by providing independent memory space, interrupts, and DMA streams for each virtual machine.



SR-IOV architecture includes two functions:

- Physical Function (PF) is a full featured PCI Express function that can be discovered, managed and configured like any other PCI Express device.
- Virtual Function (VF) is similar to PF but cannot be configured and only has the ability to transfer data in and out. The VF is assigned to a Virtual Machine.

### NOTES:

- SR-IOV must be enabled in the BIOS.
- If SR-IOV is not enabled in F2-System Setup when you install Intel PROSet for Windows Device Manager, VPort Availability is not displayed on the Virtualization dialog. Enable SR-IOV in the system BIOS and reinstall Intel PROSet for Windows Device Manager to correct the display.
- If you plan to direct-assign devices to a VM in Linux\*, you must enable I/O Memory Management Unit support in order for [SR-IOV](#) to function correctly. Use the kernel boot parameters "intel\_iommu=on" and "iommu=pt" to enable IOMMU support. For best memory protection, use "intel\_iommu=on." For best performance, use both parameters ("intel\_iommu=on iommu=pt"). These parameters must be appended to the GRUB\_CMDLINE\_LINUX entry in the /etc/default/grub configuration file. For systems booting in UEFI mode, run `grub2-mkconfig -o /etc/grub2-efi.cfg`. For systems booting in legacy BIOS mode, run `grub2-mkconfig -o /boot/grub2/grub.cfg`. You will need to reboot for these changes to take effect.

## NIC Partitioning

Network Interface Card (NIC) Partitioning (NPar) allows network administrators to create multiple partitions for each physical port on a network adapter card, and to set different bandwidth allocations on each partition. To the network and operating system, each partition appears as a separate physical port on the adapter. This facilitates the reduction of switch port count and cabling complexity while maintaining network segmentation and isolation. In addition, flexible bandwidth allocation per partition allows for efficient use of the link.

NPar is available in Linux and ESXi, and in Windows Server and Windows Server Core versions starting with 2012 R2.

The following adapters support NPar. Note that NPar supports a maximum of 8 partitions per controller.

- Intel® Ethernet 25G 2P XXV710 Adapter
- Intel® Ethernet 10G 4P X710/I350 rNDC
- Intel® Ethernet 10G 4P X710-k bNDC
- Intel® Ethernet 10G 4P X710 rNDC
- Intel® Ethernet 10G 2P X710-k bNDC
- Intel® Ethernet 10G X710-k bNDC
- Intel® Ethernet Converged Network Adapter X710
- Intel® Converged Network Adapter X710-T
- Intel® Ethernet Server Adapter X710-DA2 for OCP



### NOTES:

- Adapters support NPar in NIC (LAN) mode only.
- The following are supported on the first partition of each port only:
  - PXE Boot
  - iSCSIboot
  - Speed and Duplex settings
  - Flow Control
  - Power Management settings
  - SR-IOV
  - NVGRE processing
- Resource limits in Microsoft Windows may affect the number of ports that are displayed. If you have several adapters installed in a system, and enable NPar or NParEP on the adapters, Windows Device Manager may not display all of the ports.
- Minimum bandwidth may not be distributed equally between the NIC partitions when changing NPAR/NPAR EP mode. The minimum bandwidth values can be adjusted after changing the NPAR/NPAR EP mode.
- iSCSI Offload is not supported on NIC partitions of Intel X710 based devices. X710 adapters incorrectly show a value of "True" for "iSCSI Offload Support". Enabling "iSCSI Offload Mode" from the [NIC Partitioning Configuration] page enables the partition for iSCSI storage traffic.
- The Loopback diagnostic test is not supported when the device is in NPAR mode.
- When configuring the system for a Microsoft Windows based OS, do not enable iSCSI Offload Mode in the Partition Configuration for Intel® X710 devices either directly in BIOS via HII, or through remote configuration such as racadm or WSMAN.
- If you have NPAR enabled, make sure the "RSS load balancing profile" Advanced setting is set to NUMAScalingStatic.
- NVGRE is not supported when the device is in NPAR mode. If your device has NPAR enabled, NVGRE (the Encapsulated Task Offload setting on the Advanced tab in Windows Device Manager) is not supported.

## NParEP Mode

NParEP Mode is a combination of NPar and PCIe ARI, and increases the maximum number of partitions on an adapter to 16 per controller.

## NParEP Platform Support

Dell EMC Plat- form	OCP Mezz	Rack NDC Slot	PCI Express Slot													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
C4130			yes	yes												
C4140		no	yes	no	yes											
C6420	yes		yes													
R230			no	no												
R240			no	no												
R330			no	no												
R340			no	no												
R430			yes	yes												
R440			yes	yes	yes											
R530			yes	yes	yes	no	no									
R530XD			yes	yes	no											
R540			yes	yes	yes	yes	yes	no								
R630		yes	yes	yes	yes											
R640		yes	yes	yes	yes											
R730		yes	yes	yes	yes	yes	yes	yes	yes							
R730XD		yes	yes	yes	yes	yes	yes	yes								
R740		yes	yes	yes	yes	yes	yes	yes	yes	yes						
R740XD2		no	yes	yes	yes	yes	yes	no								
R830		yes	yes	yes	yes	yes	yes	yes								
R840		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes				
R930		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes				
R940		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
T130			no	no	no	no										
T140			no	no	no	no										
T330			no	no	no	yes										
T340			no	no	no	no										
T430			no	no	yes	yes	yes	yes								
T440			no	yes	yes	yes	yes									
T630			yes	no	yes	yes	yes	yes	yes							
T640		yes	yes	yes	yes	yes	yes	yes	yes	yes						



Dell EMC Platform	Blade NDC Slot	Mezzanine Slot	
		B	C
FC430			
FC630	yes		
FC830	yes		
M630	yes		
M630 for VRTX	yes		
M640	yes		
M640 for VRTX	yes		
M830	yes		
M830 for VRTX	yes		
MX740c	yes	yes	yes
MX840c	yes	yes	yes

Supported platforms or slots are indicated by "yes." Unsupported are indicated by "no". Not applicable are indicated by blank cells.

## Configuring NPar Mode

### Configuring NPar from the Boot Manager

When you boot the system, press the **F2** key to enter the **System Setup** menu. Select **Device Settings** from the list under **System Setup Main Menu**, then select your adapter from the list to get to the Device Configuration menu. Select **Device Level Configuration** in the list under **Main Configuration Page**. This brings up the Virtualization settings under **Device Level Configuration**.

There are four options in the **Virtualization Mode** drop down list.

- None: the adapter operates normally
- NPar: allows up to 8 partitions on the adapter. If you select NPar Virtualization Mode, you will then be presented with the option to enable NParEP Mode, which will extend the number of partitions per adapter to a total of 16 by pairing NPar with PCIe ARI.

#### NOTES:

- When an adapter is running in NPar Mode, it is limited to 8 partitions total. A two-port adapter will have four partitions per port. A four-port adapter will have two partitions per port.
- NParEP Mode can only be enabled when NPar Mode has been enabled.
- When an adapter is running in NParEP Mode, it is limited to 16 partitions total. A two-port adapter will have eight partitions per port. A four port adapter will have four partitions per port.
- SR-IOV: activates SR-IOV on the port
- NPar+SR-IOV: Allows up to 8 partitions (physical functions) for the adapter and activates SR-IOV.

#### NOTES:

- SR-IOV is limited to the root partition of each port.
- When an adapter is running in NPar mode, virtualization (SR-IOV) settings apply to all ports on the adapter, and to all partitions on each port. Changes made the virtualization settings on one port are applied to all ports on the adapter.

When you have completed your selection, click the **Back** button, and you will return to the **Main Configuration Page**. Click the new item, titled **NIC Partitioning Configuration**, in the configuration list to go to the NIC Partitioning Configuration page, where you will see a list of the NPar (or NParEP) partitions on your adapter.

The Global Bandwidth Allocation page lets you specify the minimum and maximum guaranteed bandwidth allocation for each partition on a port. Minimum TX Bandwidth is the guaranteed minimum data transmission bandwidth, as a percentage of the full physical port link speed, that the partition will receive. The bandwidth the partition is awarded will never fall below the level you specify here. The valid range of values is:

1 to ((100 minus # of partitions on the physical port) plus 1)

For example, if a physical port has 4 partitions, the range would be:

1 to ((100 - 4) + 1 = 97)

The Maximum Bandwidth percentage represents the maximum transmit bandwidth allocated to the partition as a percentage of the full physical port link speed. The accepted range of values is 0-100. The value here can be used as a limiter, should you choose that any one particular partition not be able to consume 100% of a port's bandwidth should it be available. The sum of all the values for Maximum Bandwidth is not restricted, because no more than 100% of a port's bandwidth can ever be used.


 **NOTE:**

- If the sum of the minimum bandwidth percentages does not equal 100, then settings will be automatically adjusted so that the sum equals 100.
- If a partition's maximum bandwidth percentage is set lower than the partition's minimum bandwidth percentage, then the maximum bandwidth percentage will be automatically set to the value of the minimum bandwidth percentage.
- When you attempt to set values for minimum bandwidth percentage via iDRAC with Lifecycle Controller using jobs that do not include the values for all enabled partitions, then the values seen after the jobs have completed may be different than the values that were supposed to be set. To avoid this issue, set the values for minimum bandwidth percentage on all partitions using a single job and make sure the sum of the values is 100.

Click the **Back** button when you have finished making your bandwidth allocation settings to return to the NIC Partitioning Configuration page. From there you may click on one of the **Partition Configuration** list items under **Global Bandwidth Allocation**. This will bring up a partition configuration information page on a particular port. You can see the NIC Mode, PCI;Device ID, PCI Address, MAC Address, and the virtual MAC Address (if applicable) for all the partitions on any given port by clicking through the items in the Partition Configuration list.

When you have completed the configuration of all the partitions on a port, back out to the Main Configuration Page, click the **Finish** button, then click the **OK** button in the Success (Saving Changes) dialog.

Repeat the partition configuration process for all the ports on your adapter.


-  **NOTE:** Once NPar has been enabled on one of the partition on a port, it will appear enabled for all subsequent partitions on that port. If that first setting of NPar included enabling NParEP mode, NParEP Mode will appear enabled on all subsequent partitions on that port as well.

When you have configured all the partitions on all the ports on all the adapters in your server, back out to the System Setup Main Menu, and click the **Finish** button. Then click **Yes** to exit the System Setup Menu and to reboot the system in order to apply your changes.

Once the system has completed the boot process, NPar will remain enabled until you explicitly disable it by turning off the option during a subsequent boot sequence.

## Configuring NPar in Microsoft Windows

You can configure an adapter port partition in Windows just like any adapter port. Run Device Manager, select the and open the partition's properties sheets to configure options.

-  **NOTE:** On Microsoft\* Windows Server\* 2019 (and later) and Microsoft Windows\* 10 Version 1809 (and later), you must use Intel® PROSet for Windows PowerShell to configure NPar.

## Enabling NPar

NPar is enabled and disabled from the **Advanced** tab in the Device Manager property sheet.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "NIC Partitioning" -DisplayValue "NPAR"


## Boot Options

On the Boot Options tab, you will be advised that the device is in NPar mode and that legacy preboot protocol settings can only be configured on the root partition. Clicking the **Properties** button will launch the property sheet for the root partition on the adapter.

To set this using Windows PowerShell, find the first partition using the Get-IntelNetAdapter cmdlet. Once you know the port with partition number 0, use that port name in the Bootutil utility for boot option configuration.

## Power Management Settings

Power Management settings are allowed only on the first partition of each physical port. If you select the **Power Management** tab in the Device Manager property sheets while any partition other than the first partition is selected, you will be presented with text in the Power Management dialog stating that Power Management settings cannot be configured on the current connection. Clicking the **Properties** button will launch the property sheet for the root partition on the adapter.

 **NOTE:** Boot options and Power Management settings are only available on the root partition of each physical port.

To set this using Windows PowerShell, find the first partition using the Get-IntelNetAdapter cmdlet. Once you know the port with partition number 0, use that port name with the Get-IntelNetAdapterSetting and Set-IntelNetAdapterSetting cmdlets.

## Flow Control

You can change the Flow Control settings for any partition on a given port. However, when a change is made to the Flow Control settings of a partition associated with a port on an adapter operating in NPar mode, the new value will be applied to all partitions on that particular port.

Flow control is reached by selecting the Intel PROSet **Advanced** tab, then selecting the **Properties** button, and then selecting **Flow Control** from the list of options in the **Settings** list of the dialog that is displayed.

To change this setting in Windows PowerShell, use the Set-IntelNetAdapterSetting cmdlet. For example, Set-IntelNetAdapterSetting -Name "<adapter name>" -DisplayName "Flow Control" -DisplayValue "Auto Negotiation"

## Identifying Port Associations

The Hardware Information dialog in the Intel PROSet property sheets facilitates the identification of the physical port associated with a particular partition. There is an **Identify Adapter** button in the **Link Speed** tab, and clicking that button will cause the ACK/Link light on the port associated with the active partition to blink.

To change this setting in Windows PowerShell, use the Test-IntelNetAdapterSetting cmdlet. For example, Test-IntelNetIdentifyAdapter -Name "<adapter name>" -Seconds 100

## Partition Bandwidth Configuration

The Bandwidth Configuration dialog provides an indication of the port for which settings are currently being made, above a list of the partitions on that port and their current bandwidth allocations (Min%, Max%). Partition Bandwidth Configuration is reached by clicking the **Bandwidth Configuration** button on the **Link Speed** tab in the Intel PROSet properties sheets.

The bandwidth allocated to each partition on the port will never drop below the value set under Min%. For all the partitions on the same physical port, the min bandwidth percentage for all of the partitions must be set to zero, or the sum of all of the minimum bandwidth percentages on each partition must equal 100, where the range of min bandwidth percentages is between 1 and (100-n)%, where  $n$  is the number of partitions for a particular port. For example, on a port with four defined partitions:

P1=0	P1=10	P1=20
P2=0	P2=20	P2=80
P3=0	P3=30	P3=0
P4=0	P4=40	P4=0

Valid	Valid	NOT Valid
-------	-------	-----------

Valid values for Max% are the value of that partition's "Min%" through "100". For example, if the Min% value for Partition 1 is 50%, the range for that partition's Max% is "50"-"100". If you cause any one partition's Max% value to exceed 100% by incrementing the value with the spinner, an error is displayed and that Max% is decremented to 100%. The *sum* of the Max% values for all partitions on a particular port has no limit.

To change the value for Min% or Max%, select a partition in the displayed list, then use the up or down arrows under "Selected Partition Bandwidth Percentages".

 **NOTE:**

- If the sum of the minimum bandwidth percentages does not equal 100, then settings will be automatically adjusted so that the sum equals 100.
- If a partition's maximum bandwidth percentage is set lower than the partition's minimum bandwidth percentage, then the maximum bandwidth percentage will be automatically set to the value of the minimum bandwidth percentage.
- When you attempt to set values for minimum bandwidth percentage via iDRAC with Lifecycle Controller using jobs that do not include the values for all enabled partitions, then the values seen after the jobs have completed may be different than the values that were supposed to be set. To avoid this issue, set the values for minimum bandwidth percentage on all partitions using a single job and make sure the sum of the values is 100.

To change this setting in Windows PowerShell, use the Set-IntelNetAdapterSetting cmdlet. For example:

```
Set-IntelNetAdapterMaximumBandwidthPercentage -Name "Intel(R) Ethernet Converged Network Adapter X710" -MaxBwPercent 100
```

```
Set-IntelNetAdapterMinimumBandwidthPercentage -Name "Intel(R) Ethernet Converged Network Adapter X710" -Partition1 25 -Partition2 25 -Partition3 25 -Partition4 25
```

## Speed and Duplex Settings

The Speed and Duplex setting for a particular port may be changed from any partition associated with that port. However, because all partitions on a particular port on an adapter operating in NPar mode share the same module that is plugged into the port, changing the Speed and Duplex setting will result in the new value being set across all partitions on that same physical port.

Changing the Speed and Duplex setting for a port on an adapter running in NPar mode will cause the driver for each partition associated with that port to be reloaded. This may result in a momentary loss of link.

## Online Diagnostics

Online tests can be performed while in NPar mode without the adapter losing link. The following diagnostics tests are available for all partitions for a particular port while an adapter is running in NPar mode:

- EEPROM
- Register
- NVM Integrity
- Connection

To change this setting in Windows PowerShell, use the Test-IntelNetAdapterSetting cmdlet. For example, Test-IntelNetDiagnostics -Name "<adapter name>" -Test Hardware

## Offline Diagnostics

Offline diagnostics are not supported while an adapter is running in NPar mode. Loopback tests and Cable Offline tests are not allowed in NPar mode.

To change this setting in Windows PowerShell, use the Test-IntelNetAdapterSetting cmdlet. For example, Test-IntelNetDiagnostics -Name "<adapter name>" -Test Hardware

## NPar Teaming Rules


No two ANS team member partitions can exist that are bound to the same physical port. If you attempt to add a partition to an existing team via the Teaming tab in Intel PROSet properties sheets for an adapter running in NPar mode, a check will be made as to whether the partition to be added is bound to the same physical port as any pre-existing team member.

When an adapter is added to a team, setting changes for the adapter and the team may cause momentary loss of connectivity.

## Virtualization

Settings for virtualization (Virtual Machine Queues and SR-IOV) are reached through the Intel PROSet Properties sheets by selecting the Advanced tab, then selecting "Virtualization" from the Settings list.

When an adapter is operating in NPar mode, only the first partition of each physical port may be configured with the virtualization settings.

 **NOTE:** Microsoft\* Hyper-V\* must be installed on the system in order for virtualization settings to be available. Without Hyper-V\* being installed, the Virtualization tab in PROSet will not appear.

To set this using Windows PowerShell, find the first partition using the Get-IntelNetAdapter cmdlet. Once you know the port with partition number 0, use that port name with the Get-IntelNetAdapterSetting and Set-IntelNetAdapterSetting cmdlets.

## Configuring NPAR in Linux

On Intel® 710 Series based adapters that support it, you can set up multiple functions on each physical port. You configure these functions through the System Setup/BIOS.

Minimum TX Bandwidth is the guaranteed minimum data transmission bandwidth, as a percentage of the full physical port link speed, that the partition will receive. The bandwidth the partition is awarded will never fall below the level you specify here.

The range for the minimum bandwidth values is:

1 to ((100 minus # of partitions on the physical port) plus 1)

For example, if a physical port has 4 partitions, the range would be

1 to ((100 - 4) + 1 = 97)

The Maximum Bandwidth percentage represents the maximum transmit bandwidth allocated to the partition as a percentage of the full physical port link speed. The accepted range of values is 1-100. The value can be used as a limiter, should you choose that any one particular function not be able to consume 100% of a port's bandwidth (should it be available). The sum of all the values for Maximum Bandwidth is not restricted, because no more than 100% of a port's bandwidth can ever be used.

 **NOTE:**

- If the sum of the minimum bandwidth percentages does not equal 100, then settings will be automatically adjusted so that the sum equals 100.
- If a partition's maximum bandwidth percentage is set lower than the partition's minimum bandwidth percentage, then the maximum bandwidth percentage will be automatically set to the value of the minimum bandwidth percentage.
- When you attempt to set values for minimum bandwidth percentage via iDRAC with Lifecycle Controller using jobs that do not include the values for all enabled partitions, then the values seen after the jobs have completed may be different than the values that were supposed to be set. To avoid this issue, set the values for minimum bandwidth percentage on all partitions using a single job and make sure the sum of the values is 100.

Once the initial configuration is complete, you can set different bandwidth allocations on each function as follows:

1. Make a new directory named /config
2. Edit etc/fstab to include:

```
configfs /config configfs defaults
```

3. Load (or reload) the i40e driver
4. Mount /config
5. Make a new directory under config for each partition upon which you wish to configure the bandwidth.

Three files will appear under the config/partition directory:

- max\_bw
- min\_bw
- commit

Read from max\_bw to get display the current maximum bandwidth setting.

Write to max\_bw to set the maximum bandwidth for this function.

Read from min\_bw to display the current minimum bandwidth setting.

Write to min\_bw to set the minimum bandwidth for this function.

Write a '1' to commit to save your changes.



#### NOTES:

- commit is write only. Attempting to read it will result in an error.
- Writing to commit is only supported on the first function of a given port. Writing to a subsequent function will result in an error.
- Oversubscribing the minimum bandwidth is not supported. The underlying device's NVM will set the minimum bandwidth to supported values in an indeterminate manner. Remove all of the directories under config and reload them to see what the actual values are.
- To unload the driver you must first remove the directories created in step 5, above.

Example of Setting the minimum and maximum bandwidth (assume there are four functions on the port eth6-eth9, and that eth6 is the first function on the port):

```
# mkdir /config/eth6
# mkdir /config/eth7
# mkdir /config/eth8
# mkdir /config/eth9
# echo 50 > /config/eth6/min_bw
# echo 100 > /config/eth6/max_bw
# echo 20 > /config/eth7/min_bw
# echo 100 > /config/eth7/max_bw
# echo 20 > /config/eth8/min_bw
# echo 100 > /config/eth8/max_bw
# echo 10 > /config/eth9/min_bw
# echo 25 > /config/eth9/max_bw
# echo 1 > /config/eth6/commit
```

## Exiting NPar Mode

NPar mode is disabled in the System Setup menu during a reboot.

Reboot the system, and press the **F2** key to enter the **System Setup** menu. Select **Device Settings** from the list under **System Setup Main Menu**, then select your adapter from the list to get to the Device Configuration menu. Select **Device Level Configuration** in the list under **Main Configuration Page**. This brings up the Virtualization settings under **Device Level Configuration**.

In the Virtualization Mode list, select "None". Then click the **Back** button, which returns you to the Main Configuration Page. There, click the **Finish** button to save your change and reboot the system. When the system completes the reboot, NPar will no longer be active.




**NOTE:** When NPar has been disabled and the system completes the reboot, any other virtualization-related settings, such as NParEP or SR-IOV will also be disabled.


# Installing the Adapter

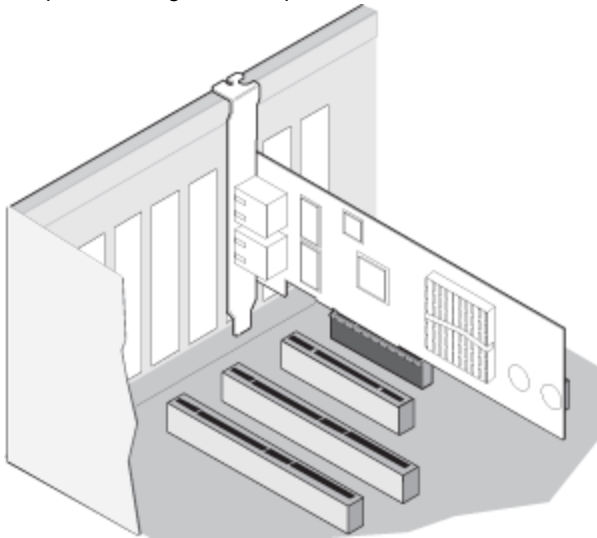
## Select the Correct Slot


One open PCI-Express slot, x4, x8, or x16, depending on your adapter.

 **NOTE:** Some systems have physical x8 PCI Express slots that actually only support lower speeds. Please check your system manual to identify the slot.

## Insert the Adapter into the Computer

1. If your computer supports PCI Hot Plug, see your computer documentation for special installation instructions.
2. Turn off and unplug your computer. Then remove the cover.
  -  **CAUTION:** Turn off and unplug the power before removing the computer's cover. Failure to do so could endanger you and may damage the adapter or computer.
3. Remove the cover bracket from an available slot.
4. Insert the adapter, pushing it into the slot until the adapter is firmly seated. You can install a smaller PCI Express adapter in a larger PCI Express slot.



 **CAUTION:** Some PCI Express adapters may have a short connector, making them more fragile than PCI adapters. Excessive force could break the connector. Use caution when pressing the board in the slot.

5. Secure the adapter bracket with a screw, if required.
6. Replace the computer cover and plug in the power cord.
7. Power on the computer.

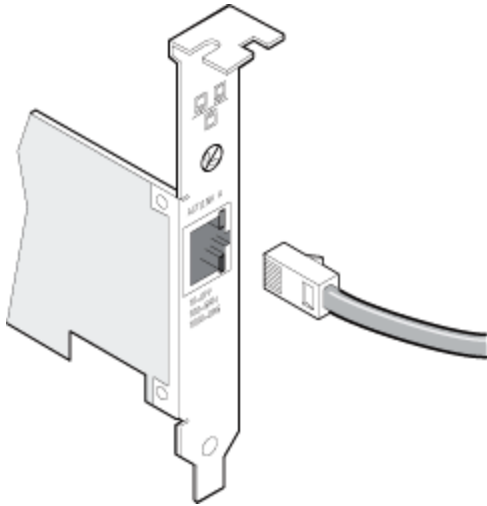
## Connecting Network Cables

Connect the appropriate network cable, as described in the following sections.

### Connect the RJ-45 Network Cable

Connect the RJ-45 network cable as shown:





The following table shows the maximum lengths for each cable type at a given transmission speed.

	Category 5	Category 6	Category 6a	Category 7
1 Gbps	100m	100m	100m	100m
10 Gbps	NA	55m	100m	100m
25 Gbps	NA	NA	NA	50m
40 Gbps	NA	NA	NA	50m



**CAUTION:** If using less than 4-pair cabling, you must manually configure the speed and duplex setting of the adapter and the link partner. In addition, with 2- and 3-pair cabling the adapter can only achieve speeds of up to 100Mbps.

In all cases:

- The adapter must be connected to a compatible link partner, preferably set to auto-negotiate speed and duplex for Intel gigabit adapters.
- Intel Gigabit and 10 Gigabit Server Adapters using copper connections automatically accommodate either MDI or MDI-X connections. The auto-MDI-X feature of Intel gigabit copper adapters allows you to directly connect two adapters without using a cross-over cable.

## Connect the Fiber Optic Network Cable



**CAUTION:** The fiber optic ports contain a Class 1 laser device. When the ports are disconnected, always cover them with the provided plug. If an abnormal fault occurs, skin or eye damage may result if in close proximity to the exposed ports.

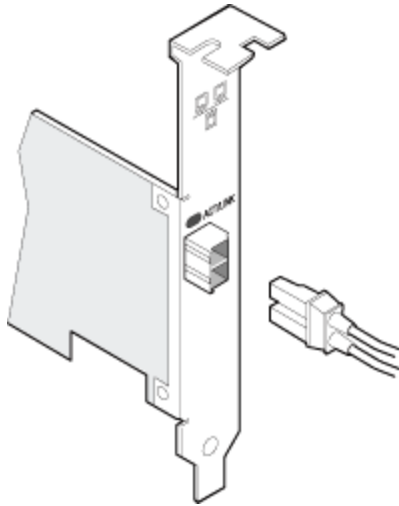
Remove and save the fiber optic connector cover. Insert a fiber optic cable into the ports on the network adapter bracket as shown below.

Most connectors and ports are keyed for proper orientation. If the cable you are using is not keyed, check to be sure the connector is oriented properly (transmit port connected to receive port on the link partner, and vice versa).

The adapter must be connected to a compatible link partner operating at the same laser wavelength as the adapter.

Conversion cables to other connector types (such as SC-to-LC) may be used if the cabling matches the optical specifications of the adapter, including length limitations.

Insert the fiber optic cable as shown below.



## Connection requirements

### Intel Ethernet LR Server Adapters

Laser wavelength: 1310 nanometer (not visible)

Connector type: LC

Cable type: Single-mode fiber with 9.0 $\mu$ m core diameter

- Maximum cable length: 10 kilometers

### Intel Ethernet 10 Gigabit SR Server Adapters

Laser wavelength: 850 nanometer (not visible)

Connector type: LC or SC

Cable type: Multi-mode fiber with 62.5 $\mu$ m core diameter

- Maximum cable length: 33 meters

Cable type: Multi-mode fiber with 50 $\mu$ m core diameter

- Maximum cable length: 300 meters

### Intel Ethernet Gigabit SR Server Adapters

Laser wavelength: 850 nanometer (not visible)

Connector type: LC or SC

Cable type: Multi-mode fiber with 62.5 $\mu$ m core diameter

- Maximum cable length: 275 meters

Cable type: Multi-mode fiber with 50 $\mu$ m core diameter

- Maximum cable length: 550 meters

## Supported SFP+ and QSFP+ Modules

Intel® Ethernet Server Adapters only support Intel optics and/or all passive and active limiting direct attach cables that comply with SFF-8431 v4.1 and SFF-8472 v10.4 specifications. When 82599-based SFP+ modules are connected back to back, they should be set to the same Speed setting using Intel PROSet for Windows or ethtool. Results may vary if you mix speed settings.

**Most Intel® Ethernet Server Adapters support the following modules:**

 **NOTE:** Intel® 710 Series based devices do not support third party modules.

Supplier	Type	Part Numbers	Supported Adapters
Dell EMC	Dual Rate 1G/10G SFP+ SR (bailed)	Y3KJN, XYD50, C5RNH <sup>1</sup> , WTRD1 <sup>1</sup>	X520, X710 <sup>2</sup> , XXV710
Dell EMC	QSFP+ F10 Passive Octopus (QSFP+ to 4xSFP+)	TCPM2, 27GG5, P8T4W	X520, X710 <sup>2</sup>
Dell EMC	SFP+ to 1000BASET Transceiver	8T47V	X710 <sup>2</sup>
Dell EMC	SFP+ LR Optic	60F4J, RN84N	X710 <sup>2,3</sup>
Dell EMC	Active Optical Cable (AOC)	YJF03, P9GND, T1KCN, 1DXKP, MT7R2, K0T7R, W5G04	X710 <sup>2</sup> , XXV710
Dell EMC	25G Optic	P7D7R, HHHHC	XXV710
Dell EMC	SFP28 Optic	68X15	XXV710
Dell EMC	SFP+ F10 Passive	V250M, 53HVN, 358VV	XXV710
Dell EMC	SFP28 Passive	2JVDD, D0R73, VXFJY, 9X8JP	XXV710
Dell EMC	QSFP28 F10 Passive Octopus (QSFP+ to 4xSFP28)	26FN3, YFNDD, 7R9N9	XXV710
Dell EMC	TRIPLE RATE 1G/10G/40G QSFP+ SR (bailed) (1G and 10G not supported on XL710)	9GCCD, 7TCDN, 5NP8R, FC6KV, J90VN	XL710

<sup>1</sup>Not supported on adapters based on the Intel® X520 controller.

<sup>2</sup>The Intel® Ethernet Server Adapter X710-DA2 for OCP only supports modules listed in the table below.

<sup>3</sup>Only supported on dual port Intel® Ethernet Converged Network Adapter X710.

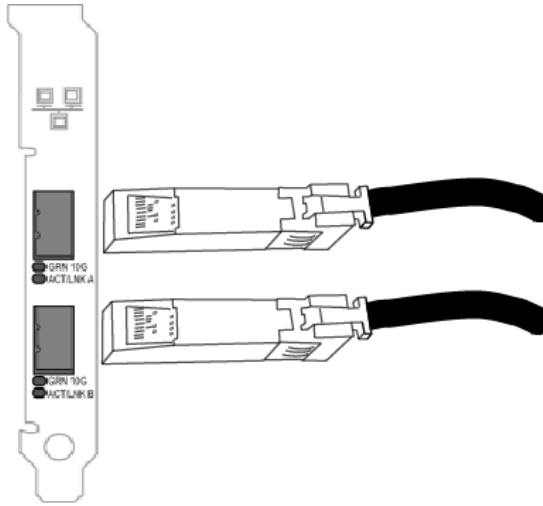
**The Intel® Ethernet Server Adapter X710-DA2 for OCP only supports the following modules:**

Supplier	Type	Part Numbers
Dell EMC	SFP+ SR High Temp Optics	N8TDR
Dell EMC	QSFP+ F10 Passive Octopus	TCPM2, 27GG5, P8T4W

THIRD PARTY OPTIC MODULES AND CABLES REFERRED TO ABOVE ARE LISTED ONLY FOR THE PURPOSE OF HIGHLIGHTING THIRD PARTY SPECIFICATIONS AND POTENTIAL COMPATIBILITY, AND ARE NOT RECOMMENDATIONS OR ENDORSEMENT OR SPONSORSHIP OF ANY THIRD PARTY'S PRODUCT BY INTEL. INTEL IS NOT ENDORSING OR PROMOTING PRODUCTS MADE BY ANY THIRD PARTY AND THE THIRD PARTY REFERENCE IS PROVIDED ONLY TO SHARE INFORMATION REGARDING CERTAIN OPTIC MODULES AND CABLES WITH THE ABOVE SPECIFICATIONS. THERE MAY BE OTHER MANUFACTURERS OR SUPPLIERS, PRODUCING OR SUPPLYING OPTIC MODULES AND CABLES WITH SIMILAR OR MATCHING DESCRIPTIONS. CUSTOMERS MUST USE THEIR OWN DISCRETION AND DILIGENCE TO PURCHASE OPTIC MODULES AND CABLES FROM ANY THIRD PARTY OF THEIR CHOICE. CUSTOMERS ARE SOLELY RESPONSIBLE FOR ASSESSING THE SUITABILITY OF THE PRODUCT AND/OR DEVICES AND FOR THE SELECTION OF THE VENDOR FOR PURCHASING ANY PRODUCT. THE OPTIC MODULES AND CABLES REFERRED TO ABOVE ARE NOT WARRANTED OR SUPPORTED BY INTEL. INTEL ASSUMES NO LIABILITY WHATSOEVER, AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF SUCH THIRD PARTY PRODUCTS OR SELECTION OF VENDOR BY CUSTOMERS.

## Connect the Direct Attach Cable

Insert the Direct Attach network cable as shown below.



Type of cabling:

- 40 Gigabit Ethernet over SFP+ Direct Attached Cable (Twinaxial)
  - Length is 7 meters max.
- 25 Gigabit Ethernet over SFP28 Direct Attached Cable (Twinaxial)
  - Length is 5 meters max.
  - For optimal performance, must use CA-25G-L with RS-FEC and 25GBASE-CR
- 10 Gigabit Ethernet over SFP+ Direct Attached Cable (Twinaxial)
  - Length is 10 meters max.

## Install a Mezzanine Card in the Blade Server

See your server documentation for detailed instructions on how to install a Mezzanine card.

1. Turn off the blade server and pull it out of the chassis, then remove its cover.



**CAUTION: Failure to turn off the blade server could endanger you and may damage the card or server.**

2. Lift the locking lever and insert the card in an available, compatible mezzanine card socket. Push the card into the socket until it is firmly seated.



**NOTE:** A switch or pass-through module must be present on the same fabric as the card in the chassis to provide a physical connection. For example, if the mezzanine card is inserted in fabric B, a switch must also be present in fabric B of the chassis.

3. Repeat steps 2 for each card you want to install.
4. Lower the locking lever until it clicks into place over the card or cards.
5. Replace the blade server cover and put the blade back into the server chassis.
6. Turn the power on.

## Install a Network Daughter Card in a Server

See your server documentation for detailed instructions on how to install a bNDC or rNDC.

1. Turn off the server and then remove its cover.




**CAUTION: Failure to turn off the server could endanger you and may damage the card or server.**

2. Locate the Network Daughter Card connector in your server. See your server's documentation for details.
3. Press the Network Daughter Card into the connector.
4. Tighten the screws on the Network Daughter Card to secure it into place.
5. Replace the server's cover.

# Microsoft\* Windows\* Driver and Software Installation and Configuration

## Installing Windows Drivers and Software

 **NOTE:** To successfully install or uninstall the drivers or software, you must have administrative privileges on the computer completing installation.

### Install the Drivers

 **NOTES:**


- This will update the drivers for all supported Intel® network adapters in your system.
- The Roll Back Driver feature of Windows Server (available on the Adapter Properties dialog's **Driver** tab) will not work correctly if an adapter team or Intel PROSet are present on the system. Before you use the Roll Back Driver feature, use Intel PROSet to remove any teams, then remove Intel PROSet using **Programs and Features** from the Control Panel of Windows. See Installing Intel PROSet for details regarding Intel PROSet.
- Using Microsoft Windows Update to upgrade or downgrade your Ethernet network drivers is not supported. Please download the latest driver package from the [support website](#).

Before installing or updating the drivers, insert your adapter(s) in the computer and plug in the network cable. When Windows discovers the new adapter, it attempts to find an acceptable Windows driver already installed with the operating system.

If found, the driver is installed without any user intervention. If Windows cannot find the driver, the Found New Hardware Wizard window is displayed.

Regardless of whether Windows finds the driver, it is recommended that you follow the procedure below to install the driver. Drivers for all Intel adapters supported by this software release are installed.

1. Download the latest drivers from the [support website](#) and transfer them to the system.
2. If the Found New Hardware Wizard screen is displayed, click **Cancel**.
3. Double-click the downloaded file.
4. Select **Install** from the Dell Update Package screen.
5. Follow the instructions in the install wizard. Be sure to select Intel PROSet for installation.

 **NOTE:** Be sure to select the "iSCSI using Data Center Bridging" install option for systems that have an NPAR capable device installed.

## Dell EMC Update Package (DUP) Syntax

The Dell EMC Update Package (DUP) is an executable package that will update the network drivers on your system.

 **NOTES:**







- If you are installing a driver in a computer with existing Intel adapters, be sure to update all the adapters and ports with the same driver and Intel® PROSet software. This ensures that all adapters will function correctly.
- If you have Fibre Channel over Ethernet (FCoE) boot enabled on any devices in the system, you will not be able to upgrade your drivers. You must disable FCoE boot before upgrading your Ethernet drivers.

### Syntax

Network\_Driver\_XXXXX\_WN64\_XX.X.X\_A00.exe [/<option1>[=<value1>]] [/<option2>[=<value2>]]...

### Command Line Option Descriptions

None	If you do not specify any command line options, the package will guide you through the installation.
/? or /h	Display the Update Package usage information.

/s	Suppress all graphical user interfaces of the Update Package.
/i	Do a fresh install of the drivers contained in the Update Package.  <b>NOTE:</b> Requires /s option
/e=<path>	Extract the entire Update Package to the folder defined in <path>.  <b>NOTE:</b> Requires /s option
/drivers=<path>	Extract only driver components of the Update Package to the folder defined in <path>.  <b>NOTE:</b> Requires /s option
/driveronly	Install or Update only the driver components of the Update Package.  <b>NOTE:</b> Requires /s option
/passthrough	(Advanced) Sends all text following the /passthrough option directly to the vendor install software of the Update Package. This mode suppresses any provided graphical user interfaces, but not necessarily those of the vendor software.
/capabilities	(Advanced) Returns a coded description of this Update Package's supported features.  <b>NOTE:</b> Requires /s option
/l=<path>	Define a specific path for the Update Package log file.  <b>NOTE:</b> This option can NOT be used in combination with /passthrough or /capabilities
/f	Override a soft dependency error returned from the Update Package.  <b>NOTE:</b> Requires /s option, can NOT be used in combination with /passthrough or /capabilities

## Examples

### Update the system silently

Network\_Driver\_XXXXX\_WN64\_XX.X.X\_A00.exe /s

### Fresh install silently

Network\_Driver\_XXXXX\_WN64\_XX.X.X\_A00.exe /s /i

### Extract the update contents to the folder C:\mydir

Network\_Driver\_XXXXX\_WN64\_XX.X.X\_A00.exe /s /e=C:\mydir

### Extract the driver components to the folder C:\mydir

Network\_Driver\_XXXXX\_WN64\_XX.X.X\_A00.exe /s /drivers=C:\mydir

### Only install driver components

Network\_Driver\_XXXXX\_WN64\_XX.X.X\_A00.exe /s /driveronly

### Change from the default log location to C:\my path with spaces\log.txt


Network\_Driver\_XXXXX\_WN64\_XX.X.X\_A00.exe /l="C:\my path with spaces\log.txt"

## Force update to continue, even on "soft" qualification errors

```
Network_Driver_XXXXX_WN64_XX.X.X_A00.exe /s /f
```

# Installing the Base Driver and Intel® PROSet on Nano Server

## Driver Installation

 **NOTE:** Installing drivers requires administrator rights to the operating system.

To install drivers on Microsoft® Windows Server® Nano Server:

1. Identify which drivers to inject into the operating system.
2. Create a directory from which to install the drivers. For example, C:\Nano\Drivers. Use the command "<Dell DUP filename>.exe /s /drivers=<path>" to extract the driver files to the desired directory.
3. Copy the appropriate drivers for the operating system and hardware. For example, "copy d:\<path>\-production\W2K16-x64\40G\_X710\\*. \* c:\Nano\Drivers /y"
4. If you are using the New-NanoServerImage module, use the above path for the -DriversPath parameter. For example, "New-NanoServerImage ...-DriversPath C:\Nano\Drivers"
5. If you are using DISM.exe as well, use the above path for the /AddDriver parameter. For example, "DISM ../Add-Driver C:\Nano\Drivers"

## Intel PROSet Installation

To install Intel PROSet on Microsoft® Windows Server® Nano Server:

1. Use the New-NanoServerImage cmdlet to add the PROSetNS.zip file from the .\Disk\APPS\PROSETDX\NanoServer directory to your -CopyPath parameter.
2. Append the NanoSetup.ps1 file (located in the same directory) to your -SetupCompleteCommands parameter.

For example:

```
New-NanoServerImage ...  
-CopyPath "<PATH>\PROSetNS.zip", "<PATH>\NanoSetup.ps1" `\  
-SetupCompleteCommands "PowerShell ""C:\NanoSetup.ps1"""
```

See the link below for more information on deploying a Nano Server image and using the cmdlet:

<https://msdn.microsoft.com/en-us/library/mt126167.aspx>

## Downgrading Drivers


You can use the /s and /f options to downgrade your drivers. For example, if you have the 17.0.0 drivers loaded and you want to downgrade to 16.5.0, type the following:

```
Network_Driver_XXXXX_WN64_16.5.0_A00.exe /s /f
```

# Saving and Restoring an Adapter's Configuration Settings

The Save and Restore Command Line Tool allows you to copy the current adapter and team settings into a standalone file (such as on a USB drive) as a backup measure. In the event of a hard drive failure, you can reinstate most of your former settings.

The system on which you restore network configuration settings must have the same configuration as the one on which the save was performed. A saved configuration file can be used to restore adapter settings after an operating system upgrade. However, all adapter configuration settings may not be restored depending on the features supported by the new operating system or adapter configuration software.

 **NOTES:**


- Only adapter settings are saved (these include ANS teaming and VLANs). The adapter's driver is not saved.
- Restore using the script only once. Restoring multiple times may result in unstable configuration.
- Intel® PROSet must be installed for the SaveRestore.ps1 script to run.

- For systems running a 64-bit OS, be sure to run the 64-bit version of Windows PowerShell, not the 32-bit (x86) version, when running the SaveRestore.ps1 script.

## Command Line Syntax

SaveRestore.ps1 -Action save|restore [-ConfigPath] [-BDF]

SaveRestore.ps1 has the following command line options:

Option	Description
-Action	<p>Required. Valid values: save   restore.</p> <p>The <b>save</b> option saves adapter and team settings that have been changed from the default settings. When you restore with the resulting file, any settings not contained in the file are assumed to be the default.</p> <p>The <b>restore</b> option restores the settings.</p>
-ConfigPath	<p>Optional. Specifies the path and filename of the main configuration save file. If not specified, it is the script path and default filename (saved_config.txt).</p>
-BDF	<p>Optional. Default configuration file names are saved_config.txt and Saved_StaticIP.txt.</p> <p>If you specify -BDF during a restore, the script attempts to restore the configuration based on the PCI Bus:Device:Function:Segment values of the saved configuration. If you removed, added, or moved a NIC to a different slot, this may result in the script applying the saved settings to a different device.</p> <p> <b>NOTES:</b></p> <ul style="list-style-type: none"> <li>• If the restore system is not identical to the saved system, the script may not restore any settings when the -BDF option is specified.</li> <li>• Virtual Function devices do not support the -BDF option.</li> <li>• If you used Windows to set NPar minimum and maximum bandwidth percentages, you must specify /bdf during save and restore to keep those settings.</li> </ul>

## Examples

### Save Example

To save the adapter settings to a file on a removable media device, do the following.

1. Open a Windows PowerShell Prompt.
2. Navigate to the directory where SaveRestore.ps1 is located (generally c:\Program Files\Intel\Wired Networking\DMIXPROSET).
3. Type the following:  

```
SaveRestore.ps1 -Action Save -ConfigPath e:\settings.txt
```

### Restore Example

To restore the adapter settings from a file on removable media, do the following:

1. Open a Windows PowerShell Prompt.
2. Navigate to the directory where SaveRestore.ps1 is located (generally c:\Program Files\Intel\Wired Networking\DMIXPROSET).
3. Type the following:  


```
SaveRestore.ps1 -Action Restore -ConfigPath e:\settings.txt
```

## Configuring Device Features

### Configuring with Intel® PROSet for Windows\* Device Manager

Use the additional Windows Device Manager tabs described below to configure Intel Ethernet adapter features.



 **NOTE:** The Intel® PROSet for Windows Device Manager is not available on Microsoft\* Windows Server\* 2019 and Microsoft Windows 10 Version 1809 (and later).

## Link Speed tab

The **Link Speed** tab allows you to change the adapter's speed and duplex setting, run diagnostics, and use the identify adapter feature.

## Advanced Tab

The settings listed on Intel PROSet for Windows Device Manager's **Advanced** tab allow you to customize how the adapter handles QoS packet tagging, Jumbo Packets, Offloading, and other capabilities. Some of the following features might not be available depending on the operating system you are running, the specific adapters installed, and the specific platform you are using.

## VLANs Tab

The **VLANs** tab allows you to create, modify, and delete VLANs. You must install Advanced Network Services in order to see this tab and use the feature.

## Teaming Tab

The **Teaming** tab allows you to create, modify, and delete adapter teams. You must install Advanced Network Services in order to see this tab and use the feature.

## Power Management Tab


The Intel® PROSet **Power Management** tab replaces the standard Microsoft\* Windows\* Power Management tab in Device Manager. The standard Windows power management functionality is included on the Intel PROSet tab.


### **NOTES:**

- The options available on the Power Management tab are adapter and system dependent. Not all adapters will display all options. There may be BIOS or operating system settings that need to be enabled for your system to wake up. In particular, this is true for Wake from S5 (also referred to as Wake from power off).
- The Intel® 10 Gigabit Network Adapters do not support power management.
- If your system has a Manageability Engine, the Link LED may stay lit even if WoL is disabled.
- When an adapter is running in NPar mode, Power Management is limited to the root partition of each port.

## Configuring with Intel® PROSet for Windows PowerShell\* software

The Intel® PROSet for Windows PowerShell\* software contains several cmdlets that allow you to configure and manage the Intel® Ethernet Adapters and devices present in your system. For a complete list of these cmdlets and their descriptions, type **get-help IntelNetCmdlets** at the Windows PowerShell prompt. For detailed usage information for each cmdlet, type **get-help <cmdlet\_name>** at the Windows PowerShell prompt.

 **NOTE:** Online help (get-help -online) is not supported.


 **NOTE** To use the Minihelp property for any cmdlet in the module, append "| Select Minihelp" to the full cmdlet syntax. For example:

```
Get-IntelNetAdapterSetting - Name "Intel(R) Ethernet Server Adapter x520-2" -  
RegistryKeyword *RSS | Select Minihelp
```

The Intel® PROSet for Windows PowerShell\* software is installed by default when you install Intel PROSet. After installation, use the Import-Module cmdlet to import the new cmdlets. You may need to restart Windows PowerShell to access the newly imported cmdlets.

To use the Import-Module cmdlet, you must specify the path. For example:

```
PS c:\> Import-Module -Name "C:\Program Files\Intel\Wired Networking\IntelNetCmdlets"
```

 **NOTE:** If you include a trailing backslash ("\") at the end of the Import-Module command, the import operation will fail. In Microsoft Windows\* 10 and Windows Server\* 2016, the auto-complete function appends a trailing backslash. If you use auto-complete when entering the Import-Module command, delete the trailing backslash from the path before pressing Return to execute the command.

See Microsoft TechNet for more information about the Import-Module cmdlet.

## System requirements

- Microsoft\* Windows PowerShell\* version 2.0
- .NET version 2.0

## Configuring SR-IOV for improved network security

In a virtualized environment, on Intel® Server Adapters that support SR-IOV, the virtual function (VF) may be subject to malicious behavior. Software-generated frames are not expected and can throttle traffic between the host and the virtual switch, reducing performance. To resolve this issue, configure all SR-IOV enabled ports for [VLAN tagging](#). This configuration allows unexpected, and potentially malicious, frames to be dropped.

## Changing Intel PROSet Settings via Microsoft\* Windows PowerShell\*

You can use the Intel® PROSet for Windows PowerShell\* software to change most Intel PROSet settings.


### NOTES:

- If an adapter is bound to an ANS team, do not change settings using the Set-NetAdapterAdvanceProperty cmdlet from Windows PowerShell\*, or any other cmdlet not provided by Intel. Doing so may cause the team to stop using that adapter to pass traffic. You may see this as reduced performance or the adapter being disabled in the ANS team. You can resolve this issue by changing the setting back to its previous state, or by removing the adapter from the ANS team and then adding it back.
- The Get-IntelNetAdapterStatus -Status General cmdlet may report the status "Link Up - This device is not linked at its maximum capable speed". In that case, if your device is set to auto-negotiate, you can adjust the speed of the device's link partner to the device's maximum speed. If the device is not set to auto-negotiate, you can adjust the device's speed manually, but you must ensure the link partner is set at the same speed.

## Changing Intel PROSet Settings Under Windows Server Core


You can use the Intel® PROSet for Windows PowerShell\* software to change most Intel PROSet settings under Windows Server Core. Please refer to the aboutIntelNetCmdlets.hlp.txt help file.

For iSCSI Crash Dump configuration, use the Intel® PROSet for Windows PowerShell\* software and refer to the aboutIntelNetCmdlets.hlp.txt help file.

 **NOTE:** Support for the Intel PROSet command line utilities (prosetcl.exe and crashdmp.exe) has been removed, and is no longer installed. This functionality has been replaced by the Intel® PROSet for Windows PowerShell\* software. Please transition all of your scripts and processes to use the Intel® PROSet for Windows PowerShell\* software.

## Configuring with Intel® PROSet Adapter Configuration Utility

The Intel® PROSet Adapter Configuration Utility (Intel® PROSet ACU) is a graphical user interface which allows you to configure and manage supported Intel® Ethernet Adapters.

 **NOTE:** The Intel® PROSet ACU is available only on Microsoft\* Windows Server\* 2019 and Microsoft Windows 10 Version 1809 (and later).

The general configuration steps are as follows:

1. Select an adapter in the Adapter Selection panel.
2. Select a setting to configure from the Adapter Settings panel.
3. Select or enter the desired value(s) for the selected setting.
4. Click the "Apply Changes" button.

# Device Features

## Adapter Teaming

Intel® Advanced Network Services (Intel® ANS) Teaming lets you take advantage of multiple adapters in a system by grouping them together. ANS teaming can use features like fault tolerance and load balancing to increase throughput and reliability.

Before creating a team or adding team members, make sure each team member has been configured similarly. Settings to check include VLANs and QoS Packet Tagging, Jumbo Packets, and the various offloads. Pay particular attention when using different adapter models or adapter versions, as adapter capabilities vary.

## Configuration Notes

- You must install the latest Microsoft\* Windows\* 10 updates before you can create Intel ANS Teams or VLANs on Windows 10 systems. Any Intel ANS Teams or VLANs created with a previous software/driver release on a Windows 10 system will be corrupted and cannot be upgraded. The installer will remove these existing teams and VLANs.
- Microsoft\* Windows Server\* 2012 R2 is the last Windows Server operating system version that supports Intel Advanced Networking Services (Intel ANS). Intel ANS is not supported on Microsoft Windows Server 2016 and later.
- To configure teams in Linux, use Channel Bonding, available in supported Linux kernels. For more information see the channel bonding documentation within the kernel source.
- Not all team types are available on all operating systems.
- Be sure to use the latest available drivers on all adapters.
- You cannot create a team that includes both Intel X710/XL710-based devices and Intel® I350-based devices. These devices are incompatible together in a team and will be blocked during team setup. Previously created teams that include this combination of devices will be removed upon upgrading.
- NDIS 6.2 introduced new RSS data structures and interfaces. Because of this, you cannot enable RSS on teams that contain a mix of adapters that support NDIS 6.2 RSS and adapters that do not.
- If a team is bound to a Hyper-V virtual NIC, you cannot change the Primary or Secondary adapter.
- To assure a common feature set, some advanced features, including hardware offloading, are automatically disabled when an adapter that does not support Intel PROSet is added to a team.
- Spanning tree protocol (STP) should be disabled on switch ports connected to teamed adapters in order to prevent data loss when the primary adapter is returned to service (failback). Alternatively, an activation delay may be configured on the adapters to prevent data loss when spanning tree is used. Set the Activation Delay on the advanced tab of team properties.
- Fibre Channel over Ethernet/Data Center Bridging will be automatically disabled when an adapter is added to a team with non-FCoE/DCB capable adapters.

## Configuring ANS Teams

Advanced Network Services (ANS) Teaming, a feature of the Advanced Network Services component, lets you take advantage of multiple adapters in a system by grouping them together. ANS teaming can use features like fault tolerance and load balancing to increase throughput and reliability.

### NOTES:

- NLB will not work when Receive Load Balancing (RLB) is enabled. This occurs because NLB and iANS both attempt to set the server's multicast MAC address, resulting in an ARP table mismatch.
- Teaming with the Intel® 10 Gigabit AF DA Dual Port Server Adapter is only supported with similar adapter types and models or with switches using a Direct Attach connection.

## Creating a team

1. Launch Windows Device Manager
2. Expand **Network Adapters**.
3. Double-click on one of the adapters that will be a member of the team.  
The adapter properties dialog box appears.
4. Click the **Teaming** tab.
5. Click **Team with other adapters**.


6. Click **New Team**.
7. Type a name for the team, then click **Next**.
8. Click the checkbox of any adapter you want to include in the team, then click **Next**.
9. Select a teaming mode, then click **Next**.
10. Click **Finish**.

The Team Properties window appears, showing team properties and settings.


To change this setting in Windows PowerShell, use the `New-IntelNetTeam` cmdlet. For example, `New-IntelNetTeam -TeamMemberNames "<adapter1_name>", "<adapter2_name>" -TeamMode AdapterFaultTolerance -TeamName "<team_name>"`.

This feature is not configurable through Intel PROSet ACU. On Microsoft Windows Server 2019 and Microsoft Windows 10 Version 1809, use Windows PowerShell.

Once a team has been created, it appears in the Network Adapters category in the Computer Management window as a virtual adapter. The team name also precedes the adapter name of any adapter that is a member of the team.

 **NOTE:** If you want to set up VLANs on a team, you must first create the team.

### Adding or Removing an Adapter from an Existing Team

 **NOTE:** A team member should be removed from the team with link down.

1. Open the Team Properties dialog box by double-clicking on a team listing in the Computer Management window.
2. Click the **Settings** tab.
3. Click **Modify Team**, then click the **Adapters** tab.
4. Select the adapters that will be members of the team.
  - Click the checkbox of any adapter that you want to add to the team.
  - Clear the checkbox of any adapter that you want to remove from the team.
5. Click **OK**.

To change this setting in Windows PowerShell, use the `Add-IntelNetTeamMember` cmdlet. For example, `Add-IntelNetTeamMember -TeamName "<team_name>" -Name "<adapter_name>"`.

### Renaming a Team


1. Open the Team Properties dialog box by double-clicking on a team listing in the Computer Management window.
2. Click the **Settings** tab.
3. Click **Modify Team**, then click the **Name** tab.
4. Type a new team name, then click **OK**.

To change this setting in Windows PowerShell, use the `Set-IntelNetTeam` cmdlet. For example, `Set-IntelNetTeam -TeamName "<team_name>" -NewTeamName "<new_team_name>"`.

### Removing a Team

1. Open the Team Properties dialog box by double-clicking on a team listing in the Computer Management window.
2. Click the **Settings** tab.
3. Select the team you want to remove, then click **Remove Team**.
4. Click **Yes** when prompted.

To change this setting in Windows PowerShell, use the `Remove-IntelNetTeamMember` cmdlet. For example, `Remove-IntelNetTeamMember -Name "<adapter_name>"`.

 **NOTE:** If you defined a VLAN or QoS Prioritization on an adapter joining a team, you may have to redefine it when it is returned to a stand-alone mode.

## Teaming and VLAN Considerations When Replacing Adapters

After installing an adapter in a specific slot, Windows treats any other adapter of the same type as a new adapter. Also, if you remove the installed adapter and insert it into a different slot, Windows recognizes it as a new adapter. Make sure that you follow the instructions below carefully.

1. Open Intel PROSet.
2. If the adapter is part of a team remove the adapter from the team.
3. Shut down the server and unplug the power cable.
4. Disconnect the network cable from the adapter.
5. Open the case and remove the adapter.
6. Insert the replacement adapter. (Use the same slot, otherwise Windows assumes that there is a new adapter.)
7. Reconnect the network cable.
8. Close the case, reattach the power cable, and power-up the server.
9. Open Intel PROSet and check to see that the adapter is available.

To do this in Windows PowerShell, use the cmdlets above to remove the team member or team, then add the replaced adapter to the team (or create a new team).

## Microsoft\* Load Balancing and Failover (LBFO) teams

Intel ANS teaming and VLANs are not compatible with Microsoft's LBFO teams. Intel® PROSet will block a member of an LBFO team from being added to an Intel ANS team or VLAN. You should not add a port that is already part of an Intel ANS team or VLAN to an LBFO team, as this may cause system instability. If you use an ANS team member or VLAN in an LBFO team, perform the following procedure to restore your configuration:

1. Reboot the machine
2. Remove LBFO team. Even though LBFO team creation failed, after a reboot Server Manager will report that LBFO is Enabled, and the LBFO interface is present in the 'NIC Teaming' GUI.
3. Remove the ANS teams and VLANs involved in the LBFO team and recreate them. This is an optional (all bindings are restored when the LBFO team is removed ), but strongly recommended step



### NOTES:

- If you add an Intel AMT enabled port to an LBFO team, do not set the port to Standby in the LBFO team. If you set the port to Standby you may lose AMT functionality.
- Data Center Bridging (DCB) is incompatible with Microsoft Server LBFO Teams. Do not create an LBFO team using Intel 10G ports when DCB is installed. Do not install DCB if Intel 10G ports are part of an LBFO team. Install failures and persistent link loss may occur if DCB and LBFO are used on the same port.

## Using Intel ANS Teams and VLANs inside a Guest Virtual Machine

Intel ANS Teams and VLANs are only supported in the following guest virtual machines

Host\Guest VM	Microsoft Windows Server 2012 R2 VM
Microsoft Windows Hyper-V	LBFO
Linux Hypervisor (Xen or KVM)	LBFO ANS VLANs
VMware ESXi	LBFO ANS VLANs

## Supported Adapters

Teaming options are supported on Intel server adapters. Selected adapters from other manufacturers are also supported. If you are using a Windows-based computer, adapters that appear in Intel PROSet may be included in a team.



**NOTE:** In order to use adapter teaming, you must have at least one Intel server adapter in your system. Furthermore, all adapters must be linked to the same switch or hub.

## Conditions that may prevent you from teaming a device

During team creation or modification, the list of available team types or list of available devices may not include all team types or devices. This may be caused by any of several conditions, including:

- The device does not support the desired team type or does not support teaming at all.
- The operating system does not support the desired team type.
- The devices you want to team together use different driver versions.
- TOE (TCP Offload Engine) enabled devices cannot be added to an ANS team and will not appear in the list of available adapters.
- You can add Intel® Active Management Technology (Intel® AMT) enabled devices to Adapter Fault Tolerance (AFT), Switch Fault Tolerance (SFT), and Adaptive Load Balancing (ALB) teams. All other team types are not supported. The Intel AMT enabled device must be designated as the primary adapter for the team.
- The device's MAC address is overridden by the Locally Administered Address advanced setting.
- Fibre Channel over Ethernet (FCoE) Boot has been enabled on the device.
- The device has "OS Controlled" or "Enabled" selected on the Data Center tab.
- The device has a virtual NIC bound to it.
- The device is part of a Microsoft\* Load Balancing and Failover (LBFO) team.

## Teaming Modes

- [Adapter Fault Tolerance \(AFT\)](#) - provides automatic redundancy for a server's network connection. If the primary adapter fails, the secondary adapter takes over. Adapter Fault Tolerance supports two to eight adapters per team. This teaming type works with any hub or switch. All team members must be connected to the same subnet.
- [Switch Fault Tolerance \(SFT\)](#) - provides failover between two adapters connected to separate switches. Switch Fault Tolerance supports two adapters per team. Spanning Tree Protocol (STP) must be enabled on the switch when you create an SFT team. When SFT teams are created, the Activation Delay is automatically set to 60 seconds. This teaming type works with any switch or hub. All team members must be connected to the same subnet.
- [Adaptive Load Balancing \(ALB\)](#) - provides load balancing of transmit traffic and adapter fault tolerance. In Microsoft\* Windows\* operating systems, you can also enable or disable receive load balancing (RLB) in ALB teams (by default, RLB is enabled).
- [Virtual Machine Load Balancing \(VMLB\)](#) - provides transmit and receive traffic load balancing across Virtual Machines bound to the team interface, as well as fault tolerance in the event of switch port, cable, or adapter failure. This teaming type works with any switch.
- [Static Link Aggregation \(SLA\)](#) - provides increased transmission and reception throughput in a team of two to eight adapters. This team type replaces the following team types from prior software releases: Fast EtherChannel\*/Link Aggregation (FEC) and Gigabit EtherChannel\*/Link Aggregation (GEC). This type also includes adapter fault tolerance and load balancing (only routed protocols). This teaming type requires a switch with Intel Link Aggregation, Cisco\* FEC or GEC, or IEEE 802.3ad Static Link Aggregation capability.

All adapters in a Link Aggregation team running in static mode must run at the same speed and must be connected to a Static Link Aggregation capable switch. If the speed capability of adapters in a Static Link Aggregation team are different, the speed of the team is dependent on the lowest common denominator.

- [IEEE 802.3ad Dynamic Link Aggregation](#) - creates one or more teams using Dynamic Link Aggregation with mixed-speed adapters. Like the Static Link Aggregation teams, Dynamic 802.3ad teams increase transmission and reception throughput and provide fault tolerance. This teaming type requires a switch that fully supports the IEEE 802.3ad standard.



### IMPORTANT:

- Be sure to use the latest available drivers on all adapters.
- Before creating a team, adding or removing team members, or changing advanced settings of a team member, make sure each team member has been configured similarly. Settings to check include VLANs and QoS Packet Tagging, Jumbo Frames, and the various offloads. These settings are available in Intel PROSet's **Advanced** tab. *Pay particular attention when using different adapter models or adapter versions, as adapter capabilities vary.*
- If team members implement Advanced features differently, failover and team functionality will be affected. To avoid team implementation issues:
  - Create teams that use similar adapter types and models.
  - Reload the team after adding an adapter or changing any Advanced features. One way to reload the team is to select a new preferred primary adapter. Although there will be a temporary

loss of network connectivity as the team reconfigures, the team will maintain its network addressing schema.

## Primary and Secondary Adapters

Teaming modes that do not require a switch with the same capabilities (AFT, SFT, ALB (with RLB)) use a primary adapter. In all of these modes except RLB, the primary is the only adapter that receives traffic. RLB is enabled by default on an ALB team.

If the primary adapter fails, another adapter will take over its duties. If you are using more than two adapters, and you want a specific adapter to take over if the primary fails, you must specify a secondary adapter. If an Intel AMT enabled device is part of a team, it must be designated as the primary adapter for the team.

There are two types of primary and secondary adapters:

- **Default primary adapter:** If you do not specify a preferred primary adapter, the software will choose an adapter of the highest capability (model and speed) to act as the default primary. If a failover occurs, another adapter becomes the primary. Once the problem with the original primary is resolved, the traffic will not automatically restore to the default (original) primary adapter in most modes. The adapter will, however, rejoin the team as a non-primary.
- **Preferred Primary/Secondary adapters:** You can specify a preferred adapter in Intel PROSet. Under normal conditions, the Primary adapter handles all traffic. The Secondary adapter will receive allback traffic if the primary fails. If the Preferred Primary adapter fails, but is later restored to an active status, control is automatically switched back to the Preferred Primary adapter. Specifying primary and secondary adapters adds no benefit to SLA and IEEE 802.3ad dynamic teams, but doing so forces the team to use the primary adapter's MAC address.

To specify a preferred primary or secondary adapter in Windows

1. In the Team Properties dialog box's **Settings** tab, click **Modify Team**.
2. On the **Adapters** tab, select an adapter.
3. Click **Set Primary** or **Set Secondary**.



**NOTE:** You must specify a primary adapter before you can specify a secondary adapter.

4. Click **OK**.

The adapter's preferred setting appears in the Priority column on Intel PROSet's **Team Configuration** tab. A "1" indicates a preferred primary adapter, and a "2" indicates a preferred secondary adapter.

To do this in Windows PowerShell, use the Set-IntelNetTeam cmdlet. For example, Set-IntelNetTeam -TeamName "Team 1" -PrimaryAdapterName "<adapter1\_name>" -SecondaryAdapterName "<adapter2\_name>".

## Failover and Failback

When a link fails, either because of port or cable failure, team types that provide fault tolerance will continue to send and receive traffic. Failover is the initial transfer of traffic from the failed link to a good link. Failback occurs when the original adapter regains link. You can use the Activation Delay setting (located on the Advanced tab of the team's properties in Device Manager) to specify a how long the failover adapter waits before becoming active. If you don't want your team to failback when the original adapter gets link back, you can set the Allow Failback setting to disabled (located on the Advanced tab of the team's properties in Device Manager).

## Adapter Fault Tolerance (AFT)

Adapter Fault Tolerance (AFT) provides automatic recovery from a link failure caused from a failure in an adapter, cable, switch, or port by redistributing the traffic load across a backup adapter.

Failures are detected automatically, and traffic rerouting takes place as soon as the failure is detected. The goal of AFT is to ensure that load redistribution takes place fast enough to prevent user sessions from being disconnected. AFT supports two to eight adapters per team. Only one active team member transmits and receives traffic. If this primary connection (cable, adapter, or port) fails, a secondary, or backup, adapter takes over. After a failover, if the connection to the user-specified primary adapter is restored, control passes automatically back to that primary adapter. For more information, see [Primary and Secondary Adapters](#).

AFT is the default mode when a team is created. This mode does not provide load balancing.


## NOTES

- AFT teaming requires that the switch not be set up for teaming and that spanning tree protocol is turned off for the switch port connected to the NIC or LOM on the server.
- All members of an AFT team must be connected to the same subnet.

## Switch Fault Tolerance (SFT)

Switch Fault Tolerance (SFT) supports only two NICs in a team connected to two different switches. In SFT, one adapter is the primary adapter and one adapter is the secondary adapter. During normal operation, the secondary adapter is in standby mode. In standby, the adapter is inactive and waiting for failover to occur. It does not transmit or receive network traffic. If the primary adapter loses connectivity, the secondary adapter automatically takes over. When SFT teams are created, the Activation Delay is automatically set to 60 seconds.

In SFT mode, the two adapters creating the team can operate at different speeds.

 **NOTE:** SFT teaming requires that the switch not be set up for teaming and that spanning tree protocol is turned on.

## Configuration Monitoring

You can set up monitoring between an SFT team and up to five IP addresses. This allows you to detect link failure beyond the switch. You can ensure connection availability for several clients that you consider critical. If the connection between the primary adapter and all of the monitored IP addresses is lost, the team will failover to the secondary adapter.

## Adaptive/Receive Load Balancing (ALB/RLB)

Adaptive Load Balancing (ALB) is a method for dynamic distribution of data traffic load among multiple physical channels. The purpose of ALB is to improve overall bandwidth and end station performance. In ALB, multiple links are provided from the server to the switch, and the intermediate driver running on the server performs the load balancing function. The ALB architecture utilizes knowledge of Layer 3 information to achieve optimum distribution of the server transmission load.

ALB is implemented by assigning one of the physical channels as Primary and all other physical channels as Secondary. Packets leaving the server can use any one of the physical channels, but incoming packets can only use the Primary Channel. With Receive Load Balancing (RLB) enabled, it balances IP receive traffic. The intermediate driver analyzes the send and transmit loading on each adapter and balances the rate across the adapters based on destination address. Adapter teams configured for ALB and RLB also provide the benefits of fault tolerance.

## NOTES:

- ALB teaming requires that the switch not be set up for teaming and that spanning tree protocol is turned off for the switch port connected to the network adapter in the server.
- ALB does not balance traffic when protocols such as NetBEUI and IPX\* are used.
- You may create an ALB team with mixed speed adapters. The load is balanced according to the adapter's capabilities and bandwidth of the channel.
- All members of ALB and RLB teams must be connected to the same subnet.
- Virtual NICs cannot be created on a team with Receive Load Balancing enabled. Receive Load Balancing is automatically disabled if you create a virtual NIC on a team.

## Virtual Machine Load Balancing

Virtual Machine Load Balancing (VMLB) provides transmit and receive traffic load balancing across Virtual Machines bound to the team interface, as well as fault tolerance in the event of switch port, cable, or adapter failure.

The driver analyzes the transmit and receive load on each member adapter and balances the traffic across member adapters. In a VMLB team, each Virtual Machine is associated with one team member for its TX and RX traffic.

If only one virtual NIC is bound to the team, or if Hyper-V is removed, then the VMLB team will act like an AFT team.



#### NOTES:

- VMLB does not load balance non-routed protocols such as NetBEUI and some IPX\* traffic.
- VMLB supports from two to eight adapter ports per team.
- You can create a VMLB team with mixed speed adapters. The load is balanced according to the lowest common denominator of adapter capabilities and the bandwidth of the channel.
- You cannot use and Intel AMT enabled adapter a VMLB team.

## Static Link Aggregation

Static Link Aggregation (SLA) is very similar to ALB, taking several physical channels and combining them into a single logical channel.

This mode works with:

- Cisco EtherChannel capable switches with channeling mode set to "on"
- Intel switches capable of Link Aggregation
- Other switches capable of static 802.3ad

#### NOTES:

- All adapters in a Static Link Aggregation team must run at the same speed and must be connected to a Static Link Aggregation-capable switch. If the speed capabilities of adapters in a Static Link Aggregation team are different, the speed of the team is dependent on the switch.
- Static Link Aggregation teaming requires that the switch be set up for Static Link Aggregation teaming and that spanning tree protocol is turned off.
- An Intel AMT enabled adapter cannot be used in an SLA team.

## IEEE 802.3ad: Dynamic Link Aggregation

IEEE 802.3ad is the IEEE standard. Teams can contain two to eight adapters. You must use 802.3ad switches (in dynamic mode, aggregation can go across switches). Adapter teams configured for IEEE 802.3ad also provide the benefits of fault tolerance and load balancing. Under 802.3ad, all protocols can be load balanced.

Dynamic mode supports multiple aggregators. Aggregators are formed by port speed connected to a switch. For example, a team can contain adapters running at 1 Gbps and 10 Gbps, but two aggregators will be formed, one for each speed. Also, if a team contains 1 Gbps ports connected to one switch, and a combination of 1 Gbps and 10 Gbps ports connected to a second switch, three aggregators would be formed. One containing all the ports connected to the first switch, one containing the 1 Gbps ports connected to the second switch, and the third containing the 10Gbps ports connected to the second switch.

#### NOTES:

- IEEE 802.3ad teaming requires that the switch be set up for IEEE 802.3ad (link aggregation) teaming and that spanning tree protocol is turned off.
- Once you choose an aggregator, it remains in force until all adapters in that aggregation team lose link.
- In some switches, copper and fiber adapters cannot belong to the same aggregator in an IEEE 802.3ad configuration. If there are copper and fiber adapters installed in a system, the switch might configure the copper adapters in one aggregator and the fiber-based adapters in another. If you experience this behavior, for best performance you should use either only copper-based or only fiber-based adapters in a system.
- An Intel AMT enabled adapter cannot be used in a DLA team.

### Before you begin

- Verify that the switch fully supports the IEEE 802.3ad standard.
- Check your switch documentation for port dependencies. Some switches require pairing to start on a primary port.
- Check your speed and duplex settings to ensure the adapter and switch are running at full duplex, either forced or set to auto-negotiate. Both the adapter and the switch must have the same speed and duplex configuration. The full-duplex requirement is part of the IEEE 802.3ad specification: <http://standards.ieee.org/>. If needed, change your speed or duplex setting before you link the adapter to the switch. Although you can change speed

and duplex settings after the team is created, Intel recommends you disconnect the cables until settings are in effect. In some cases, switches or servers might not appropriately recognize modified speed or duplex settings if settings are changed when there is an active link to the network.

- If you are configuring a VLAN, check your switch documentation for VLAN compatibility notes. Not all switches support simultaneous dynamic 802.3ad teams and VLANs. If you do choose to set up VLANs, configure teaming and VLAN settings on the adapter before you link the adapter to the switch. Setting up VLANs after the switch has created an active aggregator affects VLAN functionality.

## Removing Phantom Teams and Phantom VLANs

If you physically remove all adapters that are part of a team or VLAN from the system without removing them via the Device Manager first, a phantom team or phantom VLAN will appear in Device Manager. There are two methods to remove the phantom team or phantom VLAN.

### Removing the Phantom Team or Phantom VLAN through the Device Manager

Follow these instructions to remove a phantom team or phantom VLAN from the Device Manager:

1. In the Device Manager, double-click on the phantom team or phantom VLAN.
2. Click the Settings tab.
3. Select Remove Team or Remove VLAN.

To remove a phantom team in Windows PowerShell, use the Remove-IntelNetTeamMember cmdlet. To remove a phantom VLAN in Windows PowerShell, use the Remove-IntelNetVLAN cmdlet. For example, Remove-IntelNetVLAN -ParentName "<adapter\_name>" -VLANID "1" .

### Preventing the Creation of Phantom Devices

To prevent the creation of phantom devices, make sure you perform these steps before physically removing an adapter from the system:

1. Remove the adapter from any teams using the Settings tab on the team properties dialog box.
2. Remove any VLANs from the adapter using the VLANs tab on the adapter properties dialog box.
3. Uninstall the adapter from Device Manager.

You do not need to follow these steps in hot-replace scenarios.

## Adaptive Inter-Frame Spacing

Compensates for excessive Ethernet packet collisions on the network.

The default setting works best for most computers and networks. By enabling this feature, the network adapter dynamically adapts to the network traffic conditions. However, in some rare cases you might obtain better performance by disabling this feature. This setting forces a static gap between packets.

<b>Default</b>	Disabled
<b>Range</b>	<ul style="list-style-type: none"><li>• Enabled</li><li>• Disabled</li></ul>

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Adaptive Inter-Frame Spacing" -DisplayValue "Enabled"

## Direct Memory Access (DMA) Coalescing

DMA (Direct Memory Access) allows the network device to move packet data directly to the system's memory, reducing CPU utilization. However, the frequency and random intervals at which packets arrive do not allow the system to enter a lower power state. DMA Coalescing allows the NIC to collect packets before it initiates a DMA event. This may increase network latency but also increases the chances that the system will consume less energy. Adapters and network devices based on the Intel® Ethernet Controller I350 (and later controllers) support DMA Coalescing.

Higher DMA Coalescing values result in more energy saved but may increase your system's network latency. If you enable DMA Coalescing, you should also set the Interrupt Moderation Rate to 'Minimal'. This minimizes the latency impact imposed by DMA Coalescing and results in better peak network throughput performance. You must enable DMA Coalescing on all active ports in the system. You may not gain any energy savings if it is enabled only on some of the ports in your system. There are also several BIOS, platform, and application settings that will affect your potential energy savings. A white paper containing information on how to best configure your platform is available on the Intel website.

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "DMA Coalescing" -DisplayValue "Enabled"

## Forward Error Correction (FEC) Mode

Allows you to set the Forward Error Correction (FEC) mode. FEC improves link stability, but increases latency. Many high quality optics, direct attach cables, and backplane channels provide a stable link without FEC.

The driver allows you to set the following FEC Modes:

- Auto FEC - Sets the FEC Mode based on the capabilities of the attached cable.
- CL108 RS-FEC - Selects only RS-FEC ability and request capabilities.
- CL74 FC-FEC/BASE-R - Selects only BASE-R ability and request capabilities.
- No FEC - Disables FEC.



**NOTE:** For devices to benefit from this feature, link partners must have FEC enabled.

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "FEC Mode" -DisplayValue "Auto FEC"

## Flow Control

Enables adapters to more effectively regulate traffic. Adapters generate flow control frames when their receive queues reach a pre-defined limit. Generating flow control frames signals the transmitter to slow transmission. Adapters respond to flow control frames by pausing packet transmission for the time specified in the flow control frame.

By enabling adapters to adjust packet transmission, flow control helps prevent dropped packets.



### NOTES:

- For adapters to benefit from this feature, link partners must support flow control frames.
- When an adapter is running in NPar mode, Flow Control is limited to the root partition of each port.


<b>Default</b>	RX & TX Enabled
<b>Range</b>	<ul style="list-style-type: none"><li>• Disabled</li><li>• RX Enabled</li><li>• TX Enabled</li><li>• RX &amp; TX Enabled</li></ul>

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Flow Control" -DisplayValue "Auto Negotiation"


## Gigabit Master Slave Mode

Determines whether the adapter or link partner is designated as the master. The other device is designated as the slave. By default, the IEEE 802.3ab specification defines how conflicts are handled. Multi-port devices such as switches have higher priority over single port devices and are assigned as the master. If both devices are multi-port devices, the one with higher seed bits becomes the master. This default setting is called "Hardware Default."

 **NOTE:** In most scenarios, it is recommended to keep the default value of this feature.

Setting this to either "Force Master Mode" or "Force Slave Mode" overrides the hardware default.

<b>Default</b>	Auto Detect
<b>Range</b>	<ul style="list-style-type: none"><li>• Force Master Mode</li><li>• Force Slave Mode</li><li>• Auto Detect</li></ul>

 **NOTE:** Some multi-port devices may be forced to Master Mode. If the adapter is connected to such a device and is configured to "Force Master Mode," link is not established.


On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the `Set-IntelNetAdapterSetting` cmdlet. For example: `Set-IntelNetAdapterSetting -Name "<adapter_name>" -DisplayName "Gigabit Master Slave Mode" -DisplayValue "Auto Detect"`

## Interrupt Moderation Rate

Sets the Interrupt Throttle Rate (ITR). This setting moderates the rate at which Transmit and Receive interrupts are generated.

When an event such as packet receiving occurs, the adapter generates an interrupt. The interrupt interrupts the CPU and any application running at the time, and calls on the driver to handle the packet. At greater link speeds, more interrupts are created, and CPU rates also increase. This results in poor system performance. When you use a higher ITR setting, the interrupt rate is lower and the result is better CPU performance.

 **NOTE:** A higher ITR rate also means that the driver has more latency in handling packets. If the adapter is handling many small packets, it is better to lower the ITR so that the driver can be more responsive to incoming and outgoing packets.

Altering this setting may improve traffic throughput for certain network and system configurations, however the default setting is optimal for common network and system configurations. Do not change this setting without verifying that the desired change will have a positive effect on network performance.

<b>Default</b>	Adaptive
<b>Range</b>	<ul style="list-style-type: none"><li>• Adaptive</li><li>• Extreme</li><li>• High</li><li>• Medium</li><li>• Low</li><li>• Minimal</li><li>• Off</li></ul>

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the `Set-IntelNetAdapterSetting` cmdlet. For example: `Set-IntelNetAdapterSetting -Name "<adapter_name>" -DisplayName "Interrupt Moderation Rate" -DisplayValue "Adaptive"`

## IPv4 Checksum Offload

This allows the adapter to compute the IPv4 checksum of incoming and outgoing packets. This feature enhances IPv4 receive and transmit performance and reduces CPU utilization.

With Offloading off, the operating system verifies the IPv4 checksum.

With Offloading on, the adapter completes the verification for the operating system.

<b>Default</b>	RX & TX Enabled
<b>Range</b>	<ul style="list-style-type: none"><li>• Disabled</li></ul>

	<ul style="list-style-type: none"> <li>• RX Enabled</li> <li>• TX Enabled</li> <li>• RX &amp; TX Enabled</li> </ul>
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On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "IPv4 Checksum Offload" -DisplayValue "Tx Enabled"

## Jumbo Frames

Enables or disables Jumbo Packet capability. The standard Ethernet frame size about 1514 bytes, while Jumbo Packets are larger than this. Jumbo Packets can increase throughput and decrease CPU utilization. However, additional latency may be introduced.

Enable Jumbo Packets only if ALL devices across the network support them and are configured to use the same frame size. When setting up Jumbo Packets on other network devices, be aware that network devices calculate Jumbo Packet sizes differently. Some devices include the frame size in the header information while others do not. Intel adapters do not include frame size in the header information.

Jumbo Packets can be implemented simultaneously with VLANs and teaming. If a team contains one or more non-Intel adapters, the Jumbo Packets feature for the team is not supported. Before adding a non-Intel adapter to a team, make sure that you disable Jumbo Packets for all non-Intel adapters using the software shipped with the adapter.

## Restrictions

- Supported protocols are limited to IP (TCP, UDP).
- Jumbo frames require compatible switch connections that forward Jumbo Frames. Contact your switch vendor for more information.
- When standard-sized Ethernet frames (64 to 1518 bytes) are used, there is no benefit to configuring Jumbo Frames.
- The Jumbo Packets setting on the switch must be set to at least 8 bytes larger than the adapter setting for Microsoft Windows operating systems, and at least 22 bytes larger for all other operating systems.

<b>Default</b>	Disabled
<b>Range</b>	Disabled (1514), 4088, or 9014 bytes. (Set the switch 4 bytes higher for CRC, plus 4 bytes if using VLANs.)



### NOTES:

- End-to-end hardware must support this capability; otherwise, packets will be dropped.
- Intel adapters that support Jumbo Packets have a frame size limit of 9238 bytes, with a corresponding MTU size limit of 9216 bytes.

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Jumbo Packet" -DisplayValue "4088 Bytes"

## Large Send Offload (IPv4 and IPv6)

Sets the adapter to offload the task of segmenting TCP messages into valid Ethernet frames. The maximum frame size limit for large send offload is set to 64,000 bytes.

Since the adapter hardware is able to complete data segmentation much faster than operating system software, this feature may improve transmission performance. In addition, the adapter uses fewer CPU resources.

<b>Default</b>	Enabled
<b>Range</b>	<ul style="list-style-type: none"> <li>• Enabled</li> <li>• Disabled</li> </ul>

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Large Send Offload V2 (IPv4)" -DisplayValue "Enabled"

## Locally Administered Address

Overrides the initial MAC address with a user-assigned MAC address. To enter a new network address, type a 12-digit hexadecimal number in this box.

<b>Default</b>	None
<b>Range</b>	0000 0000 0001 - FFFF FFFF FFFD Exceptions: <ul style="list-style-type: none"><li>• Do not use a multicast address (Least Significant Bit of the high byte = 1). For example, in the address 0Y123456789A, "Y" cannot be an odd number. (Y must be 0, 2, 4, 6, 8, A, C, or E.)</li><li>• Do not use all zeros or all Fs.</li></ul> If you do not enter an address, the address is the original network address of the adapter. For example, Multicast: 0123 4567 8999 Broadcast: FFFF FFFF FFFF Unicast (legal): 0070 4567 8999



**NOTE:** In a team, Intel PROSet uses either:

- The primary adapter's permanent MAC address if the team does not have an LAA configured, or
- The team's LAA if the team has an LAA configured.

Intel PROSet does not use an adapter's LAA if the adapter is the primary adapter in a team and the team has an LAA.

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Locally Administered Address" -DisplayValue "<desired address>"

## Log Link State Event

This setting is used to enable/disable the logging of link state changes. If enabled, a link up change event or a link down change event generates a message that is displayed in the system event logger. This message contains the link's speed and duplex. Administrators view the event message from the system event log.

The following events are logged.

- The link is up.
- The link is down.
- Mismatch in duplex.
- Spanning Tree Protocol detected.


<b>Default</b>	Enabled
<b>Range</b>	Enabled, Disabled

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Log Link State Event" -DisplayValue "Enabled"

## Low Latency Interrupts

LLI enables the network device to bypass the configured interrupt moderation scheme based on the type of data being received. It configures which arriving TCP packets trigger an immediate interrupt, enabling the system to handle the packet more quickly. Reduced data latency enables some applications to gain faster access to network data.

 **NOTE:** When LLI is enabled, system CPU utilization may increase.

LLI can be used for data packets containing a TCP PSH flag in the header or for specified TCP ports.

- **Packets with TCP PSH Flag** - Any incoming packet with the TCP PSH flag will trigger an immediate interrupt. The PSH flag is set by the sending device.
- **TCP Ports** - Every packet received on the specified ports will trigger an immediate interrupt. Up to eight ports may be specified.


<b>Default</b>	Disabled
<b>Range</b>	<ul style="list-style-type: none"><li>• Disabled</li><li>• PSH Flag-Based</li><li>• Port-Based</li></ul>

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Low Latency Interrupts" -DisplayValue "Port-Based"

## Network Virtualization using Generic Routing Encapsulation (NVGRE)

Network Virtualization using Generic Routing Encapsulation (NVGRE) increases the efficient routing of network traffic within a virtualized or cloud environment. Some Intel® Ethernet Network devices perform Network Virtualization using Generic Routing Encapsulation (NVGRE) processing, offloading it from the operating system. This reduces CPU utilization.

 **NOTE:** When a port is in NPar mode, NVGRE (the Encapsulated Task Offload setting) is available only on the first partition on the port.

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "NVGRE Encapsulated Task Offload" -DisplayValue "Enabled"

## Performance Options

### Performance Profile

Performance Profiles are supported on Intel® 10GbE adapters and allow you to quickly optimize the performance of your Intel® Ethernet Adapter. Selecting a performance profile will automatically adjust some Advanced Settings to their optimum setting for the selected application. For example, a standard server has optimal performance with only two RSS (Receive-Side Scaling) queues, but a web server requires more RSS queues for better scalability.

You must install Intel® PROSet for Windows Device Manager to use Performance profiles. Profiles are selected on the Advanced tab of the adapter's property sheet.

<b>Profiles</b>	<ul style="list-style-type: none"><li>• Standard Server – This profile is optimized for typical servers.</li><li>• Web Server – This profile is optimized for IIS and HTTP-based web servers.</li><li>• Virtualization Server – This profile is optimized for Microsoft's Hyper-V virtualization environment.</li><li>• Storage Server – This profile is optimized for Fibre Channel over Ethernet or for iSCSI over DCB performance. Selecting this profile will disable SR-IOV and VMQ.</li><li>• Storage + Virtualization – This profile is optimized for a combination of storage and virtualization requirements.</li><li>• Low Latency – This profile is optimized to minimize network latency.</li></ul>
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## NOTES:

- Not all options are available on all adapter/operating system combinations.
- If you have selected the Virtualization Server profile or the Storage + Virtualization profile, and you uninstall the Hyper-V role, you should select a new profile.

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Profile" -DisplayValue "Standard Server"

### Teaming Considerations

When you create a team with all members of the team supporting Performance Profiles, you will be asked which profile to use at the time of team creation. The profile will be synchronized across the team. If there is not a profile that is supported by all team members then the only option will be Use Current Settings. The team will be created normally. Adding an adapter to an existing team works in much the same way.

If you attempt to team an adapter that supports performance profiles with an adapter that doesn't, the profile on the supporting adapter will be set to Custom Settings and the team will be created normally.

This feature is not configurable through Intel PROSet ACU. On Microsoft Windows Server 2019 and Microsoft Windows 10 Version 1809, use Windows PowerShell.

## Power Options

The Intel PROSet Power Management tab includes several settings that control the adapter's power consumption. For example, you can set the adapter to reduce its power consumption if the cable is disconnected.

On the device's Device Manager property sheet, this setting is found on the Power Management tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Wake on Link Settings" -DisplayValue "Enabled"

## Reduce Power if Cable Disconnected & Reduce Link Speed During Standby

Enables the adapter to reduce power consumption when the LAN cable is disconnected from the adapter and there is no link. When the adapter regains a valid link, adapter power usage returns to its normal state (full power usage).

The Hardware Default option is available on some adapters. If this option is selected, the feature is disabled or enabled based on the system hardware.

<b>Default</b>	The default varies with the operating system and adapter.
<b>Range</b>	The range varies with the operating system and adapter.

## Energy Efficient Ethernet

The Energy Efficient Ethernet (EEE) feature allows a capable device to enter Low-Power Idle between bursts of network traffic. Both ends of a link must have EEE enabled for any power to be saved. Both ends of the link will resume full power when data needs to be transmitted. This transition may introduce a small amount of network latency.

### NOTES:

- Both ends of the EEE link must automatically negotiate link speed.
- EEE is not supported on any 10 GbE, 25 GbE, or 40 GbE adapter.

## Wake on LAN Options

The ability to remotely wake computers is an important development in computer management. This feature has evolved over the last few years from a simple remote power-on capability to a complex system interacting with a variety of device and operating system power states.



Microsoft Windows Server is ACPI-capable. Windows does not support waking from a power-off (S5) state, only from standby (S3) or hibernate (S4). When shutting down the system, these states shut down ACPI devices, including Intel adapters. This disarms the adapter's remote wake-up capability. However, in some ACPI-capable computers, the BIOS may have a setting that allows you to override the operating system and wake from an S5 state anyway. If there is no support for wake from S5 state in your BIOS settings, you are limited to Wake From Standby when using these operating systems in ACPI computers.

The Intel PROSet Power Management tab includes **Wake on Magic Packet** and **Wake on directed packet settings**. These control the type of packets that wake up the system from standby.

For some adapters, the Power Management tab in Intel PROSet includes a setting called **Wake on Magic Packet from power off state**. Enable this setting to explicitly allow wake-up with a Magic Packet\* from shutdown under APM power management mode.



**NOTES:**

- To use the Wake on Directed Packet feature, WoL must first be enabled in the EEPROM using BootUtil.
- If **Reduce speed during standby** is enabled, then **Wake on Magic Packet** and/or **Wake on directed packet** must be enabled. If both of these options are disabled, power is removed from the adapter during standby.
- **Wake on Magic Packet from power off state** has no effect on this option.

## WoL Supported Devices

[All devices](#) support Wake on LAN on all ports, with the following exceptions:

Device	Adapter Port(s) supporting WoL
Intel® Gigabit 2P I350-t Adapter Intel® Gigabit 4P I350-t Adapter	port 1 only
Intel® Ethernet Converged Network Adapter X710-4 Intel® Ethernet Converged Network Adapter X710-2 Intel® Ethernet Converged Network Adapter X710	port 1 only
Intel® Ethernet 25G 2P XXV710 Mezz Intel® Ethernet 25G 2P XXV710 Adapter	Not supported
Intel® Ethernet Converged Network Adapter X710-T Intel® Ethernet Converged Network Adapter XL710-Q2	Not supported
Intel® Ethernet 10G 2P X520 Adapter Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz	Not Supported
Intel® Ethernet 10G 2P X540-t Adapter	Not Supported
Intel® Ethernet 10G 2P X550-t Adapter	Not Supported

## Wake on Link Settings

Wakes the computer if the network connection establishes link while the computer is in standby mode. You can enable the feature, disable it, or let the operating system use its default.



**NOTES:**

- If a copper-based Intel adapter is advertising a speed of one gigabit only, this feature does not work because the adapter cannot identify a gigabit link at a D3 state.
- The network cable must be disconnected when entering into S3/S4 in order to wake the system up by link up event.

<b>Default</b>	Disabled
<b>Range</b>	Disabled

	OS Controlled Forced
--	-------------------------

## Remote Wake-Up

Remote wake-up can wake your server from a low power or powered off state. If Wake On LAN is enabled, when your system is powered down, the network interface draws standby power and listens for specially designed packet. If it receives such a packet it will wake your server.

## Advanced Configuration and Power Interface (ACPI)

ACPI supports a variety of power states. Each state represents a different level of power, from fully powered up to completely powered down, with partial levels of power in each intermediate state.

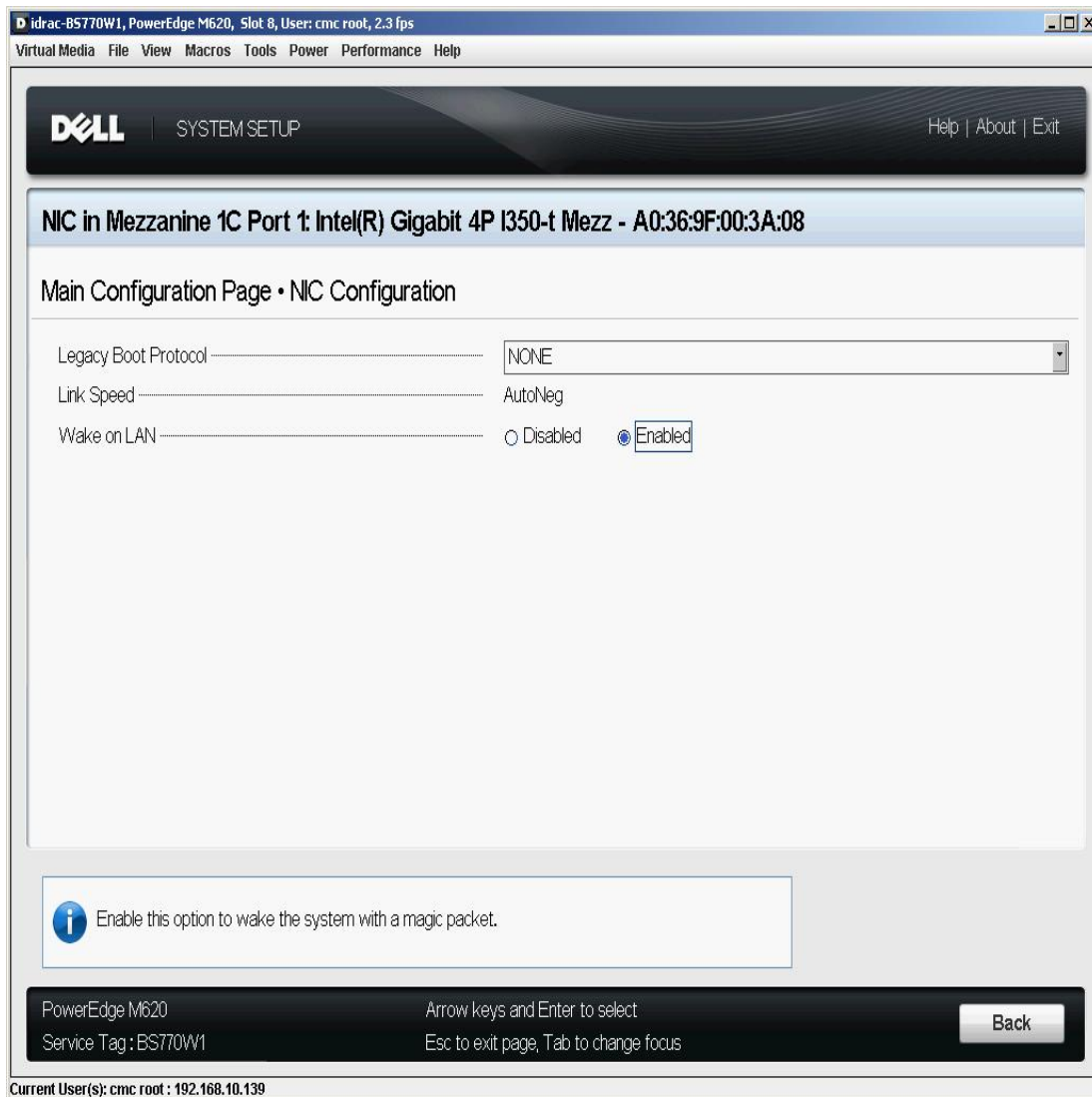
### ACPI Power States

Power State	Description
S0	On and fully operational
S1	System is in low-power mode (sleep mode). The CPU clock is stopped, but RAM is powered on and being refreshed.
S2	Similar to S1, but power is removed from the CPU.
S3	Suspend to RAM (standby mode). Most components are shut down. RAM remains operational.
S4	Suspend to disk (hibernate mode). The memory contents are swapped to the disk drive and then reloaded into RAM when the system is awakened.
S5	Power off

## Enabling Wake From Power Off

If you want to wake your system from a power off state, you must enable it from the System Setup.

1. Go to System Setup.
2. Choose a port and go to configuration.
3. Specify Wake on LAN.



## Wake-Up Address Patterns

Remote wake-up can be initiated by a variety of user selectable packet types and is not limited to the Magic Packet format. For more information about supported packet types, see the [operating system settings](#) section.

The wake-up capability of Intel adapters is based on patterns sent by the OS. You can configure the driver to the following settings using Intel PROSet for Windows. For Linux\*, WoL is provided through the ethtool\* utility. For more information on ethtool, see the following Web site: <http://sourceforge.net/projects/gkernel>.

- Wake on Directed Packet - accepts only patterns containing the adapter's Ethernet address in the Ethernet header or containing the IP address, assigned to the adapter, in the IP header.
- Wake on Magic Packet - accept only patterns containing 16 consecutive repetitions of the adapter's MAC address.
- Wake on Directed Packet and Wake on Magic Packet - accepts the patterns of both directed packets and magic packets.

Choosing "Wake on directed packet" will also allow the adapter to accept patterns of the Address Resolution Protocol (ARP) querying the IP address assigned to the adapter. If multiple IP addresses are assigned to an adapter, the operating system may request to wake up on ARP patterns querying any of the assigned addresses. However, the adapter will only awaken in response to ARP packets querying the first IP address in the list, usually the first address assigned to the adapter.

## Physical Installation Issues

### Slot

Some motherboards will only support remote wake-up (or remote wake-up from S5 state) in a particular slot. See the documentation that came with your system for details on remote wake-up support.

### Power

Newer Intel PRO adapters are 3.3 volt and some are 12 volt. They are keyed to fit either type of slot.

The 3.3 volt standby supply must be capable of supplying at least 0.2 amps for each Intel PRO adapter installed. Turning off the remote wake-up capability on the adapter using the BootUtil utility reduces the power draw to around 50 milliamps (.05 amps) per adapter.

## Operating System Settings

### Microsoft Windows Products

Windows Server is ACPI-capable. These operating systems do not support remote wake-up from a powered off state (S5), only from standby. When shutting down the system, they shut down ACPI devices including the Intel PRO adapters. This disarms the adapters' remote wake-up capability. However, in some ACPI-capable computers, the BIOS may have a setting that allows you to override the OS and wake from an S5 state anyway. If there is no support for wake from S5 state in your BIOS settings, you are limited to wake from standby when using these operating systems in ACPI computers.

The **Power Management** tab in Intel PROSet includes a setting called Wake on Magic Packet from power off state for some adapters. To explicitly allow wake-up with a Magic Packet from shutdown under APM power management mode, check this box to enable this setting. See Intel PROSet help for more details.

In ACPI-capable versions of Windows, the Intel PROSet advanced settings include a setting called Wake on Settings. This setting controls the type of packets that wake the system from standby. See Intel PROSet help for more details.

If you do not have Intel PROSet installed you will need to do the following:

1. Open the Device Manager, then navigate to the **Power Management** tab, check "**Allow this device to bring the computer out of standby.**"
2. On the **Advanced** tab, set the "**Wake on Magic packet**" option to Enabled.

In order to wake from S5 without Intel PROSET, on the **Advanced tab**, set "**Enable PME**" to Enabled.

### Other Operating Systems

Remote Wake-Up is also supported in [Linux](#).

## Priority & VLAN Tagging

Enables the adapter to offload the insertion and removal of priority and VLAN tags for transmit and receive.

<b>Default</b>	Priority & VLAN Enabled
<b>Range</b>	<ul style="list-style-type: none"><li>• Priority &amp; VLAN Disabled</li><li>• Priority Enabled</li><li>• VLAN Enabled</li><li>• Priority &amp; VLAN Enabled</li></ul>

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To set this in Windows Powershell, first disable DCB, then set priority and VLAN tagging. For example:

```
Set-IntelNetAdapterSetting -Name "<adapter_name>" -DisplayName "DCB" -DisplayValue "Disabled"
```

```
Set-IntelNetAdapterSetting -Name "<adapter_name>" -DisplayName "Packet Priority & VLAN" -DisplayValue "VLAN Enabled"
```

## Quality of Service

Quality of Service (QoS) allows the adapter to send and receive IEEE 802.3ac tagged frames. 802.3ac tagged frames include 802.1p priority-tagged frames and 802.1Q VLAN-tagged frames. In order to implement QoS, the adapter must be connected to a switch that supports and is configured for QoS. Priority-tagged frames allow programs that deal with real-time events to make the most efficient use of network bandwidth. High priority packets are processed before lower priority packets.

To implement QoS, the adapter must be connected to a switch that supports and is configured for 802.1p QoS.

QoS Tagging is enabled and disabled in the **Advanced** tab of Intel PROSet for Windows Device Manager.

To set this in Windows Powershell, first disable DCB, then set QoS using the Priority and VLAN tagging DisplayName in the cmdlet. For example:

```
Set-IntelNetAdapterSetting -Name "<adapter_name>" -DisplayName "DCB" -DisplayValue "Disabled"
```

```
Set-IntelNetAdapterSetting -Name "<adapter_name>" -DisplayName "Packet Priority & VLAN" -DisplayValue "VLAN Enabled"
```

Once QoS is enabled, you can specify levels of priority based on IEEE 802.1p/802.1Q frame tagging.

## Receive Buffers

Defines the number of Receive Buffers, which are data segments. They are allocated in the host memory and used to store the received packets. Each received packet requires at least one Receive Buffer, and each buffer uses 2KB of memory.

You might choose to increase the number of Receive Buffers if you notice a significant decrease in the performance of received traffic. If receive performance is not an issue, use the default setting appropriate to the adapter.

<b>Default</b>	512, for all adapters.
<b>Range</b>	128-4096, in intervals of 64, for all adapters.
<b>Recommended Value</b>	Teamed adapter: 256 Using IPSec and/or multiple features: 352

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Receive Buffers" -DisplayValue "256"

## Receive Side Scaling

When Receive Side Scaling (RSS) is enabled, all of the receive data processing for a particular TCP connection is shared across multiple processors or processor cores. Without RSS all of the processing is performed by a single processor, resulting in less efficient system cache utilization. RSS can be enabled for a LAN or for FCoE. In the first case, it is called "LAN RSS". In the second, it is called "FCoE RSS".

### LAN RSS

LAN RSS applies to a particular TCP connection.



**NOTE:** This setting has no effect if your system has only one processing unit.

### LAN RSS Configuration



RSS is enabled on the **Advanced** tab of the adapter property sheet. If your adapter does not support RSS, or if the SNP or SP2 is not installed, the RSS setting will not be displayed. If RSS is supported in your system environment, the following will be displayed:

- **Port NUMA Node.** This is the NUMA node number of a device.
- **Starting RSS CPU.** This setting allows you to set the preferred starting RSS processor. Change this setting if the current processor is dedicated to other processes. The setting range is from 0 to the number of logical CPUs - 1.
- **Max number of RSS CPU.** This setting allows you to set the maximum number of CPUs assigned to an adapter and is primarily used in a Hyper-V environment. By decreasing this setting in a Hyper-V environment, the total number of interrupts is reduced which lowers CPU utilization. The default is 8 for Gigabit adapters and 16 for 10 Gigabit adapters.
- **Preferred NUMA Node.** This setting allows you to choose the preferred NUMA (Non-Uniform Memory Access) node to be used for memory allocations made by the network adapter. In addition the system will attempt to use the CPUs from the preferred NUMA node first for the purposes of RSS. On NUMA platforms, memory access latency is dependent on the memory location. Allocation of memory from the closest node helps improve performance. The Windows Task Manager shows the NUMA Node ID for each processor.

 **NOTES:**

- This setting only affects NUMA systems. It will have no effect on non-NUMA systems.
- Choosing a value greater than the number of NUMA nodes present in the system selects the NUMA node closest to the device.

- **Receive Side Scaling Queues.** This setting configures the number of RSS queues, which determine the space to buffer transactions between the network adapter and CPU(s).

<b>Default</b>	2 queues for the Intel® 10 Gigabit Server Adapters
<b>Range</b>	<ul style="list-style-type: none"> <li>• 1 queue is used when low CPU utilization is required.</li> <li>• 2 queues are used when good throughput and low CPU utilization are required.</li> <li>• 4 queues are used for applications that demand maximum throughput and transactions per second.</li> <li>• 8 and 16 queues are supported on the Intel® 82598-based and 82599-based adapters.</li> </ul> <p> <b>NOTES:</b></p> <ul style="list-style-type: none"> <li>• The 8 and 16 queues are only available when PROSet for Windows Device Manager is installed. If PROSet is not installed, only 4 queues are available.</li> <li>• Using 8 or more queues will require the system to reboot.</li> </ul> <p> <b>NOTE:</b> Not all settings are available on all adapters.</p>

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Receive Side Scaling" -DisplayValue "Enabled"

## LAN RSS and Teaming

- If RSS is not enabled for all adapters in a team, RSS will be disabled for the team.
- If an adapter that does not support RSS is added to a team, RSS will be disabled for the team.

## FCoE RSS

If FCoE is installed, FCoE RSS is enabled and applies to FCoE receive processing that is shared across processor cores.

This feature is not configurable through Intel PROSet ACU. On Microsoft Windows Server 2019 and Microsoft Windows 10 Version 1809, use Windows PowerShell.

## FCoE RSS Configuration

If your adapter supports FCoE RSS, the following configuration settings can be viewed and changed on the base driver Advanced Performance tab:

- **FCoE NUMA Node Count.** This setting specifies the number of consecutive NUMA Nodes where the allocated FCoE queues will be evenly distributed.
- **FCoE Starting NUMA Node.** This setting specifies the NUMA node representing the first node within the FCoE NUMA Node Count.
- **FCoE Starting Core Offset.** This setting specifies the offset to the first NUMA Node CPU core that will be assigned to FCoE queue.
- **FCoE Port NUMA Node.** This setting is an indication from the platform of the optimal closest NUMA Node to the physical port, if available. This setting is read-only and cannot be configured.

## Performance Tuning

The Intel Network Controller provides a new set of advanced FCoE performance tuning options. These options will direct how FCoE transmit/receive queues are allocated in NUMA platforms. Specifically, they direct what target set of NUMA node CPUs can be selected from to assign individual queue affinity. Selecting a specific CPU has two main effects:

- It sets the desired interrupt location for processing queue packet indications.
- It sets the relative locality of the queue to available memory.

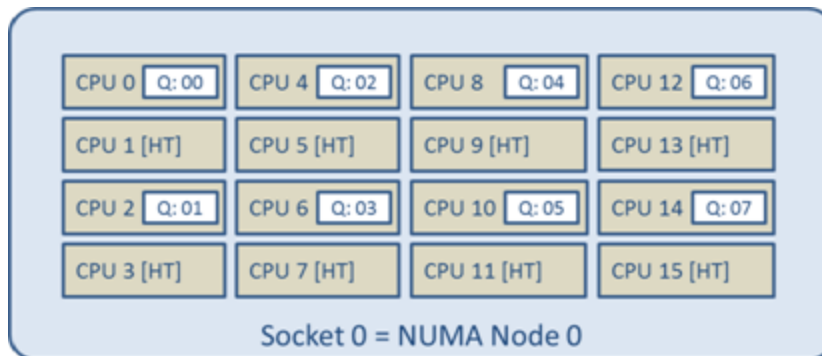
As indicated, these are intended as advanced tuning options for those platform managers attempting to maximize system performance. They are generally expected to be used to maximize performance for multi-port platform configurations. Since all ports share the same default installation directives (the .inf file, etc.), the FCoE queues for every port will be associated with the same set of NUMA CPUs which may result in CPU contention.

The software exporting these tuning options defines a NUMA Node to be equivalent to an individual processor (socket). Platform ACPI information presented by the BIOS to the operating system helps define the relation of PCI devices to individual processors. However, this detail is not currently reliably provided in all platforms. Therefore, using the tuning options may produce unexpected results. Consistent or predictable results when using the performance options cannot be guaranteed.

The performance tuning options are listed in the [LAN RSS Configuration](#) section.

**Example 1:** A platform with two physical sockets, each socket processor providing 8 core CPUs (16 when hyper threading is enabled), and a dual port Intel adapter with FCoE enabled.

By default 8 FCoE queues will be allocated per NIC port. Also, by default the first (non-hyper thread) CPU cores of the first processor will be assigned affinity to these queues resulting in the allocation model pictured below. In this scenario, both ports would be competing for CPU cycles from the same set of CPUs on socket 0.



Socket Queue to CPU Allocation

Using performance tuning options, the association of the FCoE queues for the second port can be directed to a different non-competing set of CPU cores. The following settings would direct SW to use CPUs on the other processor socket:

- FCoE NUMA Node Count = 1: Assign queues to cores from a single NUMA node (or processor socket).
- FCoE Starting NUMA Node = 1: Use CPU cores from the second NUMA node (or processor socket) in the system.
- FCoE Starting Core Offset = 0: SW will start at the first CPU core of the NUMA node (or processor socket).

The following settings would direct SW to use a different set of CPUs on the same processor socket. This assumes a processor that supports 16 non-hyperthreading cores.

- FCoE NUMA Node Count = 1
- FCoE Starting NUMA Node = 0
- FCoE Starting Core Offset = 8

**Example 2:** Using one or more ports with queues allocated across multiple NUMA nodes. In this case, for each NIC port the FCoE NUMA Node Count is set to that number of NUMA nodes. By default the queues will be allocated evenly from each NUMA node:

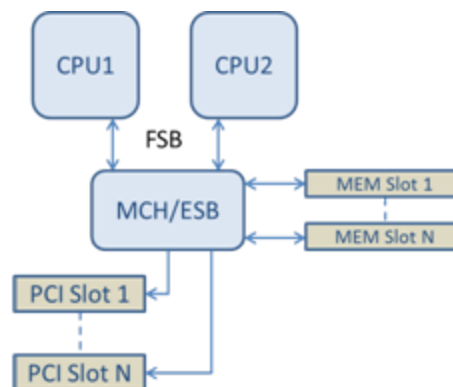
- FCoE NUMA Node Count = 2
- FCoE Starting NUMA Node = 0
- FCoE Starting Core Offset = 0

**Example 3:** The display shows FCoE Port NUMA Node setting is 2 for a given adapter port. This is a read-only indication from SW that the optimal nearest NUMA node to the PCI device is the third logical NUMA node in the system. By default SW has allocated that port's queues to NUMA node 0. The following settings would direct SW to use CPUs on the optimal processor socket:

- FCoE NUMA Node Count = 1
- FCoE Starting NUMA Node = 2
- FCoE Starting Core Offset = 0

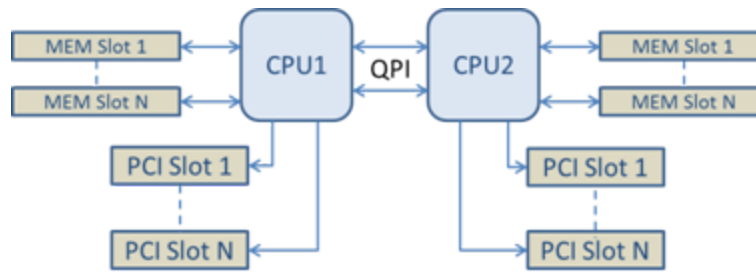
This example highlights the fact that platform architectures can vary in the number of PCI buses and where they are attached. The figures below show two simplified platform architectures. The first is the older common FSB style architecture in which multiple CPUs share access to a single MCH and/or ESB that provides PCI bus and memory connectivity. The second is a more recent architecture in which multiple CPU processors are interconnected via QPI, and each processor itself supports integrated MCH and PCI connectivity directly.

There is a perceived advantage in keeping the allocation of port objects, such as queues, as close as possible to the NUMA node or collection of CPUs where it would most likely be accessed. If the port queues are using CPUs and memory from one socket when the PCI device is actually hanging off of another socket, the result may be undesirable QPI processor-to-processor bus bandwidth being consumed. It is important to understand the platform architecture when using these performance options.



Shared Single Root PCI/Memory Architecture





Distributed Multi-Root PCI/Memory Architecture

**Example 4:** The number of available NUMA node CPUs is not sufficient for queue allocation. If your platform has a processor that does not support an even power of 2 CPUs (for example, it supports 6 cores), then during queue allocation if SW runs out of CPUs on one socket it will by default reduce the number of queues to a power of 2 until allocation is achieved. For example, if there is a 6 core processor being used, the SW will only allocate 4 FCoE queues if there only a single NUMA node. If there are multiple NUMA nodes, the NUMA node count can be changed to a value greater than or equal to 2 in order to have all 8 queues created.

### Determining Active Queue Location

The user of these performance options will want to determine the affinity of FCoE queues to CPUs in order to verify their actual effect on queue allocation. This is easily done by using a small packet workload and an I/O application such as IoMeter. IoMeter monitors the CPU utilization of each CPU using the built-in performance monitor provided by the operating system. The CPUs supporting the queue activity should stand out. They should be the first non-hyper thread CPUs available on the processor unless the allocation is specifically directed to be shifted via the performance options discussed above.

To make the locality of the FCoE queues even more obvious, the application affinity can be assigned to an isolated set of CPUs on the same or another processor socket. For example, the IoMeter application can be set to run only on a finite number of hyper thread CPUs on any processor. If the performance options have been set to direct queue allocation on a specific NUMA node, the application affinity can be set to a different NUMA node. The FCoE queues should not move and the activity should remain on those CPUs even though the application CPU activity moves to the other processor CPUs selected.

## Setting Speed and Duplex

### Overview

The Link Speed and Duplex setting lets you choose how the adapter sends and receives data packets over the network.

In the default mode, an Intel network adapter using copper connections will attempt to auto-negotiate with its link partner to determine the best setting. If the adapter cannot establish link with the link partner using auto-negotiation, you may need to manually configure the adapter and link partner to the identical setting to establish link and pass packets. This should only be needed when attempting to link with an older switch that does not support auto-negotiation or one that has been forced to a specific speed or duplex mode.

Auto-negotiation is disabled by selecting a discrete speed and duplex mode in the adapter properties sheet.

#### NOTES:

- When an adapter is running in NPar mode, Speed settings are limited to the root partition of each port.
- Fiber-based adapters operate only in full duplex at their native speed.

The settings available when auto-negotiation is disabled are dependent on your device. Not all speeds are available on all devices. Your link partner must match the setting you choose.

#### NOTES:

- Although some adapter property sheets (driver property settings) list 10 Mbps and 100 Mbps in full or half duplex as options, using those settings is not recommended.
- Only experienced network administrators should force speed and duplex manually.
- You cannot change the speed or duplex of Intel adapters that use fiber cabling.

- The Link Speed tab may display a blue informational icon with a mouse-over message "This device is not linked at its maximum capable speed". In that case, if your device is set to auto-negotiate, you can adjust the speed of the device's link partner to the device's maximum speed. If the device is not set to auto-negotiate, you can adjust the device's speed manually, but you must ensure the link partner is set at the same speed.

Intel 10 Gigabit adapters that support 1 gigabit speed allow you to configure the speed setting. If this option is not present, your adapter only runs at its native speed.

If the adapter cannot establish link with the gigabit link partner using auto-negotiation, set the adapter to **1 Gbps Full duplex**.

Intel 10 gigabit fiber-based adapters and SFP direct-attach devices operate only in full duplex, and only at their native speed. Multi-speed 10 gigabit SFP+ fiber modules support full duplex at 10 Gbps and 1 Gbps.

## Manually Configuring Duplex and Speed Settings

Configuration is specific to your operating system driver. To set a specific Link Speed and Duplex mode, refer to the section below that corresponds to your operating system.



**CAUTION: The settings at the switch must always match the adapter settings. Adapter performance may suffer, or your adapter might not operate correctly if you configure the adapter differently from your switch.**

### Windows

The default setting is for auto-negotiation to be enabled. Only change this setting to match your link partner's speed and duplex setting if you are having trouble connecting.

1. In Windows Device Manager, double-click the adapter you want to configure.
2. On the **Link Speed** tab, select a speed and duplex option from the **Speed and Duplex** drop-down menu.
3. Click **OK**.

More specific instructions are available in the Intel PROSet help.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Speed & Duplex" -DisplayValue "Auto Negotiation"

### Linux

See [Linux\\* Driver for the Intel® Gigabit Family of Adapters](#) for information on configuring Speed and Duplex on Linux systems.

## SR-IOV (Single Root I/O Virtualization)

SR-IOV lets a single network port appear to be several virtual functions in a virtualized environment. If you have an SR-IOV capable NIC, each port on that NIC can assign a virtual function to several guest partitions. The virtual functions bypass the Virtual Machine Manager (VMM), allowing packet data to move directly to a guest partition's memory, resulting in higher throughput and lower CPU utilization. SR-IOV also allows you to move packet data directly to a guest partition's memory. See your operating system documentation for system requirements.

For devices that support it, SR-IOV is enabled in the host partition on the adapter's Device Manager property sheet, under Virtualization on the Advanced Tab. Some devices may need to have SR-IOV enabled in a preboot environment.



### NOTES:

- **Configuring SR-IOV for improved network security:** In a virtualized environment, on Intel® Server Adapters that support SR-IOV, the virtual function (VF) may be subject to malicious behavior. Software-generated frames are not expected and can throttle traffic between the host and the virtual switch, reducing performance. To resolve this issue, configure all SR-IOV enabled ports for [VLAN tagging](#). This configuration allows unexpected, and potentially malicious, frames to be dropped.
- You must enable VMQ for SR-IOV to function.
- For best performance, on the host use 'Set-VMNetworkAdapter -IovQueuePairsRequested 4' on the VF to allow the virtual network to use 4 queues (maximum supported value) and assign 4 or more virtual CPUs to the connected VM. In the

- VM, set 'Maximum number of Receive Queues' in the VF's adapter properties to 4.
- SR-IOV is not supported with ANS teams.
- VMWare ESXi does not support SR-IOV on 1GbE ports.
- Some multiport adapters contain more than one controller. On these adapters, enabling SR-IOV on a port will not enable SR-IOV on all ports. Only ports bound to the same controller will be enabled.
- If SR-IOV is disabled in BIOS or the Boot Manager, enabling SR-IOV from Intel PROSet will require a system reboot.
- When an adapter is running in NPar mode, SR-IOV is limited to the root partition of each port.
- When an adapter is running in NPar mode, virtualization (SR-IOV) settings apply to all ports on the adapter. Changes made the virtualization settings on one port are applied to all ports on the adapter.
- Due to chipset limitations, not all systems or slots support SR-IOV. Below is a chart summarizing SR-IOV support on Dell EMC server platforms.

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "SR-IOV" -DisplayValue "Enabled"

## SR-IOV Support on Network Adapters

NDC, LOM, or Adapter	40Gbe	25Gbe	10Gbe	1Gbe
Intel® Ethernet Converged Network Adapter XL710-Q2	Yes			
Intel® Ethernet 40G 2P XL710 QSFP+ rNDC	Yes			
Intel® Ethernet 25G 2P XXV710 Mezz		Yes		
Intel® Ethernet 25G 2P XXV710 Adapter		Yes		
Intel® Ethernet 10G 4P X710-k bNDC			Yes	
Intel® Ethernet 10G 2P X710-k bNDC			Yes	
Intel® Ethernet 10G X710-k bNDC			Yes	
Intel® EthernetConverged Network Adapter X710			Yes	
Intel® EthernetConverged Network Adapter X710-T			Yes	
Intel® Ethernet Server Adapter X710-DA2 for OCP			Yes	
Intel® Ethernet 10G 4P X710/I350 rNDC			Yes	No
Intel® Ethernet 10G 4P X710 SFP+ rNDC			Yes	
Intel® Ethernet 10G X710 rNDC			Yes	No
Intel® Ethernet 10G 4P X550 rNDC			Yes	
Intel® Ethernet 10G 4P X550/I350 rNDC			Yes	No
Intel® Ethernet 10G 2P X550-t Adapter			Yes	
Intel® Ethernet 10G 2P X540-t Adapter			Yes	
Intel® Ethernet 10G 4P X540/I350 rNDC			Yes	No
Intel® Ethernet 10G 4P X520/I350 rNDC			Yes	No
Intel® Ethernet 10G 2P X520-k bNDC			Yes	
Intel® Ethernet 10G 2P X520 Adapter			Yes	



Dell EMC Plat- form	OCP Mezz	Rack NDC	PCI Express Slot												
			1	2	3	4	5	6	7	8	9	10	11	12	13
R540			yes	yes	yes	yes	yes	no							
R530XD			yes	yes	no										
R620			yes	yes	yes										
R630			yes	yes	yes										
R640		yes	yes	yes	yes										
R720XD		yes	yes	yes	yes	yes	yes	yes							
R720		yes	yes	yes	yes	yes	yes	yes	yes						
R730			yes	yes	yes	yes	yes	yes	yes						
R730XD			yes	yes	yes	yes	yes	yes							
R740		yes	yes	yes	yes	yes	yes	yes	yes	yes					
R740XD2			yes	yes	yes	yes	yes	no							
R820		yes	yes	yes	yes	yes	yes	yes	yes						
R830			yes	yes	yes	yes	yes	yes							
R840		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes			
R920		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes			
R930			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes			
R940		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
T130			no	no	no	no									
T140			no	no	no	no									
T320			no	no	yes	yes		yes							
T330			no	no	no	no									
T340			no	no	no	no									
T420			no	no	yes	yes	yes	yes							
T430			no	no	yes	yes	yes	yes							
T440			no	yes	yes	yes	yes								
T620			yes	yes	no	yes	yes	yes	yes						
T630			yes	no	yes	yes	yes	yes	yes						
T640		yes	yes	yes	yes	yes	yes	yes	yes	yes					

Dell EMC Platform	Blade NDC	Mezzanine Slot	
		B	C
FC430	yes	yes	yes
FC630	yes	yes	yes
FC830	yes	yes	yes

Dell EMC Platform	Blade NDC	Mezzanine Slot	
		B	C
M420	yes	yes	yes
M520	no	yes	yes
M620	yes	yes	yes
M630	yes	yes	yes
M630 for VRTX	yes		
M640	yes	yes	yes
M640 for VRTX	yes		
M820	yes	yes	yes
M830	yes	yes	yes
M830 for VRTX	yes		
MX740c	yes	yes	yes
MX840c	yes	yes	yes

Supported platforms or slots are indicated by "yes." Unsupported are indicated by "no". Not applicable are indicated by blank cells.

## TCP Checksum Offload (IPv4 and IPv6)

Allows the adapter to verify the TCP checksum of incoming packets and compute the TCP checksum of outgoing packets. This feature enhances receive and transmit performance and reduces CPU utilization.

With Offloading off, the operating system verifies the TCP checksum.

With Offloading on, the adapter completes the verification for the operating system.

<b>Default</b>	RX & TX Enabled
<b>Range</b>	<ul style="list-style-type: none"> <li>• Disabled</li> <li>• RX Enabled</li> <li>• TX Enabled</li> <li>• RX &amp; TX Enabled</li> </ul>

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "TCP Checksum Offload (IPv4)" -DisplayValue "Tx Enabled"

## TCP/IP Offloading Options

### Thermal Monitoring

Adapters and network controllers based on the Intel® Ethernet Controller I350 (and later controllers) can display temperature data and automatically reduce the link speed if the controller temperature gets too hot.



**NOTE:** This feature is enabled and configured by the equipment manufacturer. It is not available on all adapters and network controllers. There are no user configurable settings.

## Monitoring and Reporting

Temperature information is displayed on the **Link** tab in Intel® PROSet for Windows\* Device Manager. There are three possible conditions:

- Temperature: Normal  
Indicates normal operation.
- Temperature: Overheated, Link Reduced  
Indicates that the device has reduced link speed to lower power consumption and heat.
- Temperature: Overheated, Adapter Stopped  
Indicates that the device is too hot and has stopped passing traffic so it is not damaged.

If either of the overheated events occur, the device driver writes a message to the system event log.

To change this setting in Windows PowerShell use the Get-IntelNetAdapter cmdlet. For example: Get-IntelNetAdapter –Name "<adapter\_name" | fl

## Transmit Buffers

Defines the number of Transmit Buffers, which are data segments that enable the adapter to track transmit packets in the system memory. Depending on the size of the packet, each transmit packet requires one or more Transmit Buffers.

You might choose to increase the number of Transmit Buffers if you notice a possible problem with transmit performance. Although increasing the number of Transmit Buffers can enhance transmit performance, Transmit Buffers do consume system memory. If transmit performance is not an issue, use the default setting. This default setting varies with the type of adapter.

View the [Adapter Specifications](#) topic for help identifying your adapter.

<b>Default</b>	512, depending on the requirements of the adapter
<b>Range</b>	128-16384, in intervals of 64, for 10 Gigabit Server Adapters. 128-4096, in intervals of 64, for all other adapters.

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Transmit Buffers" –DisplayValue "128"

## UDP Checksum Offload (IPv4 and IPv6)

Allows the adapter to verify the UDP checksum of incoming packets and compute the UDP checksum of outgoing packets. This feature enhances receive and transmit performance and reduces CPU utilization.

With Offloading off, the operating system verifies the UDP checksum.

With Offloading on, the adapter completes the verification for the operating system.

<b>Default</b>	RX & TX Enabled
<b>Range</b>	<ul style="list-style-type: none"><li>• Disabled</li><li>• RX Enabled</li><li>• TX Enabled</li><li>• RX &amp; TX Enabled</li></ul>

On the device's Device Manager property sheet, this setting is found on the Advanced tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "UDP Checksum Offload (IPv4)" –DisplayValue "Tx Enabled"

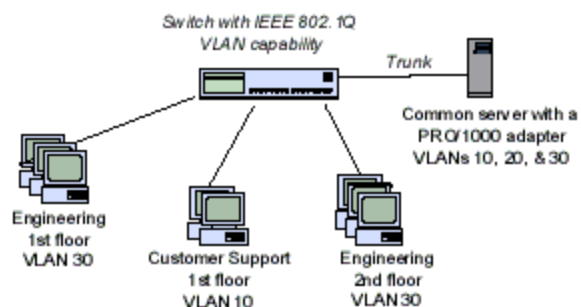
# Virtual LANs

## Overview

### NOTES:

- Windows\* users must install Intel® PROSet for Windows Device Manager and Intel Advanced Networking Services in order to use VLANs.
- You must install the latest Microsoft\* Windows\* 10 updates before you can create Intel ANS Teams or VLANs on Windows 10 systems. Any Intel ANS Teams or VLANs created with a previous software/driver release on a Windows 10 system will be corrupted and cannot be upgraded. The installer will remove these existing teams and VLANs.
- Microsoft Windows Server 2012 R2 is the last Windows Server operating system version that supports Intel Advanced Networking Services (Intel ANS). Intel ANS is not supported on Microsoft Windows Server 2016 and later.
- Intel ANS VLANs are not compatible with Microsoft's Load Balancing and Failover (LBFO) teams. Intel® PROSet will block a member of an LBFO team from being added to an Intel ANS VLAN. You should not add a port that is already part of an Intel ANS VLAN to an LBFO team, as this may cause system instability.

The term VLAN (Virtual Local Area Network) refers to a collection of devices that communicate as if they were on the same physical LAN. Any set of ports (including all ports on the switch) can be considered a VLAN. LAN segments are not restricted by the hardware that physically connects them.



VLANs offer the ability to group computers together into logical workgroups. This can simplify network administration when connecting clients to servers that are geographically dispersed across the building, campus, or enterprise network.

Typically, VLANs consist of co-workers within the same department but in different locations, groups of users running the same network protocol, or a cross-functional team working on a joint project.

By using VLANs on your network, you can:

- Improve network performance
- Limit broadcast storms
- Improve LAN configuration updates (adds, moves, and changes)
- Minimize security problems
- Ease your management task

## Other Considerations

- **Configuring SR-IOV for improved network security:** In a virtualized environment, on Intel® Server Adapters that support SR-IOV, the virtual function (VF) may be subject to malicious behavior. Software-generated frames are not expected and can throttle traffic between the host and the virtual switch, reducing performance. To resolve this issue, configure all SR-IOV enabled ports for VLAN tagging. This configuration allows unexpected, and potentially malicious, frames to be dropped.
- Intel ANS VLANs are not compatible with the Microsoft Hyper-V virtual machine switch. If you want to bind the virtual machine switch to a VLAN, you must create the VLAN from within the Virtual Switch Manager.
- To set up IEEE VLAN membership (multiple VLANs), the adapter must be attached to a switch with IEEE 802.1Q VLAN capability.
- VLANs can co-exist with teaming (if the adapter supports both). If you do this, the team must be defined first, then you can set up your VLAN.
- You can set up only one untagged VLAN per adapter or team. You must have at least one tagged VLAN before you can set up an untagged VLAN.

**IMPORTANT:** When using IEEE 802.1Q VLANs, VLAN ID settings must match between the switch and those adapters using the VLANs.



## Configuring VLANs in Microsoft\* Windows\*

On the device's Device Manager property sheet, this setting is found on the VLANs tab.

To add a VLAN using Windows PowerShell, use the Add-IntelNetVLAN cmdlet. For example, Add-IntelNetVLAN -ParentName "Name" -VLANID "1".

To remove a VLAN using Windows PowerShell, use the Remove-IntelNetVLAN cmdlet. For example, Remove-IntelNetVLAN -ParentName "Name" -VLANID "1".



### CAUTION:

- **VLANs cannot be used on teams that contain non-Intel network adapters**
- **Do not use the Network and Dial-up Connections dialog box to enable or disable VLANs. Otherwise, the VLAN driver may not be correctly enabled or disabled.**



### NOTES:

- The VLAN ID keyword is supported. The VLAN ID must match the VLAN ID configured on the switch. Adapters with VLANs must be connected to network devices that support IEEE 802.1Q.
- If you change a setting under the Advanced tab for one VLAN, it changes the settings for all VLANs using that port.
- In most environments, a maximum of 64 VLANs per network port or team are supported by Intel PROSet.
- ANS VLANs are not supported on adapters and teams that have VMQ enabled. However, VLAN filtering with VMQ is supported via the Microsoft Hyper-V VLAN interface. For more information see [Using Intel® Network Adapters in a Microsoft\\* Hyper-V\\* Environment](#).
- You can have different VLAN tags on a child partition and its parent. Those settings are separate from one another, and can be different or the same. The only instance where the VLAN tag on the parent and child MUST be the same is if you want the parent and child partitions to be able to communicate with each other through that VLAN. For more information see [Using Intel® Network Adapters in a Microsoft\\* Hyper-V\\* Environment](#).

## Setting Up an IEEE tagged VLAN

1. In the adapter properties window, click the **VLANs** tab.
2. Click **New**.
3. Type a name and ID number for the VLAN you are creating.  
The VLAN ID must match the VLAN ID on the switch. Valid ID range is from 1-4094, though your switch might not support this many IDs. The VLAN Name is for information only and does not have to match the name on the switch. The VLAN Name is limited to 256 characters.



**NOTE:** VLAN IDs 0 and 1 are often reserved for other uses.

4. Click **OK**.

The VLAN entry will appear under Network Adapters in the Computer Management window.

Complete these steps for each adapter you want to add to a VLAN.



**NOTE:** If you configure a team to use VLANs, the team object icon in the Network Connections Panel will indicate that the team is disconnected. You will not be able to make any TCP/IP changes, such as changing an IP address or subnet mask. You will, however, be able to configure the team (add or remove team members, change team type, etc.) through Device Manager.

## Setting Up an Untagged VLAN

You can set up only one untagged VLAN per adapter or team.



**NOTE:** An untagged VLAN cannot be created unless at least one tagged VLAN already exists.

1. In the adapter properties window, click the **VLANs** tab.
2. Click **New**.
3. Check the **Untagged VLAN** box.

4. Type a name for the VLAN you are creating.  
The VLAN name is for information only and does not have to match the name on the switch. It is limited to 256 characters.
5. Click **OK**.

#### Removing a VLAN

1. On the **VLANS** tab, select the VLAN you want to remove.
2. Click **Remove**.
3. Click **Yes** to confirm.

## Removing Phantom Teams and Phantom VLANs

If you physically remove all adapters that are part of a team or VLAN from the system without removing them via the Device Manager first, a phantom team or phantom VLAN will appear in Device Manager. There are two methods to remove the phantom team or phantom VLAN.

### Removing the Phantom Team or Phantom VLAN through the Device Manager

Follow these instructions to remove a phantom team or phantom VLAN from the Device Manager:

1. In the Device Manager, double-click on the phantom team or phantom VLAN.
2. Click the **Settings** tab.
3. Select **Remove Team** or **Remove VLAN**.

### Removing the Phantom Team or Phantom VLAN using the savresdx.vbs Script

For Windows Server, the savresdx.vbs script is located in the driver update package in the WMI directory of the appropriate Windows folder. From the DOS command box type: `"cscript savresdx.vbs removephantoms"`.

### Preventing the Creation of Phantom Devices

To prevent the creation of phantom devices, make sure you perform these steps before physically removing an adapter from the system:

1. Remove the adapter from any teams using the **Settings** tab on the team properties dialog box.
2. Remove any VLANs from the adapter using the **VLANS** tab on the adapter properties dialog box.
3. Uninstall the adapter from Device Manager.

You do not need to follow these steps in hot-replace scenarios.

## Wait for Link

Determines whether the driver waits for auto-negotiation to be successful before reporting the link state. If this feature is off, the driver does not wait for auto-negotiation. If the feature is on, the driver does wait for auto-negotiation.

If this feature is on and the speed is not set to auto-negotiation, the driver will wait for a short time for link to be established before reporting the link state.

If the feature is set to **Auto Detect**, this feature is automatically set to **On** or **Off** depending on speed and adapter type when the driver is installed. The setting is:

- Off for copper Intel gigabit adapters with a speed of "Auto".
- On for copper Intel gigabit adapters with a forced speed and duplex.
- On for fiber Intel gigabit adapters with a speed of "Auto".

<b>Default</b>	Auto Detect
<b>Range</b>	<ul style="list-style-type: none"> <li>• On</li> <li>• Off</li> <li>• Auto Detect</li> </ul>

On the device's Device Manager property sheet, this setting is found on the **Advanced** tab.

To change this setting in Windows PowerShell use the Set-IntelNetAdapterSetting cmdlet. For example: Set-IntelNetAdapterSetting -Name "<adapter\_name>" -DisplayName "Wait for Link" -DisplayValue "Off"

# Linux\* Driver Installation and Configuration

## Overview

This release includes Linux Base Drivers for Intel® Network Connections. Specific information on building and installation, configuration, and command line parameters for these drivers are located in the following sections:

- [igb Linux Driver for Intel® Gigabit Ethernet Adapters](#) based on the 82575, 82576, I350, and I354 controllers
- [ixgbe Linux Driver for Intel® 10 Gigabit Ethernet Adapters](#) based on the 82599, X540, and X550 controllers
- [i40e Linux Driver for Intel® 10 Gigabit Ethernet Adapters](#) based on the X710 and XL710 controllers

See the [Supported Adapters](#) section below to determine which driver to use.

These drivers are only supported as a loadable module. Intel is not supplying patches against the kernel source to allow for static linking of the driver.

This release also includes support for Single Root I/O Virtualization (SR-IOV) drivers. More detail on SR-IOV can be found [here](#). The following drivers support the listed virtual function devices that can only be activated on kernels that support SR-IOV. SR-IOV requires the correct platform and OS support.

- [igbvf Linux Driver for the Intel® Gigabit Family of Adapters](#) for 82575, 82576, I350, and I354-based Gigabit Family of Adapters
- [ixgbev Linux Driver for the Intel® 10 Gigabit Family of Adapters](#) for 82599, X540, and X550 10 Gigabit Family of Adapters.
- [i40evf and i40e Linux Driver for the Intel® 10 Gigabit Family of Adapters](#) for the 710 Series Family of Adapters.



### NOTES:

- On systems running Linux or ESXi, the base driver must be loaded for the Dell EMC FW DUP to function correctly.
- The i40e driver does not support SR-IOV on ESXi 5.1.
- If you plan to direct-assign devices to a VM in Linux\*, you must enable I/O Memory Management Unit support in order for [SR-IOV](#) to function correctly. Use the kernel boot parameters "intel\_iommu=on" and "iommu=pt" to enable IOMMU support. For best memory protection, use "intel\_iommu=on." For best performance, use both parameters ("intel\_iommu=on iommu=pt"). These parameters must be appended to the GRUB\_CMDLINE\_LINUX entry in the /etc/default/grub configuration file. For systems booting in UEFI mode, run `grub2-mkconfig -o /etc/grub2-efi.cfg`. For systems booting in legacy BIOS mode, run `grub2-mkconfig -o /boot/grub2/grub.cfg`. You will need to reboot for these changes to take effect.

## Supported Adapters

The following Intel network adapters are compatible with the drivers in this release:

### Devices supported by the igb Linux Base Driver

- Intel® Gigabit 4P X550/I350 rNDC
- Intel® Gigabit 4P I350-t rNDC
- Intel® Gigabit 4P X540/I350 rNDC
- Intel® Gigabit 4P X520/I350 rNDC
- Intel® Gigabit 4P I350-t Mezz
- Intel® Gigabit 4P X710/I350 rNDC
- Intel® Gigabit 4P I350 bNDC
- Intel® Gigabit 2P I350-t Adapter
- Intel® Gigabit 4P I350-t Adapter
- Intel® Ethernet Connection I354 1.0 GbE Backplane
- Intel® Gigabit 2P I350-t LOM
- Intel® Gigabit I350-t LOM
- Intel® Gigabit 2P I350 LOM

## Devices Supported by the ixgbe Linux Base Driver

- Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
- Intel® Ethernet 10G 2P X540-t Adapter
- Intel® Ethernet 10G 2P X550-t Adapter
- Intel® Ethernet 10G 4P X550 rNDC
- Intel® Ethernet 10G 4P X550/I350 rNDC
- Intel® Ethernet 10G 4P X540/I350 rNDC
- Intel® Ethernet 10G 4P X520/I350 rNDC
- Intel® Ethernet 10G 2P X520-k bNDC
- Intel® Ethernet 10G 2P X520 Adapter
- Intel® Ethernet 10G X520 LOM

## Devices Supported by the i40e Linux Base Driver

- Intel® Ethernet 10G 4P X710-k bNDC
- Intel® Ethernet 10G 2P X710-k bNDC
- Intel® Ethernet 10G X710-k bNDC
- Intel® Ethernet Converged Network Adapter X710
- Intel® Ethernet Converged Network Adapter X710-T
- Intel® Ethernet 10G 4P X710/I350 rNDC
- Intel® Ethernet 10G 4P X710 SFP+ rNDC
- Intel® Ethernet 10G X710 rNDC
- Intel® Ethernet Server Adapter X710-DA2 for OCP
- Intel® Ethernet 40G 2P XL710 QSFP+ rNDC
- Intel® Ethernet Converged Network Adapter XL710-Q2
- Intel® Ethernet 25G 2P XXV710 Adapter
- Intel® Ethernet 25G 2P XXV710 Mezz

To verify your adapter is supported, find the board ID number on the adapter. Look for a label that has a barcode and a number in the format 123456-001 (six digits hyphen three digits). Match this to the list of numbers above.

For more information on how to identify your adapter or for the latest network drivers for Linux, see [Customer Support](#).

## Supported Linux Versions

Linux drivers are provided for the following distributions (only Intel® 64 versions are supported):

Red Hat Enterprise Linux (RHEL):

- Red Hat\* Enterprise Linux\* (RHEL) 6.10
- Red Hat\* Enterprise Linux\* (RHEL) 7.5

SUSE Linux Enterprise Server (SLES):

- Novell\* SUSE\* Linux Enterprise Server (SLES) 15



**NOTE:** The following devices also support RHEL 7.3 x64, and SLES 12 SP2 x64.

- Intel® Gigabit 4P I350-t rNDC
- Intel® Gigabit 4P X550/I350 rNDC
- Intel® Gigabit 4P X710/I350 rNDC
- Intel® Ethernet 10G 4P X550/I350 rNDC
- Intel® Ethernet 10G 4P X710/I350 rNDC

## NIC Partitioning

On Intel® 710 Series based adapters that support it, you can set up multiple functions on each physical port. You configure these functions through the System Setup/BIOS.

Minimum TX Bandwidth is the guaranteed minimum data transmission bandwidth, as a percentage of the full physical port link speed, that the partition will receive. The bandwidth the partition is awarded will never fall below the level you specify here.

The range for the minimum bandwidth values is:

1 to ((100 minus # of partitions on the physical port) plus 1)

For example, if a physical port has 4 partitions, the range would be

1 to ((100 - 4) + 1 = 97)

The Maximum Bandwidth percentage represents the maximum transmit bandwidth allocated to the partition as a percentage of the full physical port link speed. The accepted range of values is 1-100. The value can be used as a limiter, should you choose that any one particular function not be able to consume 100% of a port's bandwidth (should it be available). The sum of all the values for Maximum Bandwidth is not restricted, because no more than 100% of a port's bandwidth can ever be used.

 **NOTE:**

- If the sum of the minimum bandwidth percentages does not equal 100, then settings will be automatically adjusted so that the sum equals 100.
- If a partition's maximum bandwidth percentage is set lower than the partition's minimum bandwidth percentage, then the maximum bandwidth percentage will be automatically set to the value of the minimum bandwidth percentage.
- When you attempt to set values for minimum bandwidth percentage via iDRAC with Lifecycle Controller using jobs that do not include the values for all enabled partitions, then the values seen after the jobs have completed may be different than the values that were supposed to be set. To avoid this issue, set the values for minimum bandwidth percentage on all partitions using a single job and make sure the sum of the values is 100.

Once the initial configuration is complete, you can set different bandwidth allocations on each function as follows:

1. Make a new directory named /config
2. Edit etc/fstab to include:  

```
configfs /config configfs defaults
```
3. Load (or reload) the i40e driver
4. Mount /config
5. Make a new directory under config for each partition upon which you wish to configure the bandwidth.

Three files will appear under the config/partition directory:

```
- max_bw  
- min_bw  
- commit
```

Read from max\_bw to get display the current maximum bandwidth setting.

Write to max\_bw to set the maximum bandwidth for this function.

Read from min\_bw to display the current minimum bandwidth setting.

Write to min\_bw to set the minimum bandwidth for this function.

Write a '1' to commit to save your changes.

 **NOTES:**

- commit is write only. Attempting to read it will result in an error.
- Writing to commit is only supported on the first function of a given port. Writing to a subsequent function will result in an error.
- Oversubscribing the minimum bandwidth is not supported. The underlying device's NVM will set the minimum bandwidth to supported values in an indeterminate manner. Remove all of the directories under config and reload them to see what the actual values are.
- To unload the driver you must first remove the directories created in step 5, above.


Example of Setting the minimum and maximum bandwidth (assume there are four functions on the port eth6-eth9, and that eth6 is the first function on the port):


```
# mkdir /config/eth6  
# mkdir /config/eth7
```

```
# mkdir /config/eth8
# mkdir /config/eth9
# echo 50 > /config/eth6/min_bw
# echo 100 > /config/eth6/max_bw
# echo 20 > /config/eth7/min_bw
# echo 100 > /config/eth7/max_bw
# echo 20 > /config/eth8/min_bw
# echo 100 > /config/eth8/max_bw
# echo 10 > /config/eth9/min_bw
# echo 25 > /config/eth9/max_bw
# echo 1 > /config/eth6/commit
```

# igb Linux\* Driver for the Intel® Gigabit Adapters

## igb Overview

 **NOTE:** In a virtualized environment, on Intel® Server Adapters that support SR-IOV, the virtual function (VF) may be subject to malicious behavior. Software-generated layer two frames, like IEEE 802.3x (link flow control), IEEE 802.1Qbb (priority based flow-control), and others of this type, are not expected and can throttle traffic between the host and the virtual switch, reducing performance. To resolve this issue, configure all SR-IOV enabled ports for VLAN tagging. This configuration allows unexpected, and potentially malicious, frames to be dropped.

 **NOTE:** To configure VLAN tagging for the ports on an SR-IOV enabled adapter, use the following command. The VLAN configuration should be done before the VF driver is loaded or the VM is booted.

```
$ ip link set dev <PF netdev id> vf <id> vlan <vlan id>
```

For example, the following instructions will configure PF eth0 and the first VF on VLAN 10. `$ ip link set dev eth0 vf 0 vlan 10.`

This file describes the Linux\* Base Driver for the Gigabit Intel® Network Connections based on the Intel® 82575EB, the Intel® 82576, the Intel® I350, and the Intel® I354. This driver supports kernel versions 2.6.30 and newer.

This driver is only supported as a loadable module. Intel is not supplying patches against the kernel source to allow for static linking of the driver.

The following features are now available in supported kernels:

- Native VLANs
- Channel Bonding (teaming)

Adapter teaming is now implemented using the native Linux Channel bonding module. This is included in supported Linux kernels. Channel Bonding documentation can be found in the Linux kernel source: `/documentation/networking/bonding.txt`

The igb driver supports IEEE time stamping for kernels 2.6.30 and above.

The igb driver supports 2.5 Gbps operating speed on 2500BASE-KX only for I354-based network connections.

Use `ethtool`, `lspci`, or `ifconfig` to obtain driver information. Instructions on updating the `ethtool` can be found in the [Additional Configurations](#) section later in this page.

## igb Linux Base Driver Supported Devices

The following Intel network adapters are compatible with the igb driver in this release:

- Intel® Gigabit 4P X550/I350 rNDC
- Intel® Gigabit 4P I350-t rNDC
- Intel® Gigabit 4P X540/I350 rNDC
- Intel® Gigabit 4P X520/I350 rNDC
- Intel® Gigabit 4P I350-t Mezz
- Intel® Gigabit 4P X710/I350 rNDC
- Intel® Gigabit 4P I350 bNDC
- Intel® Gigabit 2P I350-t Adapter
- Intel® Gigabit 4P I350-t Adapter
- Intel® Ethernet Connection I354 1.0 GbE Backplane
- Intel® Gigabit 2P I350-t LOM
- Intel® Gigabit I350-t LOM
- Intel® Gigabit 2P I350 LOM

## Building and Installation

There are three methods for installing the igb driver:

- [Install from Source Code](#)
- [Install Using KMP RPM](#)
- [Install Using KMOD RPM](#)



## Install from Source Code

To build a binary RPM\* package of this driver, run 'rpmbuild -tb <filename.tar.gz>'. Replace <filename.tar.gz> with the specific filename of the driver.

### NOTE:

- For the build to work properly it is important that the currently running kernel MATCH the version and configuration of the installed kernel source. If you have just recompiled your kernel, reboot the system.
- RPM functionality has only been tested in Red Hat distributions.

1. Download the base driver tar file to the directory of your choice. For example, use '/home/username/igb' or '/usr/local/src/igb'.
2. Untar/unzip the archive, where <x.x.x> is the version number for the driver tar:

```
tar xzf igb-<x.x.x>.tar.gz
```

3. Change to the driver src directory, where <x.x.x> is the version number for the driver tar:

```
cd igb-<x.x.x>/src/
```

4. Compile the driver module:

```
# make install
```

The binary will be installed as:

```
/lib/modules/<KERNEL_VERSION>/kernel/drivers/net/igb/igb.ko
```

The install locations listed above are the default locations. This might differ for various Linux distributions. For more information, see the ldistrib.txt file included in the driver tar.

5. Install the module using the modprobe command:

```
modprobe igb
```

For 2.6 based kernels, make sure that the older igb drivers are removed from the kernel, before loading the new module:

```
rmmmod igb.ko; modprobe igb
```

6. Assign an IP address to and activate the Ethernet interface by entering the following, where <x> is the interface number:

```
ifconfig eth<x> <IP_address> up
```

7. Verify that the interface works. Enter the following, where <IP\_address> is the IP address for another machine on the same subnet as the interface that is being tested:

```
ping <IP_address>
```

### NOTE: Some systems have trouble supporting MSI and/or MSI-X interrupts. If your system needs to disable this type of interrupt, the driver can be built and installed with the command:

```
#make CFLAGS_EXTRA=-DDISABLE_PCI_MSI install
```

Normally, the driver generates an interrupt every two seconds. If interrupts are not received in cat /proc/interrupts for the ethX e1000e device, then this workaround may be necessary.

#### To build igb driver with DCA

If your kernel supports DCA, the driver will build by default with DCA enabled.

## Install Using KMP RPM

### NOTE: KMP is only supported on SLES11 and newer.

The KMP RPMs update existing igb RPMs currently installed on the system. These updates are provided by SuSE in the SLES release. If an RPM does not currently exist on the system, the KMP will not install.

The RPMs are provided for supported Linux distributions. The naming convention for the included RPMs is:

```
intel-<component name>-<component version>.<arch type>.rpm
```

For example, intel-igb-1.3.8.6-1.x86\_64.rpm: igb is the component name; 1.3.8.6-1 is the component version; and x86\_64 is the architecture type.

KMP RPMs are provided for supported Linux distributions. The naming convention for the included KMP RPMs is:

```
intel-<component name>-kmp-<kernel type>-<component version>_<kernel version>.<arch type>.rpm
```

For example, intel-igb-kmp-default-1.3.8.6\_2.6.27.19\_5-1.x86\_64.rpm: igb is the component name; default is the kernel type; 1.3.8.6 is the component version; 2.6.27.19\_5-1 is the kernel version; and x86\_64 is the architecture type.

To install the KMP RPM, type the following two commands:

```
rpm -i <rpm filename>
rpm -i <kmp rpm filename>
```

For example, to install the igb KMP RPM package, type the following:

```
rpm -i intel-igb-1.3.8.6-1.x86_64.rpm
rpm -i intel-igb-kmp-default-1.3.8.6_2.6.27.19_5-1.x86_64.rpm
```

## Install Using KMOD RPM

The KMOD RPMs are provided for supported Linux distributions. The naming convention for the included RPMs is:

```
kmod-<driver name>-<version>-1.<arch type>.rpm
```

For example, kmod-igb-2.3.4-1.x86\_64.rpm:

- igb is the driver name
- 2.3.4 is the version
- x86\_64 is the architecture type

To install the KMOD RPM, go to the directory of the RPM and type the following command:

```
rpm -i <rpm filename>
```

For example, to install the igb KMOD RPM package from RHEL 6.4, type the following:

```
rpm -i kmod-igb-2.3.4-1.x86_64.rpm
```

## Command Line Parameters

If the driver is built as a module, the following optional parameters are used by entering them on the command line with the modprobe command using this syntax:

```
modprobe igb [<option>=<VAL1>,<VAL2>,...]
```




A value (<VAL#>) must be assigned to each network port in the system supported by this driver. The values are applied to each instance, in function order. For example:



```
modprobe igb InterruptThrottleRate=16000,16000
```


In this case, there are two network ports supported by igb in the system. The default value for each parameter is generally the recommended setting, unless otherwise noted.

The following table contains parameters and possible values for modprobe commands:

Parameter Name	Valid Range/Settings	Default	Description
InterruptThrottleRate	0, 1, 3, 100-100000 (0=off, 1=dynamic, 3=dynamic conservative)	3	Interrupt Throttle Rate controls the number of interrupts each interrupt vector can generate per second. Increasing ITR lowers latency at the cost of increased CPU utilization, though it may help throughput in some circumstances.

Parameter Name	Valid Range/Settings	Default	Description
			<p>0 = Setting InterruptThrottleRate to 0 turns off any interrupt moderation and may improve small packet latency. However, this is generally not suitable for bulk throughput traffic due to the increased CPU utilization of the higher interrupt rate. NOTES: - On 82599, and X540, and X550-based adapters, disabling InterruptThrottleRate will also result in the driver disabling HW RSC. - On 82598-based adapters, disabling InterruptThrottleRate will also result in disabling LRO (Large Receive Offloads).</p> <p>1 = Setting InterruptThrottleRate to Dynamic mode attempts to moderate interrupts per vector while maintaining very low latency. This can sometimes cause extra CPU utilization. If planning on deploying igb in a latency sensitive environment, this parameter should be considered.</p> <p>&lt;min_ITR&gt;-&lt;max_ITR&gt; = 100-100000</p> <p>Setting InterruptThrottleRate to a value greater or equal to &lt;min_ITR&gt; will program the adapter to send at most that many interrupts per second, even if more packets have come in. This reduces interrupt load on the system and can lower CPU utilization under heavy load, but will increase latency as packets are not processed as quickly.</p> <p> <b>NOTE:</b> Un-supported Adapters: InterruptThrottleRate is NOT supported by 82542, 82543, or 82544-based adapters.</p>
LLIPort	0-65535	0 (disabled)	<p>LLIPort configures the port for Low Latency Interrupts (LLI).</p> <p>Low Latency Interrupts allow for immediate generation of an interrupt upon processing receive packets that match certain criteria as set by the parameters described below. LLI parameters are not enabled when Legacy interrupts are used. You must be using MSI or MSI-X (see cat /proc/interrupts) to successfully use LLI.</p> <p>For example, using LLIPort=80 would cause the board to generate an immediate interrupt upon receipt of any packet sent to TCP port 80 on the local machine.</p> <p> <b>CAUTION:</b> Enabling LLI can result in an excessive number of interrupts/second that may cause problems with the system and in some cases may cause a kernel panic.</p>
LLIPush	0-1	0 (disabled)	<p>LLIPush can be set to enabled or disabled (default). It is most effective in an environment with many small transactions.</p> <p> <b>NOTE:</b> Enabling LLIPush may allow a denial of service attack.</p>
LLISize	0-1500	0 (disabled)	<p>LLISize causes an immediate interrupt if the board receives a packet smaller than the specified size.</p>



Parameter Name	Valid Range/Settings	Default	Description																									
IntMode	0-2	2	<p>This allows load time control over the interrupt type registered by the driver. MSI-X is required for multiple queue support. Some kernels and combinations of kernel .config options will force a lower level of interrupt support. 'cat/-proc/interrupts' will show different values for each type of interrupt.</p> <p>0 = Legacy Interrupts.  1 = MSI Interrupts.  2 = MSI-X interrupts (default).</p>																									
RSS	0-8	1	<p>0 = Assign up to whichever is less between the number of CPUs or the number of queues.  X = Assign X queue, where X is less than or equal to the maximum number of queues. The driver allows maximum supported queue value. For example, I350-based adapters allow RSS=8, where 8 is the maximum queues allowed.</p> <p> <b>NOTE:</b> For 82575-based adapters, the maximum number of queues is 4; for 82576-based and newer adapters it is 8; for I210-based adapters it is 4 queues; and for I211-based adapters it is 2 queues.</p> <p>This parameter is also affected by the VMDq parameter in that it will limit the queues more.</p> <table border="1" data-bbox="808 884 1458 1136"> <thead> <tr> <th></th> <th colspan="4">VMDQ</th> </tr> <tr> <th>Model</th> <th>0</th> <th>1</th> <th>2</th> <th>3+</th> </tr> </thead> <tbody> <tr> <td>82575</td> <td>4</td> <td>4</td> <td>3</td> <td>1</td> </tr> <tr> <td>82576</td> <td>8</td> <td>2</td> <td>2</td> <td>2</td> </tr> <tr> <td>82580</td> <td>8</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>		VMDQ				Model	0	1	2	3+	82575	4	4	3	1	82576	8	2	2	2	82580	8	1	1	1
	VMDQ																											
Model	0	1	2	3+																								
82575	4	4	3	1																								
82576	8	2	2	2																								
82580	8	1	1	1																								
VMDQ	0-8	0	<p>This supports enabling VMDq pools, which is needed to support SR-IOV.</p> <p>This parameter is forced to 1 or more if the max_vfs module parameter is used. In addition, the number of queues available for RSS is limited if this is set to 1 or greater.</p> <p>0 = Disabled  1 = Sets the netdev as pool 0  2 or greater = Add additional queues. However, these are currently not used.</p> <p> <b>NOTE:</b> When either SR-IOV mode or VMDq mode is enabled, hardware VLAN filtering and VLAN tag stripping/insertion will remain enabled.</p>																									
max_vfs	0-7	0	<p>This parameter adds support for SR-IOV. It causes the driver to spawn up to max_vfs worth of virtual function.</p>																									

 **NOTE:** When either SR-IOV mode or VMDq mode is enabled, hardware VLAN filtering and VLAN tag stripping/insertion will remain enabled. Please remove the old VLAN filter before the new VLAN filter is added. For example,

```

ip link set eth0 vf 0 vlan 100
// set vlan 100 for VF 0
ip link set eth0 vf 0 vlan 0
// Delete vlan 100
ip link set eth0 vf 0 vlan 200
// set a new vlan 200 for VF 0

```

Parameter Name	Valid Range/Settings	Default	Description
			 <b>NOTE:</b> When either SR-IOV mode or VMDq mode is enabled, hardware VLAN filtering and VLAN tag stripping/insertion will remain enabled. Please remove the old VLAN filter before the new VLAN filter is added. For example, <pre> ip link set eth0 vf 0 vlan 100 // set vlan 100 for VF 0 ip link set eth0 vf 0 vlan 0 // Delete vlan 100 ip link set eth0 vf 0 vlan 200 // set a new vlan 200 for VF 0 </pre>
QueuePairs	0-1	1	<p>This option can be overridden to 1 if there are not sufficient interrupts available. This can occur if any combination of RSS, VMDQ and max_vfs results in more than 4 queues being used.</p> <p>0 = When MSI-X is enabled, the TX and RX will attempt to occupy separate vectors.  1 = TX and RX are paired onto one interrupt vector (default).</p>
Node	0-n, where n is the number of the NUMA node that should be used to allocate memory for this adapter port.  -1, uses the driver default of allocating memory on whichever processor is running modprobe.	-1 (off)	<p>The Node parameter allows you to choose which NUMA node you want to have the adapter allocate memory from. All driver structures, in-memory queues, and receive buffers will be allocated on the node specified. This parameter is only useful when interrupt affinity is specified, otherwise some portion of the time the interrupt could run on a different core than the memory is allocated on, causing slower memory access and impacting throughput, CPU, or both.</p>
EEE	0-1	1 (enabled)	<p>This option allows for the ability of IEEE802.3az, Energy Efficient Ethernet (EEE), to be advertised to the link partner on parts supporting EEE.</p> <p>A link between two EEE-compliant devices will result in periodic bursts of data followed by periods where the link is in an idle state. This Low Power Idle (LPI) state is supported both 1 Gbps and 100 Mbps link speeds.</p>  <b>NOTES:</b> <ul style="list-style-type: none"> <li>• EEE support requires auto-negotiation.</li> <li>• EEE is disabled by default on all I350-based adapters.</li> </ul>

Parameter Name	Valid Range/Settings	Default	Description
DMAC	0, 250, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000	0 (disabled)	<p>Enables or disables DMA Coalescing feature. Values are in microseconds and increase the internal DMA Coalescing feature's internal timer. Direct Memory Access (DMA) allows the network device to move packet data directly to the system's memory, reducing CPU utilization. However, the frequency and random intervals at which packets arrive do not allow the system to enter a lower power state. DMA Coalescing allows the adapter to collect packets before it initiates a DMA event. This may increase network latency but also increases the chances that the system will enter a lower power state.</p> <p>Turning on DMA Coalescing may save energy with kernel 2.6.32 and later. This will impart the greatest chance for your system to consume less power. DMA Coalescing is effective in helping potentially saving the platform power only when it is enabled across all active ports.</p> <p>InterruptThrottleRate (ITR) should be set to dynamic. When ITR=0, DMA Coalescing is automatically disabled.</p> <p>A white paper containing information on how to best configure your platform is available on the Intel website.</p>
MDD	0-1	1 (enabled)	<p>The Malicious Driver Detection (MDD) parameter is only relevant for I350 devices operating in SR-IOV mode. When this parameter is set, the driver detects malicious VF driver and disables its TX/RX queues until a VF driver reset occurs.</p>

## Additional Configurations

### Configuring the Driver on Different Distributions

Configuring a network driver to load properly when the system is started is distribution dependent. Typically, the configuration process involves adding an alias line to `/etc/modules.conf` or `/etc/modprobe.conf` as well as editing other system start up scripts and/or configuration files. Many Linux distributions ship with tools to make these changes for you. To learn the proper way to configure a network device for your system, refer to your distribution documentation. If during this process you are asked for the driver or module name, the name for the Linux Base Driver for the Intel Gigabit Family of Adapters is `igb`.


As an example, if you install the `igb` driver for two Intel Gigabit adapters (`eth0` and `eth1`) and set the speed and duplex to 10 Full and 100 Half, add the following to `modules.conf`:

```
alias eth0 igb
alias eth1 igb
options igb IntMode=2,1
```

### Viewing Link Messages

Link messages will not be displayed to the console if the distribution is restricting system messages. In order to see network driver link messages on your console, set `dmesg` to eight by entering the following:

```
dmesg -n 8
```

 **NOTE:** This setting is not saved across reboots.

## Jumbo Frames

Jumbo Frames support is enabled by changing the MTU to a value larger than the default of 1500 bytes. Use the `ifconfig` command to increase the MTU size. For example:

```
ifconfig eth<x> mtu 9000 up
```

This setting is not saved across reboots. The setting change can be made permanent by adding `MTU = 9000` to the file `/etc/sysconfig/network-scripts/ifcfg-eth<x>`, in Red Hat distributions. Other distributions may store this setting in a different location.

### NOTES:

- Using Jumbo Frames at 10 or 100 Mbps may result in poor performance or loss of link.
- To enable Jumbo Frames, increase the MTU size on the interface beyond 1500.
- The maximum Jumbo Frames size is 9234 bytes, with a corresponding MTU size of 9216 bytes.

## ethtool

The driver utilizes the `ethtool` interface for driver configuration and diagnostics, as well as displaying statistical information. `ethtool` version 3 or later is required for this functionality, although we strongly recommend downloading the latest version at: <http://www.kernel.org/pub/software/network/ethtool/>.

## Speed and Duplex Configuration

In the default mode, an Intel® Network Adapter using copper connections will attempt to auto-negotiate with its link partner to determine the best setting. If the adapter cannot establish link with the link partner using auto-negotiation, you may need to manually configure the adapter and link partner to identical settings to establish link and pass packets. This should only be needed when attempting to link with an older switch that does not support auto-negotiation or one that has been forced to a specific speed or duplex mode.

Your link partner must match the setting you choose. Fiber-based adapters operate only in full duplex, and only at their native speed.

Speed and Duplex are configured through the `ethtool*` utility. `ethtool` is included with all versions of Red Hat after Red Hat 7.2. For other Linux distributions, download and install `ethtool` from the following website: <http://www.kernel.org/pub/software/network/ethtool/>.



**CAUTION:** Only experienced network administrators should force speed and duplex manually. The settings at the switch must always match the adapter settings. Adapter performance may suffer or your adapter may not operate if you configure the adapter differently from your switch.

## Enabling Wake on LAN\*

Wake on LAN (WoL) is configured through the `ethtool*` utility. `ethtool` is included with all versions of Red Hat after Red Hat 7.2. For other Linux distributions, download and install `ethtool` from the following website: <http://www.kernel.org/pub/software/network/ethtool/>.

For instructions on enabling WoL with `ethtool`, refer to the website listed above.

WoL will be enabled on the system during the next shut down or reboot. For this driver version, in order to enable WoL, the `igb` driver must be loaded prior to shutting down or suspending the system.

### NOTES:

- Wake on LAN is only supported on port A of multi-port devices.
- Wake On LAN is not supported for the Intel® Gigabit VT Quad Port Server Adapter.

## Multiqueue

In this mode, a separate MSI-X vector is allocated for each queue and one for “other” interrupts such as link status change and errors. All interrupts are throttled via interrupt moderation. Interrupt moderation must be used to avoid interrupt storms while the driver is processing one interrupt. The moderation value should be at least as large as the expected time for the driver to process an interrupt. Multiqueue is off by default.


MSI-X support is required for Multiqueue. If MSI-X is not found, the system will fall back to MSI or to Legacy interrupts. This driver supports multiqueue in kernel versions 2.6.24 and greater and supports receive multiqueue on all kernels supporting MSI-X.

#### **NOTES:**

- Do not use MSI-X with the 2.6.19 or 2.6.20 kernels. It is recommended to use the 2.6.21 or later kernel.
- Some kernels require a reboot to switch between single queue mode and multiqueue modes or vice-versa.

## Large Receive Offload (LRO)

Large Receive Offload (LRO) is a technique for increasing inbound throughput of high-bandwidth network connections by reducing CPU overhead. It works by aggregating multiple incoming packets from a single stream into a larger buffer before they are passed higher up the networking stack, thus reducing the number of packets that have to be processed. LRO combines multiple Ethernet frames into a single receive in the stack, thereby potentially decreasing CPU utilization for receives.


 **NOTE:** LRO requires 2.6.22 or later kernel version.

IGB\_LRO is a compile time flag. It can be enabled at compile time to add support for LRO from the driver. The flag is used by adding `CFLAGS_EXTRA="-DIGB_LRO"` to the make file when it is being compiled. For example:

```
# make CFLAGS_EXTRA="-DIGB_LRO" install
```


You can verify that the driver is using LRO by looking at these counters in ethtool:

- `lro_aggregated` - count of total packets that were combined
- `lro_flushed` - counts the number of packets flushed out of LRO
- `lro_no_desc` - counts the number of times an LRO descriptor was not available for the LRO packet

 **NOTE:** IPv6 and UDP are not supported by LRO.


## IEEE 1588 Precision Time Protocol (PTP) Hardware Clock (PHC)

Precision Time Protocol (PTP) is an implementation of the IEEE 1588 specification allowing network cards to synchronize their clocks over a PTP-enabled network. It works through a series of synchronization and delay notification transactions that allow a software daemon to implement a PID controller to synchronize the network card clocks.

 **NOTE:** PTP requires a 3.0.0 or later kernel version with PTP support enabled in the kernel and a user-space software daemon.

IGB\_PTP is a compile time flag. The user can enable it at compile time to add support for PTP from the driver. The flag is used by adding `CFLAGS_EXTRA="-DIGB_PTP"` to the make file when it's being compiled:

```
make CFLAGS_EXTRA="-DIGB_PTP" install
```

 **NOTE:** The driver will fail to compile if your kernel does not support PTP.

You can verify that the driver is using PTP by looking at the system log to see whether a PHC was attempted to be registered or not. If you have a kernel and version of ethtool with PTP support, you can check the PTP support in the driver by executing:

```
ethtool -T ethX
```

## MAC and VLAN anti-spoofing feature

When a malicious driver attempts to send a spoofed packet, it is dropped by the hardware and not transmitted. An interrupt is sent to the PF driver notifying it of the spoof attempt.

When a spoofed packet is detected the PF driver will send the following message to the system log (displayed by the "dmesg" command):

```
Spoof event(s) detected on VF(n)
```



Where n=the VF that attempted to do the spoofing.

## Setting MAC Address, VLAN and Rate Limit Using IProute2 Tool

You can set a MAC address of a Virtual Function (VF), a default VLAN and the rate limit using the IProute2 tool. Download the latest version of the iproute2 tool from Sourceforge if your version does not have all the features you require.

## Known Issues



**NOTE:** After installing the driver, if your Intel® Ethernet Network Connection is not working, verify that you have installed the correct driver. Intel® Active Management Technology 2.0, 2.1, and 2.5 are not supported in conjunction with the Linux driver.

## MAC address of Virtual Function changes unexpectedly

If a Virtual Function's MAC address is not assigned in the host, then the VF (virtual function) driver will use a random MAC address. This random MAC address may change each time the VF driver is reloaded. You can assign a static MAC address in the host machine. This static MAC address will survive a VF driver reload.

## Using the igb driver on 2.4 or older 2.6 based kernels

Due to limited support for PCI-Express in 2.4 kernels and older 2.6 kernels, the igb driver may run into interrupt related problems on some systems, such as no link or hang when bringing up the device.

We recommend the newer 2.6 based kernels, as these kernels correctly configure the PCI-Express configuration space of the adapter and all intervening bridges. If you are required to use a 2.4 kernel, use a 2.4 kernel newer than 2.4.30. For 2.6 kernels we recommend using the 2.6.21 kernel or newer.

Alternatively, on 2.6 kernels you may disable MSI support in the kernel by booting with the "pci=noms" option or permanently disable MSI support in your kernel by configuring your kernel with CONFIG\_PCI\_MSI unset.

## Detected Tx Unit Hang in Quad Port Adapters

In some cases ports 3 and 4 don't pass traffic and report 'Detected Tx Unit Hang' followed by 'NETDEV WATCHDOG: ethX: transmit timed out' errors. Ports 1 and 2 do not show any errors and will pass traffic.

This issue may be resolved by updating to the latest kernel and BIOS. You should use an OS that fully supports Message Signaled Interrupts (MSI) and make sure that MSI is enabled in your system's BIOS.

## Compiling the Driver

When trying to compile the driver by running make install, the following error may occur: "Linux kernel source not configured - missing version.h"

To solve this issue, create the version.h file by going to the Linux source tree and entering:

```
# make include/linux/version.h
```

## Performance Degradation with Jumbo Frames

Degradation in throughput performance may be observed in some Jumbo frames environments. If this is observed, increasing the application's socket buffer size and/or increasing the /proc/sys/net/ipv4/tcp\_\*mem entry values may help.

See the specific application manual and /usr/src/linux\*/Documentation/networking/ip-sysctl.txt for more details.

## Jumbo Frames on Foundry BigIron 8000 switch

There is a known issue using Jumbo frames when connected to a Foundry BigIron 8000 switch. This is a 3rd party limitation. If you experience loss of packets, lower the MTU size.

## Multiple Interfaces on Same Ethernet Broadcast Network

Due to the default ARP behavior on Linux, it is not possible to have one system on two IP networks in the same Ethernet broadcast domain (non-partitioned switch) behave as expected. All Ethernet interfaces will respond to IP traffic for any IP address assigned to the system. This results in unbalanced receive traffic.

If you have multiple interfaces in a server, either turn on ARP filtering by entering:

```
echo 1 > /proc/sys/net/ipv4/conf/all/arp_filter
```

This only works if your kernel's version is higher than 2.4.5.



**NOTE:** This setting is not saved across reboots. The configuration change can be made permanent by adding the following line to the file `/etc/sysctl.conf`:

```
net.ipv4.conf.all.arp_filter = 1
```

Another alternative is to install the interfaces in separate broadcast domains (either in different switches or in a switch partitioned to VLANs).

## Disable rx Flow Control with ethtool

In order to disable receive flow control using ethtool, you must turn off auto-negotiation on the same command line:

```
ethtool -A eth? autoneg off rx off
```

## Unplugging Network Cable While ethtool -p is Running

In kernel versions 2.5.50 and newer, unplugging the network cable while ethtool -p is running will cause the system to become unresponsive to keyboard commands, except for control-alt-delete. Restarting the system appears to be the only remedy.

## Trouble Passing Traffic on Ports 1 and 2 Using RHEL3

There is a known hardware compatibility issue on some systems with RHEL3 kernels. Traffic on ports 1 and 2 may be slower than expected, and ping times, higher than expected.

This issue MAY be resolved by updating to the latest kernel and BIOS. You can check your system BIOS by downloading the Linux Firmware Developer Kit at

<http://www.linuxfirmwarekit.org/>.

## Do Not Use LRO When Routing Packets

Due to a known general compatibility issue with LRO and routing, do not use LRO when routing packets.

## Build Error with Asianux 3.0 - Redefinition of typedef 'irq\_handler\_t'

Some systems may experience build issues due to the redefinition of `irq_handler_t`. To resolve this issue, build the driver (step 4 above) using the command:

```
# make CFLAGS_EXTRA=-DAX_RELEASE_CODE=1 install
```

## MSI-X Issues with Kernels Between 2.6.19 - 2.6.21 (inclusive)

Kernel panics and instability may be observed on any MSI-X hardware if you use `irqbalance` with kernels between 2.6.19 and 2.6.21. If such problems are encountered, you may disable the `irqbalance` daemon or upgrade to a newer kernel.

## Rx Page Allocation Errors

'Page allocation failure. order:0' errors may occur under stress with kernels 2.6.25 and newer. This is caused by the way the Linux kernel reports this stressed condition.

Under Red Hat 5.4-GA, the system may crash when closing the guest OS window after loading or unloading the Physical Function (PF) driver. Do not remove the igb driver from Dom0 while Virtual Functions (VFs) are assigned to guests. VFs must first use the xm "pci-detach" command to hot-plug the VF device out of the VM it is assigned to or else shut down the VM.

Unloading Physical Function (PF) driver causes the system to reboot when the VM is running and VF is loaded on the VM. Do not unload the PF driver (igb) while VFs are assigned to guests.

### **Host May Reboot after Removing PF when VF is Active in Guest**

Using kernel versions earlier than 3.2, do not unload the PF driver with active VFs. Doing this will cause your VFs to stop working until you reload the PF driver and may cause a spontaneous reboot of your system.

Prior to unloading the PF driver, you must first ensure that all VFs are no longer active. Do this by shutting down all VMs and unloading the VF driver.

# igbvf Linux\* Driver for the Intel® Gigabit Adapters

## igbvf Overview

This driver supports upstream kernel versions 2.6.30 (or higher) x86\_64.

The igbvf driver supports 82576-based and I350-based virtual function devices that can only be activated on kernels that support SR-IOV. SR-IOV requires the correct platform and OS support.

The igbvf driver requires the igb driver, version 2.0 or later. The igbvf driver supports virtual functions generated by the igb driver with a max\_vfs value of 1 or greater. For more information on the max\_vfs parameter refer to the section on the [igb](#) driver.

The guest OS loading the igbvf driver must support MSI-X interrupts.

This driver is only supported as a loadable module at this time. Intel is not supplying patches against the kernel source to allow for static linking of the driver. For questions related to hardware requirements, refer to the documentation supplied with your Intel Gigabit adapter. All hardware requirements listed apply to use with Linux.



**NOTE:** For VLANs, there is a limit of a total of 32 shared VLANs to 1 or more VFs.

## igbvf Linux Base Driver Supported Devices

The following Intel network adapters are compatible with the igbvf driver in this release:

- Intel® Gigabit 4P X550/I350 rNDC
- Intel® Gigabit 4P I350-t rNDC
- Intel® Gigabit 4P X540/I350 rNDC
- Intel® Gigabit 4P X520/I350 rNDC
- Intel® Gigabit 4P I350-t Mezz
- Intel® Gigabit 4P X710/I350 rNDC
- Intel® Gigabit 4P I350 bNDC
- Intel® Gigabit 2P I350-t Adapter
- Intel® Gigabit 4P I350-t Adapter
- Intel® Gigabit 2P I350-t LOM
- Intel® Gigabit I350-t LOM
- Intel® Gigabit 2P I350 LOM

## Building and Installation

There are two methods for installing the igbvf driver:

- [Install from Source Code](#)
- [Install Using KMP RPM](#)

### Install from Source Code

To build a binary RPM\* package of this driver, run 'rpmbuild -tb <filename.tar.gz>'. Replace <filename.tar.gz> with the specific filename of the driver.



**NOTE:** For the build to work properly it is important that the currently running kernel MATCH the version and configuration of the installed kernel source. If you have just recompiled your kernel, reboot the system.

1. Download the base driver tar file to the directory of your choice. For example, use '/home/username/igbvf' or '/usr/local/src/igbvf'.
2. Untar/unzip the archive, where <x.x.x> is the version number for the driver tar:

```
tar xzf igbvf-<x.x.x>.tar.gz
```

3. Change to the driver src directory, where <x.x.x> is the version number for the driver tar:

```
cd igbvf-<x.x.x>/src/
```

4. Compile the driver module:

```
# make install
```

The binary will be installed as:

```
/lib/modules/<KERNEL_VERSION>/kernel/drivers/net/igbvf/igbvf.ko
```

The install locations listed above are the default locations. This might differ for various Linux distributions. For more information, see the `ldistrib.txt` file included in the driver tar.

5. Install the module using the `modprobe` command:

```
modprobe igbvf
```

For 2.6 based kernels, make sure that the older `igbvf` drivers are removed from the kernel, before loading the new module:

```
rmmmod igbvf.ko; modprobe igbvf
```

6. Assign an IP address to and activate the Ethernet interface by entering the following, where `<x>` is the interface number:

```
ifconfig eth<x> <IP_address> up
```

7. Verify that the interface works. Enter the following, where `<IP_address>` is the IP address for another machine on the same subnet as the interface that is being tested:

```
ping <IP_address>
```



**NOTE:** Some systems have trouble supporting MSI and/or MSI-X interrupts. If your system needs to disable this type of interrupt, the driver can be built and installed with the command:

```
#make CFLAGS_EXTRA=-DDISABLE_PCI_MSI install
```

Normally, the driver generates an interrupt every two seconds. If interrupts are not received in `cat /proc/interrupts` for the `ethX e1000e` device, then this workaround may be necessary.

To build `igbvf` driver with DCA

If your kernel supports DCA, the driver will build by default with DCA enabled.

## Install Using KMP RPM



**NOTE:** KMP is only supported on SLES11 and newer.

The KMP RPMs update existing `igbvf` RPMs currently installed on the system. These updates are provided by SuSE in the SLES release. If an RPM does not currently exist on the system, the KMP will not install.

The RPMs are provided for supported Linux distributions. The naming convention for the included RPMs is:

```
intel-<component name>-<component version>.<arch type>.rpm
```

For example, `intel-igbvf-1.3.8.6-1.x86_64.rpm`: `igbvf` is the component name; `1.3.8.6-1` is the component version; and `x86_64` is the architecture type.

KMP RPMs are provided for supported Linux distributions. The naming convention for the included KMP RPMs is:

```
intel-<component name>-kmp-<kernel type>-<component version>_<kernel version>.<arch type>.rpm
```

For example, `intel-igbvf-kmp-default-1.3.8.6_2.6.27.19_5-1.x86_64.rpm`: `igbvf` is the component name; `default` is the kernel type; `1.3.8.6` is the component version; `2.6.27.19_5-1` is the kernel version; and `x86_64` is the architecture type.

To install the KMP RPM, type the following two commands:

```
rpm -i <rpm filename>
rpm -i <kmp rpm filename>
```

For example, to install the `igbvf` KMP RPM package, type the following:

```
rpm -i intel-igbvf-1.3.8.6-1.x86_64.rpm
rpm -i intel-igbvf-kmp-default-1.3.8.6_2.6.27.19_5-1.x86_64.rpm
```

## Command Line Parameters

If the driver is built as a module, the following optional parameters are used by entering them on the command line with the modprobe command using this syntax:

```
modprobe igbvf [<option>=<VAL1>,<VAL2>,...]
```

A value (<VAL#>) must be assigned to each network port in the system supported by this driver. The values are applied to each instance, in function order. For example:

```
modprobe igbvf InterruptThrottleRate=16000,16000
```

In this case, there are two network ports supported by igb in the system. The default value for each parameter is generally the recommended setting, unless otherwise noted.

The following table contains parameters and possible values for modprobe commands:

Parameter Name	Valid Range/Settings	Default	Description
Interrupt-ThrottleRate	0, 1, 3, 100-100000 (0=off, 1=dynamic, 3=dynamic conservative)	3	<p>The driver can limit the number of interrupts per second that the adapter will generate for incoming packets. It does this by writing a value to the adapter that is based on the maximum number of interrupts that the adapter will generate per second.</p> <p>Setting InterruptThrottleRate to a value greater or equal to 100 will program the adapter to send out a maximum of that many interrupts per second, even if more packets have come in. This reduces interrupt load on the system and can lower CPU utilization under heavy load, but will increase latency as packets are not processed as quickly.</p> <p>The default behavior of the driver previously assumed a static InterruptThrottleRate value of 8000, providing a good fallback value for all traffic types, but lacking in small packet performance and latency. The hardware can handle many more small packets per second however, and for this reason an adaptive interrupt moderation algorithm was implemented.</p> <p>The driver has two adaptive modes (setting 1 or 3) in which it dynamically adjusts the InterruptThrottleRate value based on the traffic that it receives. After determining the type of incoming traffic in the last time frame, it will adjust the InterruptThrottleRate to an appropriate value for that traffic.</p> <p>The algorithm classifies the incoming traffic every interval into classes. Once the class is determined, the InterruptThrottleRate value is adjusted to suit that traffic type the best. There are three classes defined: "Bulk traffic", for large amounts of packets of normal size; "Low latency", for small amounts of traffic and/or a significant percentage of small packets; and "Lowest latency", for almost completely small packets or minimal traffic.</p> <p>In dynamic conservative mode, the InterruptThrottleRate value is set to 4000 for traffic that falls in class "Bulk traffic". If traffic falls in the "Low latency" or "Lowest latency" class, the InterruptThrottleRate is increased stepwise to 20000. This default mode is suitable for most applications.</p>

Parameter Name	Valid Range/Settings	Default	Description
			<p>For situations where low latency is vital such as cluster or grid computing, the algorithm can reduce latency even more when InterruptThrottleRate is set to mode 1. In this mode, which operates the same as mode 3, the InterruptThrottleRate will be increased stepwise to 70000 for traffic in class "Lowest latency".</p> <p>Setting InterruptThrottleRate to 0 turns off any interrupt moderation and may improve small packet latency, but is generally not suitable for bulk throughput traffic.</p>

#### NOTES:

- Dynamic interrupt throttling is only applicable to adapters operating in MSI or Legacy interrupt mode, using a single receive queue.
- When igbvf is loaded with default settings and multiple adapters are in use simultaneously, the CPU utilization may increase non-linearly. In order to limit the CPU utilization without impacting the overall throughput, it is recommended to load the driver as follows:

```
modprobe igbvf InterruptThrottleRate=3000,3000,3000
```

This sets the InterruptThrottleRate to 3000 interrupts/sec for the first, second, and third instances of the driver. The range of 2000 to 3000 interrupts per second works on a majority of systems and is a good starting point, but the optimal value will be platform-specific. If CPU utilization is not a concern, use default driver settings.

## Additional Configurations

### Configuring the Driver on Different Distributions

Configuring a network driver to load properly when the system is started is distribution dependent. Typically, the configuration process involves adding an alias line to `/etc/modules.conf` or `/etc/modprobe.conf` as well as editing other system startup scripts and/or configuration files. Many Linux distributions ship with tools to make these changes for you. To learn the proper way to configure a network device for your system, refer to your distribution documentation. If during this process you are asked for the driver or module name, the name for the Linux Base Driver for the Intel Gigabit Family of Adapters is `igbvf`.


As an example, if you install the `igbvf` driver for two Intel Gigabit adapters (`eth0` and `eth1`) and want to set the interrupt mode to MSI-X and MSI, respectively, add the following to `modules.conf` or `/etc/modprobe.conf`:

```
alias eth0 igbvf
alias eth1 igbvf
options igbvf InterruptThrottleRate=3,1
```

### Viewing Link Messages

Link messages will not be displayed to the console if the distribution is restricting system messages. In order to see network driver link messages on your console, set `dmesg` to eight by entering the following:

```
dmesg -n 8
```

 **NOTE:** This setting is not saved across reboots.

### Jumbo Frames

Jumbo Frames support is enabled by changing the MTU to a value larger than the default of 1500 bytes. Use the `ifconfig` command to increase the MTU size. For example:

```
ifconfig eth<x> mtu 9000 up
```

This setting is not saved across reboots. The setting change can be made permanent by adding `MTU = 9000` to the file `/etc/sysconfig/network-scripts/ifcfg-eth<x>`, in Red Hat distributions. Other distributions may store this setting in a different location.

#### **NOTES:**

- Using Jumbo Frames at 10 or 100 Mbps may result in poor performance or loss of link.
- To enable Jumbo Frames, increase the MTU size on the interface beyond 1500.
- The maximum Jumbo Frames size is 9234 bytes, with a corresponding MTU size of 9216 bytes.

## ethtool

The driver utilizes the ethtool interface for driver configuration and diagnostics, as well as displaying statistical information. ethtool version 3 or later is required for this functionality, although we strongly recommend downloading the latest version at: <http://www.kernel.org/pub/software/network/ethtool/>.

## Known Issues

### Compiling the Driver

When trying to compile the driver by running `make install`, the following error may occur:

```
"Linux kernel source not configured - missing version.h"
```

To solve this issue, create the `version.h` file by going to the Linux Kernel source tree and entering:

```
# make include/linux/version.h
```


### Multiple Interfaces on Same Ethernet Broadcast Network

Due to the default ARP behavior on Linux, it is not possible to have one system on two IP networks in the same Ethernet broadcast domain (non-partitioned switch) behave as expected. All Ethernet interfaces will respond to IP traffic for any IP address assigned to the system. This results in unbalanced receive traffic.

If you have multiple interfaces in a server, turn on ARP filtering by entering:

```
echo 1 > /proc/sys/net/ipv4/conf/all/arp_filter
```

(this only works if your kernel's version is higher than 2.4.5).

 **NOTE:** This setting is not saved across reboots. However this configuration change can be made permanent through one of the following methods:

- Add the following line to `/etc/sysctl.conf`:

```
net.ipv4.conf.all.arp_filter = 1
```

- Install the interfaces in separate broadcast domains (either in different switches or in a switch partitioned to VLANs).

### Do Not Use LRO when Routing Packets

Due to a known general compatibility issue with LRO and routing, do not use LRO when routing packets.

### MSI-X Issues with Kernels Between 2.6.19 and 2.6.21 (inclusive)

Kernel panics and instability may be observed on any MSI-X hardware if you use `irqbalance` with kernels between 2.6.19 and 2.6.21. If these types of problems are encountered, you may disable the `irqbalance` daemon or upgrade to a newer kernel.

### Rx Page Allocation Errors

Page allocation failure `order:0` errors may occur under stress with kernels 2.6.25 and above. This is caused by the way the Linux kernel reports this stressed condition.



## **Unloading Physical Function (PF) Driver Causes System Reboots when VM is Running and VF is Loaded on the VM**




Do not unload the PF driver (igb) while VFs are assigned to guests.

### **Host May Reboot after Removing PF when VF is Active in Guest**

Using kernel versions earlier than 3.2, do not unload the PF driver with active VFs. Doing this will cause your VFs to stop working until you reload the PF driver and may cause a spontaneous reboot of your system.

# ixgbe Linux\* Driver for the Intel® 10 Gigabit Server Adapters

## ixgbe Overview

	<b>WARNING:</b> By default, the ixgbe driver complies with the Large Receive Offload (LRO) feature enabled. This option offers the lowest CPU utilization for receives but is incompatible with routing/ip forwarding and bridging. If enabling ip forwarding or bridging is a requirement, it is necessary to disable LRO using compile time options as noted in the LRO section later in this section. The result of not disabling LRO when combined with ip forwarding or bridging can be low throughput or even a kernel panic.
	<b>NOTE:</b> Do not unload a port's driver if a Virtual Function (VF) with an active Virtual Machine (VM) is bound to it. Doing so will cause the port to appear to hang. Once the VM shuts down, or otherwise releases the VF, the command will complete.
	<b>NOTE:</b> In a virtualized environment, on Intel® Server Adapters that support SR-IOV, the virtual function (VF) may be subject to malicious behavior. Software-generated layer two frames, like IEEE 802.3x (link flow control), IEEE 802.1Qbb (priority based flow-control), and others of this type, are not expected and can throttle traffic between the host and the virtual switch, reducing performance. To resolve this issue, configure all SR-IOV enabled ports for VLAN tagging. This configuration allows unexpected, and potentially malicious, frames to be dropped.

This file describes the Linux\* Base Driver for the 10 Gigabit Intel® Network Connections. This driver supports the 2.6.x and newer kernels and includes support for any Linux supported system, including X86\_64, i686 and PPC.

This driver is only supported as a loadable module. Intel is not supplying patches against the kernel source to allow for static linking of the driver. A version of the driver may already be included by your distribution or the kernel.

The following features are now available in supported kernels:

- Native VLANs
- Channel Bonding (teaming)
- Generic Receive Offload
- Data Center Bridging

Adapter teaming is now implemented using the native Linux Channel bonding module. This is included in supported Linux kernels. Channel Bonding documentation can be found in the Linux kernel source: /documentation/networking/bonding.txt


Use ethtool, lspci, or ifconfig to obtain driver information. Instructions on updating the ethtool can be found in the [Additional Configurations](#) section later in this page.

## ixgbe Linux Base Driver Supported Devices

The following Intel network adapters are compatible with the Linux driver in this release:

- Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
- Intel® Ethernet 10G 2P X540-t Adapter
- Intel® Ethernet 10G 2P X550-t Adapter
- Intel® Ethernet 10G 4P X550 rNDC
- Intel® Ethernet 10G 4P X550/I350 rNDC
- Intel® Ethernet 10G 4P X540/I350 rNDC
- Intel® Ethernet 10G 4P X520/I350 rNDC
- Intel® Ethernet 10G 2P X520-k bNDC
- Intel® Ethernet 10G 2P X520 Adapter
- Intel® Ethernet 10G X520 LOM

## SFP+ Devices with Pluggable Optics

 **NOTE:** For 92500-based SFP+ fiber adapters, using "ifconfig down" turns off the laser. "ifconfig up" turns the laser on.

See [SFP+ and QSFP+ Devices](#) for more information.

## Building and Installation

There are three methods for installing the Linux driver:

- [Install from Source Code](#)
- [Install Using KMP RPM](#)
- [Install Using KMOD RPM](#)

### Install from Source Code

To build a binary RPM\* package of this driver, run 'rpmbuild -tb <filename.tar.gz>'. Replace <filename.tar.gz> with the specific filename of the driver.

#### NOTES:

- For the build to work properly it is important that the currently running kernel MATCH the version and configuration of the installed kernel source. If you have just recompiled your kernel, reboot the system.
- RPM functionality has only been tested in Red Hat distributions.

1. Download the base driver tar file to the directory of your choice. For example, use '/home/username/ixgbe' or '/usr/local/src/ixgbe'.
2. Untar/unzip the archive, where <x.x.x> is the version number for the driver tar:

```
tar xzf ixgbe-<x.x.x>.tar.gz
```

3. Change to the driver src directory, where <x.x.x> is the version number for the driver tar:


```
cd ixgbe-<x.x.x>/src/
```

4. Compile the driver module:

```
make install
```

The binary will be installed as: /lib/modules/<KERNEL VERSION>/kernel/drivers/net/ixgbe/ixgbe.ko

The install locations listed above are the default locations. This might differ for various Linux distributions. For more information, see the ldistrib.txt file included in the driver tar.

 **NOTE:** IXGBE\_NO\_LRO is a compile time flag. The user can enable it at compile time to remove support for LRO from the driver. The flag is used by adding 'CFLAGS\_EXTRA="-DIXGBE\_NO\_LRO"' to the make file when it is being compiled. For example:

```
make CFLAGS_EXTRA="-DIXGBE_NO_LRO" install
```

5. Install the module using the modprobe command for kernel 2.6.x:

```
modprobe ixgbe <parameter>=<value>
```

For 2.6 based kernels, make sure that the older ixgbe drivers are removed from the kernel, before loading the new module:

```
rmmmod ixgbe; modprobe ixgbe
```

6. Assign an IP address to and activate the Ethernet interface by entering the following, where <x> is the interface number:

```
ifconfig eth<x> <IP_address> netmask <netmask>
```

7. Verify that the interface works. Enter the following, where <IP\_address> is the IP address for another machine on the same subnet as the interface that is being tested:

```
ping <IP_address>
```

### Install Using KMP RPM

 **NOTE:** KMP is only supported on SLES11 and newer.

The KMP RPMs update existing ixgbe RPMs currently installed on the system. These updates are provided by SuSE in the SLES release. If an RPM does not currently exist on the system, the KMP will not install.

The RPMs are provided for supported Linux distributions. The naming convention for the included RPMs is:

```
intel-<component name>-<component version>.<arch type>.rpm
```

For example, intel-ixgbe-1.3.8.6-1.x86\_64.rpm: ixgbe is the component name; 1.3.8.6-1 is the component version; and x86\_64 is the architecture type.

KMP RPMs are provided for supported Linux distributions. The naming convention for the included KMP RPMs is:

```
intel-<component name>-kmp-<kernel type>-<component version>_<kernel version>.<arch type>.rpm
```

For example, intel-ixgbe-kmp-default-1.3.8.6\_2.6.27.19\_5-1.x86\_64.rpm: ixgbe is the component name; default is the kernel type; 1.3.8.6 is the component version; 2.6.27.19\_5-1 is the kernel version; and x86\_64 is the architecture type.

To install the KMP RPM, type the following two commands:

```
rpm -i <rpm filename>
rpm -i <kmp rpm filename>
```

For example, to install the ixgbe KMP RPM package, type the following:

```
rpm -i intel-ixgbe-1.3.8.6-1.x86_64.rpm
rpm -i intel-ixgbe-kmp-default-1.3.8.6_2.6.27.19_5-1.x86_64.rpm
```

## Install Using KMOD RPM

The KMOD RPMs are provided for supported Linux distributions. The naming convention for the included RPMs is:

```
kmod-<driver name>-<version>-1.<arch type>.rpm
```

For example, kmod-ixgbe-2.3.4-1.x86\_64.rpm:

- ixgbe is the driver name
- 2.3.4 is the version
- x86\_64 is the architecture type

To install the KMOD RPM, go to the directory of the RPM and type the following command:

```
rpm -i <rpm filename>
```

For example, to install the ixgbe KMOD RPM package from RHEL 6.4, type the following:

```
rpm -i kmod-ixgbe-2.3.4-1.x86_64.rpm
```

## Command Line Parameters

If the driver is built as a module, the following optional parameters are used by entering them on the command line with the modprobe command using this syntax:



```
modprobe ixgbe [<option>=<VAL1>,<VAL2>,...]
```





For example:






```
modprobe ixgbe InterruptThrottleRate=16000,16000
```




The default value for each parameter is generally the recommended setting, unless otherwise noted.

The following table contains parameters and possible values for modprobe commands:

Parameter Name	Valid Range/Settings	Default	Description
RSS	0 - 16	1	<p>Receive Side Scaling allows multiple queues for receiving data.</p> <p>0 = Sets the descriptor queue count to the lower value of either the number of CPUs or 16. 1 - 16 = Sets the descriptor queue count to 1 - 16.</p> <p>RSS also effects the number of transmit queues allocated on 2.6.23 and newer kernels with CONFIG_NET_MULTIQUEUE set in the kernel .config file. CONFIG_NETDEVICES_MULTIQUEUE is only supported in kernels 2.6.23 to 2.6.26. For kernels 2.6.27 or newer, other options enable multiqueue.</p> <p> <b>NOTE:</b> The RSS parameter has no effect on 82599-based adapters unless the FdirMode parameter is simultaneously used to disable Flow Director. See <a href="#">Intel® Ethernet Flow Director</a> section for more detail.</p>
Multiqueue	0, 1	1	<p>Multi Queue support.</p> <p>0 = Disables Multiple Queue support. 1 = Enables Multiple Queue support (prerequisite for RSS).</p>
Direct Cache Access (DCA)	0, 1		<p>0 = Disables DCA support in the driver 1 = Enables DCA support in the driver</p> <p>If the driver is enabled for DCA, this parameter allows load-time control of the feature.</p> <p> <b>NOTE:</b> DCA is not supported on X550-based adapters.</p>
IntMode	0 - 2	2	<p>Interrupt mode controls the allowed load time control over the type of interrupt registered for by the driver. MSI-X is required for multiple queue support, and some kernels and combinations of kernel .config options will force a lower level of interrupt support. 'cat /proc/interrupts' will show different values for each type of interrupt.</p> <p>0 = Legacy interrupt 1 = MSI 2 = MSIX</p>




Parameter Name	Valid Range/Settings	Default	Description
InterruptThrottleRate	956 - 488,281 (0=off, 1=d- dynamic)	1	<p>Interrupt Throttle Rate controls the number of interrupts each interrupt vector can generate per second. Increasing ITR lowers latency at the cost of increased CPU utilization, though it may help throughput in some circumstances.</p> <p>0 = Setting InterruptThrottleRate to 0 turns off any interrupt moderation and may improve small packet latency. However, this is generally not suitable for bulk throughput traffic due to the increased CPU utilization of the higher interrupt rate. NOTES: - On 82599, and X540, and X550-based adapters, disabling InterruptThrottleRate will also result in the driver disabling HW RSC. - On 82598-based adapters, disabling InterruptThrottleRate will also result in disabling LRO (Large Receive Offloads).</p> <p>1 = Setting InterruptThrottleRate to Dynamic mode attempts to moderate interrupts per vector while maintaining very low latency. This can sometimes cause extra CPU utilization. If planning on deploying igb in a latency sensitive environment, this parameter should be considered.</p> <p>&lt;min_ITR&gt;-&lt;max_ITR&gt; = 100-100000</p> <p>Setting InterruptThrottleRate to a value greater or equal to &lt;min_ITR&gt; will program the adapter to send at most that many interrupts per second, even if more packets have come in. This reduces interrupt load on the system and can lower CPU utilization under heavy load, but will increase latency as packets are not processed as quickly.</p>
LLI			<p>Low Latency Interrupts allow for immediate generation of an interrupt upon processing receive packets that match certain criteria as set by the parameters described below. LLI parameters are not enabled when Legacy interrupts are used. You must be using MSI or MSI-X (see cat /proc/interrupts) to successfully use LLI.</p> <p> <b>NOTE:</b> LLI is not supported on X550-based adapters.</p>
LLIPort	0 - 65535	0 (dis- abled)	<p>LLI is configured with the LLIPort command-line parameter, which specifies which TCP should generate Low Latency Interrupts.</p> <p>For example, using LLIPort=80 would cause the board to generate an immediate interrupt upon receipt of any packet sent to TCP port 80 on the local machine.</p> <p> <b>WARNING:</b> Enabling LLI can result in an excessive number of interrupts/second that may cause problems with the system and in some cases may cause a kernel panic.</p> <p> LLI is not supported on X550-based adapters.</p>
LLIPush	0 - 1	0 (dis- abled)	<p>LLIPush can be set to be enabled or disabled (default). It is most effective in an environment with many small transactions.</p> <p> <b>NOTES:</b></p> <ul style="list-style-type: none"> <li>• Enabling LLIPush may allow a denial of service attack.</li> <li>• LLI is not supported on X550-based adapters.</li> </ul>


Parameter Name	Valid Range/Settings	Default	Description
LLISize	0 - 1500	0 (disabled)	LLISize causes an immediate interrupt if the board receives a packet smaller than the specified size.  <b>NOTE:</b> LLI is not supported on X550-based adapters.
LLIEType	0 - x8FFF	0 (disabled)	Low Latency Interrupt Ethernet Protocol Type.  <b>NOTE:</b> LLI is not supported on X550-based adapters.
LLIVLANP	0 - 7	0 (disabled)	Low Latency Interrupt on VLAN Priority Threshold.  <b>NOTE:</b> LLI is not supported on X550-based adapters.
Flow Control			Flow Control is enabled by default. If you want to disable a flow control capable link partner, use ethtool:  <pre>ethtool -A eth? autoneg off rx off tx off</pre>  <b>NOTE:</b> For 82598 backplane cards entering 1 Gbps mode, flow control default behavior is changed to off. Flow control in 1 Gbps mode on these devices can lead to transmit hangs.
Intel® Ethernet Flow Director			 <b>NOTE:</b> Flow director parameters are only supported on kernel versions 2.6.30 or later. Flow control in 1 Gbps mode on these devices can lead to transmit hangs.  The Flow Director performs the following tasks: <ul style="list-style-type: none"> <li>• Directs receive packets according to their flows to different queues.</li> <li>• Enables tight control on routing a flow in the platform.</li> <li>• Matches flows and CPU cores for flow affinity.</li> <li>• Supports multiple parameters for flexible flow classification and load balancing (in SFP mode only).</li> </ul> An included script (set_irq_affinity) automates setting the IRQ to CPU affinity.  Flow director masking works in the opposite manner from subnet masking. In the following command:  <pre>#ethtool -N eth11 flow-type ip4 src-ip 172.4.1.2 m 255.0.0.0 dst-ip 172.21.1.1 m 255.128.0.0 action 31</pre> The src-ip value that is written to the filter will be 0.4.1.2, not 172.0.0.0 as might be expected. Similarly, the dst-ip value written to the filter will be 0.21.1.1, not 172.0.0.0.  Other ethtool Commands:  To enable Flow Director  <pre>ethtool -K ethX ntuple on</pre> To add a filter, use -U switch  <pre>ethtool -U ethX flow-type tcp4 src-ip 192.168.0.100 action 1</pre> To see the list of filters currently present


Parameter Name	Valid Range/Settings	Default	Description
			<pre>ethtool -u ethX</pre> <p><b>Perfect Filter:</b></p> <p>Perfect filter is an interface to load the filter table that funnels all flow into queue_0 unless an alternative queue is specified using "action." In that case, any flow that matches the filter criteria will be directed to the appropriate queue.</p> <p>Support for Virtual Function (VF) is via the user-data field. You must update to the version of ethtool built for the 2.6.40 kernel. Perfect Filter is supported on all kernels 2.6.30 and later. Rules may be deleted from the table itself. This is done via "ethtool -U ethX delete N" where N is the rule number to be deleted.</p> <p> <b>NOTE:</b> Flow Director Perfect Filters can run in single queue mode, when SR-IOV is enabled, or when DCB is enabled.</p> <p>If the queue is defined as -1, the filter will drop matching packets.</p> <p>To account for filter matches and misses, there are two stats in ethtool: fdir_match and fdir_miss. In addition, rx_queue_N_packets shows the number of packets processed by the Nth queue.</p> <p> <b>NOTES:</b></p> <ul style="list-style-type: none"> <li>• Receive Packet Steering (RPS) and Receive Flow Steering (RFS) are not compatible with Flow Director. If Flow Director is enabled, these will be disabled.</li> <li>• For VLAN Masks only 4 masks are supported.</li> <li>• Once a rule is defined, you must supply the same fields and masks (if masks are specified).</li> </ul> <p><b>Support for UDP RSS</b></p> <p>This feature adds an ON/OFF switch for hashing over certain flow types. You can't turn on anything other than UDP. The default setting is disabled. We only support enabling/disabling hashing on ports for UDP over IPv4 (udp4) or IPv6 (udp6).</p> <p> <b>NOTE:</b> Fragmented packets may arrive out of order when RSS UDP support is configured.</p> <p><b>Supported ethtool Commands and Options</b></p> <pre>-n --show-nfc</pre> <p>Retrieves the receive network flow classification configurations.</p> <pre>rx-flow-hash tcp4 udp4 ah4 esp4 sctp4 tcp6 udp6 ah6 esp6 sctp6</pre> <p>Retrieves the hash options for the specified network traffic type.</p> <pre>-N --config-nfc</pre> <p>Configures the receive network flow classification.</p> <pre>rx-flow-hash tcp4 udp4 ah4 esp4 sctp4 tcp6 udp6 ah6 esp6 sctp6 m v t s d f n r...</pre> <p>Configures the hash options for the specified network traffic type.</p>



Parameter Name	Valid Range/Settings	Default	Description
			<p>udp4 UDP over IPv4</p> <p>udp6 UDP over IPv6</p> <p>f Hash on bytes 0 and 1 of the Layer 4 header of the rx packet.</p> <p>n Hash on bytes 2 and 3 of the Layer 4 header of the rx packet.</p> <p><b>The following is an example using udp4 (UDP over IPv4):</b></p> <p>To include UDP port numbers in RSS hashing run:  <code>ethtool -N eth1 rx-flow-hash udp4 sdfn</code></p> <p>To exclude UDP port numbers from RSS hashing run:  <code>ethtool -N eth1 rx-flow-hash udp4 sd</code></p> <p>To display UDP hashing current configuration run:  <code>ethtool -n eth1 rx-flow-hash udp4</code></p> <p>The results of running that call will be the following, if UDP hashing is enabled:</p> <p style="padding-left: 40px;">UDP over IPv4 flows use these fields for computing Hash flow key:  IP SA  IP DA  L4 bytes 0 &amp; 1 [TCP/UDP src port]  L4 bytes 2 &amp; 3 [TCP/UDP dst port]</p> <p>The results if UDP hashing is disabled would be:</p> <p style="padding-left: 40px;">UDP over IPv4 flows use these fields for computing Hash flow key:  IP SA  IP DA</p> <p>The following two parameters impact Flow Director: FdirPballoc and AtrSampleRate.</p>
FdirPballoc	0 - 2	0 (64k)	<p>Flow Allocated Packet Buffer Size.</p> <p>0 = 64k  1 = 128k  2 = 256k</p>
AtrSampleRate	1 - 100	20	<p>Software ATR Tx Packet Sample Rate. For example, when set to 20, every 20th packet is sampled to determine if the packet will create a new flow.</p>

Parameter Name	Valid Range/Settings	Default	Description
max_vfs	1 - 63	0	<p>This parameter adds support for SR-IOV. It causes the driver to spawn up to max_vfs worth of virtual function.</p> <p>If the value is greater than 0, it will also force the VMDq parameter to be 1 or more.</p> <p> <b>NOTE:</b> When either SR-IOV mode or VMDq mode is enabled, hardware VLAN filtering and VLAN tag stripping/insertion will remain enabled. Please remove the old VLAN filter before the new VLAN filter is added. For example:</p> <pre> ip link set eth0 vf 0 vlan 100 // set vlan 100 for VF 0 ip link set eth0 vf 0 vlan 0 // Delete vlan 100 ip link set eth0 vf 0 vlan 200 // set a new vlan 200 for VF 0 </pre> <p> This parameter is only used on kernel 3.7.x and below. On kernel 3.8.x and above, use sysfs to enable VFs. Also, for Red Hat distributions, this parameter is only used on version 6.6 and older. For version 6.7 and newer, use sysfs. For example:</p> <pre> #echo \$num_vf_enabled &gt; /sys/- class/net/\$dev/device/sriov_numvfs //enable VFs  #echo 0 &gt; /sys/class/net/\$dev/device/sriov_ numvfs //disable VFs </pre> <p>The parameters for the driver are referenced by position. So, if you have a dual port 82599-based adapter and you want N virtual functions per port, you must specify a number for each port with each parameter separated by a comma.</p> <p>For example: <code>modprobe ixgbe max_vfs=63,63</code></p> <p> <b>NOTE:</b> If both 82598 and 82599-based adapters are installed on the same machine, you must be careful in loading the driver with the parameters. Depending on system configuration, number of slots, etc., it is impossible to predict in all cases where the positions would be on the command line and the user will have to specify zero in those positions occupied by an 82598 port.</p> <p>With kernel 3.6, the driver supports the simultaneous usage of max_vfs and DCB features, subject to the constraints described below. Prior to kernel 3.6, the driver did not support the simultaneous operation of max_vfs &gt; 0 and the DCB features (multiple traffic classes utilizing Priority Flow Control and Extended Transmission Selection).</p>

Parameter Name	Valid Range/Settings	Default	Description
			<p>When DCB is enabled, network traffic is transmitted and received through multiple traffic classes (packet buffers in the NIC). The traffic is associated with a specific class based on priority, which has a value of 0 through 7 used in the VLAN tag. When SR-IOV is not enabled, each traffic class is associated with a set of RX/TX descriptor queue pairs. The number of queue pairs for a given traffic class depends on the hardware configuration. When SR-IOV is enabled, the descriptor queue pairs are grouped into pools. The Physical Function (PF) and each Virtual Function (VF) is allocated a pool of RX/TX descriptor queue pairs. When multiple traffic classes are configured (for example, DCB is enabled), each pool contains a queue pair from each traffic class. When a single traffic class is configured in the hardware, the pools contain multiple queue pairs from the single traffic class.</p> <p>The number of VFs that can be allocated depends on the number of traffic classes that can be enabled. The configurable number of traffic classes for each enabled VF is as follows:</p> <ul style="list-style-type: none"> <li>0 - 15 VFs = Up to 8 traffic classes, depending on device support</li> <li>16 - 31 VFs = Up to 4 traffic classes</li> <li>32 - 63 = 1 traffic class</li> </ul> <p>When VFs are configured, the PF is allocated one pool as well. The PF supports the DCB features with the constraint that each traffic class will only use a single queue pair. When zero VFs are configured, the PF can support multiple queue pairs per traffic class.</p>
L2LBen	0-1	1 (enabled)	This parameter controls the internal switch (L2 loopback between pf and vf). By default the switch is enabled.
LRO	0-1		<p>0=off, 1=on</p> <p>Large Receive Offload (LRO) is a technique for increasing inbound throughput of high-bandwidth network connections by reducing CPU overhead. It works by aggregating multiple incoming packets from a single stream into a larger buffer before they are passed higher up the networking stack, thus reducing the number of packets that have to be processed. LRO combines multiple Ethernet frames into a single receive in the stack, thereby potentially decreasing CPU utilization for receives.</p> <p>This technique is also referred to as Hardware Receive Side Coalescing (HW RSC). 82599 and X540, and X550-based adapters support HW RSC. The LRO parameter controls HW RSC enablement.</p> <p>You can verify that the driver is using LRO by looking at these counters in ethtool:</p> <ul style="list-style-type: none"> <li>• hw_rsc_aggregated - counts total packets that were combined</li> <li>• hw_rsc_flushed - counts the number of packets flushed out of LRO</li> </ul> <p> <b>NOTE:</b> IPv6 and UDP are not supported by LRO.</p>

Parameter Name	Valid Range/Settings	Default	Description
EEE	0-1		<p>0 = Disables EEE</p> <p>1 = Enables EEE</p> <p>A link between two EEE-compliant devices will result in periodic bursts of data followed by periods where the link is in an idle state. This Low Power Idle (LPI) state is supported in both 1 Gbps and 10 Gbps link speeds.</p> <p> <b>NOTES:</b></p> <ul style="list-style-type: none"> <li>EEE support requires auto-negotiation. Both link partners must support EEE.</li> <li>EEE is not supported on all Intel® Ethernet Network devices or at all link speeds.</li> </ul>
DMAC	0, 41-10000		<p>This parameter enables or disables DMA Coalescing feature. Values are in microseconds and set the internal DMA Coalescing internal timer. DMAC is available on Intel® X550 (and later) based adapters.</p> <p>DMA (Direct Memory Access) allows the network device to move packet data directly to the system's memory, reducing CPU utilization. However, the frequency and random intervals at which packets arrive do not allow the system to enter a lower power state. DMA Coalescing allows the adapter to collect packets before it initiates a DMA event. This may increase network latency but also increases the chances that the system will enter a lower power state.</p> <p>Turning on DMA Coalescing may save energy with kernel 2.6.32 and newer. DMA Coalescing must be enabled across all active ports in order to save platform power.</p> <p>InterruptThrottleRate (ITR) should be set to dynamic. When ITR=0, DMA Coalescing is automatically disabled.</p> <p>A whitepaper containing information on how to best configure your platform is available on the Intel website.</p>
MDD	0-1	1 (enabled)	<p>The Malicious Driver Detection (MDD) parameter is only relevant for devices operating in SR-IOV mode. When this parameter is set, the driver detects malicious VF driver and disables its TX/RX queues until a VF driver reset occurs.</p>

## Additional Configurations


### Configuring the Driver on Different Distributions

Configuring a network driver to load properly when the system is started is distribution dependent. Typically, the configuration process involves adding an alias line to `/etc/modules.conf` or `/etc/modprobe.conf` as well as editing other system startup scripts and/or configuration files. Many Linux distributions ship with tools to make these changes for you. To learn the proper way to configure a network device for your system, refer to your distribution documentation. If during this process you are asked for the driver or module name, the name for the Linux Base Driver for the Intel® 10 Gigabit PCI Express Family of Adapters is `ixgbe`.

### Viewing Link Messages

Link messages will not be displayed to the console if the distribution is restricting system messages. In order to see network driver link messages on your console, set `dmesg` to eight by entering the following:

```
dmesg -n 8
```

 **NOTE:** This setting is not saved across reboots.

## Jumbo Frames

Jumbo Frames support is enabled by changing the MTU to a value larger than the default of 1500 bytes. The maximum value for the MTU is 9710. Use the `ifconfig` command to increase the MTU size. For example, enter the following where `<x>` is the interface number:

```
ifconfig ethx mtu 9000 up
```

This setting is not saved across reboots. The setting change can be made permanent by adding `MTU = 9000` to the file `/etc/sysconfig/network-scripts/ifcfg-eth<x>` for RHEL or to the file `/etc/sysconfig/network/<config_file>` for SLES.

The maximum MTU setting for Jumbo Frames is 9710. This value coincides with the maximum Jumbo Frames size of 9728. This driver will attempt to use multiple page sized buffers to receive each jumbo packet. This should help to avoid buffer starvation issues when allocating receive packets.

For 82599-based network connections, if you are enabling jumbo frames in a virtual function (VF), jumbo frames must first be enabled in the physical function (PF). The VF MTU setting cannot be larger than the PF MTU.

## ethtool

The driver uses the `ethtool` interface for driver configuration and diagnostics, as well as displaying statistical information. The latest `ethtool` version is required for this functionality.

The latest release of `ethtool` can be found at: <http://sourceforge.net/projects/gkernel>.

## NAPI

NAPI (Rx polling mode) is supported in the `ixgbe` driver.

See <https://wiki.linuxfoundation.org/networking/napi> for more information on NAPI.

## Large Receive Offload (LRO)

Large Receive Offload (LRO) is a technique for increasing inbound throughput of high-bandwidth network connections by reducing CPU overhead. It works by aggregating multiple incoming packets from a single stream into a larger buffer before they are passed higher up the networking stack, thus reducing the number of packets that have to be processed. LRO combines multiple Ethernet frames into a single receive in the stack, thereby potentially decreasing CPU utilization for receives.

`IXGBE_NO_LRO` is a compile time flag. The user can enable it at compile time to remove support for LRO from the driver. The flag is used by adding `CFLAGS_EXTRA="-DIXGBE_NO_LRO"` to the make file when it's being compiled.

```
make CFLAGS_EXTRA="-DIXGBE_NO_LRO" install
```

You can verify that the driver is using LRO by looking at these counters in `ethtool`:

- `Iro_flushed` - the total number of receives using LRO.
- `Iro_coal` - counts the total number of Ethernet packets that were combined.

## HW RSC

82599-based adapters support hardware based receive side coalescing (RSC) which can merge multiple frames from the same IPv4 TCP/IP flow into a single structure that can span one or more descriptors. It works similarly to software large receive offload technique. By default HW RSC is enabled, and SW LRO can not be used for 82599-based adapters unless HW RSC is disabled.

`IXGBE_NO_HW_RSC` is a compile time flag that can be enabled at compile time to remove support for HW RSC from the driver. The flag is used by adding `CFLAGS_EXTRA="-DIXGBE_NO_HW_RSC"` to the make file when it is being compiled.

```
make CFLAGS_EXTRA="-DIXGBE_NO_HW_RSC" install
```

You can verify that the driver is using HW RSC by looking at the counter in ethtool:

```
hw_rsc_count - counts the total number of Ethernet packets that were being combined.
```

## rx\_dropped\_backlog


When in a non-Napi (or Interrupt) mode, this counter indicates that the stack is dropping packets. There is an adjustable parameter in the stack that allows you to adjust the amount of backlog. We recommend increasing the `netdev_max_backlog` if the counter goes up.

```
# sysctl -a |grep netdev_max_backlog
net.core.netdev_max_backlog = 1000
# sysctl -e net.core.netdev_max_backlog=10000
net.core.netdev_max_backlog = 10000
```

## Flow Control

Flow control is disabled by default. To enable it, use ethtool:

```
ethtool -A eth? autoneg off rx on tx on
```


 **NOTE:** You must have a flow control capable link partner.

## MAC and VLAN Anti-spoofing Feature

When a malicious driver attempts to send a spoofed packet, it is dropped by the hardware and not transmitted. An interrupt is sent to the PF driver notifying it of the spoof attempt. When a spoofed packet is detected the PF driver will send the following message to the system log (displayed by the "dmesg" command):

```
ixgbe ethx: ixgbe_spoof_check: n spoofed packets detected
```

Where x=the PF interface# and n=the VF that attempted to do the spoofing.

 **NOTE:** This feature can be disabled for a specific Virtual Function (VF).

## Support for UDP RSS

This feature adds an ON/OFF switch for hashing over certain flow types. The default setting is disabled. NOTE: Fragmented packets may arrive out of order when RSS UDP support is configured.

### Supported ethtool Commands and Options

```
-n --show-nfc
```

Retrieves the receive network flow classification configurations.

```
rx-flow-hash tcp4|udp4|ah4|esp4|sctp4|tcp6|udp6|ah6|esp6|sctp6
```

Retrieves the hash options for the specified network traffic type.

```
-N --config-nfc
```

Configures the receive network flow classification.

```
rx-flow-hash tcp4|udp4|ah4|esp4|sctp4|tcp6|udp6|ah6|esp6|sctp6 m|v|t|s|d|f|n|r...
```

Configures the hash options for the specified network traffic type.


```
udp4 UDP over IPv4
```

```
udp6 UDP over IPv6
```

f Hash on bytes 0 and 1 of the Layer 4 header of the rx packet.

n Hash on bytes 2 and 3 of the Layer 4 header of the rx packet.

## Known Issues

 **NOTE:** After installing the driver, if your Intel® Ethernet Network Connection is not working, verify that you have installed the correct driver. Intel® Active Management Technology 2.0, 2.1, and 2.5 are not supported in conjunction with the Linux driver.

### MAC address of Virtual Function changes unexpectedly

If a Virtual Function's MAC address is not assigned in the host, then the VF (virtual function) driver will use a random MAC address. This random MAC address may change each time the VF driver is reloaded. You can assign a static MAC address in the host machine. This static MAC address will survive a VF driver reload.

### MSI-X Issues with Kernels Between 2.6.19 - 2.6.21 (inclusive)

Kernel panics and instability may be observed on any MSI-X hardware if you use irqbalance with kernels between 2.6.19 and 2.6.21. If such problems are encountered, you may disable the irqbalance daemon or upgrade to a newer kernel.

### LRO and iSCSI Incompatibility

LRO is incompatible with iSCSI target or initiator traffic. A panic may occur when iSCSI traffic is received through the ixgbe driver with LRO enabled. To workaround this, the driver should be built and installed with:

```
# make CFLAGS_EXTRA=-DIXGBE_NO_LRO install
```


### Multiple Interfaces on Same Ethernet Broadcast Network

Due to the default ARP behavior on Linux, it is not possible to have one system on two IP networks in the same Ethernet broadcast domain (non-partitioned switch) behave as expected. All Ethernet interfaces will respond to IP traffic for any IP address assigned to the system. This results in unbalanced receive traffic.

If you have multiple interfaces in a server, either turn on ARP filtering by entering:

```
echo 1 > /proc/sys/net/ipv4/conf/all/arp_filter
```

This only works if your kernel's version is higher than 2.4.5.

 **NOTE:** This setting is not saved across reboots. The configuration change can be made permanent by adding the following line to the file `/etc/sysctl.conf`:

```
net.ipv4.conf.all.arp_filter = 1
```

Another alternative is to install the interfaces in separate broadcast domains (either in different switches or in a switch partitioned to VLANs).

### UDP Stress Test Dropped Packet Issue

Under small packet UDP stress with the ixgbe driver, the system may drop UDP packets due to socket buffers being full. Setting the driver Flow Control variables to the minimum may resolve the issue. You may also try increasing the kernel's default buffer sizes by changing the values in `/proc/sys/net/core/rmem_default` and `rmem_max`

### Cisco Catalyst 4948-10GE port resets may cause switch to shut down ports

82598-based hardware can re-establish link quickly and when connected to some switches, rapid resets within the driver may cause the switch port to become isolated due to "link flap". This is typically indicated by a yellow instead of a green link light. Several operations may cause this problem, such as repeatedly running `ethtool` commands that cause a reset.

A potential workaround is to use the Cisco IOS command "no errdisable detect cause all" from the Global Configuration prompt which enables the switch to keep the interfaces up, regardless of errors.

## Rx Page Allocation Errors

'Page allocation failure. order:0' errors may occur under stress with kernels 2.6.25 and newer. This is caused by the way the Linux kernel reports this stressed condition.

## DCB: Generic segmentation offload on causes bandwidth allocation issues

In order for DCB to work correctly, Generic Segmentation Offload (GSO), also known as software TSO, must be disabled using ethtool. Since the hardware supports TSO (hardware offload of segmentation), GSO will not be running by default. The GSO state can be queried with ethtool using `ethtool -k ethX`. When using 82598-based network connections, ixgbe driver only supports 16 queues on a platform with more than 16 cores.

Due to known hardware limitations, RSS can only filter in a maximum of 16 receive queues.

82599 and X540, and X550-based network connections support up to 64 queues.

## Lower than expected performance

Some PCIe x8 slots are actually configured as x4 slots. These slots have insufficient bandwidth for full line rate with dual port and quad port devices. In addition, if you put a PCIe Generation 3-capable adapter into a PCIe Generation 2 slot, you cannot get full bandwidth. The driver detects this situation and writes the following message in the system log:

```
"PCI-Express bandwidth available for this card is not sufficient for optimal performance. For optimal performance a x8 PCI-Express slot is required."
```

If this error occurs, moving your adapter to a true PCIe Generation 3 x8 slot will resolve the issue.

## ethtool may incorrectly display SFP+ fiber module as direct attached cable

Due to kernel limitations, port type can only be correctly displayed on kernel 2.6.33 or greater.

Under Redhat 5.4, system may crash when closing guest OS window after loading/unloading the Physical Function (PF) driver. Do not remove the ixgbe driver from Dom0 while Virtual Functions (VFs) are assigned to guests. VFs must first use the `xm "pci-detach"` command to hot-plug the VF device out of the VM it is assigned to or else shut down the VM.

Unloading Physical Function (PF) driver may cause kernel panic or system reboot when VM is running and VF is loaded on the VM. On pre-3.2 Linux kernels, unloading the Physical Function (PF) driver causes system reboots when the VM is running and VF is loaded on the VM. Do not unload the PF driver (ixgbe) while VFs are assigned to guests.

## Running ethtool -t ethX command causes break between PF and test client

When there are active VFs, "ethtool -t" will only run the link test. The driver will also log in syslog that VFs should be shut down to run a full diagnostic test.

## Unable to obtain DHCP lease on boot with RedHat

In configurations where the auto-negotiation process takes more than 5 seconds, the boot script may fail with the following message:


```
"ethX: failed. No link present. Check cable?"
```

This error may occur even though the presence of link can be confirmed using `ethtool ethx`. In this case, try setting "LINKDELAY=30" in `/etc/sysconfig/network-scripts/ifcfg-ethx`.

The same issue can occur during a network boot (via PXE) on RedHat distributions that use the dracut script:

```
"Warning: No carrier detected on interface <interface_name>"
```

In this case add "rd.net.timeout.carrier=30" at the kernel command line.

 **NOTE:** Link time can vary. Adjust LINKDELAY value accordingly.



## Host May Reboot after Removing PF when VF is Active in Guest

Using kernel versions earlier than 3.2, do not unload the PF driver with active VFs. Doing this will cause your VFs to stop working until you reload the PF driver and may cause a spontaneous reboot of your system.

Prior to unloading the PF driver, you must first ensure that all VFs are no longer active. Do this by shutting down all VMs and unloading the VF driver.

## Out of memory issues on IA32 systems

The driver may consume a lot of memory based on the number of CPUs and network interfaces. This leads to memory segmentation. Thus, the driver may not be able to allocate enough memory. To resolve this, reduce the number of descriptors using `ethtool -G` or the number of queues through the `RSS` parameter.

## VLAN tags are stripped on kernels earlier than 2.6.36

In order to support DCB, kernels earlier than 2.6.36 strip VLAN tags for VLAN0. This ensures connectivity using 802.1p frames between kernels that have built-in support and kernels that do not.

If the VLAN tags are necessary AND DCB is NOT used, disable vlan stripping on older kernels at build time with the following:

```
# make CFLAGS_EXTRA=-DIXGBE_DISABLE_8021P_SUPPORT
```

# ixgbev Linux\* Driver for the Intel® 10 Gigabit Server Adapters

## ixgbev Overview

SR-IOV is supported by the ixgbev driver, which should be loaded on both the host and VMs. This driver supports upstream kernel versions 2.6.30 (or higher) x86\_64.

The ixgbev driver supports 82599, X540, and X550 virtual function devices that can only be activated on kernels supporting SR-IOV. SR-IOV requires the correct platform and OS support.

The ixgbev driver requires the ixgbe driver, version 2.0 or later. The ixgbev driver supports virtual functions generated by the ixgbe driver with a max\_vfs value of 1 or greater. For more information on the max\_vfs parameter refer to the section on the [ixgbe](#) driver.

The guest OS loading the ixgbev driver must support MSI-X interrupts.

This driver is only supported as a loadable module at this time. Intel is not supplying patches against the kernel source to allow for static linking of the driver. For questions related to hardware requirements, refer to the documentation supplied with your Intel 10GbE adapter. All hardware requirements listed apply to use with Linux.

## ixgbev Linux Base Driver Supported Adapters

The following Intel network adapters are compatible with the ixgbev Linux driver in this release and can support up to 63 virtual functions per port.

- Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
- Intel® Ethernet 10G 2P X540-t Adapter
- Intel® Ethernet 10G 2P X550-t Adapter
- Intel® Ethernet 10G 4P X550 rNDC
- Intel® Ethernet 10G 4P X550/I350 rNDC
- Intel® Ethernet 10G 4P X540/I350 rNDC
- Intel® Ethernet 10G 4P X520/I350 rNDC
- Intel® Ethernet 10G 2P X520-k bNDC
- Intel® Ethernet 10G 2P X520 Adapter
- Intel® Ethernet 10G X520 LOM

## SR-IOV Capable Operating Systems

- Citrix XenServer 6.0 with Red Hat Enterprise Linux
- VMWare\* ESXi\* 6.0 U3
- Red Hat\* Enterprise Linux\* (RHEL) 6.10
- Red Hat\* Enterprise Linux\* (RHEL) 7.5
- Novell\* SUSE\* Linux Enterprise Server (SLES) 15

## Building and Installation

To enable SR-IOV on your system:

1. Ensure both Virtualization and SR-IOV are enabled in the BIOS.
2. Install the Linux operating system. You can verify that the KVM driver is loaded by typing: `lsmod | grep -i kvm`
3. Load the Linux Base Driver using the modprobe command: `modprobe ixgbe option max_vfs=xx,yy`  
xx and yy are the number of virtual functions you want to create. You must specify a number for each port with each parameter separated by a comma. For example, xx is the number of virtual functions for port 1; and yy, for port 2. You can create up to 63 functions per port.
4. Compile and install the ixgbev driver for SR-IOV. This is loaded against the virtual functions created.



**NOTE:** For VLANs, there is a limit of a total of 32 shared VLANs to 1 or more virtual functions.

There are three methods for installing the Linux driver:

- [Install from Source Code](#)
- [Install Using KMP RPM](#)
- [Install Using KMOD RPM](#)

## Install from Source Code

To build a binary RPM\* package of this driver, run 'rpmbuild -tb <filename.tar.gz>'. Replace <filename.tar.gz> with the specific filename of the driver.

### NOTES:

- For the build to work properly it is important that the currently running kernel MATCH the version and configuration of the installed kernel source. If you have just recompiled your kernel, reboot the system.
- RPM functionality has only been tested in Red Hat distributions.

1. Download the base driver tar file to the directory of your choice. For example, use '/home/username/ixgbevf' or '/usr/local/src/ixgbevf'.
2. Untar/unzip the archive, where <x.x.x> is the version number for the driver tar:

```
tar xzf ixgbevf-<x.x.x>.tar.gz
```

3. Change to the driver src directory, where <x.x.x> is the version number for the driver tar:

```
cd ixgbevf-<x.x.x>/src/
```

4. Compile the driver module:

```
make install
```

The binary will be installed as: /lib/modules/<KERNEL VERSION>/kernel/drivers/net/ixgbevf/ixgbevf.ko

The install locations listed above are the default locations. This might differ for various Linux distributions. For more information, see the ldistrib.txt file included in the driver tar.

5. Install the module using the modprobe command for kernel 2.6.x:

```
modprobe ixgbevf <parameter>=<value>
```

For 2.6 based kernels, make sure that the older ixgbevf drivers are removed from the kernel, before loading the new module:

```
rmmod ixgbevf; modprobe ixgbevf
```


6. Assign an IP address to and activate the Ethernet interface by entering the following, where <x> is the interface number:

```
ifconfig eth<x> <IP_address> netmask <netmask>
```

7. Verify that the interface works. Enter the following, where <IP\_address> is the IP address for another machine on the same subnet as the interface that is being tested:

```
ping <IP_address>
```

## Install Using KMP RPM

 **NOTE:** KMP is only supported on SLES11 and newer.

The KMP RPMs update existing ixgbevf RPMs currently installed on the system. These updates are provided by SuSE in the SLES release. If an RPM does not currently exist on the system, the KMP will not install.

The RPMs are provided for supported Linux distributions. The naming convention for the included RPMs is:

```
intel-<component name>-<component version>.<arch type>.rpm
```

For example, intel-ixgbevf-1.3.8.6-1.x86\_64.rpm: ixgbevf is the component name; 1.3.8.6-1 is the component version; and x86\_64 is the architecture type.

KMP RPMs are provided for supported Linux distributions. The naming convention for the included KMP RPMs is:

intel-<component name>-kmp-<kernel type>-<component version>\_<kernel version>.<arch type>.rpm

For example, intel-ixgbevf-kmp-default-1.3.8.6\_2.6.27.19\_5-1.x86\_64.rpm: ixgbevf is the component name; default is the kernel type; 1.3.8.6 is the component version; 2.6.27.19\_5-1 is the kernel version; and x86\_64 is the architecture type.

To install the KMP RPM, type the following two commands:

```
rpm -i <rpm filename>
rpm -i <kmp rpm filename>
```

For example, to install the ixgbevf KMP RPM package, type the following:

```
rpm -i intel-ixgbevf-1.3.8.6-1.x86_64.rpm
rpm -i intel-ixgbevf-kmp-default-1.3.8.6_2.6.27.19_5-1.x86_64.rpm
```

## Install Using KMOD RPM

The KMOD RPMs are provided for supported Linux distributions. The naming convention for the included RPMs is:

kmod-<driver name>-<version>-1.<arch type>.rpm

For example, kmod-ixgbevf-2.3.4-1.x86\_64.rpm:

- ixgbevf is the driver name
- 2.3.4 is the version
- x86\_64 is the architecture type

To install the KMOD RPM, go to the directory of the RPM and type the following command:

```
rpm -i <rpm filename>
```

For example, to install the ixgbevf KMOD RPM package from RHEL 6.4, type the following:

```
rpm -i kmod-ixgbevf-2.3.4-1.x86_64.rpm
```

## Command Line Parameters

If the driver is built as a module, the following optional parameters are used by entering them on the command line with the `modprobe` command using this syntax:

```
modprobe ixgbevf [<option>=<VAL1>,<VAL2>,...]
```


For example:

```
modprobe ixgbevf InterruptThrottleRate=16000,16000
```

The default value for each parameter is generally the recommended setting, unless otherwise noted.

The following table contains parameters and possible values for `modprobe` commands:

Parameter Name	Valid Range/Settings	Default	Description
InterruptThrottleRate	0, 1, 956 - 488,281 (0=off, 1=dynamic)	8000	<p>The driver can limit the number of interrupts per second that the adapter will generate for incoming packets. It does this by writing a value to the adapter that is based on the maximum number of interrupts that the adapter will generate per second.</p> <p>Setting <code>InterruptThrottleRate</code> to a value greater or equal to 100 will program the adapter to send out a maximum of that many interrupts per second, even if more packets have come in. This reduces interrupt load on the system and can lower CPU utilization under heavy load, but will increase latency as packets are not processed as quickly.</p> <p>The default behavior of the driver previously assumed a static <code>InterruptThrottleRate</code> value of 8000, providing a good fallback value for all traffic types, but lacking in small packet performance and latency. The hardware can handle many more small packets per second however, and for this reason an adaptive interrupt moderation algorithm was implemented.</p> <p>The driver has one adaptive mode (setting 1) in which it dynamically adjusts the <code>InterruptThrottleRate</code> value based on the traffic that it receives. After determining the type of incoming traffic in the last time frame, it will adjust the <code>InterruptThrottleRate</code> to an appropriate value for that traffic.</p> <p>The algorithm classifies the incoming traffic every interval into classes. Once the class is determined, the <code>InterruptThrottleRate</code> value is adjusted to suit that traffic type the best. There are three classes defined: "Bulk traffic", for large amounts of packets of normal size; "Low latency", for small amounts of traffic and/or a significant percentage of small packets; and "Lowest latency", for almost completely small packets or minimal traffic.</p> <p>In dynamic conservative mode, the <code>InterruptThrottleRate</code> value is set to 4000 for traffic that falls in class "Bulk traffic". If traffic falls in the "Low latency" or "Lowest latency" class, the <code>InterruptThrottleRate</code> is increased stepwise to 20000. This default mode is suitable for most applications.</p> <p>For situations where low latency is vital such as cluster or grid computing, the algorithm can reduce latency even more when <code>InterruptThrottleRate</code> is set to mode 1. In this mode, the <code>InterruptThrottleRate</code> will be increased stepwise to 70000 for traffic in class "Lowest latency".</p> <p>Setting <code>InterruptThrottleRate</code> to 0 turns off any interrupt moderation and may improve small packet latency, but is generally not suitable for bulk throughput traffic.</p>

Parameter Name	Valid Range/Settings	Default	Description
			 <b>NOTES:</b> <ul style="list-style-type: none"> <li>Dynamic interrupt throttling is only applicable to adapters operating in MSI or Legacy interrupt mode, using a single receive queue.</li> <li>When ixgbevf is loaded with default settings and multiple adapters are in use simultaneously, the CPU utilization may increase non-linearly. In order to limit the CPU utilization without impacting the overall throughput, it is recommended to load the driver as follows <pre>modprobe ixgbevf InterruptThrottleRate=3000,3000,3000</pre> <p>This sets the InterruptThrottleRate to 3000 interrupts/sec for the first, second, and third instances of the driver. The range of 2000 to 3000 interrupts per second works on a majority of systems and is a good starting point, but the optimal value will be platform-specific. If CPU utilization is not a concern, use default driver settings.</p> </li> </ul>



**NOTES:**

- For more information about the InterruptThrottleRate parameter, see the application note at <http://www.intel.com/design/network/applnotes/ap450.htm>.
- A descriptor describes a data buffer and attributes related to the data buffer. This information is accessed by the hardware.

## Additional Configurations

### Configuring the Driver on Different Distributions

Configuring a network driver to load properly when the system is started is distribution dependent. Typically, the configuration process involves adding an alias line to /etc/modules.conf or /etc/modprobe.conf as well as editing other system startup scripts and/or configuration files. Many Linux distributions ship with tools to make these changes for you. To learn the proper way to configure a network device for your system, refer to your distribution documentation. If during this process you are asked for the driver or module name, the name for the Linux Base Driver for the Intel® 10 Gigabit PCI Express Family of Adapters is ixgbevf.

### Viewing Link Messages

Link messages will not be displayed to the console if the distribution is restricting system messages. In order to see network driver link messages on your console, set dmesg to eight by entering the following:

```
dmesg -n 8
```



**NOTE:** This setting is not saved across reboots.

### ethtool

The driver uses the ethtool interface for driver configuration and diagnostics, as well as displaying statistical information. The latest ethtool version is required for this functionality.

The latest release of ethtool can be found at: <http://sourceforge.net/projects/gkernel>.

## MACVLAN

ixgbevf supports MACVLAN on those kernels that have the feature included. Kernel support for MACVLAN can be tested by checking if the MACVLAN driver is loaded. The user can run `'lsmod | grep macvlan'` to see if the MACVLAN driver is loaded or run `'modprobe macvlan'` to try to load the MACVLAN driver.

It may be necessary to update to a recent release of the iproute2 package to get support of MACVLAN via the 'ip' command.

## NAPI

NAPI (Rx polling mode) is supported in the ixgbevf driver and is always enabled. See <https://wiki.linux-foundation.org/networking/napi> for more information on NAPI.

## Known Issues



**NOTE:** After installing the driver, if your Intel network connection is not working, verify that you have installed the correct driver.

## Driver Compilation

When trying to compile the driver by running `make install`, the following error may occur: "Linux kernel source not configured - missing version.h"

To solve this issue, create the version.h file by going to the Linux source tree and entering:

```
make include/linux/version.h
```

## Multiple Interfaces on Same Ethernet Broadcast Network

Due to the default ARP behavior on Linux, it is not possible to have one system on two IP networks in the same Ethernet broadcast domain (non-partitioned switch) behave as expected. All Ethernet interfaces will respond to IP traffic for any IP address assigned to the system. This results in unbalanced receive traffic.

If you have multiple interfaces in a server, turn on ARP filtering by entering:

```
echo 1 > /proc/sys/net/ipv4/conf/all/arp_filter
```

(this only works if your kernel's version is higher than 2.4.5), or install the interfaces in separate broadcast domains.



**NOTE:** This setting is not saved across reboots. The configuration change can be made permanent by adding the line:

```
net.ipv4.conf.all.arp_filter= 1 to the file /etc/sysctl.conf  
or
```

install the interfaces in separate broadcast domains (either in different switches or in a switch partitioned to VLANs).

## MSI-X Issues with Kernels Between 2.6.19 and 2.6.21 (inclusive)

Kernel panics and instability may be observed on any MSI-X hardware if you use `irqbalance` with kernels between 2.6.19 and 2.6.21. If these types of problems are encountered, you may disable the `irqbalance` daemon or upgrade to a newer kernel.

## Rx Page Allocation Errors

Page allocation failure order:0 errors may occur under stress with kernels 2.6.25 and above. This is caused by the way the Linux kernel reports this stressed condition.





### **Host may Reboot after Removing PF when VF is Active in Guest**

If you are using kernel versions earlier than 3.2, do not unload the PF driver with active VFs. Doing this will cause your VFs to stop working until you reload the PF driver and may cause a spontaneous reboot of your system.



# i40e Linux\* Driver for the Intel X710 Ethernet Controller Family

## i40e Overview

	<b>NOTE:</b> The kernel assumes that TC0 is available, and will disable Priority Flow Control (PFC) on the device if TC0 is not available. To fix this, ensure TC0 is enabled when setting up DCB on your switch.
	<b>NOTE:</b> If the physical function (PF) link is down, you can force link up (from the host PF) on any virtual functions (VF) bound to the PF. Note that this requires kernel support (Redhat kernel 3.10.0-327 or newer, upstream kernel 3.11.0 or newer, and associated iproute2 user space support). If the following command does not work, it may not be supported by your system. The following command forces link up on VF 0 bound to PF eth0:  <code>ip link set eth0 vf 0 state enable</code>
	<b>NOTE:</b> Do not unload a port's driver if a Virtual Function (VF) with an active Virtual Machine (VM) is bound to it. Doing so will cause the port to appear to hang. Once the VM shuts down, or otherwise releases the VF, the command will complete.
	<b>NOTE:</b> In a virtualized environment, on Intel® Server Adapters that support SR-IOV, the virtual function (VF) may be subject to malicious behavior. Software-generated layer two frames, like IEEE 802.3x (link flow control), IEEE 802.1Qbb (priority based flow-control), and others of this type, are not expected and can throttle traffic between the host and the virtual switch, reducing performance. To resolve this issue, configure all SR-IOV enabled ports for VLAN tagging. This configuration allows unexpected, and potentially malicious, frames to be dropped.

The i40e Linux\* Base Driver for the X710/XL710 Ethernet Controller Family of Adapters supports the 2.6.32 and newer kernels, and includes support for Linux supported x86\_64 systems.

The following features are now available in supported kernels:

- VXLAN encapsulation
- Native VLANs
- Channel Bonding (teaming)
- Generic Receive Offload
- Data Center Bridging

Adapter teaming is now implemented using the native Linux Channel bonding module. This is included in supported Linux kernels. Channel Bonding documentation can be found in the Linux kernel source: /Documentation/networking/bonding.txt

Use ethtool, lspci, or iproute2's ip command to obtain driver information. Instructions on updating ethtool can be found in the [Additional Configurations](#) section.

## i40e Linux Base Driver Supported Devices

The following Intel network adapters are compatible with this driver:

- Intel® Ethernet 10G 4P X710-k bNDC
- Intel® Ethernet 10G 2P X710-k bNDC
- Intel® Ethernet 10G X710-k bNDC
- Intel® Ethernet Converged Network Adapter X710
- Intel® Ethernet Converged Network Adapter X710-T
- Intel® Ethernet 10G 4P X710/I350 rNDC
- Intel® Ethernet 10G 4P X710 SFP+ rNDC
- Intel® Ethernet 10G X710 rNDC
- Intel® Ethernet Server Adapter X710-DA2 for OCP
- Intel® Ethernet 40G 2P XL710 QSFP+ rNDC
- Intel® Ethernet Converged Network Adapter XL710-Q2
- Intel® Ethernet 25G 2P XXV710 Adapter
- Intel® Ethernet 25G 2P XXV710 Mezz

## SFP+ Devices with Pluggable Optics

 **NOTE:** For SFP+ fiber adapters, using "ifconfig down" turns off the laser. "ifconfig up" turns the laser on.

See [SFP+ and QSFP+ Devices](#) for more information.

## Building and Installation

There are three methods for installing the Linux driver:

- [Install from Source Code](#)
- [Install Using KMP RPM](#)
- [Install Using KMOD RPM](#)

### Install from Source Code

To build a binary RPM\* package of this driver, run 'rpmbuild -tb <filename.tar.gz>'. Replace <filename.tar.gz> with the specific filename of the driver.

#### **NOTES:**

- For the build to work properly it is important that the currently running kernel MATCH the version and configuration of the installed kernel source. If you have just recompiled your kernel, reboot the system.
- RPM functionality has only been tested in Red Hat distributions.

1. Download the base driver tar file to the directory of your choice. For example, use '/home/username/i40e' or '/usr/local/src/i40e'.
2. Untar/unzip the archive, where <x.x.x> is the version number for the driver tar:

```
tar xzf i40e-<x.x.x>.tar.gz
```

3. Change to the driver src directory, where <x.x.x> is the version number for the driver tar:

```
cd i40e-<x.x.x>/src/
```

4. Compile the driver module:

```
make install
```

The binary will be installed as: /lib/modules/<KERNEL VERSION>/kernel/drivers/net/i40e/i40e.ko


The install locations listed above are the default locations. This might differ for various Linux distributions. For more information, see the ldistrib.txt file included in the driver tar.

5. Install the module using the modprobe command:

```
modprobe i40e <parameter>=<value>
```

Make sure that the older i40e drivers are removed from the kernel, before loading the new module:

```
rmmmod i40e; modprobe i40e
```

 **NOTE:**For RHEL 7.5 or later, you must unload the i40iw driver before removing older i40e drivers.


6. Assign an IP address to and activate the Ethernet interface by entering the following, where <ethx> is the interface name:

```
ifconfig <ethx> <IP_address> netmask <netmask> up
```

7. Verify that the interface works. Enter the following, where <IP\_address> is the IP address for another machine on the same subnet as the interface that is being tested:

```
ping <IP_address>
```

### Install Using KMP RPM

 **NOTE:** KMP is only supported on SLES11 and newer.

The KMP RPMs update existing i40e RPMs currently installed on the system. These updates are provided by SuSE in the SLES release. If an RPM does not currently exist on the system, the KMP will not install.

The RPMs are provided for supported Linux distributions. The naming convention for the included RPMs is:

```
intel-<component name>-<component version>.<arch type>.rpm
```

For example, intel-i40e-1.3.8.6-1.x86\_64.rpm:i40e is the component name; 1.3.8.6-1 is the component version; and x86\_64 is the architecture type.

KMP RPMs are provided for supported Linux distributions. The naming convention for the included KMP RPMs is:

```
intel-<component name>-kmp-<kernel type>-<component version>_<kernel version>.<arch type>.rpm
```

For example, intel-i40e-kmp-default-1.3.8.6\_2.6.27.19\_5-1.x86\_64.rpm:i40e is the component name; default is the kernel type; 1.3.8.6 is the component version; 2.6.27.19\_5-1 is the kernel version; and x86\_64 is the architecture type.

To install the KMP RPM, type the following two commands:

```
rpm -i <rpm filename>
rpm -i <kmp rpm filename>
```

For example, to install the i40e KMP RPM package, type the following:

```
rpm -i intel-i40e-1.3.8.6-1.x86_64.rpm
rpm -i intel-i40e-kmp-default-1.3.8.6_2.6.27.19_5-1.x86_64.rpm
```

## Install Using KMOD RPM

The KMOD RPMs are provided for supported Linux distributions. The naming convention for the included RPMs is:

```
kmod-<driver name>-<version>-1.<arch type>.rpm
```

For example, kmod-i40e-2.3.4-1.x86\_64.rpm:

- i40e is the driver name
- 2.3.4 is the version
- x86\_64 is the architecture type

To install the KMOD RPM, go to the directory of the RPM and type the following command:

```
rpm -i <rpm filename>
```

For example, to install the i40e KMOD RPM package from RHEL 6.4, type the following:

```
rpm -i kmod-i40e-2.3.4-1.x86_64.rpm
```

## Command Line Parameters

In general, ethtool and other OS specific commands are used to configure user changeable parameters after the driver is loaded. The i40e driver only supports the max\_vfs kernel parameter on older kernels that do not have the standard sysfs interface. The only other module parameter is the debug parameter that can control the default logging verbosity of the driver.

If the driver is built as a module, the following optional parameters are used by entering them on the command line with the modprobe command using this syntax:

```
modprobe i40e [<option>=<VAL1>]
```


For example:




```
modprobe i40e max_vfs=7
```

The default value for each parameter is generally the recommended setting, unless otherwise noted.

The following table contains parameters and possible values for modprobe commands:


Parameter Name	Valid Range/Settings	Default	Description
max_vfs	1 - 63	0	This parameter adds support for SR-IOV. It causes the driver to spawn up to max_vfs worth of virtual function.

Parameter Name	Valid Range/Settings	Default	Description
			<p> <b>NOTES:</b></p> <ul style="list-style-type: none"> <li>This parameter is only used on kernel 3.7.x and below. On kernel 3.8.x and above, use sysfs to enable VFs. Also, for Red Hat distributions, this parameter is only used on version 6.6 and older. For version 6.7 and newer, use sysfs. For example: <pre>#echo \$num_vf_enabled &gt; /sys/class/net/\$dev/device/sriov_numvfs</pre> <pre>//enable VFs</pre> <pre>#echo 0 &gt; /sys/class/net/\$dev/device/sriov_numvfs</pre> <pre>//disable VFs</pre> </li> <li>When either SR-IOV mode is enabled, hardware VLAN filtering and VLAN tag stripping/insertion will remain enabled. Please remove the old VLAN filter before the new VLAN filter is added. For example: <pre>ip link set eth0 vf 0 vlan 100</pre> <pre>// set vlan 100 for VF 0</pre> <pre>ip link set eth0 vf 0 vlan 0</pre> <pre>// Delete vlan 100</pre> <pre>ip link set eth0 vf 0 vlan 200</pre> <pre>// set a new vlan 200 for VF 0</pre> </li> </ul> <p>The parameters for the driver are referenced by position. Thus, if you have a dual port adapter, or more than one adapter in your system, and want N virtual functions per port, you must specify a number for each port with each parameter separated by a comma. For example:</p> <pre>modprobe i40e max_vfs=4</pre> <p>This will spawn 4 VFs on the first port.</p> <pre>modprobe i40e max_vfs=2,4</pre> <p>This will spawn 2 VFs on the first port and 4 VFs on the second port.</p> <p>Caution must be used in loading the driver with these parameters. Depending on your system configuration, number of slots, etc., it is impossible to predict in all cases where the positions would be on the command line.</p> <p>Neither the device nor the driver control how VFs are mapped into config space. Bus layout will vary by operating system. On operating systems that support it, you can check sysfs to find the mapping.</p> <p>Some hardware configurations support fewer SR-IOV instances, as the whole XL710 controller (all functions) is limited to 128 SR-IOV interfaces in total.</p>
VLAN Tag Packet Steering			<p>Allows you to send all packets with a specific VLAN tag to a particular SR-IOV virtual function (VF). Further, this feature allows you to designate a particular VF as trusted, and allows that trusted VF to request selective promiscuous mode on the Physical Function (PF).</p> <p>To set a VF as trusted or untrusted, enter the following command in the Hypervisor:</p> <pre># ip link set dev eth0 vf 1 trust [on off]</pre>

Parameter Name	Valid Range/Settings	Default	Description
			<p>Once the VF is designated as trusted, use the following commands in the VM to set the VF to promiscuous mode.</p> <p>For promiscuous all: #ip link set eth2 promisc on</p> <p>Where eth2 is a VF interface in the VM</p> <p>For promiscuous Multicast:</p> <p>#ip link set eth2 allmulticast on</p> <p>Where eth2 is a VF interface in the VM</p> <p> <b>NOTE:</b> By default, the ethtool priv-flag vf-true-promisc-support is set to "off", meaning that promiscuous mode for the VF will be limited. To set the promiscuous mode for the VF to true promiscuous and allow the VF to see all ingress traffic, use the following command.</p> <p>#ethtool -set-priv-flags p261p1 vf-true-promisc-support on</p> <p>The vf-true-promisc-support priv-flag does not enable promiscuous mode; rather, it designates which type of promiscuous mode (limited or true) you will get when you enable promiscuous mode using the ip link commands above. Note that this is a global setting that affects the entire device. However, the vf-true-promisc-support priv-flag is only exposed to the first PF of the device. The PF remains in limited promiscuous mode (unless it is in MFP mode) regardless of the vf-true-promisc-support setting.</p> <p>Now add a VLAN interface on the VF interface.</p> <p>#ip link add link eth2 name eth2.100 type vlan id 100</p> <p>Note that the order in which you set the VF to promiscuous mode and add the VLAN interface does not matter (you can do either first). The end result in this example is that the VF will get all traffic that is tagged with VLAN 100.</p>
Intel® Ethernet Flow Director			<p> <b>NOTE:</b> Flow director parameters are only supported on kernel versions 2.6.30 or later. Flow control in 1 Gbps mode on these devices can lead to transmit hangs.</p> <p>The Flow Director performs the following tasks:</p> <ul style="list-style-type: none"> <li>• Directs receive packets according to their flows to different queues.</li> <li>• Enables tight control on routing a flow in the platform.</li> <li>• Matches flows and CPU cores for flow affinity.</li> <li>• Supports multiple parameters for flexible flow classification and load balancing (in SFP mode only).</li> </ul> <p> <b>NOTES:</b></p> <ul style="list-style-type: none"> <li>• An included script (set_irq_affinity) automates setting the IRQ to CPU affinity.</li> <li>• The Linux i40e driver supports the following flow types: IPv4, TCPv4, and UDPv4. For a given flow type, it supports valid combinations of IP addresses (source or destination) and UDP/TCP ports (source and destination). For example, you can supply only a source IP address, a source IP address and a destination port, or any combination of one or more of these four para-</li> </ul>

Parameter Name	Valid Range/Settings	Default	Description
			<p>           meters.           <ul style="list-style-type: none"> <li>The Linux i40e driver allows you to filter traffic based on a user-defined flexible two-byte pattern and offset by using the ethtool user-def and mask fields. Only L3 and L4 flow types are supported for user-defined flexible filters. For a given flow type, you must clear all Flow Director filters before changing the input set (for that flow type).</li> </ul> </p> <p>Other ethtool Commands:</p> <p>To enable/disable Flow Director</p> <pre>ethtool -K ethX ntuple &lt;on off&gt;</pre> <p>If you disable ntuple filters, all the user programmed filters are flushed from the driver cache and HW. You must recreate the filters when ntuple is re-enabled.</p> <p>To add a filter that directs packet to queue 2, use the -U or -N switch. e.g.,</p> <pre># ethtool -N ethX flow-type tcp4 src-ip 192.168.10.1 dst-ip \ 192.168.10.2 src-port 2000 dst-port 2001 action 2 [loc 1]</pre> <p>To set a filter using only the source and destination IP address:</p> <pre># ethtool -N ethX flow-type tcp4 src-ip 192.168.10.1 dst-ip \ 192.168.10.2 action 2 [loc 1]</pre> <p>To set a filter based on a user defined pattern and offset:</p> <pre># ethtool -N ethX flow-type tcp4 src-ip 192.168.10.1 dst-ip \ 192.168.10.2 user-def 0xffffffff00000001 m 0x40 action 2 [loc 1]</pre> <p>where the value of the user-def field (0xffffffff00000001) is the pattern and m 0x40 is the offset.</p> <p>Note that in this case the mask (m 0x40) parameter is used with the user-def field, whereas for cloud filter support the mask parameter is not used.</p> <p><b>ATR (application Targeted Routing) Perfect Filter:</b></p> <p>ATR is enabled by default when the kernel is in multiple TX queue mode. An ATR flow director filter rule is added when a TCP-IP flow starts and is deleted when the flow ends. When a TCP-IP Flow Director rule is added from ethtool (Sideband filter), ATR is turned off by the driver. In order to re-enable ATR the user can disable side-band by ethtool -K option. If sideband is re-enabled after this, ATR will remain enabled until a TCP-IP flow is added.</p> <p><b>Sideband Perfect filters</b></p> <p>Sideband Perfect Filters are used to direct traffic that matches specified characteristics. They are enabled through ethtool's ntuple interface. To add a new filter use the following command:</p>

Parameter Name	Valid Range/Settings	Default	Description
			<pre>ethtool -U &lt;device&gt; flow-type &lt;type&gt; src-ip &lt;ip&gt; dst-ip &lt;ip&gt; src-port &lt;port&gt; dst-port &lt;port&gt; action &lt;queue&gt;</pre> <p>Where:</p> <p>&lt;device&gt; - the ethernet device to program</p> <p>&lt;type&gt; - can be ip4, tcp4, udp4, or sctp4</p> <p>&lt;ip&gt; - the ip address to match on</p> <p>&lt;port&gt; - the port number to match on</p> <p>&lt;queue&gt; - the queue to direct traffic towards (-1 discards the matched traffic)</p> <p>Use the following command to display all of the active filters:</p> <pre>ethtool -u &lt;device&gt;</pre> <p>Use the following command to delete a filter:</p> <pre>ethtool -U &lt;device&gt; delete &lt;N&gt;</pre> <p>&lt;N&gt; is the filter id displayed when printing all the active filters, and may also have been specified using "loc &lt;N&gt;" when adding the filter.</p> <p>The following example matches TCP traffic sent from 192.168.0.1, port 5300, directed to 192.168.0.5, port 80, and sends it to queue 7:</p> <pre>ethtool -U enp130s0 flow-type tcp4 src-ip 192.168.0.1 dst-ip 192.168.0.5 src-port 5300 dst-port 7 action 7</pre> <p>For each flow-type, the programmed filters must all have the same matching input set. For example, issuing the following two commands is acceptable:</p> <pre>ethtool -U enp130s0 flow-type ip4 src-ip 192.168.0.1 src-port 5300 action 7</pre> <pre>ethtool -U enp130s0 flow-type ip4 src-ip 192.168.0.5 src-port 55 action 10</pre> <p>Issuing the next two commands, however, is not acceptable, since the first specifies src-ip and the second specifies dst-ip:</p> <pre>ethtool -U enp130s0 flow-type ip4 src-ip 192.168.0.1 src-port 5300 action 7</pre> <pre>ethtool -U enp130s0 flow-type ip4 dst-ip 192.168.0.5 src-port 55 action 10</pre> <p>The second command will fail with an error. You may program multiple filters with the same fields, using different values, but, on one device, you may not program two tcp4 filters with different matching fields.</p> <p>Matching on a sub-portion of a field is not supported by the i40e driver, thus partial mask fields are not supported.</p> <p>The driver also supports matching user-defined data within the packet payload.</p> <p>This flexible data is specified using the "user-def" field of the ethtool command in the following way:</p>

Parameter Name	Valid Range/Settings	Default	Description				
			<table border="1" data-bbox="716 184 1455 285"> <tr> <td data-bbox="716 184 1110 233">31 28 24 20 16</td> <td data-bbox="1110 184 1455 233">15 12 8 4 0</td> </tr> <tr> <td data-bbox="716 233 1110 285">offset into packet payload</td> <td data-bbox="1110 233 1455 285">2 bytes of flexible data</td> </tr> </table> <p data-bbox="716 310 1468 1486"> For example,  ... user-def 0x4FFFF ...  tells the filter to look 4 bytes into the payload and match that value against 0xFFFF. The offset is based on the beginning of the payload, and not the beginning of the packet. Thus  flow-type tcp4 ... user-def 0x8BEAF ...  would match TCP/IPv4 packets which have the value 0xBEAF 8 bytes into the TCP/IPv4 payload.  Note that ICMP headers are parsed as 4 bytes of header and 4 bytes of payload. Thus to match the first byte of the payload, you must actually add 4 bytes to the offset. Also note that ip4 filters match both ICMP frames as well as raw (unknown) ip4 frames, where the payload will be the L3 payload of the IP4 frame.  The maximum offset is 64. The hardware will only read up to 64 bytes of data from the payload. The offset must be even because the flexible data is 2 bytes long and must be aligned to byte 0 of the packet payload.  The user-defined flexible offset is also considered part of the input set and cannot be programmed separately for multiple filters of the same type. However, the flexible data is not part of the input set and multiple filters may use the same offset but match against different data.  To create filters that direct traffic to a specific Virtual Function, use the "action" parameter. Specify the action as a 64 bit value, where the lower 32 bits represents the queue number, while the next 8 bits represent which VF. Note that 0 is the PF, so the VF identifier is offset by 1. For example:  ... action 0x80000002 ...  specifies to direct traffic to Virtual Function 7 (8 minus 1) into queue 2 of that VF.  Note that these filters will not break internal routing rules, and will not route traffic that otherwise would not have been sent to the specified Virtual Function. </p>	31 28 24 20 16	15 12 8 4 0	offset into packet payload	2 bytes of flexible data
31 28 24 20 16	15 12 8 4 0						
offset into packet payload	2 bytes of flexible data						
Cloud Filter Support			<p data-bbox="716 1507 1468 1774"> On a complex network that supports multiple types of traffic (such as for storage as well as cloud), cloud filter support allows you to send one type of traffic (for example, the storage traffic) to the Physical Function (PF) and another type (say, the cloud traffic) to a Virtual Function (VF). Because cloud networks are typically VXLAN/Geneve-based, you can define a cloud filter to identify VXLAN/Geneve packets and send them to a queue in the VF to be processed by the virtual machine (VM). Similarly, other cloud filters can be designed for various other traffic tunneling. </p> <p data-bbox="716 1785 1468 1879">  <b>NOTES:</b> <ul style="list-style-type: none"> <li>Cloud filters are only supported when the underlying device is in Single Function per Port mode.</li> </ul> </p>				



Parameter Name	Valid Range/Settings	Default	Description
			<ul style="list-style-type: none"> <li>• The "action -1" option, which drops matching packets in regular Flow Director filters, is not available to drop packets when used with cloud filters.</li> <li>• For IPv4 and ether flow-types, cloud filters cannot be used for TCP or UDP filters.</li> <li>• Cloud filters can be used as a method for implementing queue splitting in the PF.</li> </ul> <p>The following filters are supported:</p> <p>Cloud Filters</p> <ul style="list-style-type: none"> <li>• Inner MAC, Inner VLAN (for NVGRE, VXLAN or Geneve packets)</li> <li>• Inner MAC, Inner VLAN, Tenant ID (for NVGRE, VXLAN or Geneve packets)</li> <li>• Inner MAC, Tenant ID (NVGRE packet or VXLAN/Geneve packets)</li> <li>• Outer MAC L2 filter</li> <li>• Inner MAC filter</li> <li>• Outer MAC, Tenant ID, Inner MAC</li> <li>• Application Destination IP</li> <li>• Application Source-IP, Inner MAC</li> <li>• ToQueue: Use MAC, VLAN to point to a queue</li> </ul> <p>L3 filters</p> <ul style="list-style-type: none"> <li>• Application Destination IP</li> </ul> <p>Cloud filters are specified using ethtool's ntuple interface, but the driver uses user-def to determine whether to treat the filter as a cloud filter or a regular filter. To enable a cloud filter, set the highest bit of the user-def field, "user-def 0x8000000000000000" to enable the cloud features described below. This specifies to the driver to treat the filter specially and not treat it like the regular filters described above. Note that cloud filters also read the other bits in the user-def field separately so you cannot use the flexible data feature described above.</p> <p>For regular Flow Director filters:</p> <ul style="list-style-type: none"> <li>- No user-def specified or highest bit (bit 63) is 0</li> </ul> <p>Example:</p> <pre>ethtool -U enp130s0 flow-type ip4 src-ip 192.168.0.1 dst-ip 192.168.0.109 action 6 loc</pre> <p>For L3 filters (non-tunneled packets):</p> <ul style="list-style-type: none"> <li>- "user-def 0x8000000000000000" (no Tenant ID/VNI specified in remaining bits of the user-def field)</li> <li>- Only L3 parameters (src-IP, dst-IP) are considered</li> </ul> <p>Example:</p> <pre>ethtool -U enp130s0 flow-type ip4 src-ip 192.168.42.13 dst-ip 192.168.42.33 / src-port 12344 dst-port 12344 user-def 0x8000000000000000 action / 0x200000000 loc 3</pre> <p>Redirect traffic coming from 192.168.42.13 port 12344 with destination 192.168.42.33 port 12344 into VF id 1, and call this "rule 3"</p>

Parameter Name	Valid Range/Settings	Default	Description
			<p>For cloud filters (tunneled packets):</p> <ul style="list-style-type: none"> <li>• All other filters, including where Tenant ID/VNI is specified.</li> <li>• The lower 32 bits of the user-def field can carry the tenant ID/VNI if required.</li> <li>• The VF can be specified using the "action" field, just as regular filters described in the Flow director Filter section above.</li> <li>• Cloud filters can be defined with inner MAC, outer MAC, inner IP address, inner VLAN, and VNI as part of the cloud tuple. Cloud filters filter on destination (not source) MAC and IP. The destination and source MAC address fields in the ethtool command are overloaded as dst = outer, src = inner MAC address to facilitate tuple definition for a cloud filter.</li> <li>• The 'loc' parameter specifies the rule number of the filter as being stored in the base driver</li> </ul> <p>Example:</p> <pre>ethtool -U enp130s0 flow-type ether dst 8b:9d:ed:6a:ce:43 src 1d:44:9d:54:da:de user-def 0x80000000000000022 loc 38 action 0x200000000</pre> <p>Redirect traffic on VXLAN using tunnel id 34 (hex 0x22) coming from outer MAC address 8b:9d:ed:6a:ce:43 and inner MAC address 1d:44:9d:54:da:de into VF id 1 and call this "rule 38".</p>

## Additional Configurations

### Configuring the Driver on Different Distributions

Configuring a network driver to load properly when the system is started is distribution dependent. Typically, the configuration process involves adding an alias line to `/etc/modules.conf` or `/etc/modprobe.conf` as well as editing other system startup scripts and/or configuration files. Many Linux distributions ship with tools to make these changes for you. To learn the proper way to configure a network device for your system, refer to your distribution documentation. If during this process you are asked for the driver or module name, the name for the Linux Base Driver for the Intel® 10 Gigabit PCI Express Family of Adapters is `i40e`.

### Viewing Link Messages

Link messages will not be displayed to the console if the distribution is restricting system messages. In order to see network driver link messages on your console, set `dmesg` to eight by entering the following:

```
dmesg -n 8
```



**NOTE:** This setting is not saved across reboots.

### Jumbo Frames

Jumbo Frames support is enabled by changing the MTU to a value larger than the default of 1500 bytes. The maximum value for the MTU is 9710. Use the `ifconfig` command to increase the MTU size. For example, enter the following where `<x>` is the interface number:

```
ifconfig ethx mtu 9000 up
```

This setting is not saved across reboots. The setting change can be made permanent by adding `MTU = 9000` to the file `/etc/sysconfig/network-scripts/ifcfg-eth<x>` for RHEL or to the file `/etc/sysconfig/network/<config_file>` for SLES.

The maximum MTU setting for Jumbo Frames is 9702. This value coincides with the maximum Jumbo Frames size of 9728. This driver will attempt to use multiple page sized buffers to receive each jumbo packet. This should help to avoid buffer starvation issues when allocating receive packets.

## ethtool

The driver uses the ethtool interface for driver configuration and diagnostics, as well as displaying statistical information. The latest ethtool version is required for this functionality.

The latest release of ethtool can be found at: <http://sourceforge.net/projects/gkernel>.

## Firmware LLDP Agent

On 710 Series devices, there is a Link Layer Discovery Protocol (LLDP) agent that runs in the firmware. When it is running, it prevents OS applications from receiving LLDP traffic from the network adapter. When firmware and drivers from Intel NIC Family Version 18.5.0 or newer is being used, the LLDP agent in firmware can be disabled by using a private flag with ethtool. DCB and NPAR must be disabled for the setting to take effect. To disable the LLDP agent in firmware with ethtool, run "ethtool --set-priv-flags <interface name> disable-fw-lldp on". To enable the LLDP agent in firmware with ethtool, run "ethtool --set-priv-flags <interface name> disable-fw-lldp off". The change is not persistent across reboots.

## NAPI

NAPI (Rx polling mode) is supported in the i40e driver.

See <https://wiki.linuxfoundation.org/networking/napi> for more information on NAPI.

## Flow Control

Flow control is disabled by default. To enable it, use ethtool:

```
ethtool -A eth? autoneg off rx on tx on
```



**NOTE:** You must have a flow control capable link partner.

## RSS Hash Flow

Allows you to set the hash bytes per flow type and any combination of one or more options for Receive Side Scaling (RSS) hash byte configuration.

```
#ethtool -N <dev> rx-flow-hash <type> <option>
```

Where <type> is:

- tcp4 signifying TCP over IPv4
- udp4 signifying UDP over IPv4
- tcp6 signifying TCP over IPv6
- udp6 signifying UDP over IPv6

And <option> is one or more of:

- s Hash on the IP source address of the rx packet.
- d Hash on the IP destination address of the rx packet.
- f Hash on bytes 0 and 1 of the Layer 4 header of the rx packet.
- n Hash on bytes 2 and 3 of the Layer 4 header of the rx packet.

## MAC and VLAN Anti-spoofing Feature

When a malicious driver attempts to send a spoofed packet, it is dropped by the hardware and not transmitted. An interrupt is sent to the PF driver notifying it of the spoof attempt. When a spoofed packet is detected the PF driver will send the following message to the system log (displayed by the "dmesg" command):

```
i40e ethx: i40e_spoof_check: n spoofed packets detected
```

Where x=the PF interface# and n=the VF that attempted to do the spoofing.



**NOTE:** This feature can be disabled for a specific Virtual Function (VF).

## IEEE 1588 Precision Time Protocol (PTP) Hardware Clock (PHC)

Precision Time Protocol (PTP) is used to synchronize clocks in a computer network. PTP support varies among Intel devices that support this driver.

Use "ethtool -T <netdev name>" to get a definitive list of PTP capabilities supported by the device.

## VXLAN Overlay HW Offloading

The i40e Linux driver features VXLAN Overlay HW Offloading support. The following two commands are used to view and configure VXLAN on a VXLAN-overlay offload enabled device.

This command displays the offloads and their current state:

```
# ethtool -k ethX
```

This command enables/disables VXLAN support in the driver.

```
# ethtool -K ethX tx-udp_tnl-segmentation [off|on]
```

For more information on configuring your network for VXLAN overlay support, refer to the Intel Technical Brief, "Creating Overlay Networks Using Intel Ethernet Converged Network Adapters" (Intel Networking Division, August 2013): <http://www.intel.com/content/dam/www/public/us/en/documents/technology-briefs/overlay-networks-using-converged-network-adapters-brief.pdf>

## Data Center Bridging (DCB)

DCB is a configuration Quality of Service implementation in hardware. It uses the VLAN priority tag (802.1p) to filter traffic. That means that there are 8 different priorities that traffic can be filtered into. It also enables priority flow control (802.1Qbb) which can limit or eliminate the number of dropped packets during network stress. Bandwidth can be allocated to each of these priorities, which is enforced at the hardware level (802.1Qaz).

Adapter firmware implements LLDP and DCBX protocol agents as per 802.1AB and 802.1Qaz respectively. The firmware based DCBX agent runs in willing mode only and can accept settings from a DCBX capable peer. Software configuration of DCBX parameters via dcbtool/lldptool are not supported.



**NOTE:** Firmware LLDP can be disabled by setting the private flag disable-fw-lldp.

The driver implements the DCB netlink interface layer to allow user-space to communicate with the driver and query DCB configuration for the port.

## Performance Optimization

The driver defaults are meant to fit a wide variety of workloads. If further optimization is required, we recommend experimenting with the following settings.

Pin the adapter's IRQs to specific cores by disabling the irqbalance service and running the included set\_irq\_affinity script.

The following settings will distribute the IRQs across all the cores evenly:

```
# scripts/set_irq_affinity -x all <interface1> , [ <interface2>, ... ]
```

The following settings will distribute the IRQs across all the cores that are local to the adapter (same NUMA node):

```
# scripts/set_irq_affinity -x local <interface1> , [ <interface2>, ... ]
```

Please see the script's help text for further options.

For very CPU intensive workloads, we recommend pinning the IRQs to all cores.

For IP Forwarding: Disable Adaptive ITR and lower rx and tx interrupts per queue using ethtool. Setting rx-usecs and tx-usecs to 125 will limit interrupts to about 8000 interrupts per second per queue.

```
# ethtool <interface> adaptive-rx off adaptive-tx off rx-usecs 125 tx-usecs 125
```

For lower CPU utilization: Disable Adaptive ITR and lower rx and tx interrupts per queue using ethtool. Setting rx-usecs and tx-usecs to 250 will limit interrupts to about 4000 interrupts per second per queue.

```
# ethtool <interface> adaptive-rx off adaptive-tx off rx-usecs 250 tx-usecs 250
```

For lower latency: Disable Adaptive ITR and ITR by setting rx and tx to 0 using ethtool.

```
# ethtool <interface> adaptive-rx off adaptive-tx off rx-usecs 0 tx-usecs 0
```

## Known Issues

### **X710/XXV710 devices fail to enable MAX VFs when NPAR and SR-IOV are enabled**

X710/XXV710 devices fail to enable Max VFs (64) when NPAR and SR-IOV are enabled. An error from i40e is logged that says "add vsi failed for VF N, aq\_err 16". To workaround the issue, enable less than 64 virtual functions (VFs).

### **ip link show command shows incorrect VF MAC if VF MAC was set from VF side**

Executing the command "ip link show" only shows MAC addresses if they are set by the PF. Otherwise, it shows all zeros.

This is expected behavior. The PF driver is passing zeroes to the VF driver that the VF driver can generate its own random MAC address and report it to the guest OS. Without this feature, some guest operating systems will incorrectly assign the VF a new interface name each time they reboot.

### **SSL error (No such file) when installing driver on Ubuntu 14.04**

When installing the driver on Ubuntu 14.04, you may get an SSL error stating "no such file or directory." This issue does not affect driver installation or performance and can be ignored.

### **IPv6/UDP checksum offload does not work on some older kernels**

Some distributions with older kernels do not properly enable IPv6/UDP checksum offload. To use IPv6 checksum offload, it may be necessary to upgrade to a newer kernel.

### **Poor performance when using VXLAN encapsulation**

When using VXLAN encapsulation on Red Hat Enterprise Linux 7.2 and 7.3, you may experience poor performance due to limitations in the kernel on these OS releases. To resolve this issue, upgrade your kernel.

### **depmod warning messages about unknown symbol during installation**

During driver installation, you may see depmod warning messages referring to unknown symbols i40e\_register\_client and i40e\_unregister\_client. These messages are informational only; no user action is required. The installation should complete successfully.

### **Error: <ifname> selects TX queue XX but real number of TX queues is YY**

When configuring the number of queues under heavy traffic load, you may see an error message stating "<ifname> selects TX queue XX, but real number of TX queues is YY". This message is informational only and does not affect functionality.

## Windows Server 2016 Does Not Work as a Guest OS on Older RHEL and SLES KVMs

Microsoft\* Windows Server\* 2016 does not work as a guest operating system on the KVM hypervisor version included with Red Hat\* Enterprise Linux\* (RHEL) version 6.8 and Suse\* Linux Enterprise Server (SLES) version 11.4. Windows Server 2016 does work as a guest OS on RHEL 7.2 and SLES 12.1.

## Fixing Performance Issues When Using IOMMU in Virtualized Environments

The IOMMU feature of the processor prevents I/O devices from accessing memory outside the boundaries set by the OS. It also allows devices to be directly assigned to a Virtual Machine. However, IOMMU may affect performance, both in latency (each DMA access by the device must be translated by the IOMMU) and in CPU utilization (each buffer assigned to every device must be mapped in the IOMMU).

If you experience significant performance issues with IOMMU, try using it in "passthrough" mode by adding the following to the kernel boot command line:

```
intel_iommu=on iommu=pt
```



**NOTE:** This mode enables remapping for assigning devices to VMs, providing near-native I/O performance, but does not provide the additional memory protection.

## Transmit hangs leading to no traffic

Disabling flow control while the device is under stress may cause tx hangs and eventually lead to the device no longer passing traffic. You must reboot the system to resolve this issue.

## Incomplete messages in the system log

The NVMMUpdate utility may write several incomplete messages in the system log.

These messages take the form:

```
in the driver Pci Ex config function byte index 114
```

```
in the driver Pci Ex config function byte index 115
```

These messages can be ignored.

## Bad checksum counter incorrectly increments when using VxLAN

When passing non-UDP traffic over a VxLAN interface, the port.rx\_csum\_bad counter increments for the packets.

## Statistic counters reset when promiscuous mode is changed

Changing promiscuous mode triggers a reset of the physical function driver. This will reset the statistic counters.

## Virtual machine does not get link

If the virtual machine has more than one virtual port assigned to it, and those virtual ports are bound to different physical ports, you may not get link on all of the virtual ports. The following command may work around the issue:

```
ethtool -r <PF>
```

Where <PF> is the PF interface in the host, for example: p5p1. You may need to run the command more than once to get link on all virtual ports.

## MAC address of Virtual Function changes unexpectedly

If a Virtual Function's MAC address is not assigned in the host, then the VF (virtual function) driver will use a random MAC address. This random MAC address may change each time the VF driver is reloaded. You can assign a static MAC address in the host machine. This static MAC address will survive a VF driver reload.

## Changing the number of Rx or Tx queues with ethtool -L may cause a kernel panic

Changing the number of Rx or Tx queues with ethtool -L while traffic is flowing and the interface is up may cause a kernel panic. Bring the interface down first to avoid the issue. For example:

```
ip link set ethx down  
ethtool -L ethx combined 4
```

## Adding a Flow Director Sideband rule fails incorrectly

If you try to add a Flow Director rule when no more sideband rule space is available, i40e logs an error that the rule could not be added, but ethtool returns success. You can remove rules to free up space. In addition, remove the rule that failed. This will evict it from the driver's cache.

## Flow Director Sideband Logic adds duplicate filter

The Flow Director Sideband Logic adds a duplicate filter in the software filter list if the location is not specified or the specified location differs from the previous location but has the same filter criteria. In this case, the second of the two filters that appear is the valid one in hardware and it decides the filter action.

## Multiple Interfaces on Same Ethernet Broadcast Network

Due to the default ARP behavior on Linux, it is not possible to have one system on two IP networks in the same Ethernet broadcast domain (non-partitioned switch) behave as expected. All Ethernet interfaces will respond to IP traffic for any IP address assigned to the system. This results in unbalanced receive traffic.

If you have multiple interfaces in a server, either turn on ARP filtering by entering:

```
echo 1 > /proc/sys/net/ipv4/conf/all/arp_filter
```

This only works if your kernel's version is higher than 2.4.5.



**NOTE:** This setting is not saved across reboots. The configuration change can be made permanent by adding the following line to the file /etc/sysctl.conf:

```
net.ipv4.conf.all.arp_filter = 1
```

Another alternative is to install the interfaces in separate broadcast domains (either in different switches or in a switch partitioned to VLANs).

## UDP Stress Test Dropped Packet Issue

Under small packet UDP stress with the i40e driver, the system may drop UDP packets due to socket buffers being full. Setting the driver Flow Control variables to the minimum may resolve the issue. You may also try increasing the kernel's default buffer sizes by changing the values in /proc/sys/net/core/rmem\_default and rmem\_max

## Unplugging Network Cable While ethtool -p is Running

In kernel versions 2.6.32 and newer, unplugging the network cable while ethtool -p is running will cause the system to become unresponsive to keyboard commands, except for control-alt-delete. Restarting the system appears to be the only remedy.

## Rx Page Allocation Errors

'Page allocation failure. order:0' errors may occur under stress with kernels 2.6.25 and newer.

This is caused by the way the Linux kernel reports this stressed condition.

## Lower than expected performance

Some PCIe x8 slots are actually configured as x4 slots. These slots have insufficient bandwidth for full line rate with dual port and quad port devices. In addition, if you put a PCIe Generation 3-capable adapter into a PCIe Generation 2 slot, you cannot get full bandwidth. The driver detects this situation and writes the following message in the system log:

"PCI-Express bandwidth available for this card is not sufficient for optimal performance. For optimal performance a x8 PCI-Express slot is required."

If this error occurs, moving your adapter to a true PCIe Generation 3 x8 slot will resolve the issue.

## **ethtool may incorrectly display SFP+ fiber module as direct attached cable**

Due to kernel limitations, port type can only be correctly displayed on kernel 2.6.33 or greater.

## **Running ethtool -t ethX command causes break between PF and test client**

When there are active VFs, "ethtool -t" performs a full diagnostic. In the process, it resets itself and all attached VFs. The VF drivers encounter a disruption, but are able to recover.

## **Enabling SR-IOV in a 64-bit Microsoft\* Windows Server\* 2012/R2 guest OS under Linux KVM**

KVM Hypervisor/VMM supports direct assignment of a PCIe device to a VM. This includes traditional PCIe devices, as well as SR-IOV-capable devices using Intel XL710-based controllers.

## **Unable to obtain DHCP lease on boot with RedHat**

In configurations where the auto-negotiation process takes more than 5 seconds, the boot script may fail with the following message:

```
"ethX: failed. No link present. Check cable?"
```

This error may occur even though the presence of link can be confirmed using ethtool ethx. In this case, try setting "LINKDELAY=30" in /etc/sysconfig/network-scripts/ifdfg-ethx.

The same issue can occur during a network boot (via PXE) on RedHat distributions that use the dracut script:

```
"Warning: No carrier detected on interface <interface_name>"
```

In this case add "rd.net.timeout.carrier=30" at the kernel command line.



**NOTE:** Link time can vary. Adjust LINKDELAY value accordingly. Alternatively, NetworkManager can be used to configure the interfaces, which avoids the set timeout. For configuration instructions of NetworkManager refer to the documentation provided by your distribution.

## **Loading i40e driver in 3.2.x and newer kernels displays kernel tainted message**

Due to recent kernel changes, loading an out of tree driver causes the kernel to be tainted.



# Data Center Bridging (DCB) for Intel® Network Connections

Data Center Bridging provides a lossless data center transport layer for using LANs and SANs in a single unified fabric.

Data Center Bridging includes the following capabilities:

- Priority-based flow control (PFC; IEEE 802.1Qbb)
- Enhanced transmission selection (ETS; IEEE 802.1Qaz)
- Congestion notification (CN)
- Extensions to the Link Layer Discovery Protocol standard (IEEE 802.1AB) that enable Data Center Bridging Capability Exchange Protocol (DCBX)

There are two supported versions of DCBX.

CEE Version: The specification can be found as a link within the following document: <http://www.ieee802.org/1/files/public/docs2008/dcb-baseline-contributions-1108-v1.01.pdf>

IEEE Version: The specification can be found as a link within the following document: <https://standards.ieee.org/findstds/standard/802.1Qaz-2011.html>



**NOTE:** The OS DCBX stack defaults to the CEE version of DCBX, and if a peer is transmitting IEEE TLVs, it will automatically transition to the IEEE version.

For more information on DCB, including the DCB Capability Exchange Protocol Specification, go to <http://www.ieee802.org/1/pages/dcbbridges.html>

## DCB for Windows Configuration:

Intel Ethernet Adapter DCB functions can be configured using Windows Device Manager. Open the adapter's property sheet and select the **Data Center** tab.

You can use the Intel® PROSet to perform the following tasks:

- **Display Status:**
  - Enhanced Transmission Selection
  - Priority Flow Control
  - FCoE Priority

**Non-operational status:** If the Status indicator shows that DCB is non-operational, there may be a number of possible reasons:

- DCB is not enabled - select the checkbox to enable DCB.
- One or more of the DCB features is in a non-operational state. The features which contribute to the non-operational status are PFC and APP:FCoE.

A non-operational status is most likely to occur when **Use Switch Settings** is selected or **Using Advanced Settings** is active. This is generally a result of one or more of the DCB features not getting successfully exchanged with the switch. Possible problems include:

- One of the features is not supported by the switch.
  - The switch is not advertising the feature.
  - The switch or host has disabled the feature (this would be an advanced setting for the host).
- Disable/enable DCB
  - Troubleshooting information

## Hyper-V (DCB and VMQ)




**NOTE:** Configuring a device in the VMQ + DCB mode reduces the number of VMQs available for guest OSes.

## DCB for Linux

DCB is supported on RHEL6 or later or SLES11 SP1 or later. See your operating system documentation for specifics.

## iSCSI Over DCB

Intel® Ethernet adapters support iSCSI software initiators that are native to the underlying operating system. Data Center Bridging is most often configured at the switch. If the switch is not DCB capable, the DCB handshake will fail but the iSCSI connection will not be lost.

 **NOTE:** DCB does not install in a VM. iSCSI over DCB is only supported in the base OS. An iscsi initiator running in a VM will not benefit from DCB ethernet enhancements.

## Microsoft Windows Configuration

iSCSI installation includes the installation of the iSCSI DCB Agent (iscsidcb.exe) user mode service. The Microsoft iSCSI Software Initiator enables the connection of a Windows host to an external iSCSI storage array using an Intel Ethernet adapter. Please consult your operating system documentation for configuration details.

Enable DCB on the adapter by the following:

1. From **Windows Device Manager**, expand **Networking Adapters** and highlight the appropriate adapter (such as Intel® Ethernet Server Adapter X520). Right click on the **Intel adapter** and select **Properties**.
2. In the **Property Page**, select the **Data Center** Tab.

The **Data Center** Tab provides feedback as to the DCB state, operational or non- operational, as well as providing additional details should it be non-operational.

## Using iSCSI over DCB with ANS Teaming

The Intel® iSCSI Agent is responsible for maintaining all packet filters for the purpose of priority tagging iSCSI traffic flowing over DCB-enabled adapters. The iSCSI Agent will create and maintain a traffic filter for an ANS Team if at least one member of the team has an "Operational" DCB status. However, if any adapter on the team does not have an "Operational" DCB status, the iSCSI Agent will log an error in the Windows Event Log for that adapter. These error messages are to notify the administrator of configuration issues that need to be addressed, but do not affect the tagging or flow of iSCSI traffic for that team, unless it explicitly states that the TC Filter has been removed.

## Linux Configuration

In the case of Open Source distributions, virtually all distributions include support for an Open iSCSI Software Initiator and Intel® Ethernet adapters will support them. Please consult your distribution documentation for additional configuration details on their particular Open iSCSI initiator.

Intel® 82599 and X540-based adapters support iSCSI within a Data Center Bridging cloud. Used in conjunction with switches and targets that support the iSCSI/DCB application TLV, this solution can provide guaranteed minimum bandwidth for iSCSI traffic between the host and target. This solution enables storage administrators to segment iSCSI traffic from LAN traffic, similar to how they can currently segment FCoE from LAN traffic. Previously, iSCSI traffic within a DCB supported environment was treated as LAN traffic by switch vendors. Please consult your switch and target vendors to ensure that they support the iSCSI/DCB application TLV.

# Remote Boot

Remote Boot allows you to boot a system using only an Ethernet adapter. You connect to a server that contains an operating system image and use that to boot your local system.

## Flash Images

"Flash" is a generic term for nonvolatile RAM (NVRAM), firmware, and option ROM (OROM). Depending on the device, it can be on the NIC or on the system board.

## Updating the Flash from Linux

The BootUtil command line utility can update the flash on an Intel Ethernet network adapter. Run BootUtil with the following command line options to update the flash on all supported Intel network adapters. For example, enter the following command line:

```
bootutil64e -up=efi -all
```

BootUtil can only be used to program add-in Intel network adapters. LOM (LAN On Motherboard) network connections cannot be programmed with the UEFI network driver option ROM.

See the bootutil.txt file for details on using BootUtil.

## Installing the UEFI Network Driver Option ROM from the UEFI Shell

The BootUtil command line utility can install the UEFI network driver on an Intel network adapter's option ROM. The UEFI network driver will load automatically during system UEFI boot when installed into the option ROM. For example, run BootUtil with the following command line options to install the UEFI network driver on all supported Intel network adapters:

```
FS0:\>bootutil64e -up=efi -all
```

BootUtil can only be used to program add-in Intel Ethernet network adapters. LOM (LAN On Motherboard) network connections cannot be programmed with the UEFI network driver option ROM.

See the bootutil.txt file for details on using BootUtil.

## Enable Remote Boot

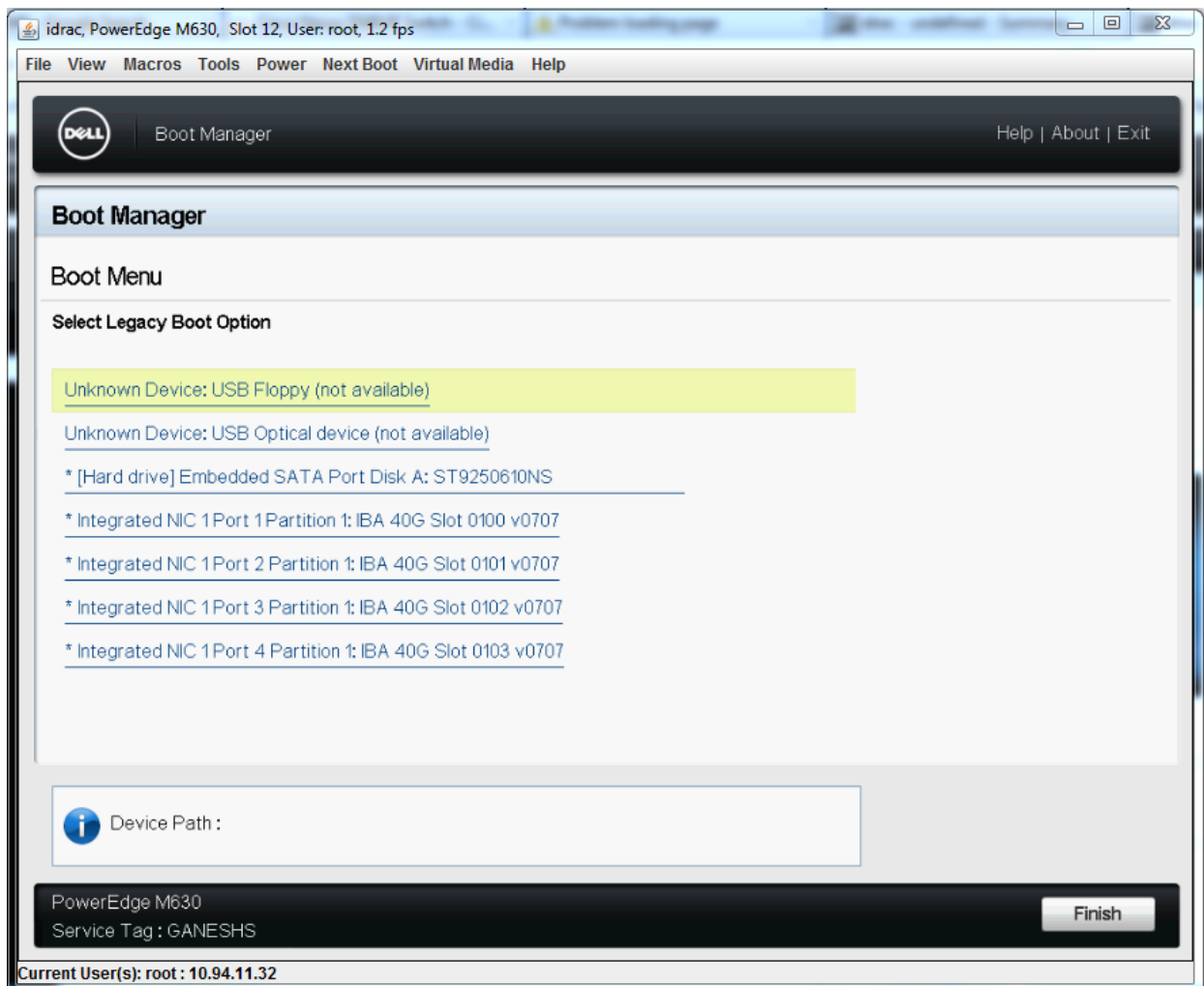
If you have an Intel Desktop Adapter installed in your client computer, the flash ROM device is already available in your adapter, and no further installation steps are necessary. For Intel Server Adapters, the flash ROM can be enabled using the BootUtil utility. For example, from the command line type:

```
BOOTUTIL -E  
BOOTUTIL -NIC=1 -FLASHENABLE
```

The first line will enumerate the ports available in your system. Choose a port. Then type the second line, selecting the port you wish to enable. For more details, see the bootutil.txt file.

## Intel Adapters in the Boot Menu

The Boot Menu section of the Boot Manager will report the PXE-enabled ports on an Intel X710-based adapter as being 40G ports, as illustrated in the following figure. The ports on an X710 adapter are, in fact, 10G ports.



In the Boot Manager Boot Menu, Intel adapters are identified as follows:

- X710-controlled adapters: "IBA 40G"
- Other 10G adapters: "IBA XE"
- 1G adapters: "IBA 1G"

## Intel® Boot Agent Configuration


### Boot Agent Client Configuration

The Boot Agent is enabled and configured from HII.

### Intel Boot Agent Target/Server Setup

#### Overview

For the Intel® Boot Agent software to perform its intended job, there must be a server set up on the same network as the client computer. That server must recognize and respond to the PXE or BOOTP boot protocols that are used by the Intel Boot Agent software.

 **NOTE:** When the Intel Boot Agent software is installed as an upgrade for an earlier version boot ROM, the associated server-side software may not be compatible with the updated Intel Boot Agent. Contact your system administrator to determine if any server updates are necessary.

## Linux\* Server Setup

Consult your Linux\* vendor for information about setting up the Linux Server.

## Windows\* Deployment Services

Nothing is needed beyond the standard driver files supplied on the media. Microsoft\* owns the process and associated instructions for Windows Deployment Services. For more information on Windows Deployment Services perform a search of Microsoft articles at: <http://technet.microsoft.com/en-us/library/default.aspx>

## Intel® Boot Agent Messages

Message Text	Cause
Invalid PMM function number.	PMM is not installed or is not working correctly. Try updating the BIOS.
PMM allocation error.	PMM could not or did not allocate the requested amount of memory for driver usage.
Option ROM initialization error. 64-bit PCI BAR addresses not supported, AX=	<p>This may be caused by the system BIOS assigning a 64-bit BAR (Base Address Register) to the network port. Running the BootUtil utility with the -64d command line option may resolve this issue.</p> <p>To work around the issue on Intel® Ethernet X710 or XL710 based adapters, disable NPar and NParEP. Alternatively, put the system into UEFI boot mode.</p>
PXE-E00: This system does not have enough free conventional memory. The Intel Boot Agent cannot continue.	System does not have enough free memory to run PXE image. The Intel Boot Agent was unable to find enough free base memory (below 640K) to install the PXE client software. The system cannot boot via PXE in its current configuration. The error returns control to the BIOS and the system does not attempt to remote boot. If this error persists, try updating your system's BIOS to the most-recent version. Contact your system administrator or your computer vendor's customer support to resolve the problem.
PXE-E01: PCI Vendor and Device IDs do not match!	Image vendor and device ID do not match those located on the card. Make sure the correct flash image is installed on the adapter.
PXE-E04: Error reading PCI configuration space. The Intel Boot Agent cannot continue.	PCI configuration space could not be read. Machine is probably not PCI compliant. The Intel Boot Agent was unable to read one or more of the adapter's PCI configuration registers. The adapter may be mis-configured, or the wrong Intel Boot Agent image may be installed on the adapter. The Intel Boot Agent will return control to the BIOS and not attempt to remote boot. Try to update the flash image. If this does not solve the problem, contact your system administrator or <a href="#">Intel Customer Support</a> .
PXE-E05: The LAN adapter's configuration is corrupted or has not been initialized. The Intel Boot Agent cannot continue.	The adapter's EEPROM is corrupted. The Intel Boot Agent determined that the adapter EEPROM checksum is incorrect. The agent will return control to the BIOS and not attempt to remote boot. Try to update the flash image. If this does not solve the problem, contact your system administrator or <a href="#">Intel Customer Support</a> .
PXE-E06: Option ROM requires DDIM support.	The system BIOS does not support DDIM. The BIOS does not support the mapping of the PCI expansion ROMs into upper memory as required by the PCI specification. The Intel Boot Agent cannot function in this system. The Intel Boot Agent returns control to the BIOS and does not attempt to remote boot. You may be able to resolve the problem by updating the

	BIOS on your system. If updating your system's BIOS does not fix the problem, contact your system administrator or your computer vendor's customer support to resolve the problem.
PXE-E07: PCI BIOS calls not supported.	BIOS-level PCI services not available. Machine is probably not PCI compliant.
PXE-E09: Unexpected UNDI loader error. Status == xx	The UNDI loader returned an unknown error status. xx is the status returned.
PXE-E0C: Firmware recovery mode detected. Initialization failed.	The adapter is in firmware recovery mode. Refer to the "Firmware Recovery Mode" section of this document for details.
PXE-E20: BIOS extended memory copy error.	BIOS could not move the image into extended memory.
PXE-E20: BIOS extended memory copy error. AH == xx	Error occurred while trying to copy the image into extended memory. xx is the BIOS failure code.
PXE-E51: No DHCP or BOOTP offers received.	The Intel Boot Agent did not receive any DHCP or BOOTP responses to its initial request. Please make sure that your DHCP server (and/or proxyDHCP server, if one is in use) is properly configured and has sufficient IP addresses available for lease. If you are using BOOTP instead, make sure that the BOOTP service is running and is properly configured.
PXE-E53: No boot filename received.	The Intel Boot Agent received a DHCP or BOOTP offer, but has not received a valid filename to download. If you are using PXE, please check your PXE and BINL configuration. If using BOOTP, be sure that the service is running and that the specific path and filename are correct.
PXE-E61: Media test failure.	The adapter does not detect link. Please make sure that the cable is good and is attached to a working hub or switch. The link light visible from the back of the adapter should be lit.
PXE-EC1: Base-code ROM ID structure was not found.	No base code could be located. An incorrect flash image is installed or the image has become corrupted. Try to update the flash image.
PXE-EC3: BC ROM ID structure is invalid.	Base code could not be installed. An incorrect flash image is installed or the image has become corrupted. Try to update the flash image.
PXE-EC4: UNDI ID structure was not found.	UNDI ROM ID structure signature is incorrect. An incorrect flash image is installed or the image has become corrupted. Try to update the flash image.
PXE-EC5: UNDI ROM ID structure is invalid.	The structure length is incorrect. An incorrect flash image is installed or the image has become corrupted. Try to update the flash image.
PXE-EC6: UNDI driver image is invalid.	The UNDI driver image signature was invalid. An incorrect flash image is installed or the image has become corrupted. Try to update the flash image.

PXE-EC8: !PXE structure was not found in UNDI driver code segment.	The Intel Boot Agent could not locate the needed !PXE structure resource. An incorrect flash image is installed or the image has become corrupted. Try to update the flash image.  This may also be caused by the system BIOS assigning a 64-bit BAR (Base Address Register) to the network port. Running the BootUtil utility with the -64d command line option may resolve this issue.
PXE-EC9: PXENV+ structure was not found in UNDI driver code segment.	The Intel Boot Agent could not locate the needed PXENV+ structure. An incorrect flash image is installed or the image has become corrupted. Try to update the flash image.
PXE-M0F: Exiting Intel Boot Agent.	Ending execution of the ROM image.
This option has been locked and cannot be changed.	You attempted to change a configuration setting that has been locked by your system administrator. This message can appear either from within Intel® PROSet's Boot Options tab when operating under Windows* or from the Configuration Setup Menu when operating in a stand-alone environment. If you think you should be able to change the configuration setting, consult your system administrator.
PXE-M0E: Retrying network boot; press ESC to cancel.	The Intel Boot Agent did not successfully complete a network boot due to a network error (such as not receiving a DHCP offer). The Intel Boot Agent will continue to attempt to boot from the network until successful or until canceled by the user. This feature is disabled by default. For information on how to enable this feature, contact <a href="#">Intel Customer Support</a> .

## Intel Boot Agent Troubleshooting Procedures

### Common Issues

The following list of problems and associated solutions covers a representative set of problems that you might encounter while using the Intel Boot Agent.

#### After booting, my computer experiences problems

After the Intel® Boot Agent product has finished its sole task (remote booting), it no longer has any effect on the client computer operation. Thus, any issues that arise after the boot process is complete are most likely not related to the Intel Boot Agent product.

If you are having problems with the local (client) or network operating system, contact the operating system manufacturer for assistance. If you are having problems with some application program, contact the application manufacturer for assistance. If you are having problems with any of your computer's hardware or with the BIOS, contact your computer system manufacturer for assistance.

#### Cannot change boot order

If you are accustomed to redefining your computer's boot order using the motherboard BIOS setup program, the default settings of the Intel Boot Agent setup program can override that setup. To change the boot sequence, you must first override the Intel Boot Agent setup program defaults. A configuration setup menu appears allowing you to set configuration values for the Intel Boot Agent. To change your computer's boot order setting, see [Configuring the Boot Agent in a Pre-boot PXE Environment](#).

#### My computer does not complete POST

If your computer fails to boot with an adapter installed, but *does* boot when you remove the adapter, try moving the adapter to another computer and using BootUtil to disable the Flash ROM.

If this does not work, the problem may be occurring before the Intel Boot Agent software even begins operating. In this case, there may be a BIOS problem with your computer. Contact your computer manufacturer's customer support group for help in correcting your problem.

There are configuration/operation problems with the boot process

If your PXE client receives a DHCP address, but then fails to boot, you know the PXE client is working correctly. Check your network or PXE server configuration to troubleshoot the problem. Contact [Intel Customer Support](#) if you need further assistance.

PXE option ROM does not follow the PXE specification with respect to the final "discover" cycle

In order to avoid long wait periods, the option ROM no longer includes the final 32-second discover cycle. (If there was no response in the prior 16-second cycle, it is almost certain that there will be none in the final 32-second cycle.)

## iSCSI Boot Configuration

### iSCSI Initiator Setup

#### Configuring Intel® Ethernet iSCSI Boot on a Microsoft\* Windows\* Client Initiator

##### Requirements

1. Make sure the iSCSI initiator system starts the iSCSI Boot firmware. The firmware should be configured properly, be able to connect to iSCSI target, and detect the boot disk.
2. You will need Microsoft\* iSCSI Software Initiator with integrated software boot support. This boot version of the initiator is available [here](#).
3. To enable crash dump support, follow the steps in [Crash Dump Support](#).

#### Configuring Intel® Ethernet iSCSI Boot on a Linux\* Client Initiator

1. Install the Open-iSCSI initiator utilities.  

```
#yum -y install iscsi-initiator-utils
```
2. Refer to the README file found at <https://github.com/mikechristie/open-iscsi>.
3. Configure your iSCSI array to allow access.
  - a. Examine `/etc/iscsi/initiatorname.iscsi` for the Linux host initiator name.
  - b. Update your volume manager with this host initiator name.
4. Set iscsi to start on boot.

```
#chkconfig iscsd on  
#chkconfig iscsi on
```

5. Start iSCSI service (192.168.x.x is the IP Address of your target).

```
#iscsiadm -n discovery -t s -p 192.168.x.x
```

Observe the target names returned by iscsi discovery.

6. Log onto the target (-m XXX -T is XXX -l XXX -).

```
iscsiadm -m node -T iqn.2123-01.com:yada:yada: -p 192.168.2.124 -l
```

### iSCSI Boot POST Setup

Intel® Ethernet iSCSI Boot features a setup menu which allows two network ports in one system to be enabled as iSCSI Boot devices. To configure Intel® iSCSI Boot, power-on or reset the system and press the Ctrl-D key when the message "Press <Ctrl-D> to run setup..." is displayed. After pressing the Ctrl-D key, you will be taken to the Intel® iSCSI Boot Port Selection Setup Menu.

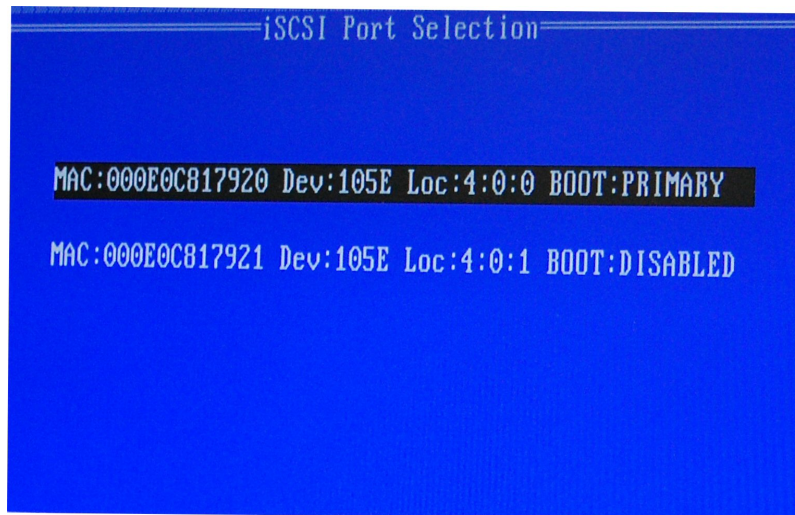


**NOTE:** When booting an operating system from a local disk, Intel® Ethernet iSCSI Boot should be disabled for all network ports.



## Intel® Ethernet iSCSI Boot Port Selection Menu

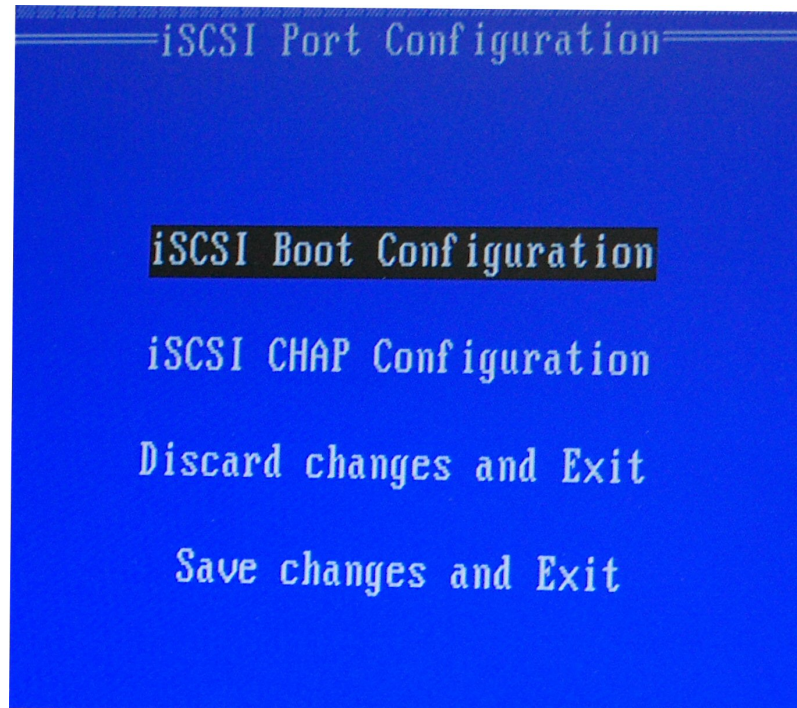
The first screen of the Intel® iSCSI Boot Setup Menu displays a list of Intel® iSCSI Boot-capable adapters. For each adapter port the associated PCI device ID, PCI bus/device/function location, and a field indicating Intel® Ethernet iSCSI Boot status is displayed. Up to 10 iSCSI Boot-capable ports are displayed within the Port Selection Menu. If there are more Intel® iSCSI Boot-capable adapters, these are not listed in the setup menu.



The usage of this menu is described below:

- One network port in the system can be selected as the primary boot port by pressing the 'P' key when highlighted. The primary boot port will be the first port used by Intel® Ethernet iSCSI Boot to connect to the iSCSI target. Only one port may be selected as a primary boot port.
- One network port in the system can be selected as the secondary boot port by pressing the 'S' key when highlighted. The secondary boot port will only be used to connect to the iSCSI target disk if the primary boot port fails to establish a connection. Only one port may be selected as a secondary boot port.
- Pressing the 'D' key with a network port highlighted will disable Intel® Ethernet iSCSI Boot on that port.
- Pressing the 'B' key with a network port highlighted will blink an LED on that port.
- Press the Esc key to leave the screen.

## Intel® Ethernet iSCSI Boot Port Specific Setup Menu

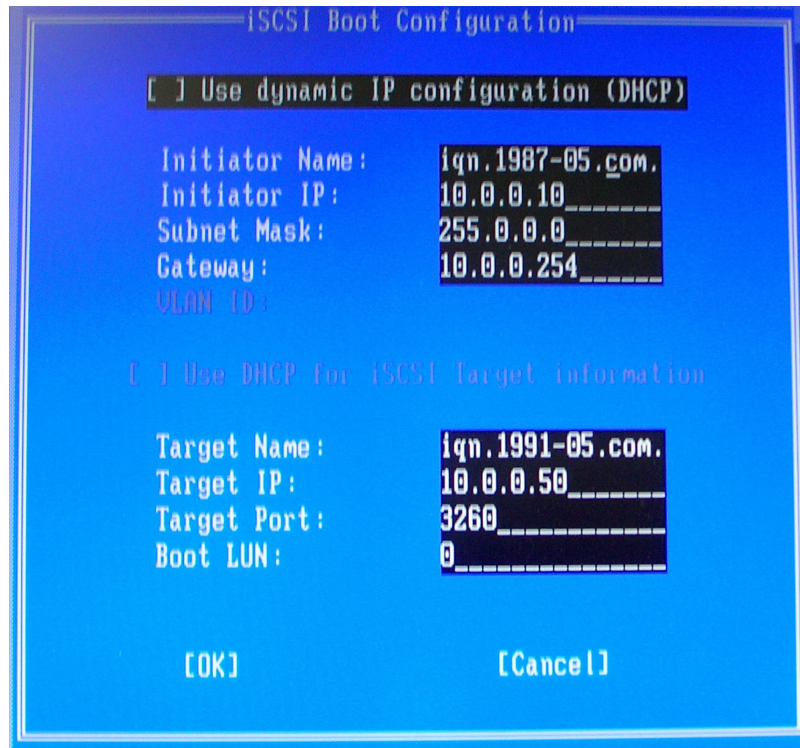


The port specific iSCSI setup menu has four options:

- **Intel® iSCSI Boot Configuration** - Selecting this option will take you to the iSCSI Boot Configuration Setup Menu. The [iSCSI Boot Configuration Menu](#) is described in detail in the section below and will allow you to configure the iSCSI parameters for the selected network port.
- **CHAP Configuration** - Selecting this option will take you to the CHAP configuration screen. The [CHAP Configuration Menu](#) is described in detail in the section below.
- **Discard Changes and Exit** - Selecting this option will discard all changes made in the iSCSI Boot Configuration and CHAP Configuration setup screens, and return back to the iSCSI Boot Port Selection Menu.
- **Save Changes and Exit** - Selecting this option will save all changes made in the iSCSI Boot Configuration and CHAP Configuration setup screens. After selecting this option, you will return to the iSCSI Boot Port Selection Menu.

### Intel® iSCSI Boot Configuration Menu

The Intel® iSCSI Boot Configuration Menu allows you to configure the iSCSI Boot and Internet Protocol (IP) parameters for a specific port. The iSCSI settings can be configured manually or retrieved dynamically from a DHCP server.



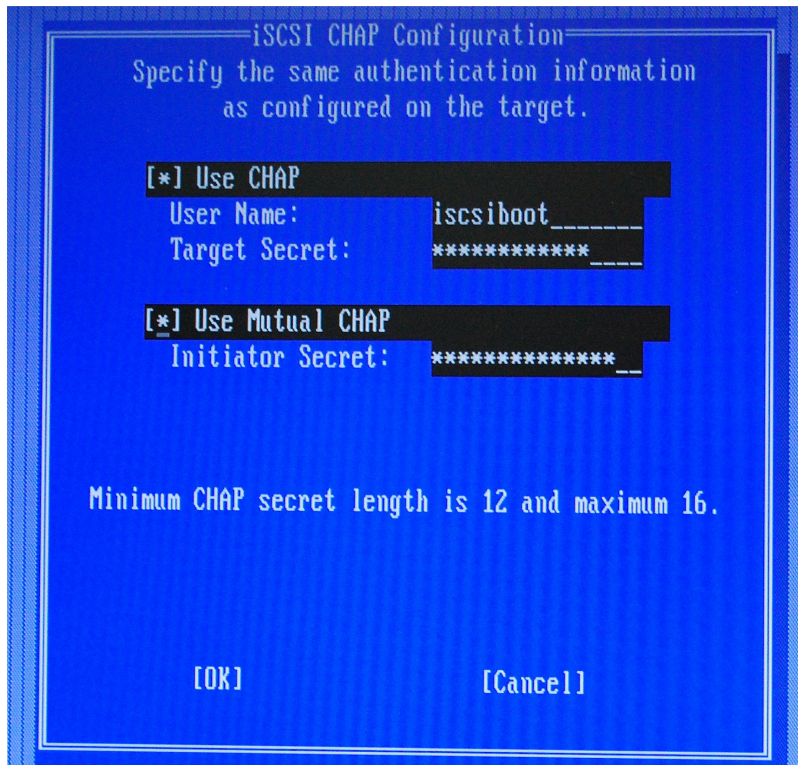
Listed below are the options in the Intel® iSCSI Boot Configuration Menu:

- **Use Dynamic IP Configuration (DHCP)** - Selecting this checkbox will cause iSCSI Boot to attempt to get the client IP address, subnet mask, and gateway IP address from a DHCP server. If this checkbox is enabled, these fields will not be visible.
- **Initiator Name** - Enter the iSCSI initiator name to be used by Intel® iSCSI Boot when connecting to an iSCSI target. The value entered in this field is global and used by all iSCSI Boot-enabled ports in the system. This field may be left blank if the "Use DHCP For Target Configuration" checkbox is enabled. For information on how to retrieve the iSCSI initiator name dynamically from a DHCP server see the section [DHCP Server Configuration](#).
- **Initiator IP** - Enter the client IP address to be used for this port as static IP configuration in this field. This IP address will be used by the port during the entire iSCSI session. This option is visible if DHCP is not enabled.
- **Subnet Mask** - Enter the IP subnet-mask in this field. This should be the IP subnet mask used on the network which the selected port will be connecting to for iSCSI. This option is visible if DHCP is not enabled.
- **Gateway IP** - Enter the IP address of the network gateway in this field. This field is necessary if the iSCSI target is located on a different sub-network than the selected Intel® iSCSI Boot port. This option is visible if DHCP is not enabled.
- **Use DHCP for iSCSI Target Information** - Selecting this checkbox will cause Intel® iSCSI Boot to attempt to gather the iSCSI target's IP address, IP port number, iSCSI target name, and SCSI LUN ID from a DHCP server on the network. For information on how to configure the iSCSI target parameters using DHCP see the section [DHCP Server Configuration](#). When this checkbox is enabled, these fields will not be visible.
- **Target Name** - Enter the IQN name of the iSCSI target in this field. This option is visible if DHCP for iSCSI target is not enabled.
- **Target IP** - Enter the target IP address of the iSCSI target in this field. This option is visible if DHCP for iSCSI target is not enabled.
- **Target Port** - TCP Port Number.
- **Boot LUN** - Enter the LUN ID of the boot disk on the iSCSI target in this field. This option is visible if DHCP for iSCSI target is not enabled.

## iSCSI CHAP Configuration

Intel® iSCSI Boot supports Mutual CHAP MD5 authentication with an iSCSI target. Intel® iSCSI Boot uses the "MD5 Message Digest Algorithm" developed by RSA Data Security, Inc.





The iSCSI CHAP Configuration menu has the following options to enable CHAP authentication:

- **Use CHAP** - Selecting this checkbox will enable CHAP authentication for this port. CHAP allows the target to authenticate the initiator. After enabling CHAP authentication, a user name and target password must be entered.
- **User Name** - Enter the CHAP user name in this field. This must be the same as the CHAP user name configured on the iSCSI target.
- **Target Secret** - Enter the CHAP password in this field. This must be the same as the CHAP password configured on the iSCSI target and must be between 12 and 16 characters in length. This password can not be the same as the **Initiator Secret**.
- **Use Mutual CHAP** - Selecting this checkbox will enable Mutual CHAP authentication for this port. Mutual CHAP allows the initiator to authenticate the target. After enabling Mutual CHAP authentication, an initiator password must be entered. Mutual CHAP can only be selected if Use CHAP is selected.
- **Initiator Secret** - Enter the Mutual CHAP password in this field. This password must also be configured on the iSCSI target and must be between 12 and 16 characters in length. This password can not be the same as the **Target Secret**.

The CHAP Authentication feature of this product requires the following acknowledgments:

This product includes cryptographic software written by Eric Young ([ey@cryptsoft.com](mailto:ey@cryptsoft.com)). This product includes software written by Tim Hudson ([tjh@cryptsoft.com](mailto:tjh@cryptsoft.com)).


This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (<http://www.openssl.org/>).

### Intel® PROSet for Windows\* Device Manager

Many of the functions of the Intel® iSCSI Boot Port Selection Setup Menu can also be configured or revised from Windows Device Manager. Open the adapter's property sheet and select the **Data Options** tab. You must install the latest Intel Ethernet Adapter drivers and software to access this.

## iSCSI Boot Target Configuration

For specific information on configuring your iSCSI target system and disk volume, refer to instructions provided by your system or operating system vendor. Listed below are the basic steps necessary to setup Intel® Ethernet iSCSI Boot to work with most iSCSI target systems. The specific steps will vary from one vendor to another.

 **NOTE:** To support iSCSI Boot, the target needs to support multiple sessions from the same initiator. Both the iSCSI Boot firmware initiator and the OS High Initiator need to establish an iSCSI session at the same time. Both these initiators use the same Initiator Name and IP Address to connect and access the OS disk but these two initiators will establish different iSCSI sessions. In order for the target to support iSCSI Boot, the target must be capable of supporting multiple sessions and client logins.

1. Configure a disk volume on your iSCSI target system. Note the LUN ID of this volume for use when configuring in Intel® Ethernet iSCSI Boot firmware setup.

2. Note the iSCSI Qualified Name (IQN) of the iSCSI target, which will likely look like:

```
iqn.1986-03.com.intel:target1
```

This value is used as the iSCSI target name when you configuring your initiator system's Intel® Ethernet iSCSI Boot firmware.


3. Configure the iSCSI target system to accept the iSCSI connection from the iSCSI initiator. This usually requires listing the initiator's IQN name or MAC address for permitting the initiator to access to the disk volume. See the [Firmware Setup](#) section for information on how to set the iSCSI initiator name.

4. One-way authentication protocol can optionally be enabled for secure communications. Challenge-Handshake Authentication Protocol (CHAP) is enabled by configuring username/password on iSCSI target system. For setting up CHAP on the iSCSI initiator, refer to the section [Firmware Setup](#) for information.

## Booting from Targets Larger than 2TB

You can connect and boot from a target LUN that is larger than 2 Terabytes with the following restrictions:

- The block size on the target must be 512 bytes
- The following operating systems are supported:
  - VMware\* ESX 5.0, or later
  - Red Hat\* Enterprise Linux\* 6.3, or later
  - SUSE\* Enterprise Linux 11SP2, or later
  - Microsoft\* Windows Server\* 2012 R2, or later
- You may be able to access data only within the first 2 TB.

 **NOTE:** The Crash Dump driver does not support target LUNs larger than 2TB.

## DHCP Server Configuration

If you are using Dynamic Host Configuration Protocol (DHCP), the DHCP server needs to be configured to provide the iSCSI Boot configurations to the iSCSI initiator. You must set up the DHCP server to specify Root Path option 17 and Host Name option 12 to respond iSCSI target information back to the iSCSI initiator. DHCP option 3, Router List may be necessary, depending on the network configuration.

### DHCP Root Path Option 17:

The iSCSI root path option configuration string uses the following format:

```
iscsi:<server name or IP address>:<protocol>:<port>:<LUN>:<targetname>
```

- **Server name:** DHCP server name or valid IPv4 address literal.  
Example: 192.168.0.20.
- **Protocol:** Transportation protocol used by iSCSI. Default is tcp (6).  
No other protocols are currently supported.
- **Port:** Port number of the iSCSI. A default value of 3260 will be used if this field is left blank.
- **LUN:** LUN ID configured on iSCSI target system. Default is zero.
- **Target name:** iSCSI target name to uniquely identify an iSCSI target in IQN format.  
Example: iqn.1986-03.com.intel:target1

### DHCP Host Name Option 12:

Configure option 12 with the hostname of the iSCSI initiator.

### DHCP Option 3, Router List:

Configure option 3 with the gateway or Router IP address, if the iSCSI initiator and iSCSI target are on different subnets.

## Creating a Bootable Image for an iSCSI Target

There are two ways to create a bootable image on an iSCSI target:

- Install directly to a hard drive in an iSCSI storage array (Remote Install).
- Install to a local disk drive and then transfer this disk drive or OS image to an iSCSI Target (Local Install).

### Microsoft\* Windows\*

Microsoft\* Windows Server\* natively supports OS installation to an iSCSI target without a local disk and also natively supports OS iSCSI boot. See Microsoft's installation instructions and Windows Deployment Services documentation for details.

### SUSE\* Linux Enterprise Server

For the easiest experience installing Linux onto an iSCSI target, you should use SLES10 or greater. SLES10 provides native support for iSCSI Booting and installing. This means that there are no additional steps outside of the installer that are necessary to install to an iSCSI target using an Intel Ethernet Server Adapter. Please refer to the SLES10 documentation for instructions on how to install to an iSCSI LUN.

### Red Hat Enterprise Linux

For the easiest experience installing Linux onto an iSCSI target, you should use RHEL 5.1 or greater. RHEL 5.1 provides native support for iSCSI Booting and installing. This means that there are no additional steps outside of the installer that are necessary to install to an iSCSI target using an Intel Ethernet Server Adapter. Please refer to the RHEL 5.1 documentation for instructions on how to install to an iSCSI LUN.

## Microsoft Windows Server iSCSI Crash Dump Support

Crash dump file generation is supported for iSCSI-booted Windows Server x64 by the Intel iSCSI Crash Dump Driver. To ensure a full memory dump is created:

1. Set the page file size equal to or greater than the amount of RAM installed on your system is necessary for a full memory dump.
2. Ensure that the amount of free space on your hard disk is able to handle the amount of RAM installed on your system.

To setup crash dump support follow these steps:

1. Setup Windows iSCSI Boot.
2. If you have not already done so, install the latest Intel Ethernet Adapter drivers and Intel PROSet for Windows Device Manager.
3. Open Intel PROSet for Windows Device Manager and select the Boot Options Tab.
4. From Settings select iSCSI Boot Crash Dump and the Value Enabled and click OK.

## iSCSI Troubleshooting

The table below lists problems that can possibly occur when using Intel® Ethernet iSCSI Boot. For each problem a possible cause and resolution are provided.

Problem	Resolution
---------	------------

<p>Intel® Ethernet iSCSI Boot does not load on system startup and the sign-on banner is not displayed.</p>	<ul style="list-style-type: none"> <li>• While the system logon screen may display for a longer time during system startup, Intel Ethernet iSCSI Boot may not be displayed during POST. It may be necessary to disable a system BIOS feature in order to display messages from Intel iSCSI Remote Boot. From the system BIOS Menu, disable any quiet boot or quick boot options. Also disable any BIOS splash screens. These options may be suppressing output from Intel iSCSI Remote Boot.</li> <li>• Intel Ethernet iSCSI Remote Boot has not been installed on the adapter or the adapter's flash ROM is disabled. Update the network adapter using the latest version of BootUtil as described in the <a href="#">Flash Images</a> section of this document. If BootUtil reports the flash ROM is disabled, use the "BOOTUTIL - flashenable" command to enable the flash ROM and update the adapter.</li> <li>• The system BIOS may be suppressing output from Intel Ethernet iSCSI Boot.</li> <li>• Sufficient system BIOS memory may not be available to load Intel Ethernet iSCSI Boot. Attempt to disable unused disk controllers and devices in the system BIOS setup menu. SCSI controllers, RAID controller, PXE enabled network connections, and shadowing of system BIOS all reduce the memory area available to Intel Ethernet iSCSI Boot. Disable these devices and reboot the system to see if Intel iSCSI Boot is able to initialize. If disabling the devices in the system BIOS menu does not resolve the problem then attempt to remove unused disk devices or disk controllers from the system. Some system manufacturers allow unused devices to be disabled by jumper settings.</li> </ul>
<p>After installing Intel Ethernet iSCSI Boot, the system will not boot to a local disk or network boot device. The system becomes unresponsive after Intel Ethernet iSCSI Boot displays the sign-on banner or after connecting to the iSCSI target.</p>	<ul style="list-style-type: none"> <li>• A critical system error has occurred during iSCSI Remote Boot initialization. Power on the system and press the 's' key or 'ESC' key before Intel iSCSI Remote Boot initializes. This will bypass the Intel Ethernet iSCSI Boot initialization process and allow the system to boot to a local drive. Use the BootUtil utility to update to the latest version of Intel Ethernet iSCSI Remote Boot.</li> <li>• Updating the system BIOS may also resolve the issue.</li> </ul>
<p>"Intel® iSCSI Remote Boot" does not show up as a boot device in the system BIOS boot device menu.</p>	<ul style="list-style-type: none"> <li>• The system BIOS may not support Intel Ethernet iSCSI Boot. Update the system BIOS with the most recent version available from the system vendor.</li> <li>• A conflict may exist with another installed device. Attempt to disable unused disk and network controllers. Some SCSI and RAID controllers are known to cause compatibility problems with Intel iSCSI Remote Boot.</li> </ul>
<p>Error message displayed: "Failed to detect link"</p>	<ul style="list-style-type: none"> <li>• Intel Ethernet iSCSI Boot was unable to detect link on the network port. Check the link detection light on the back of the network connection. The link light should illuminate green when link is established with the link partner. If the link light is illuminated but the error message still displays then attempt to run the Intel link and cable diagnostics tests using Intel PROSet for Windows.</li> </ul>
<p>Error message displayed: "DHCP Server not found!"</p>	<p>iSCSI was configured to retrieve an IP address from DHCP but no DHCP server responded to the DHCP discovery request. This issue can have multiple causes:</p> <ul style="list-style-type: none"> <li>• The DHCP server may have used up all available IP address reservations.</li> <li>• The client iSCSI system may require static IP address assignment on the connected network.</li> <li>• There may not be a DHCP server present on the network.</li> <li>• Spanning Tree Protocol (STP) on the network switch may be preventing the Intel iSCSI Remote Boot port from contacting the DHCP server. Refer to your network switch documentation on how to disable Spanning Tree Protocol.</li> </ul>

<p>Error message displayed: "PnP Check Structure is invalid!"</p>	<ul style="list-style-type: none"> <li>• Intel Ethernet iSCSI Boot was not able to detect a valid PnP PCI BIOS. If this message displays Intel Ethernet iSCSI Boot cannot run on the system in question. A fully PnP compliant PCI BIOS is required to run Intel iSCSI Remote Boot.</li> </ul>
<p>Error message displayed: "Invalid iSCSI connection information"</p>	<ul style="list-style-type: none"> <li>• The iSCSI configuration information received from DHCP or statically configured in the setup menu is incomplete and an attempt to login to the iSCSI target system could not be made. Verify that the iSCSI initiator name, iSCSI target name, target IP address, and target port number are configured properly in the iSCSI setup menu (for static configuration) or on the DHCP server (for dynamic BOOTP configuration).</li> </ul>
<p>Error message displayed: "Unsupported SCSI disk block size!"</p>	<ul style="list-style-type: none"> <li>• The iSCSI target system is configured to use a disk block size that is not supported by Intel Ethernet iSCSI Boot. Configure the iSCSI target system to use a disk block size of 512 bytes.</li> </ul>
<p>Error message displayed: "ERROR: Could not establish TCP/IP connection with iSCSI target system."</p>	<ul style="list-style-type: none"> <li>• Intel Ethernet iSCSI Boot was unable to establish a TCP/IP connection with the iSCSI target system. Verify that the initiator and target IP address, subnet mask, port and gateway settings are configured properly. Verify the settings on the DHCP server if applicable. Check that the iSCSI target system is connected to a network accessible to the Intel iSCSI Remote Boot initiator. Verify that the connection is not being blocked by a firewall.</li> </ul>
<p>Error message displayed: "ERROR: CHAP authentication with target failed."</p>	<ul style="list-style-type: none"> <li>• The CHAP user name or secret does not match the CHAP configuration on the iSCSI target system. Verify the CHAP configuration on the Intel iSCSI Remote Boot port matches the iSCSI target system CHAP configuration. Disable CHAP in the iSCSI Remote Boot setup menu if it is not enabled on the target.</li> </ul>
<p>Error message displayed: "ERROR: Login request rejected by iSCSI target system."</p>	<ul style="list-style-type: none"> <li>• A login request was sent to the iSCSI target system but the login request was rejected. Verify the iSCSI initiator name, target name, LUN number, and CHAP authentication settings match the settings on the iSCSI target system. Verify that the target is configured to allow the Intel iSCSI Remote Boot initiator access to a LUN.</li> </ul>
<p>When installing Linux to NetApp Filer, after a successful target disk discovery, error messages may be seen similar to those listed below.</p> <p>lscsi-sfnet:hostx: Connect failed with rc -113: No route to host lscsi-sfnet:hostx: establish_session failed. Could not connect to target</p>	<ul style="list-style-type: none"> <li>• If these error messages are seen, unused iscsi interfaces on NetApp Filer should be disabled.</li> <li>• Continuous=no should be added to the iscsi.conf file</li> </ul>
<p>Error message displayed. "ERROR: iSCSI target not found."</p>	<ul style="list-style-type: none"> <li>• A TCP/IP connection was successfully made to the target IP address, however an iSCSI target with the specified iSCSI target name could not be found on the target system. Verify that the configured iSCSI target name and initiator name match the settings on the iSCSI target.</li> </ul>
<p>Error message displayed. "ERROR: iSCSI target can not accept any more connections."</p>	<ul style="list-style-type: none"> <li>• The iSCSI target cannot accept any new connections. This error could be caused by a configured limit on the iSCSI target or a limitation of resources (no disks available).</li> </ul>



<p>Error message displayed. "ERROR: iSCSI target has reported an error."</p>	<ul style="list-style-type: none"> <li>• An error has occurred on the iSCSI target. Inspect the iSCSI target to determine the source of the error and ensure it is configured properly.</li> </ul>
<p>Error message displayed. ERROR: There is an IP address conflict with another system on the network.</p>	<ul style="list-style-type: none"> <li>• A system on the network was found using the same IP address as the iSCSI Option ROM client.</li> <li>• If using a static IP address assignment, attempt to change the IP address to something which is not being used by another client on the network.</li> <li>• If using an IP address assigned by a DHCP server, make sure there are no clients on the network which are using an IP address which conflicts with the IP address range used by the DHCP server.</li> </ul>

## iSCSI Known Issues

**A device is not listed in Lifecycle Controller - Network Settings menu**

When an Intel® Ethernet iSCSI Boot device is connected to an iSCSI LUN in Legacy BIOS boot mode, the device will not be displayed in the Lifecycle Controller - Network Settings menu.

**A device cannot be uninstalled if it is configured as an iSCSI primary or secondary port.**

Disabling the iSCSI primary port also disables the secondary port. To boot from the secondary port, change it to be the primary port.

**iSCSI Remote Boot: Connecting back-to-back to a target with a Broadcom LOM**

Connecting an iSCSI boot host to a target through a Broadcom LOM may occasionally cause the connection to fail. Use a switch between the host and target to avoid this.

**iSCSI Remote Boot Firmware may show 0.0.0.0 in DHCP server IP address field**

In a Linux base DHCP server, the iSCSI Remote Boot firmware shows 0.0.0.0 in the DHCP server IP address field. The iSCSI Remote Boot firmware looks at the DHCP server IP address from the Next-Server field in the DHCP response packet. However, the Linux base DHCP server may not set the field by default. Add "Next-Server <IP Address>," in dhcpd.conf to show the correct DHCP server IP address.

**iSCSI traffic stops after disabling RSC**

To prevent a lost connection, Receive Segment Coalescing (RSC) must be disabled prior to configuring a VLAN bound to a port that will be used for connecting to an iSCSI target. Workaround this issue by disabling Receive Segment Coalescing before setting up the VLAN. This will avoid this traffic stop.

## Microsoft Windows iSCSI Boot Issues

**Microsoft Initiator does not boot without link on boot port:**

After setting up the system for Intel® Ethernet iSCSI Boot with two ports connected to a target and successfully booting the system, if you later try to boot the system with only the secondary boot port connected to the target, Microsoft Initiator will continuously reboot the system.

To work around this limitation follow these steps:

1. Using Registry Editor, expand the following registry key:

```
\System\CurrentControlSet\Services\Tcpip\Parameters
```

2. Create a DWORD value called DisableDHCPMediaSense and set the value to 0.

**Support for Platforms Booted by UEFI iSCSI Native Initiator**

Starting with version 2.2.0.0, the iSCSI crash dump driver gained the ability to support platforms booted using the native UEFI iSCSI initiator over supported Intel Network Adapters. This support is available on Windows Server or newer and only on x64 architecture. Any hotfixes listed above must also be applied.

Since network adapters on UEFI platforms may not provide legacy iSCSI option ROM, the boot options tab in DMIX may not provide the setting to enable the iSCSI crash dump driver. If this is the case, the following registry entry has to be created:

```
HKLM\SYSTEM\CurrentControlSet\Control\Class\{4D36E97B-E325-11CE-BFC1-08002BE10318}\<InstanceID>\Parameters
DumpMiniport    REG_SZ    iscsdump.sys
```

#### **Moving iSCSI adapter to a different slot:**

In a Windows\* installation, if you move the iSCSI adapter to a PCI slot other than the one that it occupied when the drivers and MS iSCSI Remote Boot Initiator were installed, then a System Error may occur during the middle of the Windows Splash Screen. This issue goes away if you return the adapter to its original PCI slot. We recommend not moving the adapter used for iSCSI boot installation. This is a known OS issue.

If you have to move the adapter to another slot, then perform the following:

1. Boot the operating system and remove the old adapter
2. Install a new adapter into another slot
3. Setup the new adapter for iSCSI Boot
4. Perform iSCSI boot to the OS via the original adapter
5. Make the new adapter iSCSI-bootable to the OS
6. Reboot
7. Move the old adapter into another slot
8. Repeat steps 2 - 5 for the old adapter you have just moved

#### **Uninstalling Driver can cause blue screen**

If the driver for the device in use for iSCSI Boot is uninstalled via Device Manager, Windows will blue screen on reboot and the OS will have to be re-installed. This is a known Windows issue.

#### **Adapters flashed with iSCSI image are not removed from the Device Manager during uninstall**

During uninstallation all other Intel Network Connection Software is removed, but drivers for iSCSI Boot adapters that have boot priority.

#### **I/OAT Offload may stop with Intel® Ethernet iSCSI Boot or with Microsoft Initiator installed**

A workaround for this issue is to change the following registry value to "0":

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\IOATDMA\Start
```

Only change the registry value if iSCSI Boot is enabled and if you want I/OAT offloading. A blue screen will occur if this setting is changed to "0" when iSCSI Boot is not enabled. It must be set back to "3" if iSCSI Boot is disabled or a blue screen will occur on reboot.

#### **iSCSI Boot and Teaming in Windows**

Teaming is not supported with iSCSI Boot. Creating a team using the primary and secondary iSCSI adapters and selecting that team during the Microsoft initiator installation may fail with constant reboots. Do not select a team for iSCSI Boot, even if it is available for selection during initiator installation.

For load balancing and failover support, you can use MSFT MPIO instead. Check the Microsoft Initiator User Guide on how to setup MPIO.

#### **Setting LAA (Locally Administered Address) on an iSCSI Boot-Enabled Port Will Cause System Failure on Next Reboot**

Do not set LAA on ports with iSCSI Boot enabled.

#### **Intel® Ethernet iSCSI Boot version does not match between displayed versions on DMIX and the scrolling text during boot**

If a device is not set to primary but is enumerated first, the BIOS will still use that device's version of iSCSI Boot. Therefore the user may end up using an earlier version of Intel® Ethernet iSCSI Boot than expected. The solution is that all devices in the system must have the same version of iSCSI Boot. To do this the user should go to the Boot Options Tab and update the devices' flash to the latest version.

#### **IPv6 iSCSI login to Dell EMC EqualLogic arrays using jumbo frames**

To establish an iSCSI session using IPv6 and jumbo frames with Dell EqualLogic arrays, TCP/UDP checksum offloads on the Intel iSCSI adapter should be disabled.

## Microsoft Windows iSCSI/DCB Known Issues

Automatic creation of iSCSI traffic filters for DCB is only supported on networks which make use of IPv4 addressing

The iSCSI for Data Center Bridging (DCB) feature uses Quality of Service (QOS) traffic filters to tag outgoing packets with a priority. The Intel iSCSI Agent dynamically creates these traffic filters as needed on networks using IPv4 addressing.

IPv6 iSCSI login to Dell EqualLogic arrays using jumbo frames

To establish an iSCSI session using IPv6 and jumbo frames with Dell EqualLogic arrays, TCP/UDP checksum offloads on the Intel iSCSI adapter should be disabled.

## Linux Known Issues

Channel Bonding

Linux Channel Bonding has basic compatibility issues with iSCSI Boot and should not be used.

Authentications errors on EqualLogic target may show up in dmesg when running Red Hat\* Enterprise Linux 4

These error messages do not indicate a block in login or booting and may safely be ignored.

LRO and iSCSI Incompatibility

LRO (Large Receive Offload) is incompatible with iSCSI target or initiator traffic. A panic may occur when iSCSI traffic is received through the ixgbe driver with LRO enabled. The driver should be built and installed with:

```
# make CFLAGS_EXTRA=-DIXGBE_NO_LRO install
```

## FCoE Boot Configuration

### FCoE Client Setup

## Installing and Configuring Intel® Ethernet FCoE Boot on a Microsoft\* Windows\* Client



### WARNINGS:

- **Do not update the base driver via the Windows Update method**  
Doing so may render the system inoperable, generating a blue screen. The FCoE Stack and base driver need to be matched. The FCoE stack may get out of sync with the base driver if the base driver is updated via Windows Update. Updating can only be done via the Intel® Network Connections Installer.
- **If you are running Microsoft\* Windows Server\* 2012 R2, you must install KB2883200.**  
Failure to do so may result in an Error 1719 and a blue screen.

### New Installation on a Windows Server\* system

From the Intel downloaded media: Click the **FCoE/DCB checkbox** to install Intel® Ethernet FCoE Protocol Driver and DCB. The MSI Installer installs all FCoE and DCB components including Base Driver.

## Intel® Ethernet FCoE Configuration Using Intel® PROSet for Windows\* Device Manager

Many FCoE functions can also be configured or revised using Intel PROSet for Windows\* Device Manager, accessed from the **FCoE Properties** button within the **Data Center** tab. You can use Intel PROSet to perform the following tasks:

- Configure FCoE initiator specific settings
- Go to the corresponding port driver
- Review FCoE initiator information
- Obtain general information
- Review statistics

- Obtain information about the initiator
- Obtain information about attached devices
- FIP discovered VLANs and status

In addition, you can find some FCoE RSS performance settings under the Performance Options of the Advanced tab of the Network Adapter device properties. For additional information see [Receive Side Scaling](#).



#### NOTES:

- From the **Boot Options** tab, the user will see the **Flash Information** button. Clicking on the **Flash Information** button will open the **Flash Information** dialog. From the **Flash Information** dialog, clicking on the **Update Flash** button allows Intel® iSCSI Remote Boot, Intel® Boot Agent (IBA), Intel® Ethernet FCoE Boot, EFI, and CLP to be written. The update operation writes a new image to the adapter's Flash and modifies the EEPROM, which may temporarily disable the operation of the Windows\* network device driver. You might need to reboot the computer following this operation.
  - You cannot update the flash image of a LOM; this button will be disabled.
1. Create a disk target (LUN) on an available Fibre Channel target. Configure this LUN to be accessible to the WWPN address of the initiator of the host being booted.
  2. Make sure the client system starts the Intel® Ethernet FCoE Boot firmware. The firmware should be configured properly, be able to connect to Fibre Channel target, and detect the boot disk.

## Intel® PROSet for Windows\* Device Manager

Many of the functions of the Intel® Ethernet FCoE Boot Port Selection Setup Menu can also be configured or revised using Intel® PROSet for Windows Device Manager.

- Intel® Ethernet FCoE Boot version is displayed on the **Boot Options** tab if the combo image supports FCoE Boot.
- Intel® Ethernet FCoE Boot is an **Active Image** option if FCoE Boot is supported by the combo image.
- The **Active Image** setting enables/disables Intel® Ethernet FCoE Boot in the EEPROM.
- Intel® Ethernet FCoE Boot settings are displayed if **FCoE Boot** is the active image.

## Installing Windows Server from a Remote Disk ("Diskless Install")

After the Option ROM is installed, if you wish to install the Windows Server operating system directly to the FCoE disk, do the following:

1. Download the driver update package from Dell's support website.
  2. Extract the driver update package using the "/s /drivers=c:\mydir" option.
  3. Locate the FCoE drivers in c:\mydir\pre-os\W2K12R2-x64\FCoE. Extract all zipped files and copy to a CD/DVD or USB media.
  4. Boot the install media.
  5. Perform a Custom install and proceed to the "Where do you want to install Windows?" screen.
  6. Use **Load Driver** to load the FCoE drivers. Browse to the location you chose previously and load the following two drivers in the specified order:
    1. Intel(R) Ethernet Setup Driver for FCoE.
    2. Intel(R) Ethernet Virtual Storage Miniport Driver for FCoE.
- Note:** the FCoE drivers will block any other network traffic from the FCoE-supported ports until after Step 7 in this section. Do not attempt to install an NDIS miniport for any FCoE-supported ports prior to Step 7 in this section.
7. You should now see the FCoE disk or disks appear in the list of available install targets. All disks accessible by this initiator through the boot port should appear.
  8. Select the FCoE disk configured for boot in the Option ROM and continue the install until Windows is installed and you are at the desktop.
  9. Follow the instructions for a [New Installation on a Windows Server\\* system](#). This will install the networking drivers and configure the FCoE drivers to work with the networking drivers. Note that you cannot deselect the FCoE feature. You will be prompted to reboot at the end of the installation process.
  10. Windows may prompt you to reboot once again after it returns to the desktop.

## Installing Windows Server with Local Disk

After the Option ROM is installed, if you wish to install Windows Server with local disk, do the following:

1. Follow the instructions for a [New Installation on a Windows Server\\* system](#).
2. Verify that the FCoE Boot disk is available in the **Fabric View** tab of Intel® PROSet for Windows Device Manager, and verify that you are online using Windows Disk Manager.
3. Open a command prompt, run the fcoeprep.bat batch file. To find the batch file, navigate to the c:\mydir\pre-os\W2K12R2-x64\FCoE directory.
4. Shut Windows down and capture the OS image to a local disk partition.
5. Transfer the image from the local hard drive to the FCoE target. This may be done from within the local Windows installation.
6. Shut down and remove the local disk.
7. Configure the system BIOS to boot from the FCoE disk and boot.



**NOTE:** See Microsoft's documentation for more detailed instructions.

## Upgrading Windows Drivers on an Intel® Ethernet FCoE-Booted System

Upgrading an FCoE-booted system can only be done via the Intel® Network Connections Installer. A reboot is required to complete the upgrade. You cannot upgrade a port's Windows driver and software package if the port is in the path to the virtual memory paging file and is also part of a Microsoft LBFO Team. To complete the upgrade, remove the port from the LBFO team and restart the upgrade.

## Validation and Storage Certification

The software components for Intel® Ethernet FCoE are comprised of two major components: the Intel® Ethernet base driver and the Intel® Ethernet FCoE Driver. They are developed and validated as an ordered pair. You are strongly encouraged to avoid scenarios, either through upgrades or Windows update, where the Intel® Ethernet driver version is not the version released with the corresponding Intel® Ethernet FCoE driver. For more information, visit the [download center](#).



### NOTES:

- Individually upgrading/downgrading the Intel® Ethernet FCoE driver will not work and may even cause a blue screen; the entire FCoE package must be the same version. Upgrade the entire FCoE package using the Intel® Network Connections installer only.
- If you uninstalled the Intel® Ethernet Virtual Storage Miniport Driver for FCoE component, just find the same version that you uninstalled and re-install it; or uninstall and then re-install the entire FCoE package.

## Intel® Ethernet FCoE Boot Option ROM Setup

### FCoE Port Selection Menu

To configure Intel® Ethernet FCoE Boot, switch on or reset the system and press Ctrl-D when the message "Press <Ctrl-D> to run setup..." is displayed. After pressing Ctrl-D, you will be taken to the Intel® Ethernet FCoE Boot Port Selection Setup Menu.

## FCoE Port Selection

```
MAC:001B21572006 Dev:10FB Loc:6:0:0 BOOT:DISABLED
MAC:001B21572007 Dev:10FB Loc:6:0:1 BOOT:DISABLED
MAC:001B213CA096 Dev:10FB Loc:7:0:0 BOOT:FCOE
MAC:001B213CA097 Dev:10FB Loc:7:0:1 BOOT:FCOE
```

The first screen of the Intel® Ethernet FCoE Boot Setup Menu displays a list of Intel® FCoE Boot-capable adapters. For each adapter port, the associated SAN MAC address, PCI device ID, PCI bus/device/function location, and a field indicating FCoE Boot status is displayed. Up to 10 FCoE Boot-capable ports can be displayed within the Port Selection Menu. If there are more Intel® FCoE Boot-capable adapters, these are not listed in the setup menu.

Highlight the desired port and press **Enter**.

## FCoE Boot Targets Configuration Menu

### FCoE Boot Targets Configuration

[Discover Targets]

Discover ULAN: 0\_\_

Target WWPN	LUN	ULAN	Boot Order
00:00:00:00:00:00:00:00	0__	0__	0__
00:00:00:00:00:00:00:00	0__	0__	0__
00:00:00:00:00:00:00:00	0__	0__	0__
00:00:00:00:00:00:00:00	0__	0__	0__

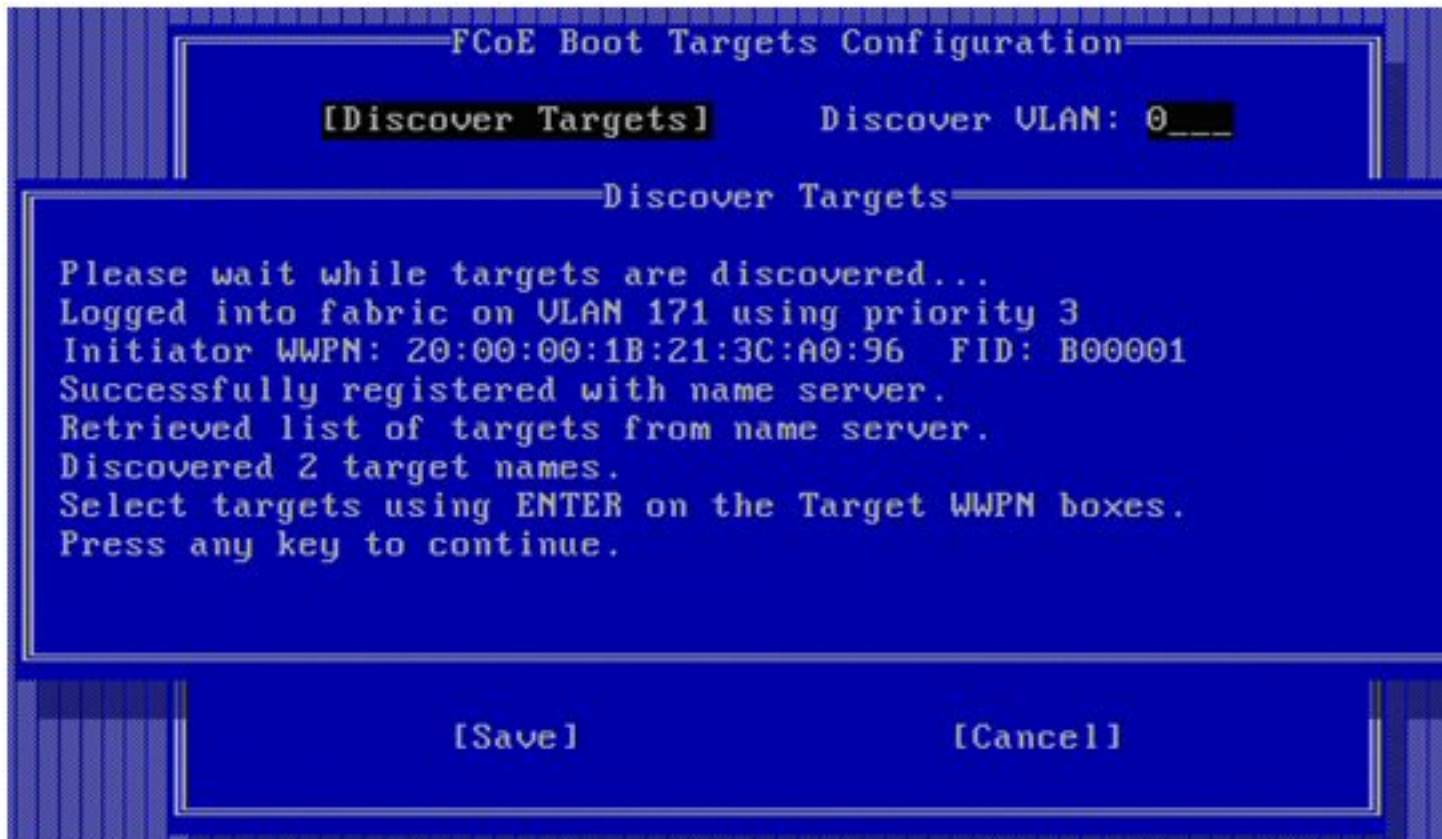
Press ENTER to discover targets

[Save]

[Cancel]



**FCoE Boot Targets Configuration:** **Discover Targets** is highlighted by default. If the **Discover VLAN** value displayed is not what you want, enter the correct value. Highlight **Discover Targets** and then press **Enter** to show targets associated with the **Discover VLAN** value. Under **Target WWPN**, if you know the desired WWPN you can manually enter it or press **Enter** to display a list of previously discovered targets.



## FCoE Target Selection Menu

```
-----Select Target from List-----  
  
WWPN                               Fabric ID  
20:16:00:A0:B8:42:13:8C - C20100  
50:00:CC:A0:04:41:6B:2E - C205D6  
  
1 / 2
```

Highlight the desired **Target** from the list and press **Enter**.

```
-----FCoE Boot Targets Configuration-----  
  
[Discover Targets]          Discover VLAN: 171_  
  
Target WWPN                LUN    VLAN    Boot  
Order  
20:16:00:A0:B8:42:13:8C    0__    171_    1__  
50:00:CC:A0:04:41:6B:2E    1__    171_    2__  
00:00:00:00:00:00:00:00    0__    0__     0__  
00:00:00:00:00:00:00:00    0__    0__     0__  
  
[Save]                      [Cancel]
```




Manually fill in the **LUN** and **Boot Order** values.

**Boot Order** valid values are 0-4, where 0 means no boot order or ignore the target. A 0 value also indicates that this port should not be used to connect to the target. Boot order values of 1-4 can only be assigned once to target(s) across all FCoE boot-enabled ports.

**VLAN** value is 0 by default. You may do a **Discover Targets** which will display a VLAN. If the VLAN displayed is not the one you require, enter the VLAN manually and then perform **Discover Targets** on that VLAN.


Hit **Save**.

 **NOTE:** After the **Discover Targets** function is executed, the Option ROM will attempt to remain logged into the fabric until the **FCoE Boot Targets Configuration Menu** is exited.

- Keyboard Shortcuts: Up/Down, TAB and SHIFT-TAB to move between the controls. Left/Right/Home/End/Del/Backspace in the edit boxes.
- Press the Esc key to leave the screen.

## FCoE Boot Target Configuration

For specific information on configuring your FCoE target system and disk volume, refer to instructions provided by your system or operating system vendor. Listed below are the basic steps necessary to setup Intel® Ethernet FCoE Boot to work with most FCoE targets. The specific steps will vary from one vendor to another.

 **NOTE:** If your FCoE Boot target is on a VLAN other than VLAN #1, then you must use the POST Boot Menu (Ctrl-D) to discover the target.

## Installing Microsoft Windows Server from a Remote Disk ("Diskless Install")

After the Option ROM is installed, if you wish to install the Windows Server operating system directly to the FCoE disk, do the following:

1. Download the driver update package from the [support website](#).
2. Extract the driver update package using the "/s /drivers=c:\mydir" option.
3. Locate the FCoE drivers in c:\mydir\pre-os\W2K12R2-x64\FCoE. Extract all zipped files and copy to a CD/DVD or USB media.
4. Boot the install media.
5. Perform a Custom install and proceed to the "Where do you want to install Windows?" screen.
6. Use **Load Driver** to load the FCoE drivers. Browse to the location you chose previously and load the following two drivers in the specified order:
  1. Intel(R) Ethernet Setup Driver for FCoE.
  2. Intel(R) Ethernet Virtual Storage Miniport Driver for FCoE.

**Note:** the FCoE drivers will block any other network traffic from the FCoE-supported ports until after Step 7. Do not attempt to install an NDIS miniport for any FCoE-supported ports until after Step 7.

7. You should now see the FCoE disk or disks appear in the list of available install targets. All disks accessible by this initiator through the boot port should appear.
8. Select the FCoE disk configured for boot in the Option ROM and continue the install until Windows is installed and you are at the desktop.
9. Follow the instructions for a [new Windows Server installation](#). This will install the networking drivers and configure the FCoE drivers to work with the networking drivers. Note that you cannot deselect the FCoE feature. You will be prompted to reboot at the end of the installation process.
10. Windows may prompt you to reboot once again after it returns to the desktop.

## Installing Windows Server with Local Disk

After the Option ROM is installed, if you wish to install Windows Server with local disk, do the following:

1. Follow the instructions for a [new Windows Server installation](#).
2. Verify that the FCoE Boot disk is available in the **Fabric View** tab of Intel® PROSet for Windows Device Manager, and verify that you are online using Windows Disk Manager.
3. Open a command prompt, run the fcoeprep.bat batch file. To find the batch file, navigate to your architecture's directory within the c:\mydir\pre-os\W2K12R2-x64\FCoE directory.
4. Shut Windows down and capture the OS image to a local disk partition.
5. Transfer the image from the local hard drive to the FCoE target. This may be done from within the local Windows installation.
6. Shut down and remove the local disk.
7. Configure the system BIOS to boot from the FCoE disk and boot.



**NOTE:** See Microsoft's documentation for more detailed instructions.

## SUSE\* Linux Enterprise Server

For the easiest experience installing Linux onto an FCoE target, you should use SLES11 or greater. SLES11 provides native support for FCoE Booting and installing. This means that there are no additional steps outside of the installer that are necessary to install to an iSCSI target using an Intel Ethernet Server Adapter. Please refer to the SLES11 documentation for instructions on how to install to an iSCSI LUN.

## Red Hat Enterprise Linux

For the easiest experience installing Linux onto an iSCSI target, you should use RHEL 6 or greater. RHEL 6 provides native support for iSCSI Booting and installing. This means that there are no additional steps outside of the installer that are necessary to install to an iSCSI target using an Intel Ethernet Server Adapter. Please refer to the RHEL 6 documentation for instructions on how to install to an iSCSI LUN.

## FCoE Known Issues

### Virtual WWN or Virtual WWPN changes unexpectedly

The last 6 octets of the Virtual WWN and Virtual WWPN are based on the Virtual FIP MAC Address. If you set or change the Virtual FIP MAC address, the last 6 octets of the Virtual WWN and Virtual WWPN are automatically changed to match. You can modify the Virtual WWPN and the Virtual WWN, but you can only change the prefix portion, which is the first 2 octets of the value for Virtual WWPN and Virtual WWN respectively. The last 6 octets of the Virtual WWPN and the Virtual WWN must be the same as the active FIP MAC address. The active FIP MAC address could either be the Virtual FIP MAC Address or the FIP MAC Address. You need to determine which one is enabled and active.

### Virtual WWN and Virtual WWPN prefixes not set to values set in server configuration XML file

If I/O Identity Optimization is enabled, you cannot change the values of Virtual WWN and Virtual WWPN prefixes from their default values. If you want to change these values, you must first disable I/O Identity Optimization. Note that if you enable I/O Identity Optimization after changing the prefix values, the prefix values will revert to their defaults.

### Setting same value for Virtual Mac and Virtual FIP MAC is not supported

You cannot use the same value for Virtual Mac and Virtual FIP MAC.

## Intel® Ethernet FCoE Windows Issues

### Intel® Ethernet Virtual Storage Miniport Driver for FCoE may disappear from Device Manager

The Intel® Ethernet Virtual Storage Miniport Driver for FCoE may disappear from the Device Manager after either:

- A virtual network is removed.
- The underlying Intel NIC adapter settings are modified.

This can occur when the corresponding Intel adapter is virtualized to create a new virtual network or delete or modify an existing Virtual Network. It can also happen when the underlying Intel NIC adapter settings are modified, including disabling or re-enabling the adapter.

As a workaround, remove all the resource dependencies of the Intel® Ethernet Virtual Storage Miniport Driver for FCoE that are currently being used by the system before making any changes to the Intel adapter for virtualization. For example, in one use case scenario, the user may have assigned the FCoE disk(s) from the FCoE storage driver to run one of its Virtual Machines, and at the same time the user wants to alter the configuration of the same Intel adapter for virtualization. In this scenario the user must remove the FCoE disks(s) from the Virtual Machine before altering the Intel adapter configuration.

#### **Virtual Port may disappear from Virtual Machine**

When the Virtual Machine starts, it asks the Intel® Ethernet Virtual Storage Miniport Driver for FCoE ("the driver") to create a Virtual Port. If the driver is subsequently disabled, the Virtual Port may disappear. The only way to get the Virtual Port back is to enable the driver and reboot the Virtual Machine.

#### **When installing FCoE after installing ANS and creating AFT Team, Storports are not installed**

If the user installs ANS and creates an AFT team and then installs FCoE/DCB, the result is that DCB is off by default. If the user then enables DCB on one port, the OS detects Storports and the user must manually click on the new hardware wizard prompts for each of them to install. If the user does not do that, DCB status is non-operational and the reason given is no peer.

#### **Intel® PROSet for Windows Device Manager (DMIX) is not synched with FCoE CTRL-D Utility**

When the user disables FCoE via the Control-D menu, the Intel PROSet for Windows Device Manager User Interface states that the flash contains an FCoE image, but that the flash needs to be updated. Updating the flash with the FCoE image again, re-enables FCoE and returns the user to the state where all the FCoE settings are available.

If the user uses the control-D menu to disable FCoE, then they should use the control-D menu to enable it because Intel PROSet for Windows Device Manager does not support enabling or disabling FCoE.

#### **82599 and X540-based adapters don't display as SPC-3 compliant in Windows MPIO configuration**

Because the FCoE initiator is a virtualized device it does not have its own unique hardware ID and thus is not displayed as a SPC-3 compliant device in Windows MPIO configuration.

#### **When removing ALB teaming, all FCOE functions fail, all DMIX tabs are grayed out, and both adapter ports fail**

For ANS teaming to work with Microsoft Network Load Balancer (NLB) in unicast mode, the team's LAA must be set to cluster node IP. For ALB mode, Receive Load Balancing must be disabled. For further configuration details, refer to <http://support.microsoft.com/?id=278431>

ANS teaming will work when NLB is in multicast mode, as well. For proper configuration of the adapter in this mode, refer to [http://technet.microsoft.com/en-ca/library/cc726473\(WS.10\).aspx](http://technet.microsoft.com/en-ca/library/cc726473(WS.10).aspx)

#### **FCoE and TCP/IP traffic on the same VLAN may not work on some switches**

This is a known switch design and configuration issue.

## **Intel® Ethernet FCoE Boot Issues**

### **Option ROM Known Issues**

#### **Discovery problems with multiple FCoE VLANs**

The FCoE Option ROM may not discover the desired VLAN when performing VLAN discovery from the Discover Targets function. If the Discover VLAN box is populated with the wrong VLAN, then enter the desired VLAN before executing Discover Targets.

### **Windows Known Issues**

#### **Brocade switch support in Release 16.4**

Intel® Ethernet FCoE Boot does not support Brocade switches in Release 16.4. If necessary, please use Release 16.2.

#### **Windows uses a paging file on the local disk**

After imaging, if the local disk is not removed before booting from the FCoE disk then Windows may use the paging file from the local disk.

#### Crash dump to FCoE disks is only supported to the FCoE Boot LUN

The following scenarios are not supported:

- Crash dump to an FCoE disk if the Windows directory is not on the FCoE Boot LUN.
- Use of the DedicatedDumpFile registry value to direct crash dump to another FCoE LUN.

#### FCoE uninstall from a local disk may be blocked because installer inaccurately reports system is booted from FCoE

When the FCoE Option ROM connects to an FCoE disk during boot, the Windows installer may be unable to determine if the system was booted from FCoE or not and will block the FCoE uninstall. To uninstall, configure the Option ROM so that it does not connect to an FCoE disk.

#### Unable to create VLAN interfaces with Intel® Ethernet FCoE Boot enabled

When booted with FCoE, a user cannot create VLANs and/or Teams for other traffic types. This prevents converged functionality for non-FCoE traffic.

#### Server adapter configured for FCoE Boot available as External-Shared vnic via Hyper-V

If a port is set as a boot port, when the user installs the Hyper V role in the system and then goes into the Hyper V Network Manager to select which port to externally virtualize, the boot port displays, which it should not.

When setting the port to a boot port in Intel PROSet for Windows Device Manager, a message shows that the user should restart the system for the changes to be effective but does not force a restart. As a result the user level applications are in boot mode (i.e., Data Center Tab is grayed out) but kernel level drivers haven't been restarted to indicate to the OS that the port is a boot port. When the user then adds the Hyper V service to the system, the OS takes a snap shot of the ports available and this is the snap shot that it uses after the Hyper V role is added, system restarted and the user goes into the Hyper V Virtual Network Manager to virtualize the ports. As a result, the boot port also shows up.

### Solutions:

Restart the system after setting a port to a boot port and before adding the Hyper V role. The port does not appear in the list of virtualizable ports in the Hyper V Virtual network manager.

Disable/enable the port in Device Manager after setting it to boot and before adding the Hyper V role. The port does not appear in the list of virtualizable ports in the Hyper V Virtual network manager.

#### FCoE Linkdown Timeout fails prematurely when Remote Booted

If an FCoE-booted port loses link for longer than the time specified in the **Linkdown Timeout** advanced setting in the Intel® Ethernet Virtual Storage Miniport Driver for FCoE, the system will crash. **Linkdown Timeout** values greater than 30 seconds may not provide extra time before a system crash.

#### Windows fails to boot properly after using the image install method

The following situation may arise when installing Windows for FCoE Boot using the imaging method: Windows boots successfully from the FCoE LUN when the local drive is installed, but when the local drive is removed, Windows seems to boot, but fails before reaching the desktop.

In this case it is likely that the Windows installation resides on both the FCoE LUN and local drive. This can be verified by booting from the FCoE LUN with the local drive installed, then comparing the drive letter in the path of files on the desktop with the drive letter for the boot partition in Windows' Disk Management tool. If the drive letters are different, then the Windows installation is split between the two disks.

If this situation is occurring, please ensure that **fcoeprep** is run prior to capturing the image, and that the system is not allowed to local boot between running **fcoeprep** and capturing the image. In addition, the local drive could be removed from the system prior to the first boot from the FCoE LUN.

# Troubleshooting


## Common Problems and Solutions

There are many simple, easy-to-fix problems related to network problems. Review each one of these before going further.

- Check for recent changes to hardware, software, or the network that may have disrupted communications.
- Check the driver software.
  - Make sure you are using the latest appropriate drivers for your adapter from the [Intel support website](#).
  - Disable (or unload), then re-enable (reload) the driver or adapter.
  - Check for conflicting settings. Disable advanced settings such as teaming or VLANs to see if it corrects the problem.
  - Re-install the drivers.
- Check the cable. Use the best available cabling for the intended data rate.
  - Check that the cable is securely attached at both points.
  - Make sure the cable length does not exceed specifications.
  - For copper connections, make sure the cable is a 4-pair Category 5 for 100BASE-T or 100BASE-TX or a 4-pair Category 6 for 10GBASE-T.
  - Perform a cable test.
  - Replace the cable.
- Check the link partner (switch, hub, etc.).
  - Make sure the link partner is active and can send and receive traffic.
  - Make sure the adapter and link partner settings match one another, or are set to auto-negotiate.
  - Make sure the port is enabled.
  - Re-connect to another available port or another link partner.
- Look for adapter hardware problems.
  - Re-seat the adapter.
  - Insert the adapter in another slot.
  - Check for conflicting or incompatible hardware devices and settings.
  - Replace the adapter.
- Check the [Intel support website](#) for possible documented issues.
  - Select your adapter from the adapter family list.
  - Check the Frequently Asked questions section.
  - Check the Knowledge Base.
- Check your process monitor and other system monitors.
  - Check to see that there is sufficient processor and memory capacity to perform networking activity.
  - Look for any unusual activity (or lack of activity).
  - Use network testing programs to check for basic connectivity.
- Check your BIOS version and settings.
  - Use the latest appropriate BIOS for your computer.
  - Make sure the settings are appropriate for your computer.

The following troubleshooting table assumes that you have already reviewed the common problems and solutions.

Problem	Solution
Your computer cannot find the adapter	Make sure your adapter slots are compatible for the type of adapter you are using: <ul style="list-style-type: none"><li>• PCI Express v1.0 (or newer)</li><li>• PCI-X v2.0</li><li>• PCI slots are v2.2</li></ul>
Diagnostics pass but the connection fails	Make sure the cable is securely attached, is the proper type and does not exceed the recommended lengths.  Try running the Sender-Responder diagnostic Test.

Problem	Solution
	Make sure the duplex mode and speed setting on the adapter matches the setting on the switch.
Another adapter stops working after you installed the Intel® Network Adapter	<p>Make sure your PCI BIOS is current. See PCI / PCI-X / PCI Express Configuration.</p> <p>Check for interrupt conflicts and sharing problems. Make sure the other adapter supports shared interrupts. Also, make sure your operating system supports shared interrupts.</p> <p>Unload all PCI device drivers, then reload all drivers.</p>
Adapter unable to connect to switch at correct speed. Gigabit adapter connects at 100 Mbps and 10 gigabit adapter connects at 1000 Mbps.	<p><i>This is applicable only to copper-based connections.</i></p> <p>Make sure the adapter and the link partner are set to auto-negotiate.</p> <p>Verify that you are running the latest operating system revision for your switch and that the switch is compliant with the proper IEEE standard:</p> <ul style="list-style-type: none"> <li>• IEEE 802.3ad-compliant (gigabit over copper)</li> <li>• IEEE 802.3an-compliant (10 gigabit over copper)</li> </ul>
The device does not connect at the expected speed.	When Gigabit Master/Slave mode is forced to "master" mode on both the Intel adapter and its link partner, the link speed obtained by the Intel adapter may be lower than expected.
The adapter stops working without apparent cause	Run the adapter and network tests described under "Test the Adapter".
The Link indicator light is off	<p>Run the adapter and network tests described under "Test the Adapter".</p> <p>Make sure the proper (and latest) driver is loaded.</p> <p>Make sure that the link partner is configured to auto-negotiate (or forced to match adapter)</p> <p>Verify that the switch is IEEE 802.3ad-compliant.</p>
The link light is on, but communications are not properly established	<p>Make sure the proper (and latest) driver is loaded.</p> <p>Both the adapter and its link partner must be set to either auto-detect or manually set to the same speed and duplex settings.</p> <p> <b>NOTE:</b> The adapter's link indicator light may be on even if communications between the adapter and its link partner have not been properly established. Technically, the link indicator light represents the presence of a carrier signal but not necessarily the ability to properly communicate with a link partner. This is expected behavior and is consistent with IEEE's specification for physical layer operation.</p>
RX or TX light is off	Network may be idle; try creating traffic while monitoring the lights.
The diagnostic utility reports the adapter is "Not enabled by BIOS"	The PCI BIOS isn't configuring the adapter correctly. See PCI / PCI-X / PCI Express Configuration.
The computer hangs when the drivers are loaded	Try changing the PCI BIOS interrupt settings. See PCI / PCI-X / PCI Express Configuration.
PCI / PCI-X / PCI Express Configuration	<p>If the adapter is not recognized by your OS or if it does not work you may need to change some BIOS settings. Try the following only if you are having problems with the adapter and are familiar with BIOS settings.</p> <ul style="list-style-type: none"> <li>• Check to see that the "Plug-and-Play" setting is compatible</li> </ul>

Problem	Solution
	<p>with the operating system you are using.</p> <ul style="list-style-type: none"> <li>• Make sure the slot is enabled.</li> <li>• Install the adapter in a bus-master slot.</li> <li>• Configure interrupts for level-triggering, as opposed to edge-triggering.</li> <li>• Reserve interrupts and/or memory addresses. This prevents multiple buses or bus slots from using the same interrupts. Check the BIOS for IRQ options for PCI / PCI-X / PCIe.</li> </ul>

## Multiple Adapters

When configuring a multi-adapter environment, you must upgrade all Intel adapters in the computer to the latest software.

If the computer has trouble detecting all adapters, consider the following:

- If you enable Wake on LAN\* (WoL) on more than two adapters, the Wake on LAN feature may overdraw your system's auxiliary power supply, resulting in the inability to boot the system and other unpredictable problems. For multiple desktop/management adapters, it is recommended that you install one adapter at a time and use the IBAUtil utility (ibautil.exe in \APPS\BOOTAGNT) to disable the WoL feature on adapters that do not require WoL capabilities. On server adapters, the WoL feature is disabled by default.
- Adapters with Intel Boot Agent enabled will require a portion of the limited start up memory for each adapter enabled. Disable the service on adapters that do not need to boot Pre-Boot Execution Environment (PXE).

## Firmware Recovery Mode

A device will enter Firmware Recovery mode if it detects a problem that requires the firmware to be reprogrammed. When a device is in Firmware Recovery mode it will not pass traffic or allow any configuration; you can only attempt to recover the device's firmware.

### Affected Products

Ethernet Device	New NVM Version	Software Driver and Tools
Intel® Ethernet Controller 700 Series	Intel® NIC Family Version 18.8.0 Firmware and newer	Intel® NIC Family Version 18.8.0 and newer
Intel® Ethernet Controller X550	2.00, Intel® NIC Family Version 18.8.0 Firmware and newer	Intel® NIC Family Version 18.8.0 and newer

## Recovery Mode Detection

During initialization, a device can enter recovery mode if the device firmware detects a problem with the LAN device, mandating NVM reprogramming to restore normal operation. After thorough internal testing of the NVM (typically less than 10 minutes, but in some cases longer), the NIC enters Recovery Mode.

## Firmware Recovery Mode Errors and Messages

When a device is in Firmware Recovery mode, the device drivers, preboot software, and utilities may log or display messages such as the following:

- Firmware recovery mode detected. Limiting functionality. Refer to the Intel® Ethernet Adapters and Devices User Guide for details on firmware recovery mode.
- Firmware recovery mode detected. The underlying hardware has been deactivated. Refer to the Intel® Ethernet Adapters and Devices User Guide for details on firmware recovery mode.
- Firmware recovery mode detected. Initialization failed.
- Firmware recovery mode detected. Limiting functionality.
- PXE-E0C: Firmware recovery mode detected. Initialization failed.

## Resolving Firmware Recovery Mode Issues

If your device is in Firmware Recovery mode you can restore it to factory defaults using the process for resolution of Firmware Recovery Mode Issues as outlined in the sub-sections below.

The process for resolution of Firmware Recovery Mode Issues is outlined in the sub-sections below.

### NVM Self Check

The process begins after power-on or reboot. At this time, the firmware will perform tests to assess whether there is damage or corruption of the device NVM image.

#### Actions:

- If NVM image damage or corruption **is not** detected, the device will initialize and operate normally. No further action is required.
- If NVM image damage or corruption **is** detected, the device will not initialize. Proceed with the additional recovery steps listed under Recovery Mode below.

### Recovery Mode

The device NVM image has exhibited damage or corruption.

#### Actions:

1. Wait 10 minutes for the NVM self-check process to complete. If during this period normal operation is achieved, the device will initialize and operate normally. No further action is required.
2. If after 10 minutes normal operation is *not* achieved:
  - a. Check the System Event log for Windows OSs or driver message and kernel logs for Linux and ESXi based distributions. Recovery Mode is confirmed by presence of message/log entries as listed in the Firmware Recovery Mode Errors and Messages section above.
  - b. Reboot the system and proceed with the additional recovery steps listed under NVM Image Restoration below.



#### NOTES:

- While in Recovery Mode, for Windows OSs, clicking on the adapter in device manager may present a dialog box indicating that Firmware Recovery Mode is active.
  - Once this dialog box is dismissed, it will not reappear (but relevant entries will remain in the event logs).
  - Once the dialog is dismissed, while the device appears to be functioning normally, it is in fact limited to only enable NVM image recovery.
- If the system is rebooted (versus power cycled), the driver status may not show a Code 10/yellow bang status as expected. Refer to events logged in System Event log for Windows OSs or driver message and kernel logs for Linux and ESXi based distributions to accurately assess the adapter status.
- When the adapter is in recovery mode, the link LED will not be lit and the adapter will not appear in the following locations:
  - F2 System Setup > Device Settings
  - System BIOS as a NIC for PXE Boot in UEFI boot mode
  - Lifecycle Controller > Network Settings
  - iDRAC Web GUI > Firmware Inventory

### NVM Image Restoration

At this point, the device is in Firmware Recovery mode and its functionality is limited to only supporting restoration of the NVM image.



## Actions:

1. Before initiating device recovery, the integrity of the host operating system, device drivers and firmware utilities must be verified and reinstalled if necessary. Fully functional operating system, device drivers and tools are required for device recovery. Please consult your operating system specific instructions on how to scan and repair potentially damaged system files.
2. If your device is in Firmware Recovery mode you can restore it to factory defaults using the latest Dell EMC Update Package for Intel Adapter Firmware (FW-DUP) or Intel NIC Family ESXi Firmware Update Package. Download the latest Dell EMC Update Package for Intel Adapter Firmware (FW-DUP) or Intel NIC Family ESXi Firmware Update Package from Dell's support website and follow the instructions in them. The Dell EMC Update Package for Intel Adapter Firmware (FW-DUP) must be executed in an operating system to recover the device, not in the Dell Lifecycle Controller or iDRAC.
3. After restoring the NVM image, perform an A/C power cycle of the system. Details for this are in the **Other General Notes** section below.



### NOTES:

- If a device is in recovery mode when the Dell DUP package is executed for inventory, the Firmware Family Version (FFV) will display "0.0.0". This is expected behavior.
- Running the FW-DUP in recovery mode does not update the option ROM. A/C power cycling and running the FW-DUP a second time will correct this.
- After running the FW-DUP in recovery mode, the firmware version is incorrect. Updating the firmware via the Dell Lifecycle Controller or iDRAC resolves the issue.
- User configured settings (i.e. iSCSI target information, user defined port/alternate MAC addresses) will not be restored to pre-recovery mode values.

## Other General Notes



### NOTES:

- To perform an AC power cycle, do the following:
  - Shut down the system if it is powered up.
  - Unplug all AC power cords from the system.
  - Leave the AC power cords unplugged for 15 seconds to allow the system power supply to discharge completely.
  - Plug in AC power cords to the system.
- If NPAR was enabled when the system was recovered, you may continue to see NIC partitions in the OS even though the HII reports that NPAR is disabled. To fix this, disable and then re-enable NPAR in HII, as follows:
  - During system boot, press F2 to enter system setup, then select Device Settings and select the desired device.
  - Select Device Level Configuration, then turn NPAR off in the Virtualization Mode menu.
  - Save changes, which will cause the system to restart.
  - Upon restart, press F2 to enter system setup, and turn NPAR on as described above.

## Other Performance Issues

Attaining the best speed requires that many components are operating at peak efficiency. Among them are the following:

- **Cable quality and length** - Do not exceed the maximum recommended length for your cable type. Shorter lengths often provide better results. Check for loose or damaged connectors. Check the cable for kinked or damaged sections.
- **Bus speed and traffic** - The PCI bus speed accommodates the slowest PCI card installed. Check to see if you have a card that is slowing down your system.
- **Processor and Memory** - Check your performance monitoring programs to see if traffic is being affected by your processor speed, available memory or other processes.
- **Transmission frame size** - Your network performance may be enhanced by adjusting or maximizing the transmission frame size. Operating systems, switches and adapters will impose varying limits on maximum frame

size. See the discussion on Jumbo Frames for your OS.

- **Operating System** - Networking feature implementation will vary by operating system version, such as off-loading and multiprocessor threading.


## Testing the Adapter

Intel's diagnostic software lets you test the adapter to see if there are problems with the adapter hardware, the cabling, or the network connection.


## Testing from Windows

Intel PROSet allows you to run three types of diagnostic tests.

- **Connection Test:** Verifies network connectivity by pinging the DHCP server, WINS server, and gateway.
- **Cable Tests:** Provide information about cable properties.

 **NOTE:** The Cable Test is not supported on all adapters and will not run on Direct Attached Cables (DAC) or Fiber. The Cable Test will only be available on adapters that support it.

- **Hardware Tests:** Determine if the adapter is functioning properly.

 **NOTE:** Hardware tests will fail if the adapter is configured for iSCSI Boot.

To access these tests, select the adapter in Windows Device Manager, click the **Link** tab, and click **Diagnostics**. A Diagnostics window displays tabs for each type of test. Click the appropriate tab and run the test.

In Intel® PROSet ACU, use the Diagnostics panel.

The availability of these tests is dependent on the adapter and operating system. Tests may be disabled if:

- iSCSI Boot is enabled on the port.
- FCoE Boot is enabled on the port.
- The port is used as a manageability port.
- The tests are being run from a virtual machine.

## Testing from Windows PowerShell\*


Intel provides two [PowerShell cmdlets](#) for testing your adapter.

- `Test-IntelNetDiagnostics` runs the specified test suite on the specified device. See the `Test-IntelNetDiagnostics` help inside PowerShell for more information.
- `Test-IntelNetIdentifyAdapter` blinks the LED on the specified device.

## Linux Diagnostics

The driver utilizes the `ethtool` interface for driver configuration and diagnostics, as well as displaying statistical information. `ethtool` version 1.6 or later is required for this functionality.

The latest release of `ethtool` can be found at: <http://sourceforge.net/projects/gkernel>.

 **NOTE:** `ethtool` 1.6 only supports a limited set of `ethtool` options. Support for a more complete `ethtool` feature set can be enabled by upgrading `ethtool` to the latest version.

## Windows\* Event Log

### Windows Event Log Service Names

Intel® Ethernet Controller	NDIS Driver File Names	Windows Event Log Service Name
I350	E1r*.sys	e1repress
I354	E1s*.sys	e1sexpress

Intel® Ethernet Controller	NDIS Driver File Names	Windows Event Log Service Name
X520	lxn*.sys	ixgbn
X540	lxt*.sys	ixgbt
X550	lxs*.sys	ixgbs
710 Series	l40ea*.sys	i40ea

## Intel® Network Adapter Messages

Below is a list of custom event messages that appear in the Windows Event Log for Intel® Ethernet adapters:

Event ID	Message	Severity
1	The Hyper-V role was disabled on the system. All Intel® Ethernet devices configured with a Virtualization performance profile were changed to a more appropriate performance profile.	Informational
6	PROBLEM: Unable to allocate the map registers necessary for operation. ACTION: Reduce the number of transmit descriptors and restart.	Error
7	PROBLEM: Could not assign an interrupt for the network adapter. ACTION: Try a different PCIe slot. ACTION: Install the latest driver from <a href="http://www.intel.com/support/go/network/adapter/home.htm">http://www.intel.com/support/go/network/adapter/home.htm</a> .	Error
23	PROBLEM: The EEPROM on the network adapter may be corrupt. ACTION: Visit the support web site at <a href="http://www.intel.com/support/go/network/adapter/home.htm">http://www.intel.com/support/go/network/adapter/home.htm</a> .	Error
24	PROBLEM: Unable to start the network adapter. ACTION: Install the latest driver from <a href="http://www.intel.com/support/go/network/adapter/home.htm">http://www.intel.com/support/go/network/adapter/home.htm</a> .	Error
25	PROBLEM: The MAC address on the network adapter is invalid. ACTION: Visit <a href="http://www.intel.com/support/go/network/adapter/home.htm">http://www.intel.com/support/go/network/adapter/home.htm</a> for assistance.	Error
27	Network link has been disconnected.	Warning
30	PROBLEM: The network adapter is configured for auto-negotiation but the link partner is not. This may result in a duplex mismatch. ACTION: Configure the link partner for auto-negotiation.	Warning
31	Network link has been established at 10 Gbps full duplex.	Informational
32	Network link has been established at 1 Gbps full duplex.	Informational
33	Network link has been established at 100 Mbps full duplex.	Informational
34	Network link has been established at 100 Mbps half duplex.	Informational
35	Network link has been established at 10 Mbps full duplex.	Informational
36	Network link has been established at 10 Mbps half duplex.	Informational
37	PROBLEM: PCI Express bandwidth available for this adapter is not sufficient for optimal performance. ACTION: Move the adapter to a x8 PCI Express slot.	Warning
40	Intel Smart Speed has downgraded the link speed from the maximum advertised.	Informational
41	The network adapter driver has been stopped.	Informational
42	The network adapter driver has been started.	Informational
43	PROBLEM: Could not allocate shared memory necessary for operation.	Error

Event ID	Message	Severity
	ACTION: Reduce the number of transmit and receive descriptors, then restart.	
44	PROBLEM: Could not allocate memory necessary for operation. ACTION: Reduce the number of transmit and receive descriptors, then restart.	Error
45	PROBLEM: Could not allocate a resource pool necessary for operation. ACTION: Reduce the number of transmit and receive descriptors, then restart.	Error
46	PROBLEM: Could not initialize scatter-gather DMA resources necessary for operation. ACTION: Reduce the number of transmit descriptors and restart.	Error
47	PROBLEM: Could not map the network adapter flash. ACTION: Install the latest driver from <a href="http://www.intel.com/support/go/network/adapter/home.htm">http://www.intel.com/support/go/network/adapter/home.htm</a> . ACTION: Try another slot.	Error
48	PROBLEM: The fan on the network adapter has failed. ACTION: Power off the machine and replace the network adapter.	Error
49	PROBLEM: The driver was unable to load due to an unsupported SFP+ module installed in the adapter. ACTION: Replace the module. ACTION: Install the latest driver from <a href="http://www.intel.com/support/go/network/adapter/home.htm">http://www.intel.com/support/go/network/adapter/home.htm</a> .	Error
50	PROBLEM: The network adapter has been stopped because it has overheated. ACTION: Restart the computer. If the problem persists, power off the computer and replace the network adapter.	Error
51	PROBLEM: The network adapter link speed was downshifted because it overheated.	Error
52	PROBLEM: The network adapter has been stopped because it has overheated.	Error
53	Jumbo Frames cannot be configured when MACSec is enabled.	Informational
54	PROBLEM: A malicious VF driver has been detected.	Warning
56	The network driver has been stopped because the network adapter has been removed.	Informational
58	Network link has been established at 25Gbps full duplex.	Informational
60	Network link has been established at 50Gbps full duplex.	Informational
61	Network link has been established at 20Gbps full duplex.	Informational
64	This network adapter's etrack ID is:	Informational
65	PROBLEM: PCI Express bandwidth available for this adapter is not sufficient for optimal performance. ACTION: Move the adapter to a Generation 3 x4 PCI Express slot.	Warning
66	PROBLEM: PCI Express bandwidth available for this adapter is not sufficient for optimal performance. ACTION: Move the adapter to a Generation 3 x8 PCI Express slot.	Warning
67	The partition detected link speed that is less than 10Gbps.	Warning
68	The driver for the device stopped because the NVM image is newer than the driver. You must install the most recent version of the network driver.	Error
69	The driver for the device detected a newer version of the NVM image than expected. Please install the most recent version of the network driver.	Warning
70	The driver for the device detected an older version of the NVM image than expected. Please update the NVM image.	Informational

Event ID	Message	Severity
71	The driver failed to load because an unsupported module type was detected.	Error
72	PROBLEM: The driver failed to load because the adapter was not provided MSI-X interrupt resources. ACTION: Move the adapter to another slot or platform.	Error
73	The 'Speed and Duplex' and 'Flow Control' user settings cannot be changed since this device is operating in virtual connect mode.	Informational

## Intel Advanced Network Services Messages

Below is a list of intermediate driver custom event messages that appear in the Windows Event Log:

Event ID	Message	Severity
1	Virtual NICs cannot be created on a team with Receive Load Balancing enabled. Receive Load Balancing will be disabled on (Team Name).	Informational
2	Unable to allocate required resources. Free some memory resources and restart.	Error
3	Unable to read required registry parameters. To resolve, remove the adapter team and then create a new team.	Error
4	Unable to bind to physical adapter. To resolve, remove the adapter team and then create a new team.	Error
5	Unable to initialize an adapter team. To resolve, remove the adapter team and then create a new team.	Error
6	Primary Adapter is initialized: <member description>	Informational
7	Adapter is initialized: <member description>	Informational
8	Team #<team ID>: Team is initialized.	Informational
9	Team #<ID>: Virtual Adapter for <VLAN name> [VID=<VLAN ID>] initialized.	Informational
10	Current Primary Adapter is switching from: <member description>	Informational
11	Adapter link down: <member description>	Warning
12	Secondary Adapter took over: <member description>	Informational
13	The <member description> has been deactivated from the team.	Warning
14	Secondary Adapter has rejoined the Team: <member description>	Informational
15	Adapter link up: <member description>	Informational
16	Team #<ID>: The last adapter has lost link. Network connection has been lost.	Error
17	Team #<ID>: An adapter has re-established link. Network connection has been restored.	Informational
18	Preferred primary adapter has been detected: <member description>	Informational
19	Preferred secondary adapter has been detected: <member description>	Informational
20	Preferred primary adapter took over: <member description>	Informational
21	Preferred secondary adapter took over: <member description>	Informational
22	Primary Adapter does not sense any Probes: <member description>. Possible reason: partitioned Team.	Warning

Event ID	Message	Severity
23	Team #<ID>: A Virtual Adapter failed to initialize.	Error
32	An illegal loopback situation has occurred on the adapter in device <member description>. Check the configuration to verify that all the adapters in the team are connected to 802.3ad compliant switch ports.	Warning
35	Initializing Team #<ID> with <missing #> missing adapters. Check the configuration to verify that all the adapters are present and functioning.	Warning
37	Virtual adapter for <VLAN name> [VID=<VLAN ID>] removed from team #<team ID>.	Informational
38	Adapter removed from team #<ID>.	Informational
39	You may not be able to change the virtual adapter settings. To resolve, reload the driver.	Warning
40	Virtual adapter unload process may have not completed successfully. Driver may not be unloaded. To resolve, reboot the system.	Warning

## Intel DCB Messages

Below is a list of intermediate driver custom event messages that appear in the Windows Event Log:

Event ID	Message	Severity
256	Service debug string	Informational
257	Enhanced Transmission Selection feature has been enabled on a device.	Informational
258	Enhanced Transmission Selection feature has been disabled on a device.	Informational
259	Priority Flow Control feature has been enabled on a device.	Informational
260	Priority Flow Control feature has been disabled on a device.	Informational
261	Enhanced Transmission Selection feature on a device has changed to operational.	Informational
262	Priority Flow Control feature on a device has changed to operational.	Informational
263	Application feature on a device has changed to operational.	Informational
264	Application feature has been disabled on a device.	Informational
265	Application feature has been enabled on a device.	Informational
269	Logical Link feature on a device has changed to operational.	Informational
270	Logical Link feature has been disabled on a device.	Informational
271	Logical Link feature has been enabled on a device.	Informational
768	Service failed while starting.	Error
770	Service handler failed while installing.	Error
771	Service could not allocate sufficient memory.	Error
772	Service unable to use network adapter.	Error
773	Service rejected configuration - invalid total for transmit bandwidth groups.	Error
774	Service rejected configuration - invalid total for receive bandwidth groups.	Error
775	Service rejected configuration - invalid transmit bandwidth group index.	Error
776	Service rejected configuration - invalid receive bandwidth group index.	Error

<b>Event ID</b>	<b>Message</b>	<b>Severity</b>
777	Service rejected configuration - link strict and non-zero bandwidth on transmit traffic class.	Error
778	Service rejected configuration - link strict and non-zero bandwidth on receive traffic class.	Error
779	Service rejected configuration - zero bandwidth on transmit traffic class.	Error
780	Service rejected configuration - zero bandwidth on receive traffic class.	Error
781	Service rejected configuration - link strict and non-zero bandwidth on transmit bandwidth group.	Error
782	Service rejected configuration - link strict and non-zero bandwidth on receive bandwidth group.	Error
783	Service rejected configuration - invalid total transmit for bandwidth group.	Error
784	Service rejected configuration - invalid total receive for bandwidth group.	Error
785	Service unable to configure needed WMI services.	Error
786	Service experienced a transmit state machine error.	Error
787	Service experienced a receive state machine error.	Error
789	Service connection to LLDP protocol driver failed.	Error
790	Enhanced Transmission Selection feature on a device has changed to non-operational.	Error
791	Priority Flow Control feature on a device has changed to non-operational.	Error
792	Application feature on a device has changed to non-operational.	Error
793	Service rejected configuration - multiple link strict bandwidth groups were detected.	Error
794	Logical Link feature on a device has changed to non-operational.	Error
795	Failed to open device.	Error
796	DCB settings of the network adapter are invalid.	Error
797	DCB settings of the network adapter are invalid - AppSelector.	Error
798	Detected a non-optimal network adapter driver component. Please install network adapter driver version 3.5 or greater.	Error

## Intel iSCSI DCB Messages

Below is a list of intermediate driver custom event messages that appear in the Windows Event Log:

<b>Event ID</b>	<b>Message</b>	<b>Severity</b>
4352	Service debug string:	Informational
4353	iSCSI DCB Agent has added a QOS filter for iSCSI traffic.	Informational
4354	iSCSI DCB Agent has removed a QOS filter for iSCSI traffic.	Informational
4355	iSCSI DCB Agent has modified a QOS filter for iSCSI traffic.	Informational
4356	iSCSI DCB Agent was notified by the QOS service that an iSCSI DCB adapter was closed.	Informational
4357	Priority Flow Control and Application User Priority are configured for iSCSI DCB traffic.	Informational
4358	All members of the Team configured for iSCSI DCB traffic have a valid DCB configuration.	Informational

<b>Event ID</b>	<b>Message</b>	<b>Severity</b>
8704	Some members of the Team configured for iSCSI DCB traffic have an invalid DCB configuration.	Warning
13056	Service failed while starting.	Error
13057	Service handler failed while installing.	Error
13058	Error returned by Traffic Control interface.	Error
13059	Service could not allocate sufficient memory.	Error
13060	iSCSI DCB Agent is unable to add the QOS filter for iSCSI traffic.	Error
13061	iSCSI DCB Agent was notified by the QOS service that all QOS filters for an iSCSI DCB adapter were removed.	Error
13062	Application User Priority or Priority Flow Control is misconfigured for iSCSI DCB traffic.	Error
13063	Priority Flow Control TLV is non-operational for iSCSI DCB traffic.	Error
13064	Application TLV is non-operational for iSCSI DCB traffic.	Error
13065	Detected unsupported Operating System.	Error
13066	No member of the Team configured for iSCSI DCB traffic has a valid DCB configuration.	Error

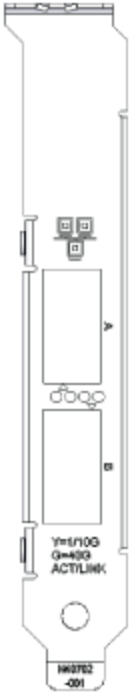


# Indicator Lights

The Intel Server and Desktop network adapters feature indicator lights on the adapter backplate that serve to indicate activity and the status of the adapter board. The following tables define the meaning for the possible states of the indicator lights for each adapter board.


## Dual Port QSFP+ Adapters

The Intel® Ethernet Converged Network Adapter XL710-Q2 has the following indicator lights:


	Label	Indication	Meaning
	ACT/LNK	Green	Linked at 40 Gb
		Blinking On/OFF	Actively transmitting or receiving data
		Off	No link.

## Dual Port SFP/SFP+ Adapters

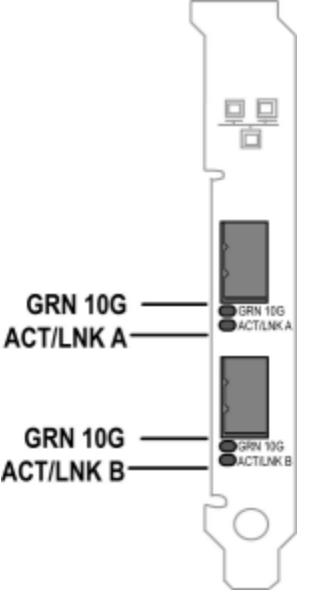
The Intel® Ethernet 25G 2P XXV710 Adapter has the following indicator lights:

	Label	Indication	Meaning
	GRN 25G	Green	Linked at 25 Gb
		Yellow	Linked at 10 Gb or 1 Gb
	ACT/LNK	Blinking On/OFF	Actively transmitting or receiving data
		Off	No link.

The Intel® Ethernet Converged Network Adapter X710 has the following indicator lights:

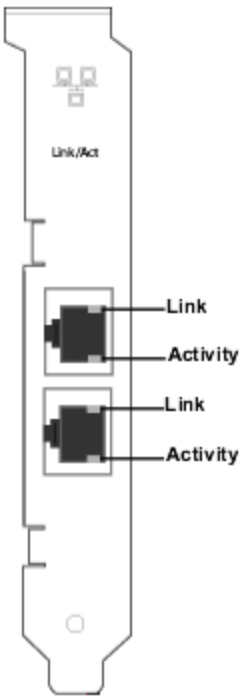
	Label	Indication	Meaning
	LNK	Green	Linked at 10 Gb
		Yellow	Linked at 1 Gb
	ACT	Blinking On/OFF	Actively transmitting or receiving data
		Off	No link.

The Intel® 10G 2P X520 Adapter has the following indicator lights:

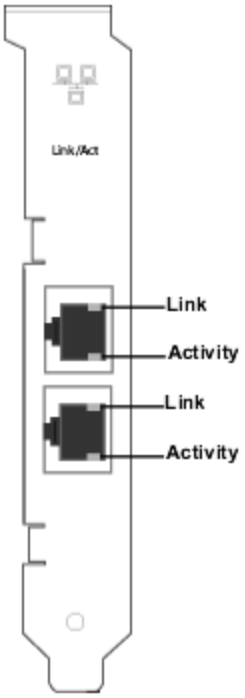
	Label	Indication	Meaning
	GRN 10G (A or B): Green	On	Linked to the LAN.
		Off	Not linked to the LAN.
	ACT/LNK (A or B): Green	Blinking On/Off	Actively transmitting or receiving data.
		Off	No link.

## Dual Port Copper Adapters

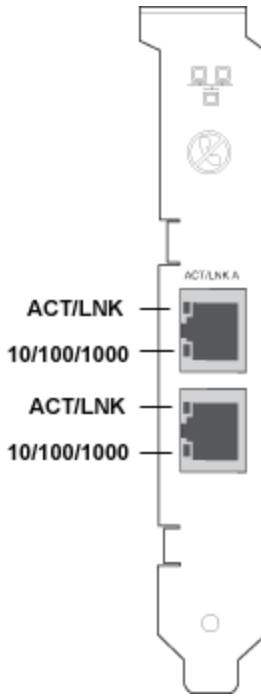
The Intel® Ethernet 10G 2P X550-t Adapter has the following indicator lights:

	Label	Indication	Meaning
	Link	Green	Linked at 10 Gb.
		Yellow	Linked at 1 Gb or 100 Mbps.
		Off	No link.
	Activity	Blinking On/Off	Actively transmitting or receiving data.
		Off	No link.

The Intel® Ethernet 10G 2P X540-t Adapter has the following indicator lights:

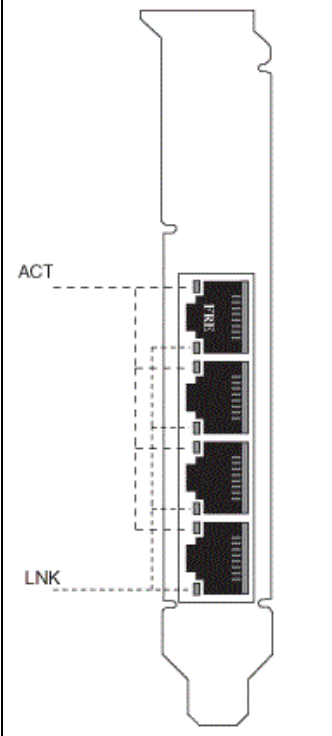
	Label	Indication	Meaning
	Link	Green	Linked at 10 Gb.
		Yellow	Linked at 1 Gb.
		Off	No link.
	Activity	Blinking On/Off	Actively transmitting or receiving data.
		Off	No link.

The Intel® Gigabit 2P I350-t Adapter has the following indicator lights:

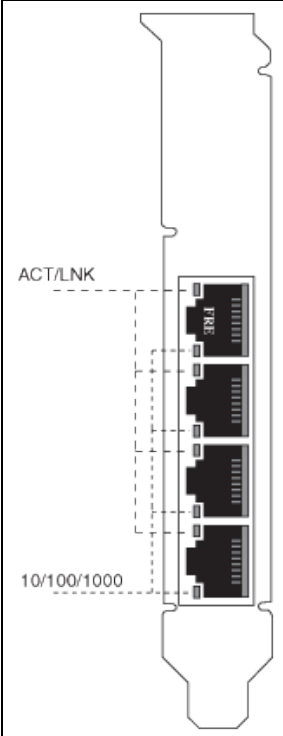
	Label	Indication	Meaning
	ACT/LNK	Green on	The adapter is connected to a valid link partner.
		Green flashing	Data activity
		Off	No link.
	10/100/1000	Off	10 Mbps
		Green	100 Mbps
		Yellow	1000 Mbps
		Orange flashing	Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.

## Quad Port Copper Adapters

The Intel® Ethernet Converged Network Adapter X710 and Intel® Ethernet Converged Network Adapter X710-T have the following indicator lights:

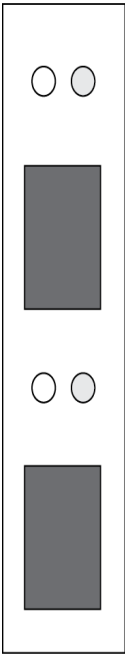
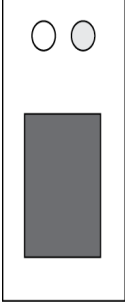
	Label	Indication	Meaning	
	ACT		Green on	The adapter is connected to a valid link partner.
			Green flashing	Data activity
			Off	No link.
	LNK		Green	10 Gbps
			Yellow	1 Gbps
		Off	100 Mbps	

The Intel® Gigabit 4P I350-t Adapter has the following indicator lights:

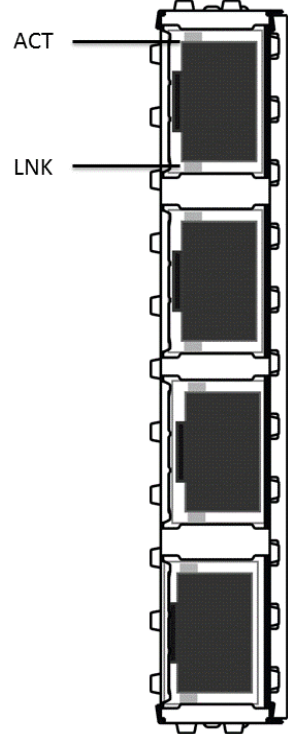
	Label	Indication	Meaning	
	ACT/LNK		Green on	The adapter is connected to a valid link partner.
			Green flashing	Data activity
			Off	No link.
	10/100/1000		Green	100 Mbps
			Yellow	1000 Mbps
			Orange flashing	Identity. Use the "Identify Adapter" button in Intel® PROSet to control blinking. See Intel PROSet Help for more information.
		Off	10 Mbps	

## rNDC (Rack Network Daughter Cards)

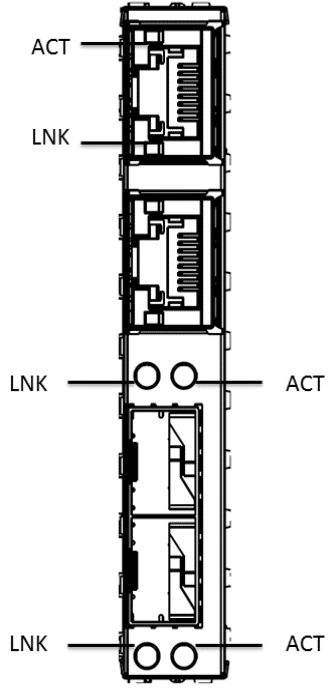
The Intel® Ethernet 40G 2P XL710 QSFP+ rNDC has the following indicator lights:

LNK ACT	Label	Indication	Meaning
	LNK (green/yellow)	Green on	Operating at maximum port speed.
		Off	No link.
	ACT (green)	Green flashing	Data activity.
		Off	No activity.

The Intel® Ethernet 10G 4P X550/I350 rNDC, Intel® Gigabit 4P X550/I350 rNDC, Intel® Ethernet 10G 4P X550 rNDC, Intel® Ethernet 10G 4P X540/I350 rNDC, Intel® Gigabit 4P X540/I350 rNDC and Intel® Gigabit 4P I350-t rNDC have the following indicator lights:

	Label	Indication	Meaning
	LNK (green/yellow)	Green on	Operating at maximum port speed.
		Yellow on	Operating at lower port speed.
		Off	No link.
	ACT (green)	Green flashing	Data activity.
		Off	No activity.

The Intel® Ethernet 10G 4P X520/I350 rNDC, Intel® Gigabit 4P X520/I350 rNDC, Intel® Ethernet Gigabit 4P x710/I350 rNDC, and Intel® 10G 4P X710/I350 rNDC have the following indicator lights:

	Label	Indication	Meaning
	LNK (green/yellow)	Green on	Operating at maximum port speed.
		Yellow on	Operating at lower port speed.
		Off	No link.
	ACT (green)	Green flashing	Data activity.
		Off	No activity.

# Known Issues

 **NOTE:** [iSCSI Known Issues](#) and [FCoE Known Issues](#) are located in their own sections of this manual.

## NVM update utilities exit with error on Linux kernel 4.16 or higher

On Linux kernel 4.16 or higher, if you update the ixgbe, igb, or i40e driver and then run any of the NVM update utilities (NVMUpdate, NVMCheck, QCU, or Bootutil), the utility may exit with the error "The selected adapter cannot be updated due to strict MMIO memory settings in the kernel." To fix this, set the iomem kernel parameter to "relaxed" (i.e., iomem-m=relaxed) and reboot the system before running the tool again. On kernel 4.16 or higher, the iomem parameter is set to "strict" by default, which prevents the NVM update utilities from accessing the MMIO of the device.

## Firmware downgrade to v18.0.x or older fails on X550 based devices

On X550 based devices, downgrading the firmware to version 18.0.x or older will fail and may result in NVM and Option ROM version incompatibility issues. To fix this issue, update to the latest firmware version.

## An error occurred when updating a module on Intel® Ethernet 10G 2P X550-t Adapter using FW 17.5.0

If you use FW DUP (Dell EMC Update Package) v17.5.0 to downgrade the firmware on an Intel® Ethernet 10G 2P X550-t Adapter, the DUP may report "An error occurred when updating a module." Please ignore this error message. The FW was successfully downgraded.

## "Rx/Tx is disabled on this device because the module does not meet thermal requirements." error during POST

This error is caused by installing a module in an X710 based device that does not meet thermal requirements for that device. To resolve the issue, please install a module that meets the device's thermal requirements. See the section "[SFP+ and QSFP+ Devices](#)" in this document.

## "Rx/Tx is disabled on this device because an unsupported SFP+ module type was detected." error during POST

This error is caused by installing an unsupported module in an X710/XL710 based device. You will not be able to send or receive traffic on this device. To resolve the issue, please install a supported module. See the section "[SFP+ and QSFP+ Devices](#)" in this document.

## Missing virtual function ports in VMWare ESX

If you enable NPar and SR-IOV on the same device, the number of virtual functions enabled and displayed in lspci may be 8 or less. ESX limits the number of virtual functions to 8 per device. Also, due to ESXi limitations, the number of virtual functions created may be less than the number requested. See the ESXi documentation for details.

<http://pubs.vmware.com/>

## Lost Data Packets caused by Frequent LLDP Packets on an Inactive Port

When ports are teamed or bonded together in an active/passive configuration (for example, in a switch fault tolerance team, or a mode 1 bond), the inactive port may send out frequent LLDP packets, which results in lost data packets. This may occur with Intel ANS teaming on Microsoft Windows operating systems or with channel bonding on Linux systems. To resolve the issue, set one of the ports to be the Primary port.

## Code 10 yellow bang errors on a Virtual Machine in Windows Device Manager

On a system running Microsoft Windows Server 2016, inside a Virtual Machine running Microsoft Windows Server 2016 or Windows Server 2012 R2, Intel Ethernet connections may have a code 10 yellow bang in Windows Device Manager. Installing a cumulative updated that contains Microsoft KB3192366 and KB3176936 will resolve the issue.



## **Dropped Receive Packets on Half-Duplex 10/100 Networks**

If you have an Intel PCI Express adapter installed, running at 10 or 100 Mbps, half-duplex, with TCP Segment Offload (TSO) enabled, you may observe occasional dropped receive packets. To work around this problem, disable TSO or update the network to operate in full-duplex or 1 Gbps.

## **Throughput Reduction After Hot-Replace**

If an Intel gigabit adapter is under extreme stress and is hot-swapped, throughput may significantly drop. This may be due to the PCI property configuration by the Hot-Plug software. If this occurs, throughput can be restored by restarting the system.

## **CPU Utilization Higher Than Expected**

Setting RSS Queues to a value greater than 4 is only advisable for large servers with several processors. Values greater than 4 may increase CPU utilization to unacceptable levels and have other negative impacts on system performance.

## **Supported SFP or SFP+ Module Not Recognized by the System**

If you try to install an unsupported module, the port may no longer install any subsequent modules, regardless of whether the module is supported or not. The port will show a yellow bang under Windows Device Manager and an event id 49 (unsupported module) will be added to the system log when this issue occurs. To resolve this issue, the system must be completely powered off.

## **Windows Known Issues**

### **Incorrect error message regarding adapter being configured for FCoE Boot**

When Microsoft Hot Fix KB2883200 is not installed on Windows Server 2012 R2, an inaccurately worded error message appears if the "Intel® Ethernet Setup Driver for FCoE" was installed in the operating system prior to running the "Dell EMC Update Package to install Intel NIC Drivers on Windows 64-bit Operating Systems".

The error message says "An adapter is either configured to boot from an FCoE drive or a paging file is located on an FCoE drive" even when no adapters are configured to connect to an FCoE drive.

To work around this, install Microsoft Hot Fix KB2883200 and run the Dell EMC Update Package again.

### **Out of box driver will not uninstall via Web Console Apps & Features**

You cannot use the Microsoft\* Windows\* 2016 Web Console Apps & Features menu to uninstall out-of-box drivers. Instead, use the Programs and Features selection in the Windows Control Panel.

### **Port is missing from Lifecycle Controller : Network Settings**

If a port is configured for iSCSI boot or FCoE boot, and it successfully connected to its boot target, then you cannot modify the port settings in the Lifecycle Controller.

### **Procedure for Installing and Upgrading Drivers and Utilities**

Intel does not recommend installing or upgrading drivers and Intel® PROSet software over a network connection. Instead, install or upgrade drivers and utilities from each system. To install or upgrade drivers and utilities, follow the instructions in the user guide.

### **Advanced Properties Settings Change While Traffic is Running**

In the Advanced Properties tab of Intel® PROSet, parameters should not be modified under heavy network loads. Otherwise, a reboot may be required to make the changes effective.

## **In a Microsoft Hyper-V environment, Virtual Machines bound to NPAR partitions will not communicate with each other**

In a Microsoft Hyper-V environment, if you have NPAR enabled on a port, and Virtual Machines (VMs) bound to partitions on that port, the VMs may not be able to communicate with each other. This happens because the virtual switch inside Hyper-V sends the packets to the physical port, which sends the packets to the switch that is connected to the port. The physical switch may not be configured for reflective relay (also called hairpin mode), so it may not send the packets back on the same connection from which it received them. Connecting the port to a Virtual Ethernet Port Aggregator (VEPA) capable switch will resolve the issue.

## **Intel drivers must be installed by Dell EMC Update Package before configuring Microsoft Hyper-V features**

Prior to configuring the Microsoft\* Hyper-V features, the Intel® NIC drivers must be installed by the Dell EMC Update Package. If the Microsoft\* Hyper-V feature is configured on an unsupported NIC partition on Intel® X710 devices prior to executing the Dell EMC Update Package to install Intel® NIC Drivers, the driver installation may not complete. To recover, you must uninstall Microsoft\* Hyper-V, uninstall 'Intel® Network Connections' from 'Programs and Features', and execute the Dell EMC Update Package to install Intel® NIC Drivers.

## **Virtual machine loses link on a Microsoft Windows Server 2012 R2 system**

On a Microsoft Windows Server 2012 R2 system with VMQ enabled, if you change the BaseRssProcessor setting, then install Microsoft Hyper-V and create one or more virtual machines, the virtual machines may lose link. Installing the April 2014 update rollup for Windows RT 8.1, Windows 8.1, and Windows Server 2012 R2 (2919355) and hotfix 3031598 will resolve the issue. See <http://support2.microsoft.com/kb/2919355> and <http://support2.microsoft.com/kb/3031598> for details.

## **Incomplete branding string displayed in the event log**

Some branding strings are too long to be displayed fully in the event log. In these cases, the branding string will be truncated and the port's PCI Bus/Device/Function are appended to the string. For example: Intel(R) Ethernet Converged Network Ad... [129,0,1].

## **DCB QoS and Priority Flow Control do not act as expected**

If you use Microsoft's Data Center Bridging (DCB) implementation configure Quality of Service (QoS) and Priority Flow Control (PFC), the actual traffic flow segregation per traffic class may not match your configuration and PFC may not pause traffic as expected. If you mapped more than one priority to a Traffic Class, enabling only one of the priorities and disabling the others will work around the issue. Installing Intel's DCB implementation will also resolve this issue. This issue affects Microsoft Windows Server 2012 R2.

## **Link loss after changing the Jumbo Frames setting**

Inside a guest partition on a Microsoft Windows Server 2012 R2 Hyper-V virtual machine, if you change the jumbo frame Advanced setting on an Intel® X540 based Ethernet Device or associated Hyper-V NetAdapter, you may lose link. Changing any other Advanced Setting will resolve the issue.

## **Virtual Machine Queues are not allocated until reboot**

On a Microsoft Windows Server 2012 R2 system with Intel® Ethernet Gigabit Server adapters installed, if you install Hyper-V and create a VM switch, Virtual Machine Queues (VMQ) are not allocated until you reboot the system. Virtual machines can send and receive traffic on the default queue, but no VMQs will be used until after a system reboot.

## **Application Error Event IDs 789, 790, and 791 in the Event Log**

If Data Center Bridging (DCB) is enabled, and the enabled port loses link, the following three events may be logged in the event log:

- Event ID 789: Enhanced Transmission Selection feature on a device has changed to non-operational
- Event ID 790: Priority Flow Control feature on a device has changed to non-operational
- Event ID 791: Application feature on a device has changed to non-operational (FCoE)

This is the expected behavior when a DCB enabled port loses link. DCB will begin working again as soon as link is reestablished. A port will lose link if the cable is disconnected, the driver or software package is updated, if the link partner goes down, or for other reasons.

## **"Malicious script detected" Warning from Norton AntiVirus During PROSet Uninstall**

The Intel PROSet uninstall process uses a Visual Basic script as part of the process. Norton AntiVirus and other virus scanning software may mistakenly flag this as a malicious or dangerous script. Letting the script run allows the uninstall process to complete normally.

## **Unexpected Connectivity Loss**

If you uncheck the "Allow the computer to turn off this device to save power" box on the Power Management tab and then put the system to sleep, you may lose connectivity when you exit sleep. You must disable and enable the NIC to resolve the issue. Installing Intel® PROSet for Windows Device Manager will also resolve the issue.

## **VLAN Creation Fails on a Team that Includes a Non-Intel Phantom Adapter**

If you are unable to create a VLAN on a team that includes a non-Intel phantom adapter, use Device Manager to remove the team, then recreate the team without the phantom adapter, and add the team to the VLAN.

## **Receive Side Scaling value is blank**

Changing the Receive Side Scaling setting of an adapter in a team may cause the value for that setting to appear blank when you next check it. It may also appear blank for the other adapters in the team. The adapter may be unbound from the team in this situation. Disabling and enabling the team will resolve the issue.

## **RSS Load Balancing Profile Advanced Setting**

Setting the "RSS load balancing profile" Advanced Setting to "ClosestProcessor" may significantly reduce CPU utilization. However, in some system configurations (such as a system with more Ethernet ports than processor cores), the "ClosestProcessor" setting may cause transmit and receive failures. Changing the setting to "NUMAScalingStatic" will resolve the issue.

## **Opening Windows Device Manager property sheet takes longer than expected**

The Windows Device Manager property sheet may take 60 seconds or longer to open. The driver must discover all Intel Ethernet devices and initialize them before it can open the property sheet. This data is cached, so subsequent openings of the property sheet are generally quicker.

# **Linux Known Issues**

HeaderDataSplit is not supported in 82599-based adapters.

## **Configuring the Driver on Different Distributions**

Configuring a network driver to load properly when the system is started (0=legacy, 1=MSI, 2=MSI-X) is distribution dependent. Typically, the configuration process involves adding an alias line to `/etc/modules.conf` or `/etc/modprobe.conf` as well as editing other system startup scripts and/or configuration files. Many popular Linux distributions ship with tools to make these changes for you. To learn the proper way to configure a network device for your system, refer to your distribution documentation.

## Enabling WOL in Linux Using Ethtool and BootUtil

By default, WOL is disabled. In a Linux environment, WOL is enabled using ethtool and, in some instances, using BootUtil is also required. Only port A (port 0) can be enabled through ethtool without using BootUtil. To enable WOL using ethtool on other ports, WOL must be enabled with BootUtil first.

## Power Management Known Issues

### System does not wake on link

On a driver-only installation, if you change 'Wake on Link Settings' to Forced and change 'Wake on Magic Packet' and 'Wake on Pattern Match' to Disabled, the system may not wake up when expected. In order to "Wake on Link" successfully, check the Power Management tab and make sure that "Allow this device to wake the computer" is checked. You may also need to change 'Wake on Magic Packet' or 'Wake on Pattern Match' to Enabled.

### Directed Packets may not wake the system

On some systems, quad port server adapters may not wake when configured to wake on directed packet. If you experience problems waking on directed packets, you must configure the adapter to use Magic Packets\*.

### Power Management options are unavailable or missing

If you install only the base drivers, later install Intel® PROSet for Windows Device Manager, then remove Intel PROSet, the settings on the Power Management tab on the Adapter Property Sheet may be unavailable or missing altogether. You must reinstall Intel PROSet to resolve the issue.

### System Wakes-Up from a Removed VLAN

If a system goes into standby mode, and a directed packet is sent to the IP address of the removed VLAN, the system will wake-up. This occurs because a directed packet bypasses VLAN filtering.

### Intel Adapters ignore consecutive Wake Up signals while transitioning into standby mode

While sending a system into standby, occasionally a wake up packet arrives before the system completes the transition into standby mode. When this happens, the system ignores consecutive wake up signals and remains in standby mode until manually powered up using the mouse, keyboard, or power button.

## Other Intel 10GbE Network Adapter Known Issues

### The System H/W Inventory (iDRAC) indicates that Auto-negotiation on the Embedded NIC is Disabled, but elsewhere link speed and duplex auto-negotiation is Enabled

If an optical module is plugged into the Intel® Ethernet 10G X520 LOM on a PowerEdge-C6320, the System H/W Inventory (iDRAC) will indicate that Auto-negotiation is Disabled. However, Windows Device Manager and HII indicate that link speed and duplex Auto-negotiation is Enabled. This is because the driver contains an algorithm that allows the LOM to link with SFP partners at 10 Gbps or 1 Gbps. This is reported to Windows Device Manager and HII, but it is not true auto-negotiation. iDRAC reads the device's firmware, which has no knowledge of the algorithm, and therefore reports that auto-negotiation is disabled.

### ETS Bandwidth Allocations Don't Match Settings

When Jumbo Frames is set to 9K with a 10GbE adapter, a 90%/10% ETS traffic split will not actually be attained on any particular port, despite settings being made on the DCB switch. When ETS is set to a 90%/10% split, an actual observed split of 70%/30% is more likely.

## **Link Loss on 10GbE Devices with Jumbo Frames Enabled**

You must not lower Receive\_Buffers or Transmit\_Buffers below 256 if jumbo frames are enabled on an Intel® 10GbE Device. Doing so will cause loss of link.

## **Failed connection and possible system instability**

If you have non-Intel networking devices capable of Receive Side Scaling installed in your system, the Microsoft Windows registry keyword "RSSBaseCPU" may have been changed from the default value of 0x0 to point to a logical processor. If this keyword has been changed, then devices based on Intel® 82598 or 82599 10 Gigabit Ethernet Controllers might not pass traffic. Attempting to make driver changes in this state may cause system instability. Set the value of RSSBaseCpu to 0x0, or to a value corresponding to a physical processor, and reboot the system to resolve the issue.

## **Continuous PFC pause frames sent from Intel® Ethernet X520 based devices**

If you have an Intel® Ethernet X520 based device connected to a switch port and modify the DCB bandwidth settings on the switch port, the Intel® Ethernet X520 device may perpetually send pause frames, causing a storm, and fail to transfer data to and from the storage targets it was using. To recover from this issue, disable the X520 ports, re-enable them, and then reconnect to the iSCSI target volumes. To avoid the issue, if the DCB bandwidth settings need to be changed, do one of the following:

- Power down the server that contains the Intel® Ethernet X520 device prior to modifying the DCB bandwidth settings.
- Disable the switch ports connected to Intel X520 based device.
- Have no traffic running on the Intel X520 based device.

## **Intel® Ethernet 10G 2P/4P X710-k bNDC does not have link and is not displayed in Windows Device Manager**

If you install an Intel® Ethernet 10G 2P X710-k bNDC or an Intel® Ethernet 10G 4P X710-k bNDC onto a Dell EMC PowerEdge M630/M830 blade server, and install that blade into an M1000e chassis, the bNDC may not have link and may display a yellow bang, or may not be displayed at all, in Windows Device Manager. This is limited to the 1.0 version of the M1000e Midplane.

## **Intel® Ethernet 10G X520 LOM links at 10 Gbps when 1.0 Gbps Full Duplex is selected**

When connected with a direct attach cable, the Intel® Ethernet 10G X520 LOM will always connect at 10 Gbps.

## **Intel X540-t and Dell Force10 will not establish link at 100 Mbps full duplex if set manually on both ends**

For an X540-t based adapter coupled with a Force10 component, in order to run at 100Mbps, the properties for BOTH components must be set to Auto-Negotiation ON.

## **When trying to identify the adapter, the Activity LED blinks and the Link LED is solid**

If you use the Identify Adapter feature with the following adapters, the Activity LED blinks instead of the Link LED. The Link LED may display a solid green light for 10G ports even if a network link is not present.

- All Intel® Ethernet X520 10GbE devices
- All Intel® Ethernet X540 10GbE devices
- All Intel® Ethernet X550 10GbE devices
- Some Intel® Gigabit I350 LOM devices

## Unexpected NMI with 82599-based NICs

If you set the PCIe Maximum Payload Size to 256 bytes in your system BIOS and install an 82599-based NIC, you may receive an NMI when the NIC attains link. This happens when the physical slot does not support a payload size of 256 Bytes even if the BIOS does. Moving the adapter to a slot that supports 256 bytes will resolve the issue. Consult your system documentation for information on supported payload values.

## Intel® 710 Series Network Controller Known Issues

Some Intel® X710 based devices report a subvendor ID of 0x0000 and may display a generic branding string. Port 0 reports the correct subvendor ID and displays the correct branding string.

Intel X710 based devices may maintain link on any and all ports as long as power is provided to the device, regardless of the device's or system's power state.

### Diagnostic button disabled

When part of an Intel® ANS team, devices based on the Intel X710 controller do not support diagnostics. Support will be added in a future release.

### Unexpected IntelDCB errors in the Windows Application Event Log

After upgrading your X710 drivers, you may see several IntelDCB errors in the Windows Application Event Log. These errors are erroneous and can be ignored.

### Lower than expected throughput on X710/XL710 based devices

If you have an X710 or XL710 based device installed in a four CPU socket system. Receive and transmit traffic may be significantly lower than expected. Setting your interrupt rate to High may mitigate the issue.

## Intel® Gigabit 4P I350-t Adapter Known Issues

### Downshifting

When connecting to any Gigabit switch via a faulty CAT 5 cable where one pair is broken, the adapter does not downshift from 1 Gig to 100Mbps. For the adapter to downshift, it must identify two broken pairs in the cable.

### System does not boot

Your system may run out of I/O resources and fail to boot if you install more than four quad port server adapters. Moving the adapters to different slots or rebalancing resources in the system BIOS may resolve the issue. This issue affects the following Adapters:

- Intel® Gigabit 4P I350-t Adapter

# Regulatory Compliance Statements

## FCC Class A Products

### 40 Gigabit Ethernet Products

- Intel® Ethernet 40G 2P XL710 QSFP+ rNDC
- Intel® Ethernet Converged Network Adapter XL710-Q2

### 25 Gigabit Ethernet Products

- Intel® Ethernet 25G 2P XXV710 Mezz
- Intel® Ethernet 25G 2P XXV710 Adapter

### 10 Gigabit Ethernet Products

- Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
- Intel® Ethernet 10G 2P X540-t Adapter
- Intel® Ethernet 10G 2P X550-t Adapter
- Intel® Ethernet 10G 4P X550 rNDC
- Intel® Ethernet 10G 4P X550/I350 rNDC
- Intel® Ethernet 10G 4P X540/I350 rNDC
- Intel® Ethernet 10G 4P X520/I350 rNDC
- Intel® Ethernet 10G 2P X520-k bNDC
- Intel® Ethernet 10G 4P X710-k bNDC
- Intel® Ethernet 10G 2P X710-k bNDC
- Intel® Ethernet 10G X710-k bNDC
- Intel® Ethernet Converged Network Adapter X710
- Intel® Ethernet Converged Network Adapter X710-T
- Intel® Ethernet 10G 4P X710/I350 rNDC
- Intel® Ethernet 10G 4P X710 SFP+ rNDC
- Intel® Ethernet 10G X710 rNDC
- Intel® Ethernet Server Adapter X710-DA2 for OCP

### Gigabit Ethernet Products

- Intel® Gigabit 4P X550/I350 rNDC
- Intel® Gigabit 4P I350-t rNDC
- Intel® Gigabit 4P X540/I350 rNDC
- Intel® Gigabit 4P X520/I350 rNDC
- Intel® Gigabit 4P I350-t Mezz
- Intel® Gigabit 4P X710/I350 rNDC
- Intel® Gigabit 4P I350 bNDC

## FCC Class B Products

### 10 Gigabit Ethernet Products

- Intel® Ethernet 10G 2P X520 Adapter
- Intel® Ethernet 10G X520 LOM

### Gigabit Ethernet Products

- Intel® Gigabit 2P I350-t Adapter
- Intel® Gigabit 4P I350-t Adapter

## Safety Compliance

The following safety standards apply to all products listed above.

- UL 60950-1, 2nd Edition, 2011-12-19 (Information Technology Equipment - Safety - Part 1: General Requirements)
- CSA C22.2 No. 60950-1-07, 2nd Edition, 2011-12 (Information Technology Equipment - Safety - Part 1: General Requirements)
- EN 60950-1:2006/A11:2009/A1:2010/A12:2011 (European Union)
- IEC 60950-1:2005 (2nd Edition); Am 1:2009 (International)
- EU LVD Directive 2006/95/EC

## EMC Compliance – The following standards may apply:

### Class A products:

- FCC Part 15 – Radiated & Conducted Emissions (USA)
- CAN ICES-3(A)/NMB-3(A) – Radiated & Conducted Emissions (Canada)
- CISPR 22 – Radiated & Conducted Emissions (International)
- EN55022: 2010 – Radiated & Conducted Emissions (European Union)
- EN55024: 2010 +A1:2001+A2:2003 – Immunity (European Union)
- EMC Directive 2004/108/EC
- VCCI (Class A) – Radiated & Conducted Emissions (Japan)
- CNS13438 – Radiated & Conducted Emissions (Taiwan)
- AS/NZS CISPR 22 – Radiated & Conducted Emissions (Australia/New Zealand)
- NRRRA No. 2012-13 (2012.06.28), NRRRA Notice No. 2012-14 (2012.06.28) (Korea)

### Class B products:

- FCC Part 15 (Class B) – Radiated & Conducted Emissions (USA)
- CAN ICES-3(B)/NMB-3(B) – Radiated & Conducted Emissions (Canada)
- CISPR 22 – Radiated & Conducted Emissions (International)
- EN55022: 2010 – Radiated & Conducted Emissions (European Union)
- EN55024: 2010 – Immunity (European Union)
- EU – EMC Directive 2004/108/EC
- VCCI (Class B) – Radiated & Conducted Emissions (Japan) (excluding optics)
- CNS13438 (Class B)-2006 – Radiated & Conducted Emissions (Taiwan) (excluding optics)
- AS/NZS CISPR 22 – Radiated & Conducted Emissions (Australia/New Zealand)
- KN22; KN24 – Korean emissions and immunity
- NRRRA No. 2012-13 (2012.06.28), NRRRA Notice No. 2012-14 (2012.06.28) (Korea)

## Regulatory Compliance Markings

When required these products are provided with the following Product Certification Markings:

- UL Recognition Mark for USA and Canada
- CE Mark
- EU WEEE Logo
- FCC markings
- VCCI marking
- Australian C-Tick Mark
- Korea MSIP mark
- Taiwan BSMI mark
- People's Republic of China "EFUP" mark

## FCC Class A User Information

The Class A products listed above comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions:



1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.



**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.



**CAUTION:** If the device is changed or modified without permission from Intel, the user may void his or her authority to operate the equipment.

## Canadian Compliance (Industry Canada)

CAN ICES-3(A)/NMB-3(A)

### VCCI Class A Statement

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

V C C I - A

### BSMI Class A Statement

**警告使用者:**

此為甲類資訊技術設備，於居住環境中使用時，可能會造成射頻擾動，在此種情況下，使用者會被要求採取某些適當的對策。

### KCC Notice Class A (Republic of Korea Only)

<p>A급 기기 (업무용 방송통신기기)</p> <p><b>CLASS A device (commercial broadcasting and communication equipment)</b></p>	<p>이 기기는 업무용(A급)으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.</p> <p>This device has been approved by EMC registration. Distributors or users pay attention to this point. This device is usually aimed to be used in other area except at home.</p>
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## BSMI Class A Notice (Taiwan)

警告使用者:

此為甲類資訊技術設備，於居住環境中使用時，可能會造成射頻擾動，在此種情況下，使用者會被要求採取某些適當的對策。

## FCC Class B User Information

This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



**CAUTION:** If the device is changed or modified without permission from Intel, the user may void his or her authority to operate the equipment.



**NOTE:** This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

## Electromagnetic Compatibility Notices

### FCC Declaration of Conformity Statement

The following products have been tested to Comply with FCC Standards for Home or Office Use.

PRO/1000 MT, PRO/1000 PT, PRO/1000 GT, Gigabit PT, Gigabit ET, I210-T1, I340-T2/T4, I350-T2/T4, PRO/100 M Desktop Adapter, PRO/100 S Desktop Adapter, PRO/100 S Server Adapter, and PRO/100 S Dual Port Server Adapter

### Canadian Compliance (Industry Canada)

CAN ICES-3 (B)/NMB-3 (B)

### VCCI Class B Statement (Japan)

この装置は、クラスB情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。

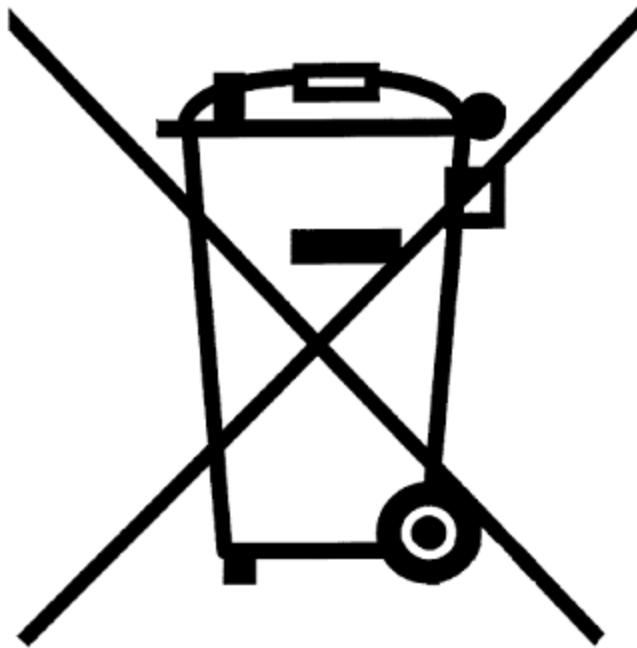
取扱説明書に従って正しい取り扱いをして下さい。

V C C I - B

## KCC Notice Class B (Republic of Korea Only)

<p>B급 기기 (가정용 방송통신기기)</p> <p><b>CLASS B device</b> residential broadcasting and communication equipment</p>	<p>이 기기는 가정용(B급)으로 전자파적합등록을 한 기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.</p> <p>This device has been approved by EMC Registration and is usually aimed to be used in a residential area so that it can be used in all other location as well as at home.</p>
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## EU WEEE Logo



# Manufacturer Declaration European Community



## Manufacturer Declaration

Intel Corporation declares that the equipment described in this document is in conformance with the requirements of the European Council Directive listed below:

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC
- RoHS Directive 2011/65/EU

These products follow the provisions of the European Directive 1999/5/EC.

Dette produkt er i overensstemmelse med det europæiske direktiv 1999/5/EC.

Dit product is in navolging van de bepalingen van Europees Directief 1999/5/EC.

Tämä tuote noudattaa EU-direktiivin 1999/5/EC määräyksiä.

Ce produit est conforme aux exigences de la Directive Européenne 1999/5/EC.

Dieses Produkt entspricht den Bestimmungen der Europäischen Richtlinie 1999/5/EC.

Þessi vara stenst reglugerð Evrópska Efnahags Bandalagsins númer 1999/5/EC.

Questo prodotto è conforme alla Direttiva Europea 1999/5/EC.

Dette produktet er i henhold til bestemmelsene i det europeiske direktivet 1999/5/EC.

Este produto cumpre com as normas da Diretiva Europeia 1999/5/EC.

Este producto cumple con las normas del Directivo Europeo 1999/5/EC.

Denna produkt har tillverkats i enlighet med EG-direktiv 1999/5/EC.

This declaration is based upon compliance of the Class A products listed above to the following standards:

EN 55022:2010 (CISPR 22 Class A) RF Emissions Control.

EN 55024:2010 (CISPR 24) Immunity to Electromagnetic Disturbance.

EN 60950-1:2006/A11:2009/A1:2010/A12:2011 Information Technology Equipment- Safety-Part 1: General Requirements.

EN 50581:2012 - Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.

This declaration is based upon compliance of the Class B products listed above to the following standards:

EN 55022:2010 (CISPR 22 Class B) RF Emissions Control.

EN 55024:2010 (CISPR 24) Immunity to Electromagnetic Disturbance.

EN 60950-1:2006/A11:2009/A1:2010/A12:2011 Information Technology Equipment- Safety-Part 1: General Requirements.

EN 50581:2012 - Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.



**WARNING:** In a domestic environment, Class A products may cause radio interference, in which case the user may be required to take adequate measures.

### Responsible Party

Intel Corporation, Mailstop JF3-446  
5200 N.E. Elam Young Parkway  
Hillsboro, OR 97124-6497  
Phone 1-800-628-8686

# China RoHS Declaration

关于符合中国《电子信息产品污染控制管理办法》的声明  
Management Methods on Control of Pollution From  
Electronic Information Products  
(China RoHS declaration)

产品中有毒有害物质的名称及含量

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷板组件	X	○	○	○	○	○
○：表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 标准规定的限量要求以下。 X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 标准规定的限量要求。						

## Class 1 Laser Products

Server adapters listed above may contain laser devices for communication use. These devices are compliant with the requirements for Class 1 Laser Products and are safe in the intended use. In normal operation the output of these laser devices does not exceed the exposure limit of the eye and cannot cause harm.

For continued safe operation in case of an abnormal circumstance, always have the provided laser connector cover in place or a compatible fiber optics cable properly connected when power is available to the product.

The Laser device must be factory serviced ONLY by the responsible manufacturer! NO adjustments, service or maintenance is to be performed otherwise.



**CAUTION:** Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

## These Class 1 Laser devices:

Comply with FDA/CDRH per CFR21, subchapter J.  
Comply with IEC 60825-1:2007

## End-of-Life / Product Recycling

Product recycling and end-of-life take-back systems and requirements vary by country.

Contact the retailer or distributor of this product for information about product recycling and/or take-back.

# Customer Support

## Web and Internet Sites

<http://support.dell.com/>

## Customer Support Technicians

If the troubleshooting procedures in this document do not resolve the problem, please contact Dell, Inc. for technical assistance (refer to the "Getting Help" section in your system documentation).

### Before you call...

You need to be at your computer with your software running and the product documentation at hand.

The technician may ask for the following:

- Your address and telephone number
- The name and model number of the product you are calling about
- The serial number and service tag of the product
- The names and version numbers of the software you are using to operate the product
- The name and version number of the operating system you are using
- The computer type (manufacturer and model number)
- Expansion boards or add-in cards in your computer
- The amount of memory in your computer

# Adapter Specifications

## Intel® 40 Gigabit Network Adapter Specifications

Feature	Intel® Ethernet Converged Network Adapter XL710-Q2
<b>Bus Connector</b>	PCI Express 3.0
<b>Bus Speed</b>	x8
<b>Transmission Mode/Connector</b>	QSFP+
<b>Cabling</b>	40GBase-SR4, Twinax DAC (7m max)
<b>Power Requirements</b>	6.5 W Maximum @ +12 V
<b>Dimensions</b> (excluding bracket)	5.21 x 2.71 in 13.3 x 6.9 cm
<b>Operating Temperature</b>	32 - 131 deg. F (0 - 55 deg. C)
<b>MTBF</b>	159 years
<b>Available Speeds</b>	40 Gbps
<b>Duplex Modes</b>	Full only
<b>Indicator Lights</b>	<i>Two per port:</i> Link and Activity
<b><u>Standards Conformance</u></b>	IEEE 802.3ba SFF-8436 PCI Express 3.0
<b>Regulatory and Safety</b>	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>EN 60 950 (European Union)</li> <li>IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>EN55024 - 1998 - (Immunity) (European Union)</li> <li>CE - EMC Directive (89/336/EEC) (European Union)</li> <li>VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>

## Intel® 40GbE Network Daughter Cards (NDC) Specifications

Feature	Intel® Ethernet 40G 2P XL710 QSFP+ rNDC
<b>Bus Connector</b>	PCI Express 3.0
<b>Bus Speed</b>	x8
<b>Transmission Mode/Connector</b>	QSFP+

<b>Cabling</b>	40GBase-SR4, Twinax DAC (7m max)
<b>Power Requirements</b>	6.2 W Maximum @ +12 V
<b>Dimensions</b> (excluding bracket)	3.66 x 6.081 in 9.3 x 15.5 cm
<b>Operating Temperature</b>	32 - 140 deg. F (0 - 60 deg. C)
<b>MTBF</b>	112 years
<b>Available Speeds</b>	40 Gbps
<b>Duplex Modes</b>	Full only
<b>Indicator Lights</b>	<i>Two per port:</i> Link and Activity
<b><u>Standards Conformance</u></b>	IEEE 802.3ba SFF-8436 PCI Express 3.0
<b>Regulatory and Safety</b>	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>• UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>• EN 60 950 (European Union)</li> <li>• IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>• FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>• ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>• CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>• EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>• EN55024 - 1998 - (Immunity) (European Union)</li> <li>• CE - EMC Directive (89/336/EEC) (European Union)</li> <li>• VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>• CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>• AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>• MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>

## Intel® 25 Gigabit Network Adapter Specifications

Feature	Intel® Ethernet 25G 2P XXV710 Adapter
<b>Bus Connector</b>	PCI Express 3.0
<b>Bus Speed</b>	x8
<b>Transmission Mode/Connector</b>	SFP28
<b>Cabling</b>	25GBase-CR, Twinax DAC (3m max)
<b>Power Requirements</b>	6.5 W Maximum @ +12 V
<b>Dimensions</b> (excluding bracket)	2.70 x 2.02 in 6.86 x 5.12 cm
<b>Operating Temperature</b>	32 - 131 deg. F (0 - 55 deg. C)
<b>MTBF</b>	239 years



<b>Available Speeds</b>	25 Gbps
<b>Duplex Modes</b>	Full only
<b>Indicator Lights</b>	<i>Two per port:</i> Link and Activity
<b><u>Standards Conformance</u></b>	IEEE 802.3-2015 SFF-8431 PCI Express 3.0
<b>Regulatory and Safety</b>	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>• UL/CSA 60950-1-07 2nd Edition</li> <li>• EN 60 950 (European Union)</li> <li>• IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>• FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>• ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>• CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>• EN55032-2015- Radiated &amp; Conducted Emissions (European Union)</li> <li>• EN55024 - 2010- (Immunity) (European Union)</li> <li>• REACH, WEEE, RoHS Directives (European Union)</li> <li>• VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>• CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>• AS/NZS CISPR - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>• KN32 -Radiated &amp; Conducted Emissions (Korea)</li> <li>• KN35 - (Immunity) (Korea)</li> <li>• RoHS (China)</li> </ul>

## Intel® 25 Gigabit Network Mezzanine Card Specifications

Feature	Intel® Ethernet 25G 2P XXV710 Mezz
<b>Bus Connector</b>	PCI Express 3.0
<b>Bus Speed</b>	x8
<b>Transmission Mode/Connector</b>	SFP28
<b>Cabling</b>	25GBase-CR, Twinax DAC (3m max)
<b>Power Requirements</b>	9.78W @ +12V
<b>Dimensions</b> (excluding bracket)	3.78 x 3.15 9.60 x 8.001
<b>Operating Temperature</b>	105° F max
<b>MTBF</b>	353years
<b>Available Speeds</b>	25 Gbps
<b>Duplex Modes</b>	Full only
<b>Indicator Lights</b>	NA Link and Activity
<b><u>Standards Conformance</u></b>	TBD
<b>Regulatory and Safety</b>	<p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>• FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>• ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>• CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> </ul>

	<ul style="list-style-type: none"> <li>• EN55032-2015- Radiated &amp; Conducted Emissions (European Union)</li> <li>• EN55024 - 2010- (Immunity) (European Union)</li> <li>• REACH, WEEE, RoHS Directives (European Union)</li> <li>• VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>• CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>• AS/NZS CISPR - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>• KN22 -Radiated &amp; Conducted Emissions (Korea)</li> <li>• RoHS (China)</li> </ul>
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## Intel® 10 Gigabit Network Adapter Specifications

Feature	Intel® Ethernet 10G 2P X540-t Adapter	Intel® Ethernet 10G 2P X520 Adapter	Intel® Ethernet 10G 2P X550-t Adapter
<b>Bus Connector</b>	PCI Express 2.0	PCI Express 2.0	PCI Express 3.0
<b>Bus Speed</b>	x8	x8	x8
<b>Transmission Mode/Connector</b>	10GBase-T/RJ-45	Twinaxial copper/SFP+ 10GBase-SR/LR	10GBase-T/RJ-45
<b>Cabling</b>	10GBase-T (Category 6A)	10 Gigabit Ethernet over SFP+ Direct Attach Copper (10GSFP+Cu)	10GBase-T (Category 6A)
<b>Power Requirements</b>	15 W Maximum @ +12 V	6.2 W Maximum @ +3.3 V	13W Maximum @ +12 V
<b>Dimensions (excluding bracket)</b>	5.7 x 2.7 in 14.5 x 6.9 cm	5.7 x 2.7 in 14.5 x 6.9 cm	5.13 x 2.7 in 13.0 x 6.9 cm
<b>Operating Temperature</b>	32 - 131 deg. F (0 - 55 deg. C)	32 - 131 deg. F (0 - 55 deg. C)	32 - 131 deg. F (0 - 55 deg. C)
<b>MTBF</b>	108 years	83.9 years	TBD
<b>Available Speeds</b>	10 Gbps/1 Gbps	10 Gbps/1 Gbps	10 Gbps/1 Gbps
<b>Duplex Modes</b>	Full only	Full only	Full only
<b>Indicator Lights</b>	<i>Two per port:</i> Link and Activity	<i>Two per port:</i> Link and Activity	Link Activity
<b><a href="#">Standards Conformance</a></b>	IEEE 802.1p IEEE 802.1Q IEEE 802.3an IEEE 802.3ac IEEE 802.3ad IEEE 802.3an IEEE 802.3x ACPI v1.0 PCI Express 2.0	IEEE 802.1p IEEE 802.1Q IEEE 802.3an IEEE 802.3ac IEEE 802.3ad IEEE 802.3x ACPI v1.0 PCI Express 2.0	IEEE 802.1p IEEE 802.1Q IEEE 802.3an IEEE 802.3ac IEEE 802.3ad IEEE 802.3x ACPI v1.0 PCI Express 3.0
<b>Regulatory and Safety</b>	<b>Safety Compliance</b> <ul style="list-style-type: none"> <li>• UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>• EN 60 950 (European Union)</li> <li>• IEC 60 950 (International)</li> </ul> <b>EMC Compliance</b> <ul style="list-style-type: none"> <li>• FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>• ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>• CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>• EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>• EN55024 - 1998 - (Immunity) (European Union)</li> <li>• CE - EMC Directive (89/336/EEC) (European Union)</li> </ul>		

Feature	Intel® Ethernet 10G 2P X540-t Adapter	Intel® Ethernet 10G 2P X520 Adapter	Intel® Ethernet 10G 2P X550-t Adapter
	<ul style="list-style-type: none"> <li>VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>		

Feature	Intel® Ethernet Converged Network Adapter X710-T	Intel® Ethernet Converged Network Adapter X710	Ethernet Server Adapter X710-DA2 for OCP
<b>Bus Connector</b>	PCI Express 3.0	PCI Express 3.0	PCI Express 3.0
<b>Bus Speed</b>	x8	x8	x8
<b>Transmission Mode/Connector</b>	SFP+	SFP+	SFP+
<b>Cabling</b>	Twinax 10GBase-SR/LR	Twinax 10GBase-SR/LR	Direct Attach 10GBASE-SR
<b>Power Requirements</b>	8.53 W (idle) @ 12V Main	6.7 Watts (maximum) @ 12 V	3.08 Watts (max) @ 5V Main
<b>Dimensions (excluding bracket)</b>	6.578 x 4.372 in 16.708 x 11.107 cm	6.578 x 4.372 in 16.708 x 11.107 cm	2.67 x 4.59 in 6.78 x 11.658 cm
<b>Operating Temperature</b>	32 - 131 deg. F (0 - 55 deg. C)	41 - 131 deg. F (5 - 55 deg. C)	32 - 131 deg. F (0 - 55 deg. C)
<b>MTBF</b>	493	491 years	1276
<b>Available Speeds</b>	10 Gbps/1 Gbps	10 Gbps/1 Gbps	10 Gbps
<b>Duplex Modes</b>	Full only	Full Only	Full only
<b>Indicator Lights</b>	Link/Activity 1Gig/10Gig	Link/Activity 1Gig/10Gig	Link/Activity 1Gig/10Gig
<b><a href="#">Standards Conformance</a></b>	PCI Express 3.0 SFF-8431 IEEE 802.3z IEEE 802.3ae	PCI Express 3.0 SFF-8431 IEEE 802.3z IEEE 802.3ae	PCI Express 3.0 SFF-8431 IEEE 802.3z IEEE 802.3ae
<b>Regulatory and Safety</b>	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>EN 60 950 (European Union)</li> <li>IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>EN55024 - 1998 - (Immunity) (European Union)</li> <li>CE - EMC Directive (89/336/EEC) (European Union)</li> <li>VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>		

## Intel® 10 Gigabit Network Mezzanine Card Specifications

Feature	Intel® Ethernet X520 10GbE Dual Port KX4-KR Mezz
Bus Connector	PCI Express 2.0
Bus Speed	x8
Power Requirements	7.4 Watts (maximum) @ 3.3 V
Dimensions	3.65 x 3.3 in.
Operating Temperature	32 - 131 deg. F (0 - 55 deg. C)
MTBF	147 years
Available Speeds	10 Gbps/1 Gbps
Duplex Modes	Full only
<a href="#">Standards Conformance</a>	IEEE 802.1p IEEE 802.1Q IEEE 802.3ac IEEE 802.3ad IEEE 802.3ae IEEE 802.3x ACPI v1.0 PCI Express 2.0
Regulatory and Safety	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>EN 60 950 (European Union)</li> <li>IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>EN55024 - 1998 - (Immunity) (European Union)</li> <li>CE - EMC Directive (89/336/EEC) (European Union)</li> <li>VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>

## Intel® 10GbE Network Daughter Cards (NDC) Specifications

Feature	Intel® Ethernet 10G 4P X550/l350 rNDC	Intel® Ethernet 10G 4P X550 rNDC	
Bus Connector	PCI Express 3.0	PCI Express 3.0	
Bus Speed	x8	x8	
Transmission Mode/Connector	Twisted copper/RJ-45	Twisted copper/RJ-45	
Cabling	Cat-5e	Cat-5e	

<b>Power Requirements</b>	15.39 Watts (max) @12 V	33.6 Watts (maximum) @ 12 V	
<b>Dimensions</b>	4.34 x 4.012 in 11.04 x 10.19 cm	4.37 x 5.86 in 11.10 x 14.883 cm	
<b>Operating Temperature</b>	60° F	60° F	
<b>MTBF</b>	445	436	
<b>Available Speeds</b>	10 Gbps/1 Gbps	10 Gbps/1 Gbps	
<b>Duplex Modes</b>	Full only	Full only	
<b><a href="#">Standards Conformance</a></b>	IEEE 802.1p IEEE 802.1Q IEEE 802.3ac IEEE 802.3ad IEEE 802.3ae IEEE 802.3x ACPI v1.0 PCI Express 2.0a	IEEE 802.1p IEEE 802.1Q IEEE 802.3ac IEEE 802.3ad IEEE 802.3ae IEEE 802.3x ACPI v1.0 PCI Express 2.0a	
<b>Regulatory and Safety</b>	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>EN 60 950 (European Union)</li> <li>IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>EN55024 - 1998 - (Immunity) (European Union)</li> <li>CE - EMC Directive (89/336/EEC) (European Union)</li> <li>VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>		

Feature	Intel® Ethernet 10G 4P X540/I350 rNDC	Intel® Ethernet 10G 4P X520/I350 rNDC	Intel® Ethernet 10G 2P X520-k bNDC
<b>Bus Connector</b>	PCI Express 2.0	PCI Express 2.0	PCI Express 2.0
<b>Bus Speed</b>	x8	x8	x8
<b>Transmission Mode/Connector</b>	Twisted copper/RJ-45	SFP+	Copper/Backplane
<b>Cabling</b>	Cat-5e	SFP+ SR/DA	10GBase-KR and 1000Base-KX
<b>Power Requirements</b>	5.5 Watts (maximum) @ 3.3 V	10.1 Watts (maximum) @ 12 V	0.6 Watts @ 3.3 V (AUX), 6.3 Watts @ 1.2 V (VCORE)
<b>Dimensions</b>	3.93 x 3.67 in.	4.3 x 3.7 in.	3.0 x 2.5 in.
<b>Operating Temperature</b>	32 - 131 deg. F (0 - 55 deg. C)	32 - 131 deg. F (0 - 55 deg. C)	32 - 131 deg. F (0 - 55 deg. C)
<b>MTBF</b>	68 years	65 years	147 years
<b>Available Speeds</b>	10 Gbps/1 Gbps	10 Gbps/1 Gbps	10 Gbps/1 Gbps
<b>Duplex Modes</b>	Full only	Full only	Full only
<b><a href="#">Standards Con-</a></b>	IEEE 802.1p	IEEE 802.1p	IEEE 802.1p

<a href="#">formance</a>	IEEE 802.1Q IEEE 802.3ac IEEE 802.3ad IEEE 802.3ae IEEE 802.3x ACPI v1.0 PCI Express 2.0a	IEEE 802.1Q IEEE 802.3ac IEEE 802.3ad IEEE 802.3ae IEEE 802.3x ACPI v1.0 PCI Express 2.0a	IEEE 802.1Q IEEE 802.3ac IEEE 802.3ad IEEE 802.3ap IEEE 802.3x ACPI v1.0 PCI Express 2.0
<b>Regulatory and Safety</b>	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>• UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>• EN 60 950 (European Union)</li> <li>• IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>• FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>• ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>• CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>• EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>• EN55024 - 1998 - (Immunity) (European Union)</li> <li>• CE - EMC Directive (89/336/EEC) (European Union)</li> <li>• VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>• CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>• AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>• MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>		

Feature	Intel® Ethernet 10G 4P X710-k bNDC	Intel® Ethernet 10G 4P X710/I350 rNDC	Intel® Ethernet 10G 4P X710 SFP+ rNDC
<b>Bus Connector</b>	Dell EMC bNDC	PCI Express 3.0	PCI Express 3.0
<b>Bus Speed</b>	x8	x8	x8
<b>Transmission Mode/Connector</b>	KX/KR	SFP+	SFP+
<b>Cabling</b>	Backplane	Twinax 10GBase-SR/LR	Twinax 10GBase-SR/LR
<b>Power Requirements</b>	3.3 Watts @ 3.3 V (AUX), 12.6 Watts @ 12 V (AUX)	10.7 Watts Maximum @ +12 V	9.5 Watts Maximum @ +12 V
<b>Dimensions</b>	3.000x2.449 in 7.62x6.220cm	4.331x3.661 in 11.0x9.298 cm	4.331x3.661 in 11.0x9.298 cm
<b>Operating Temperature</b>	32 - 131 deg. F (0 - 55 deg. C)	32 - 131 deg. F (0 - 55 deg. C)	32 - 131 deg. F (0 - 55 deg. C)
<b>MTBF</b>	828 years	108 years	505 years
<b>Available Speeds</b>	10 Gbps/1 Gbps	10 Gbps/1 Gbps	10 Gbps/1 Gbps
<b>Duplex Modes</b>	Full only	Full only	Full only
<b>Indicator Lights</b>	None	Link/Activity Speed	Link/Activity Speed
<a href="#">Standards Conformance</a>	PCI Express 3.0 IEEE 802.3ap	PCI Express 3.0 SFF-8431 IEEE 802.3z IEEE 802.3ae	PCI Express 3.0 SFF-8431 IEEE 802.3z IEEE 802.3ae
<b>Regulatory and Safety</b>	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>• UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>• EN 60 950 (European Union)</li> <li>• IEC 60 950 (International)</li> </ul>		

	<p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>• FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>• ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>• CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>• EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>• EN55024 - 1998 - (Immunity) (European Union)</li> <li>• CE - EMC Directive (89/336/EEC) (European Union)</li> <li>• VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>• CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>• AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>• MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>
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## Intel® Gigabit Network Adapter Specifications

Feature	Intel® Gigabit 2P I350-t Adapter and Intel® Gigabit 4P I350-t Adapter
<b>Bus Connector</b>	PCI Express 2.0
<b>Bus Speed</b>	x4
<b>Transmission Mode/Connector</b>	Twisted copper/RJ-45
<b>Cabling</b>	1000Base-T (Category 3 or Category 5)
<b>Power Requirements</b>	Intel® Gigabit 2P I350-t Adapter: 4.8 Watts @ 12 V Intel® Gigabit 4P I350-t Adapter: 6.0 Watts @ 12 V
<b>Dimensions</b> (excluding bracket)	5.3 x 2.7 in. 13.5 x 6.9 cm
<b>Operating Temperature</b>	32 - 131 deg. F (0 - 55 deg. C)
<b>MTBF</b>	68 years
<b>Available Speeds</b>	10/100/1000 auto-negotiate
<b>Duplex Modes</b>	Full or half at 10/100 Mbps; full only at 1000 Mbps
<b><u>Standards Conformance</u></b>	IEEE 802.1p IEEE 802.1Q IEEE 802.3ab IEEE 802.3ac IEEE 802.3ad IEEE 802.3az IEEE 802.3u IEEE 802.3x IEEE 802.3z ACPI v1.0 PCI Express 2.0
<b>Indicator Lights</b>	<i>Two per port:</i> Activity and Speed
<b>Regulatory and Safety</b>	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>• UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>• EN 60 950 (European Union)</li> <li>• IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>• FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>• ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>• CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> </ul>

	<ul style="list-style-type: none"> <li>• EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>• EN55024 - 1998 - (Immunity) (European Union)</li> <li>• CE - EMC Directive (89/336/EEC) (European Union)</li> <li>• VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>• CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>• AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>• MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>
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## Intel® Gigabit Network Mezzanine Card Specifications

Feature	Intel® Gigabit 4P I350-t Mezz
<b>Bus Connector</b>	PCI Express 2.0
<b>Bus Speed</b>	x4
<b>Power Requirements</b>	3.425 Watts (maximum) @ 3.3 V
<b>Dimensions</b>	3.65 x 3.3 in.
<b>Operating Temperature</b>	32 - 131 deg. F (0 - 55 deg. C)
<b>MTBF</b>	108 years
<b>Available Speeds</b>	Full only at 1000 Mbps
<b>Duplex Modes</b>	Full at 1000 Mbps
<b><a href="#">Standards Conformance</a></b>	IEEE 802.1p IEEE 802.1Q IEEE 802.3ab IEEE 802.3ac IEEE 802.3ad IEEE 802.3x ACPI v1.0 PCI Express 2.0
<b>Regulatory and Safety</b>	<p>Safety Compliance</p> <ul style="list-style-type: none"> <li>• UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>• EN 60 950 (European Union)</li> <li>• IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>• FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>• ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>• CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>• EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>• EN55024 - 1998 - (Immunity) (European Union)</li> <li>• CE - EMC Directive (89/336/EEC) (European Union)</li> <li>• VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>• CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>• AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>• MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>

## Intel® Gigabit Network Daughter Cards Specifications

Feature	Intel® Gigabit 4P X710/I350 rNDC	Intel® Ethernet Gigabit 4P X550/I350 rNDC	Intel® Gigabit 4P I350-t rNDC
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<b>Bus Connector</b>	PCI Express 2.0	PCI Express 2.0	PCI Express 2.0
<b>Bus Speed</b>	x8	x8	x8
<b>Transmission Mode/Connector</b>	Twisted copper/RJ-45	Twisted copper/RJ-45	Twisted copper/RJ-45
<b>Cabling</b>	Cat-5e	Cat-5e	Cat-5e
<b>Power Requirements</b>	10.7W Maximum @ +12 V	15.39 W (max) @ +12 V	TBD
<b>Dimensions (excluding bracket)</b>	4.331 x 3.661 in 11.007 x 9.298 cm	5.86 x 4.35 in 14.882 x 11.04 cm	TBD
<b>Operating Temperature</b>	32 - 131 deg. F (0 - 55 deg. C)	60° F	TBD
<b>MTBF</b>	108 years	251 years	TBD
<b>Available Speeds</b>	10 Gbps/1 Gbps	10 Gbps/1 Gbps	1 Gbps
<b>Duplex Modes</b>	Full only	Full only	Full only
<b><a href="#">Standards Conformance</a></b>	PCI Express 2.1 IEEE 802.3i IEEE 802.3ab IEEE 802.3u IEEE 802.3ad IEEE 802.3az	IEEE 802.1p IEEE 802.1Q IEEE 802.3ac IEEE 802.3ad IEEE 802.3ae IEEE 802.3x ACPI v1.0 PCI Express 2.1	IEEE 802.1p IEEE 802.1Q IEEE 802.3ac IEEE 802.3ad IEEE 802.3ae IEEE 802.3x ACPI v1.0 PCI Express 2.1
<b>Regulatory and Safety</b>	<p><b>Safety Compliance</b></p> <ul style="list-style-type: none"> <li>• UL 60950 Third Edition- CAN/CSA-C22.2 No.60950-00 (USA/Canada)</li> <li>• EN 60 950 (European Union)</li> <li>• IEC 60 950 (International)</li> </ul> <p><b>EMC Compliance</b></p> <ul style="list-style-type: none"> <li>• FCC Part 15 - Radiated &amp; Conducted Emissions (USA)</li> <li>• ICES-003 - Radiated &amp; Conducted Emissions (Canada)</li> <li>• CISPR 22 - Radiated &amp; Conducted Emissions (International)</li> <li>• EN55022-1998 - Radiated &amp; Conducted Emissions (European Union)</li> <li>• EN55024 - 1998 - (Immunity) (European Union)</li> <li>• CE - EMC Directive (89/336/EEC) (European Union)</li> <li>• VCCI - Radiated &amp; Conducted Emissions (Japan)</li> <li>• CNS13438 - Radiated &amp; Conducted Emissions (Taiwan)</li> <li>• AS/NZS3548 - Radiated &amp; Conducted Emissions (Australia/New Zealand)</li> <li>• MIC notice 1997-41, EMI and MIC notice 1997-42 - EMS (Korea)</li> </ul>		

# Standards

- IEEE 802.1p: Priority Queuing (traffic prioritizing) and Quality of Service levels
- IEEE 802.1Q: Virtual LAN identification
- IEEE 802.3ab: Gigabit Ethernet over copper
- IEEE 802.3ac: Tagging
- IEEE 802.3ad: SLA (FEC/GEC/Link Aggregation - static mode)
- IEEE 802.3ad: Dynamic mode
- IEEE 802.3ae: 10 Gbps Ethernet
- IEEE 802.3an: 10GBase-T 10 Gbps Ethernet over unshielded twisted pair
- IEEE 802.3ap: Backplane Ethernet
- IEEE 802.3u: Fast Ethernet
- IEEE 802.3x: Flow Control
- IEEE 802.3z: Gigabit Ethernet over optical fiber
- ACPI: Advanced Configuration and Power Management
- PCI Express: system bus specification: 32/64-bit, x1, x2, x4, x8, x16

More information on IEEE 802 standards available at <http://www.ieee802.org>.

IEEE 802.3ac VLANs:

VLANs require VLAN-capable switches either implicit (switch only) or explicit (IEEE 802.3ac). IEEE 802.3ac VLANs allow multiple VLANs per adapter or team since both the switch and adapter use a tag in the packet header to sort VLANs.

Intel gigabit and 10 gigabit network adapters fully support implicit and explicit VLANs.

# X-UEFI Attributes

This section contains information about X-UEFI attributes and their expected values.

## List of Multi-controller Devices

The adapters listed below contain more than one controller. On these adapters, configuring controller based settings will not affect all ports. Only ports bound to the same controller will be affected.

The following settings apply to all ports on a given controller:

- Virtualization Mode
- NParEP Mode
- PCI Virtual Functions Advertised

Multi-controller Devices	Number of controllers on the device	Controller 1	Controller 2
Intel® Ethernet 10G 4P X520/I350 rNDC Intel® Gigabit 4P X520/I350 rNDC	2	10G Ports 1 and 2	1G Ports 3 and 4
Intel® Ethernet 10G 4P X540/I350 rNDC Intel® Gigabit 4P X540/I350 rNDC	2	10G Ports 1 and 2	1G Ports 3 and 4
Intel® Ethernet 10G 4P X550 rNDC	2	10G Ports 1 and 2	10G Ports 3 and 4
Intel® Ethernet 10G 4P X550/I350 rNDC Intel® Gigabit 4P X550/I350 rNDC	2	10G Ports 1 and 2	1G Ports 3 and 4
Intel® Ethernet 10G 4P X710/I350 rNDC Intel® Ethernet 10G X710 rNDC Intel® Gigabit 4P X710/I350 rNDC	2	10G Ports 1 and 2	1G Ports 3 and 4

## Table of X-UEFI Attributes

Display Name	X-UEFI Name	Supported Adapters							User Configurable	User Configurable Values	Values that can be displayed	Dependencies for Values	I/O Identity Optimization (iDRAC 8/9)	Information
		I350	X520	X540	X550	X710	XL710	XXV710						
Virtualization Mode	VirtualizationMode	X	X	X	X	X	X	X	Yes	None/NPAR/SR-IOV/NPAR + SR-IOV	None/NPAR/SR-IOV/NPAR + SR-IOV		No	Specifies the virtualization mode setting of the controller. "NPAR" and "NPAR + SR-IOV" are only supported on X710 and XXV710 devices. They are not supported on client operating systems. The attribute setting applies to all ports on a given controller.
Number of Virtual Functions Supported	NumberVFSupported	X	X	X	X	X	X	X	No		0-256		No	The number of virtual functions supported on this port.

Display Name	X-UEFI Name	Supported Adapters							User Configurable	User Configurable Values	Values that can be displayed	Dependencies for Values	I/O Identity Optimization (iDRAC 8/9)	Information
		I350	X520	X540	X550	X710	XL710	XXV710						
Partition State Interpretation	PartitionStateInterpretation					X		X	No		Variable/Fixed		No	Describes how partitioning is implemented and how the PartitionState attribute is used in the controller. <b>Fixed</b> is the only value used.
RDMA Support	RDMASupport	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates whether any RDMA protocol is supported by the controller. <b>Unavailable</b> is the only value used.
SR-IOV Support	SRIOVSupport	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates whether SR-IOV capability is supported.
VF Allocation Basis	VFAllocBasis	X	X	X	X	X	X	X	No		Device/Port		No	Defines the domain in which Virtual Functions are allocated. <b>Port</b> is the only value used.
VF Allocation Multiple	VFAllocMult	X	X	X	X	X	X	X	No		1-255		No	Virtual Functions must be allocated to a port in multiples of this number.
NParEP Mode	NParEP					X		X	Yes	Disabled/Enabled	Disabled/Enabled	VirtualizationMode - NPAR or NPAR + SR-IOV	No	NParEP mode enables more than 8 partitions on the device. It must not be enabled if the system and OS do not support devices with more than 8 PCI Physical Functions. The attribute setting applies to all ports on a given controller.
Boot Order	BootOrderFirstFCoETarget		X	X	X*				Yes	0-4	0-4		Yes	Specify this port's place in the FCoE boot order 1-4 or 0=disabled.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter.
	BootOrderSecondFCoETarget		X	X	X*				Yes	0-4	0-4		Yes	
	BootOrderThirdFCoETarget		X	X	X*				Yes	0-4	0-4		Yes	
	BootOrderFourthFCoETarget		X	X	X*				Yes	0-4	0-4		Yes	
Boot LUN	FirstFCoEBootTargetLUN		X	X	X*				Yes	0-255	0-255		Yes	The Logical Unit Number to use on the FCoE target. The value of the LUN must be represented in decimal format.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter.
	INTEL_SecondFCoEBootTargetLUN		X	X	X*				Yes	0-255	0-255		No	
	INTEL_ThirdFCoEBootTargetLUN		X	X	X*				Yes	0-255	0-255		No	
	INTEL_FourthFCoEBootTargetLUN		X	X	X*				Yes	0-255	0-255		No	
Virtual LAN ID	FirstFCoEFCFVLANID		X	X	X*				Yes	1-4094	1-4094		Yes	Specify the VLAN ID for the FCoE Target.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter.
	INTEL_SecondFCoEFCFVLANID		X	X	X*				Yes	1-4094	1-4094		No	
	INTEL_ThirdFCoEFCFVLANID		X	X	X*				Yes	1-4094	1-4094		No	
	INTEL_FourthFCoEFCFVLANID		X	X	X*				Yes	1-4094	1-4094		No	
World Wide Port Name Target	FirstFCoEWWPNTarget		X	X	X*				Yes	XX:XX:XX:XX:XX:XX:XX:XX	XX:XX:XX:XX:XX:XX:XX:XX		Yes	Specifies the World Wide Port Name (WWPN) of the first FCoE storage target.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter.
	INTEL_SecondFCoEWWPNTarget		X	X	X*				Yes	XX:XX:XX:XX:XX:XX:XX:XX	XX:XX:XX:XX:XX:XX:XX:XX		No	
	INTEL_ThirdFCoEWWPNTarget		X	X	X*				Yes	XX:XX:XX:XX:XX:XX:XX:XX	XX:XX:XX:XX:XX:XX:XX:XX		No	
	INTEL_FourthFCoEWWPNTarget		X	X	X*				Yes	XX:XX:XX:XX:XX:XX:XX:XX	XX:XX:XX:XX:XX:XX:XX:XX		No	
Partition n Maximum TX Band-	MaxBandwidth[Partition:n]					X		X	Yes	1-100	1-100		Yes	Represents the maximum transmit band-

Display Name	X-UEFI Name	Supported Adapters							User Configurable	User Configurable Values	Values that can be displayed	Dependencies for Values	I/O Identity Optimization (iDRAC 8/9)	Information
		I350	X520	X540	X550	X710	XL710	XXV710						
width														width of the partition as a percentage of the full physical port link speed. The Maximum Bandwidth range is 1-100 percent for each enabled partition. If the remotely configured Maximum Bandwidth value on partition n is lower than Minimum Bandwidth on partition n, Minimum Bandwidth will be used.
Partition n Minimum TX Bandwidth	MinBandwidth[Partition:n]					X		X	Yes	1-100	1-100		Yes	Represents the minimum transmit bandwidth of the partition as a percentage of the full physical port link speed. The Minimum Bandwidth range is 1-100 percent for each enabled partition. The minimum bandwidth across all enabled partitions on a port must add up to 100%. If the remotely configured Minimum Bandwidth percentages do not add up to 100, the firmware will automatically normalize them to 100.
Boot LUN	FirstTgtBootLun	X	X	X	X	X	X	X	Yes	0-255	0-255		Yes	Specifies the boot Logical Unit Number (LUN) on the first iSCSI storage target.
CHAP Secret	FirstTgtChapPwd	X	X	X	X	X	X	X	Yes	string	string		Yes	Specifies the Challenge-Handshake Authentication Protocol secret (CHAP password) of the first iSCSI storage target. The string value is limited to alphanumeric characters, '.' (dot), ':' (colon), and '-' (dash).
IP Address	FirstTgtIpAddress	X	X	X	X	X	X	X	Yes	X.X.X.X	X.X.X.X		Yes	Specifies the IP address of the first iSCSI target.
iSCSI Name	FirstTgtiscsiName	X	X	X	X	X	X	X	Yes	string	string		Yes	Specifies the iSCSI Qualified Name (IQN) of the first iSCSI storage target. The string value is limited to alphanumeric characters, '.' (dot), ':' (colon), and '-' (dash).
TCP Port	FirstTgtTcpPort	X	X	X	X	X	X	X	Yes	1024-65535	1024-65535		Yes	Specifies the TCP Port number of the first iSCSI target.
CHAP ID	IscsiInitiatorChapId	X	X	X	X	X	X	X	Yes	string	string	ChapAuthEnable - Enabled	Yes	Specifies the first iSCSI storage target Challenge-Handshake Authentication Protocol (CHAP) ID. The string value is limited to alphanumeric characters, '.' (dot), ':' (colon), and '-' (dash).
CHAP Authentication	ChapAuthEnable	X	X	X	X	X	X	X	Yes	Enabled/Disabled	Enabled/Disabled		No	Enables the initiator to use CHAP authentication when connecting to the iSCSI target.
TCP/IP Parameters via DHCP	TcpIpViaDHCP	X	X	X	X	X	X	X	Yes	Disabled/Enabled	Disabled/Enabled		No	Controls the source of the initiator IP address, DHCP or static assignment. This option is specific to IPv4.
IP Version	IpVer	X	X	X	X	X	X	X	No		IPv4		No	Controls whether IPv4 or IPv6 network addressing will be used for iSCSI initiator and targets. Currently only IPv4 is supported.
CHAP Mutual Authentication	ChapMutualAuth	X	X	X	X	X	X	X	Yes	Disabled/Enabled	Disabled/Enabled	ChapAuthEnable - Enabled	No	Enables or disables CHAP Mutual Authentication. To use mutual CHAP authentication, you must specify an initiator secret on the Initiator Parameters page and configure that secret on the target.

Display Name	X-UEFI Name	Supported Adapters							User Configurable	User Configurable Values	Values that can be displayed	Dependencies for Values	I/O Identity Optimization (iDRAC 8/9)	Information
		I350	X520	X540	X550	X710	XL710	XXV710						
iSCSI Parameters via DHCP	IscsiViaDHCP	X	X	X	X	X	X	X	Yes	Disabled/Enabled	Disabled/Enabled	TcplpViaDHCP - Enabled	No	Enables the acquisition of iSCSI target parameters from DHCP.
iSCSI Name	IscsiInitiatorName	X	X	X	X	X	X	X	Yes	string	string		Yes	Specifies the initiator's iSCSI Qualified Name (IQN). The attribute setting applies to all ports on a given controller. It is recommended to use the same IscsiInitiatorName on all ports for a given device.
CHAP Secret	IscsiInitiatorChapPwd	X	X	X	X	X	X	X	Yes	string	string	ChapAuthEnable - Enabled	Yes	Sets the iSCSI initiator Challenge-Handshake Authentication Protocol (CHAP) secret (password). The string value is limited to alphanumeric characters, '.' (dot), ':' (colon), and '-' (dash).
Default Gateway	IscsiInitiatorGateway	X	X	X	X	X	X	X	Yes	X.X.X.X	X.X.X.X	TcplpViaDHCP - Disabled	Yes	Specifies the IP address of the default Gateway used by the iSCSI initiator.
IP Address	IscsiInitiatorIpAddr	X	X	X	X	X	X	X	Yes	X.X.X.X	X.X.X.X	TcplpViaDHCP - Disabled	Yes	Specifies the IP address of the iSCSI initiator.
Subnet Mask	IscsiInitiatorSubnet	X	X	X	X	X	X	X	Yes	X.X.X.X	X.X.X.X	TcplpViaDHCP - Disabled	Yes	Specifies the IPv4 Subnet Mask of the iSCSI initiator.
Blink LEDs	BlnkLeds	X	X	X	X	X	X	X	Yes	0-15	0-15		No	Specifies the number of seconds the LEDs on the physical network port should blink to assist with port identification.
Virtual FIP MAC Address	VirtFIPMacAddr		X	X	X*				Yes	XX:XX:XX:XX:XX:XX	XX:XX:XX:XX:XX:XX		Yes	Sets the programmatically assignable FIP-MAC address for FCoE.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter in X550 device family.
Virtual MAC Address	VirtMacAddr	X	X	X	X	X	X	X	Yes	XX:XX:XX:XX:XX:XX	XX:XX:XX:XX:XX:XX		Yes	Sets the programmatically assignable MAC address for port.
Virtual World Wide Node Name	VirtWWN		X	X	X*				Yes	XX:XX:XX:XX:XX:XX:XX:XX	XX:XX:XX:XX:XX:XX:XX:XX		Yes	Sets the programmatically assignable Fibre Channel World Wide Node Name identifier for FCoE. The last 6 bytes must be consistent with active FIP MAC Address.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter.
Virtual World Wide Port Name	VirtWWPN		X	X	X*				Yes	XX:XX:XX:XX:XX:XX:XX:XX	XX:XX:XX:XX:XX:XX:XX:XX		Yes	Sets the programmatically assignable Fibre Channel World Wide Port Name identifier for FCoE. The last 6 bytes must be consistent with active FIP MAC Address.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter.
FCoE Boot Support	FCoEBootSupport	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates whether Fibre Channel over Ethernet Boot capability is supported.
FIP MAC Address	FIPMacAddr		X	X	X*				No		XX:XX:XX:XX:XX:XX		No	Sets the permanent FIP-MAC address for FCoE assigned during manufacturing.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter.

Display Name	X-UEFI Name	Supported Adapters							User Configurable	User Configurable Values	Values that can be displayed	Dependencies for Values	I/O Identity Optimization (iDRAC 8/9)	Information
		I350	X520	X540	X550	X710	XL710	XXV710						
FlexAddressing	FlexAddressing	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates whether the Dell FlexAddressing feature is supported.
iSCSI Boot Support	iSCSIBootSupport	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates whether iSCSI Boot is supported.
iSCSI Dual IP Version Support	iSCSIDualIPVersionSupport	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates support for simultaneous IPv4 and IPv6 configurations of iSCSI initiator and iSCSI primary and secondary targets. <b>Unavailable</b> is the only value used.
iSCSI Offload Support	iSCSIOffloadSupport	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates whether the iSCSI Offload capability is supported. <b>Unavailable</b> is the only value used.
Link Status	LinkStatus	X	X	X	X	X	X	X	No		Disconnected/Connected		No	Reports the physical link status of the network ports reported by the controller.
MAC Address	MacAddr	X	X	X	X	X	X	X	No		XX:XX:XX:XX:XX		No	Reports the permanent MAC address assigned during manufacturing.
NIC Partitioning Support	NicPartitioningSupport	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates whether NIC Partitioning capability is supported.
OS BMC Management Pass Through	OSBMCManagementPassThrough					X	X	X	No		Available/Unavailable		No	Indicates whether OS-BMC Management Pass Through capability is supported.
PCI Device ID	PCIDeviceID	X	X	X	X	X	X	X	No		XXXX		No	Reports the PCI Device ID of the controller.
PXE Boot Support	PXEBootSupport	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates whether PXE Boot capability is supported.
RX Flow Control	RXFlowControl					X	X	X	No		Available/Unavailable		No	Indicates whether Receive (RX) Flow control capability is supported. "Unavailable" is the only value used.
TOE Support	TOESupport	X	X	X	X	X	X	X	No		Available/Unavailable		No	Indicates whether TCP/IP Offload Engine capability is supported. <b>Unavailable</b> is the only value used.
TX Bandwidth Control Maximum	TXBandwidthControlMaximum								No		Available/Unavailable		No	Indicates whether Transmit (TX) Bandwidth Control Maximum capability is supported.
TX Flow Control	TXFlowControl					X	X	X	No		Available/Unavailable		No	Indicates whether Transmit (TX) Flow Control capability is supported. <b>Unavailable</b> is the only value used.
World Wide Node Name	WWN		X	X	X*				No		XX:XX:XX:XX:XX:XX		No	Reports the Fibre Channel World Wide Node Name identifier for FCoE. Assigned during manufacturing.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter.
World Wide Port Name	WWPN		X	X	X*				No		XX:XX:XX:XX:XX:XX		No	Reports the Fibre Channel World Wide Port Name identifier for FCoE. Assigned during manufacturing.  * Only supported on Intel® Ethernet 10G 2P X550-t Adapter.

Display Name	X-UEFI Name	Supported Adapters							User Configurable	User Configurable Values	Values that can be displayed	Dependencies for Values	I/O Identity Optimization (iDRAC 8/9)	Information
		I350	X520	X540	X550	X710	XL710	XXV710						
Legacy Boot Protocol	LegacyBootProto	X	X	X	X	X	X	X	Yes	None/PXE/iSCSI Primary/iSCSI Secondary/*FCoE)	None/PXE/iSCSI Primary/iSCSI Secondary/*FCoE		No	Selects a boot protocol to be used in legacy BIOS (non-UEFI) boot mode.  * FCoE option will only show on FCoE supported devices
Legacy Virtual LAN ID	VLanId	X	X	X	X	X	X	X	Yes	0-4094	0-4094		No	Specifies the ID (tag) to be used for PXE VLAN Mode. The VLAN ID must be in the range from 0 to 4094. PXE VLAN is disabled if value is set to 0.
Wake On LAN	WakeOnLan	X	X	X	X	X	X	X	Yes	Disabled/Enabled*/N/A'	Disabled/Enabled*/N/A'		No	Enables power on of the system via LAN. Note that configuring Wake on LAN in the operating system does not change the value of this setting, but does override the behavior of Wake on LAN in OS controlled power states.
Link Speed	LnkSpeed	X	X	X	X	X	X	X	*Yes	Auto Negotiated/1000 Mbps Full/10 Mbps Half/10 Mbps Full/100 Mbps Half/100 Mbps Full	Auto Negotiated/1000 Mbps Full/10 Mbps Half/10 Mbps Full/100 Mbps Half/100 Mbps Full		No	Specifies the port link speed to be used when booting the selected protocol.  *The attribute is only writable on 1G (I350) devices.
PCI Virtual Functions Advertised	NumberVFAdvertised	X	X	X	X	X	X	X	Yes	I350: 1-8, X520/X540/X550: 1-64, X710/XL710/XXV710: 0-127	I350: 1-8, X520/X540/X550: 1-64, X710/XL710/XXV710: 0-127	VirtualizationMode - SR-IOV	No	Specifies the number of PCI Virtual Functions (VFs) to be advertised in non-NPAR mode. Available values vary between product families. On I350, X520, X540, and X550 based devices, the value represents the total number of PCI VFs that will be shared across all ports on a given controller. On all other devices, the value represents the number of PCI VFs that will be dedicated to each port.
PCI Virtual Functions Advertised	NumberVFAdvertised					X		X	Yes	0-128	0-128	VirtualizationMode -NPAR+ SR-IOV	No	Specifies the number of PCI Virtual Functions (VFs) to be advertised on this port in NPAR mode. This attribute is present only in HII Browser. Virtual Functions in NPAR mode can be assigned only to the first partition on a port. Use the VFDistribution attribute for remote configuration.
Number of PCI Physical Functions Currently Enabled per Port	NumberPCIFunctionsEnabled					X	X	X	No		1-8		No	Reports the number of PCI Physical Functions currently enabled on this port.
Number of PCI Physical Functions Supported	NumberPCIFunctionsSupported					X	X	X	No		1-8		No	Reports the number of PCI Physical Functions supported on this port. This value may change depending on the support and configuration of NParEP.
Partition n	PartitionState[Partition:n]					X	X	X	No		Enabled/Disabled		No	Reports the current enablement state of the partition.
Virtual MAC Address	VirtMacAddr[Partition:n]					X	X	X	Yes	XX:XX:XX:XX:XX:XX	XX:XX:XX:XX:XX:XX			Reports the programmatically assignable MAC address for partition.
MAC Address	MacAddr[Partition:n]					X	X	X	No		XX:XX:XX:XX:XX:XX		No	Reports the permanent MAC address assigned during manufacturing.



Display Name	X-UEFI Name	Supported Adapters							User Configurable	User Configurable Values	Values that can be displayed	Dependencies for Values	I/O Identity Optimization (iDRAC 8/9)	Information
		I350	X520	X540	X550	X710	XL710	XXV710						
NIC Mode	NicMode[Partition:n]					X	X	X	No		Disabled/Enabled		No	Specifies use of the partition for L2-Ethernet traffic. <b>Enabled</b> is the only value used.
PCI Device ID	PCIDeviceID[Partition:n]					X	X	X	No		XXXX		No	Reports the PCI Device ID of the partition.
Port Number	PortNumber[Partition:n]					X	X	X	No		1-4		No	Reports the port to which the partition belongs, where n is the number of the partitions.
VF Distribution	VFDistribution					X	X	X	Yes	X:0:0:0:....:0:0 (The number of zeros depends on the number of partitions currently enabled on the port)	X:0:0:0:....:0:0 (The number of zeros depends on the number of partitions currently enabled on the port)	VirtualizationMode - NPAR + SR-IOV	No	Defines the distribution of VFs to PFs within the domain specified by VFAllocBasis. A value appears in the colon-separated list for each Physical Function that can be potentially present within the allocation domain. Values in the list from left to right apply to function numbers in the domain from least to greatest.

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