

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 5.

1. Make sure that you are installing the latest driver software for your adapter. [Visit Intel's support website](#) to download the latest drivers.
2. Review [system requirements](#).
3. [Insert the adapter\(s\) in the computer](#).
4. Attach the [copper](#) or [fiber](#) network cable(s).
5. [Install the driver](#).
6. For Windows systems, install the [Intel® PROSet](#) software.

If you have any problems with basic installation, see [Troubleshooting](#).

You can now set up advanced features, if necessary. The available features and the configuration process varies with the adapter and your operating system.

Supported Devices

For help identifying your network device and finding supported devices, click the link below:

<http://www.intel.com/support>

Compatibility Notes

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.

Some older Intel(R) Ethernet Adapters do not have full software support for the most recent versions of Microsoft Windows*. Many older Intel Ethernet Adapters have base drivers supplied by Microsoft Windows.

Lists of supported devices per OS are available at

<http://www.intel.com/support/go/network/adapter/nicoscomp.htm>

Some Intel® 10 Gigabit Network Adapters and Connections support SFP+ pluggable optical modules. Please see [SFP+ Devices with Pluggable Optics](#)

System Requirements

Before installing the network adapter, check your system for the following minimum configuration requirements.

Hardware Compatibility

- The latest BIOS for your computer
- One of the following slot types, depending on your adapter:
 - One open PCI bus master slot, 32-bit or 64-bit, operating at 33 or 66 MHz
 - One open PCI-X slot operating at 66, 100 or 133 MHz (recommended)
 - One open PCI-Express slot (v1.0a or newer), 4x, 8x, or 16x.



NOTES:

- The PRO/1000 MT Quad Port Server adapter requires a 3.3 volt only slot. It cannot be installed in a 5.0 volt or universal slot.
- The Intel® 10 Gigabit AT Server Adapter will only fit into x8 or larger PCI Express slots. Some systems have physical x8 PCI Express slots that actually support lower speeds. Please check your system manual to identify the slot.

Supported 32-bit Operating Systems



NOTE: Intel 10GbE Ethernet Adapters do not support Microsoft* Windows* 32-bit operating systems. They support 32-bit versions of Linux* and FreeBSD*.

Basic software and drivers are supported on the following operating systems:

- DOS
- SunSoft* Solaris* (drivers and support are provided by the operating system vendor)

Advanced software and drivers are supported on the following operating systems:

- Microsoft* Windows* 7
- Microsoft Windows 8
- Microsoft Windows 8.1
- Microsoft Windows 10
- Linux*, v2.4 kernel or higher
- FreeBSD*

Supported Intel® 64 Architecture Operating Systems

- Microsoft Windows 7
- Microsoft Windows 8
- Microsoft Windows 8.1
- Microsoft Windows 10
- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2012
- Microsoft Windows Server 2012 R2
- Red Hat Linux
- SUSE Linux
- FreeBSD

Supported Operating Systems for Itanium-based Systems

- Linux, v2.x kernel and higher, except v2.6

Some older Intel(R) Ethernet Adapters do not have full software support for the most recent versions of Microsoft Windows*. Many older Intel Ethernet Adapters have base drivers supplied by Microsoft Windows. Lists of supported devices per OS are available at

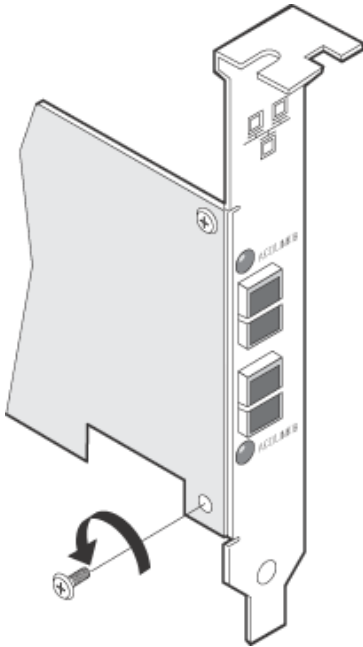
<http://www.intel.com/support/go/network/adapter/nicoscomp.htm>

Hardware Installation

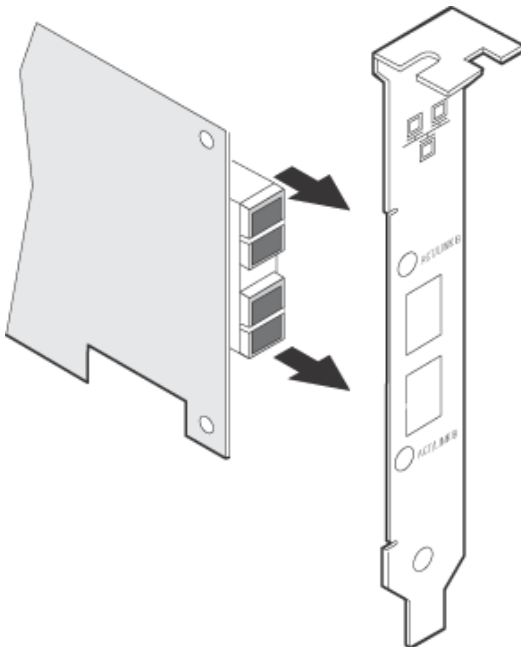
Attaching the Low Profile Bracket (Optional)

Some adapter models come with a small bracket in the product package, to be used in a low profile slot. If you need to install the adapter in a low-profile slot, follow these instructions.

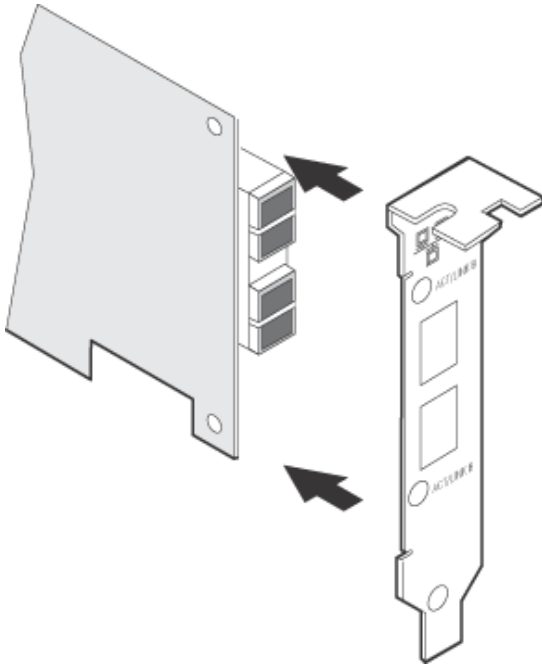
1. Before handling the adapter, ground yourself to dissipate any static charge.
2. Remove the two screws securing the standard bracket to the back side of the adapter.



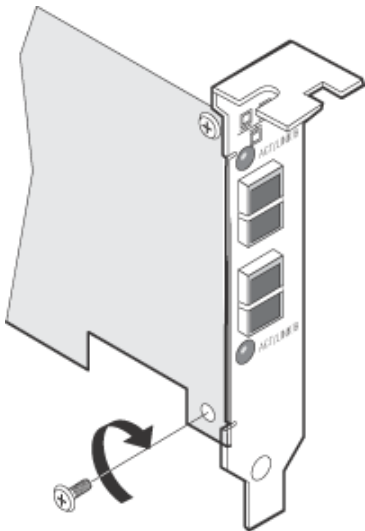
3. Slide the bracket away from the adapter.



- Slide the low profile bracket onto the adapter.



- Attach the low profile bracket to the adapter using the screws you removed in step 2.



- Carefully tighten the screws until they are seated. Do not over tighten.

You may re-attach the standard sized bracket in the future if necessary.

Installing the Adapter

Selecting the Correct Slot

PCI-Express Adapters

- One open PCI-Express slot (v1.0a or newer), x4, x8, or x16.



NOTE: The Intel® 10 Gigabit AT Server Adapter will only fit into x8 or larger PCI Express slots. Some systems have physical x8 PCI Express slots that actually support lower speeds. Please check your system manual to identify the slot.

PCI and PCI-X Adapters

One of the following slot types, depending on your adapter:

- One open PCI bus master slot, 32-bit or 64-bit, operating at 33 or 66 MHz
- One open PCI-X slot operating at 66, 100 or 133 MHz (recommended)



NOTE: The PRO/1000 MT Quad Port Server adapter requires a 3.3 volt only slot. It cannot be installed in a 5.0 volt or universal slot.

If you have configuration problems, see your computer's documentation to determine if the PCI slots are bus master-enabled. If you get a PCI or PCI-X configuration error, select Troubleshooting in the Table of Contents.

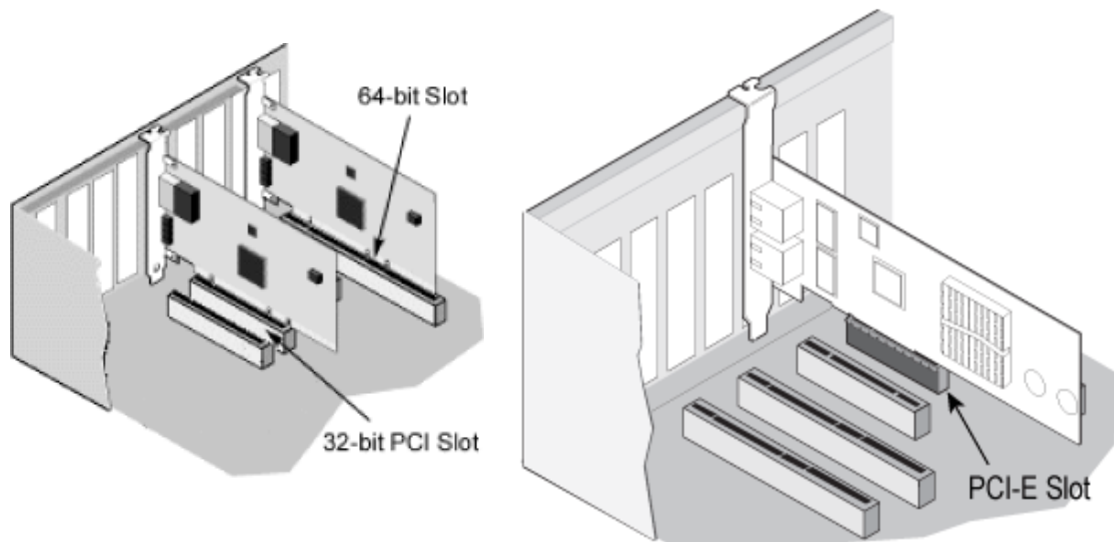
Insert the Adapter into the Computer

1. If your computer supports PCI Hot Plug, see your computer documentation for special installation instructions.
2. Shut down the operating system (if it's running).
3. 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.

4. Remove the cover bracket from an appropriate slot.
5. Insert the adapter, pushing it into the slot until the adapter is firmly seated.
 - If you install a 64-bit PCI adapter in a 32-bit slot, the adapter will still function, but the end of the edge connector will be exposed and not connected. If this is the case, make sure the exposed contacts do not touch anything that would cause an electrical problem.
 - If you are installing a PCI-Express adapter, be aware that you can install a smaller PCI-Express adapter in a larger PCI-Express slot.



6. Secure the adapter bracket with a screw, if required.
7. Repeat steps 4 through 6 for each additional adapter to be installed.
8. Replace the computer cover and plug in the power cord.
9. Turn the power on and start your operating system.

Attaching Cables

Intel® Gigabit and 10 Gigabit Network Adapters using copper connections automatically accommodate either MDI or MDI-X connections. The auto-MDI-X feature of Intel Gigabit Network adapters allows you to directly connect two adapters without using a cross-over cable.

To ensure compliance with CISPR 24 and the EU's EN55024, Intel® 10 Gigabit Server Adapters and Connections should be used only with CAT 6a shielded cables that are properly terminated according to the recommendations in EN50174-2.

Attach an RJ45 Network Cable

Cable types

Use one of the following types of network cabling, depending on your adapter and the intended use:



NOTE: If you are using this adapter in a residential environment (at any speed), use Category 5 or better wiring. If the cable runs between rooms or through walls and/or ceilings, it should be plenum-rated for fire safety.

- Maximum lengths for Intel® 10 Gigabit Server Adapters and Connections that use 10GBASE-T on Category 6, Category 6a, or Category 7 wiring, twisted 4-pair copper:
 - Maximum length for Category 6 is 55 meters.
 - Maximum length for Category 6a is 100 meters.
 - Maximum length for Category 7 is 100 meters.

- To ensure compliance with CISPR 24 and the EU's EN55024, Intel® 10 Gigabit Server Adapters and Connections should be used only with CAT 6a shielded cables that are properly terminated according to the recommendations in EN50174-2.
- For 1000 Mbps operation (1000BaseT), use Category 5 or better (must be 4-pair wiring). Make sure you use Category 5 cable that complies with the TIA-568 wiring specification.



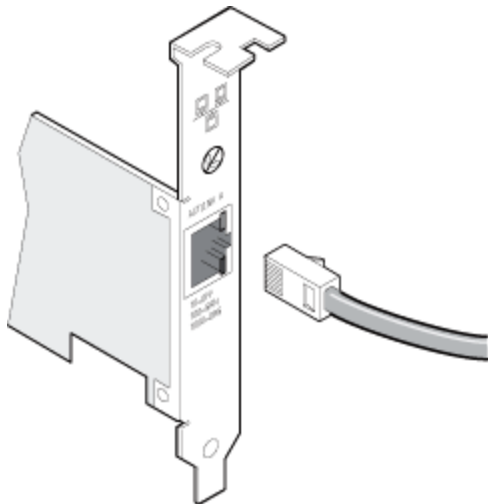
NOTE: To insure compliance with CISPR 24 and the EU's EN55024, devices based on the 82576 controller should be used only with CAT 5E shielded cables that are properly terminated according to the recommendations in EN50174-2.

- For 100 Mbps operation (100BaseTX), use Category 5 wiring or better.
- For 10 Mbps operation (10BaseT), use Category 3 wiring or better.
- In all cases:
 - Segment length is limited to 100 meters (328 feet, 1 inch).
 - The adapter must be connected to a compatible link partner, and may be set to auto-negotiate speed and duplex.
- For more information on this specification, see the Telecommunications Industry Association's website: www.tiaonline.org.



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.

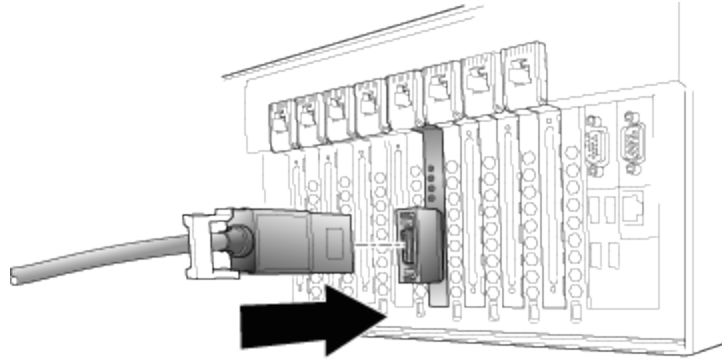
Insert the twisted pair, RJ45 network cable as shown.



CX4

Physical cabling characteristics for the Intel® CX4 Dual Port Server Adapter must meet IEEE Std 802.3ak, Clause 54 specifications. The required cable connector is an MDI latch-type receptacle, as defined by IEC 61076-3-113.

The IEEE standard defines a worst-case cable length of 15 meters, based on 100 Ω, twinaxial cable characteristics. However, commercial cable manufacturers may offer enhanced products that will permit successful operation over greater distances.



Fiber Optic Cabling

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

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 that is operating at the same laser wavelength as the adapter.

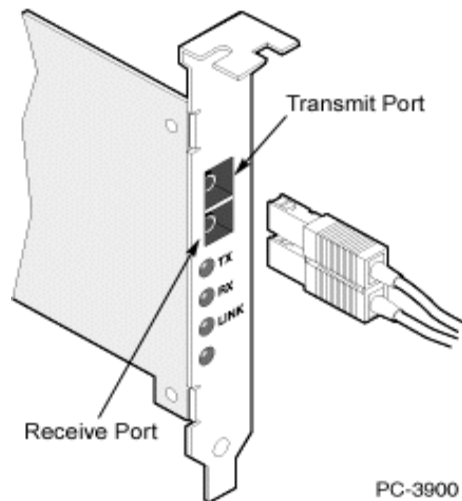


CAUTION: The fiber optic ports contain a Class 1 laser device. When the ports are disconnected, always cover them with the provided plug. If an abnormal fault occurs, skin or eye damage may result if in close proximity to the exposed ports.

Connecting Fiber Optic SC Cables

The connection requirements are as follows:

- Laser wavelength: 850 nanometer (not visible).
- SX Cable type:
 - Multi-mode fiber with 50 micron core diameter; maximum length is 550 meters.
 - Multi-mode fiber with 62.5 micron core diameter; maximum length is 275 meters.
- Connector type: SC.



Single-port fiber adapter with SC connector

Connecting Fiber Optic LC Cables

- Laser type: 850 nanometer wavelength (not visible).
- SX Cabling:
 - Multi-mode fiber with 50 micron core diameter. Maximum length is 550 meters.
 - Multi-mode fiber with 62.5 micron core diameter. Maximum length is 275 meters
- Connector type: LC.

"LX" Adapters

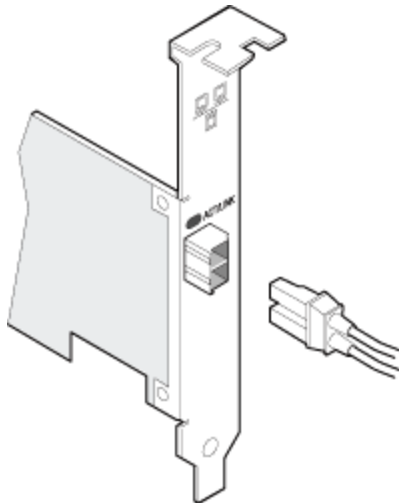
Adapters with an "LX" marking on the bracket support the 1000Base-LX connectivity standard. They are designed for long-haul operation, and have different connectivity requirements:

- Laser type: 1310 nanometer wavelength (not visible).
- LX Cabling: single-mode fiber with 9.0 micron core diameter.
- Maximum length: 10 kilometers.
- Connector type: LC.



NOTES:

- Although LX adapters are designed for use with long-haul single-mode fiber, they can also be used with short-haul multi-mode fiber. Maximum cable length is 550 meters. Must be connected to compatible LX ports.
- If needed, an LC-to-SC adapter cable may be used to mate with SC connectors.



Single-port fiber adapter with LC connector

SFP+ Devices with Pluggable Optics

X710 and XL710-Based Adapters



NOTE: If your Intel® Network Adapter came with Intel SFP+ optics, or is an Intel® Ethernet Converged Network Adapter X710 type of adapter, then it only supports Intel optics and/or the direct attach cables listed below, as well as the 3rd party modules listed in the table immediately following.

Supplier	Type	Part Numbers
<i>SR Modules</i>		
Intel	DUAL RATE 1G/10G SFP+ SR (bailed)	E10GSFPSR
<i>LR Modules</i>		
Intel	DUAL RATE 1G/10G SFP+ LR (bailed)	E10GSFPLR
<i>QSFP Modules</i>		
Intel	TRIPLE RATE 1G/10G/40G QSFP+ SR (bailed) (1G not supported on XL710)	E40GQSFP SR

The following is a list of 3rd party SFP modules that have received some testing. Not all modules are applicable to all devices.

Supplier	Type	Part Numbers
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Finisar	1000BASE-T SFP	FCLF-8251-3
Kinnex A	1000BASE-T SFP	XSFP-T-RJ12-0101-DLL
Avago	1000BASE-T SFP	ABCU-5710RZ

82599-Based Adapters



NOTES:

- If your 82599-based Intel® Network Adapter came with Intel optics, or is an Intel® Ethernet Server Adapter X520-2, then it only supports Intel optics and/or the direct attach cables listed below.
- 82599-Based adapters support all passive and active limiting direct attach cables that comply with SFF-8431 v4.1 and SFF-8472 v10.4 specifications.

Supplier	Type	Part Numbers
<i>SR Modules</i>		
Intel	DUAL RATE 1G/10G SFP+ SR (bailed)	AFBR-703SDZ-IN2
Intel	DUAL RATE 1G/10G SFP+ SR (bailed)	FTLX8571D3BCV-IT
Intel	DUAL RATE 1G/10G SFP+ SR (bailed)	AFBR-703SDDZ-IN1
<i>LR Modules</i>		
Intel	DUAL RATE 1G/10G SFP+ LR (bailed)	FTLX1471D3BCV-IT
Intel	DUAL RATE 1G/10G SFP+ LR (bailed)	AFCT-701SDZ-IN2
Intel	DUAL RATE 1G/10G SFP+ LR (bailed)	AFCT-701SDDZ-IN1
<i>QSFP Modules</i>		
Intel	TRIPLE RATE 1G/10G/40G QSFP+ SR (bailed) (40G not supported on 82599)	E40GQSFP SR

The following is a list of 3rd party SFP+ modules that have received some testing. Not all modules are applicable to all devices.

Supplier	Type	Part Numbers
Finisar	SFP+ SR bailed, 10g single rate	FTLX8571D3BCL
Avago	SFP+ SR bailed, 10g single rate	AFBR-700SDZ
Finisar	SFP+ LR bailed, 10g single rate	FTLX1471D3BCL
Finisar	DUAL RATE 1G/10G SFP+ SR (No Bail)	FTLX8571D3QCV-IT
Avago	DUAL RATE 1G/10G SFP+ SR (No Bail)	AFBR-703SDZ-IN1
Finisar	DUAL RATE 1G/10G SFP+ LR (No Bail)	FTLX1471D3QCV-IT
Avago	DUAL RATE 1G/10G SFP+ LR (No Bail)	AFCT-701SDZ-IN1
Finisar	1000BASE-T SFP	FCLF8522P2BTL
Avago	1000BASE-T SFP	ABCU-5710RZ
HP	1000BASE-SX SFP	453153-001

82598-Based Adapters



NOTES:

- Intel® Network Adapters that support removable optical modules only support their original module type (i.e., the Intel® 10 Gigabit SR Dual Port Express Module only supports SR optical modules). If you plug in a different type of module, the driver will not load.
- 82598-Based adapters support all passive direct attach cables that comply with SFF-8431 v4.1 and SFF-8472 v10.4 specifications. Active direct attach cables are not supported.
- Hot Swapping/hot plugging optical modules is not supported.
- Only single speed, 10 gigabit modules are supported.
- LAN on Motherboard (LOMs) may support DA, SR, or LR modules. Other module types are not supported. Please see your system documentation for details.

The following is a list of SFP+ modules and direct attach cables that have received some testing. Not all modules are applicable to all devices.

Supplier	Type	Part Numbers
Finisar	SFP+ SR bailed, 10g single rate	FTLX8571D3BCL
Avago	SFP+ SR bailed, 10g single rate	AFBR-700SDZ
Finisar	SFP+ LR bailed, 10g single rate	FTLX1471D3BCL
Molex	1m - Twin-ax cable	74752-1101
Molex	3m - Twin-ax cable	74752-2301
Molex	5m - Twin-ax cable	74752-3501
Molex	10m - Twin-ax cable	74752-9004
Tyco	1m - Twin-ax cable	2032237-2
Tyco	3m - Twin-ax cable	2032237-4
Tyco	5m - Twin-ax cable	2032237-6
Tyco	10m - Twin-ax cable	1-2032237-1

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.

PCI Hot Plug Support

Intel® PRO/100 Server Adapters and most Intel® Gigabit Server Adapters are enabled for use in selected servers equipped with Hot Plug support. Exceptions: Intel Gigabit Quad Port Server adapters do not support Hot Plug operations.

If you replace an adapter in a Hot Plug slot, do not place the removed adapter back into the same network until the server has rebooted (unless you return it to the same slot and same team as before). This prevents a conflict in having two of the same Ethernet addresses on the same network.

The system will require a reboot if you

- Change the primary adapter designator.
- Add a new adapter to an existing team and make the new adapter the primary adapter.
- Remove the primary adapter from the system and replace it with a different type of adapter.



NOTE: To replace an existing SLA-teamed adapter in a Hot Plug slot, first unplug the adapter cable. When the adapter is replaced, reconnect the cable.

PCI Hot Plug Support for Microsoft* Windows* Operating Systems

Intel® network adapters are enabled for use in selected servers equipped with PCI Hot Plug support and running Microsoft* Windows* operating systems. For more information on setting up and using PCI Hot Plug support in your server, see your hardware and/or Hot Plug support documentation for details. PCI Hot Plug only works when you hot plug an identical Intel network adapter.



NOTES:

- The MAC address and driver from the removed adapter will be used by the replacement adapter unless you remove the adapter from the team and add it back in. If you do not remove and restore the replacement adapter from the team, and the original adapter is used elsewhere on your network, a MAC address conflict will occur.
- For SLA teams, ensure that the replacement NIC is a member of the team before connecting it to the switch.

Getting the Most From Your Intel® 10 Gigabit Server Adapter



NOTE: 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 your BIOS, operating system or network driver configuration.

1. Install the adapter in a PCIe x8 slot.



NOTE: Some PCIe x8 slots are actually configured as x4 slots. These slots have insufficient bandwidth for full 10Gbe line rate with dual port 10GbE 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.

2. Use the proper cabling for the adapter you have. See [Attach the Network Cable](#) for details.
3. Enable Jumbo Frames, if your other network components can also be configured for it.
4. If your BIOS has an MMRBC (Maximum Memory Read Byte Count) adjustment, change it from its default (usually 512) to 4096 (maximum).



NOTE: Some systems may set the adapter's MMRBC to 4096 by default.

5. Increase the number of TCP and Socket resources from the default value.
6. 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.

Advanced Features



NOTE: The options available on the Advanced tab are adapter and system dependent. Not all adapters will display all options.

Jumbo Frames

Jumbo Frames are Ethernet frames that are larger than 1518 bytes. You can use Jumbo Frames to reduce server CPU utilization and increase throughput. However, additional latency may be introduced.



NOTES:

- Jumbo Frames are supported at 1000 Mbps and higher. Using Jumbo Frames at 10 or 100 Mbps is not supported and may result in poor performance or loss of link.
- End-to-end network hardware must support this capability; otherwise, packets will be dropped.

Jumbo Frames can be implemented simultaneously with VLANs and teaming.

To configure Jumbo Frames at the switch, consult your network administrator or switch user's guide.

Jumbo Frame Restrictions:

- Jumbo Frames are not supported in multi-vendor team configurations.
- 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.
- The Jumbo Frame setting inside a virtual machine must be the same, or lower than, the setting on the physical port.
- When standard sized Ethernet frames (64 to 1518 bytes) are used, there is no benefit to configuring Jumbo Frames.
- The Jumbo Frames 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.
- The Intel® PRO/1000 PL Network Connection supports Jumbo Frames in Microsoft* Windows* operating systems only when Intel® PROSet for Windows Device Manager is installed.
- The following devices do not support Jumbo Frames larger than 4096 bytes:
 - Intel® 82577LM Gigabit Network Connection
 - Intel® 82578DM Gigabit Network Connection.
- The following devices do not support Jumbo Frames:
 - Intel® 82567V-4 Gigabit Network Connection
 - Intel® 82578DC Gigabit Network Connection
 - Intel® 82577LC Gigabit Network Connection
 - Intel® 82567LF-3 Gigabit Network Connection
 - Intel® 82567V-2 Gigabit Network Connection

- Intel® 82567LF-2 Gigabit Network Connection
- Intel® 82567V Gigabit Network Connection
- Intel® 82567LF Gigabit Network Connection
- Intel® PRO/1000 Gigabit Server Adapter
- Intel® PRO/1000 PM Network Connection
- Intel® PRO/1000 PM Network Connection
- Intel® 82562V 10/100 Network Connection
- Intel® 82562GT 10/100 Network Connection
- Intel® 82566DM Gigabit Network Connection
- Intel® 82566DC Gigabit Network Connection
- Intel® 82566DC-2 Gigabit Network Connection
- Intel® 82562V-2 10/100 Gigabit Network Connection
- Intel® 82562G-2 10/100 Gigabit Network Connection
- Intel® 82562GT-2 10/100 Gigabit Network Connection
- Intel® 82552 10/100 Network Connection

Setting Up Jumbo Frames in Microsoft* Windows*

 **NOTE:** Jumbo Frames are not supported in multi-vendor team configurations.

1. Open Microsoft* Windows* Device Manager.
2. Open **Properties** on your adapter.
3. Click the **Advanced** tab.
4. Select Jumbo Frames from the list of advanced features.
5. Set your desired packet size (based on network capability).
6. Click **OK** to apply the changes.

All equipment on the network must also support the larger frame size. When setting up Jumbo Frames on other network devices, be aware that different network devices calculate Jumbo Frame size differently. Some devices include the header information in the frame size while others do not. Intel adapters do not include header information in the frame size. When configuring Jumbo Frames on a switch, set the frame size four bytes higher for CRC, plus four bytes if you are using VLANs or QoS packet tagging.

Advanced Network Services Teaming

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. Before you can set up ANS teaming in Microsoft* Windows*, you must install Intel® PROSet software. For more information, select Intel PROSet in the Table of Contents (left pane) of this window.



NOTES:

- ANS Teams are not supported on Microsoft* Windows* 10. Any Teams created with Release 20.1, 20.2 or 20.3 on a Windows 10 system will be corrupted and cannot be upgraded to version 20.4. The version 20.4 installer will remove existing Teams.
- Be sure to use the latest available drivers on all adapters.
- 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.
- Intel adapters that do not support Intel PROSet may still be included in a team. However, they are restricted in the same way non-Intel adapters are. See [Multi-Vendor Teaming](#) for more information.
- 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.
- Hot Plug operations in a Multi-Vendor Team may cause system instability. We recommended that you restart the system or reload the team after performing Hot Plug operations with a Multi-Vendor 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 (fail-back). 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.
- ANS teaming of Virtual Function devices inside a Windows 2008 R2 guest running on an open source hypervisor is supported.
- 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.

Supported Adapters

Teaming options are supported on Intel® PRO/100, Intel® Gigabit, and Intel® 10GbE adapters. Selected adapters from other manufacturers are also supported.

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 operating system does not support the desired team type.
- The device does not support the desired team type or does not support teaming at all.
- The devices you want to team together use different driver versions.
- You are trying to team an Intel PRO/100 device with an Intel 10GbE device.
- 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" 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.

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



NOTE: 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.

ANS Teaming Types

- [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.
- [Multi-Vendor Teaming \(MVT\)](#) - adds the capability to include adapters from selected other vendors in a team. If you are using a Windows-based computer, you can team adapters that appear in the Intel PROSet teaming wizard.



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 off-loads. 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.



NOTES:

- Hot Plug operations for an adapter that is part of a team are only available in Windows Server.
- For SLA teams, all team members must be connected to the same switch. For AFT, ALB, and RLB teams, all team members must belong to the same subnet. The members of an SFT team must be connected to a different switch.
- Teaming only one adapter port is possible, but provides no benefit.

Primary and Secondary Adapters

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. 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 non-TCP/IP traffic. The Secondary adapter will receive fallback 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.

To specify a preferred primary or secondary adapter

1. From Device Manager, open the properties of a team.
2. Click the **Settings** tab.
3. Click the **Modify Team** button.
4. Select the adapter you want to be the primary adapter and click the **Set Primary** button.

The adapter's preferred setting appears in the Priority column.

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

Adapter Fault Tolerance (AFT) provides the safety of an additional backup link between the server and switch. In the case of switch port, cable, or adapter failure, network connectivity is maintained.

Adapter Fault Tolerance is implemented with a primary adapter and one or more backup, or secondary adapters. During normal operation, the backup adapters are in standby. If the link to the primary adapter fails, the link to the secondary adapter automatically takes over. For more information, see [Primary and Secondary Adapters](#).

To use Adapter Fault Tolerance all adapters must be connected to the same subnet.

Switch Fault Tolerance

Switch Fault Tolerance (SFT) teaming allows you to connect each of two teamed adapters to a separate switch.

Switch Fault Tolerance can detect failures when they occur:

- on either teamed adapter
- on either cable connecting the teamed adapter to its switch
- on switch ports connected to the adapters, if link is lost

In SFT teams, one adapter is the primary adapter and one adapter is the secondary adapter. During normal operation, the secondary adapter is in standby. In standby, the adapter is inactive and waiting for failover to occur. It does not transmit or receive other network traffic. If the primary adapter loses connectivity, the secondary adapter automatically takes over.

In SFT teams, each adapter in the team can operate at a different speed than the other.

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 Load Balancing

Adaptive Load Balancing (ALB) uses software to balance routable traffic among a team of two to eight adapters or LOMs (the team must include at least one server adapter) connected to the same subnet. The software 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 also provide the benefits of fault tolerance.



NOTES:

- ALB does not load balance non-routed protocols such as NetBEUI and some IPX* traffic.
- You can create an ALB team with mixed speed adapters. The load is balanced according to the lowest common denominator of adapter capabilities and the bandwidth of the channel.
- On Windows systems, Receive Load Balancing is enabled by default.
- Receive Load Balancing is not supported on Microsoft Hyper-V*.

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 ALB 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 an Intel AMT enabled adapter in a VMLB team.

Static Link Aggregation

Static Link Aggregation (SLA) is a performance technology developed by Cisco to increase throughput between switches. This team type 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

The transmission speed will never exceed the adapter base speed to any single address (per specification). Teams can contain two to eight adapters, but must match the capability of the switch. Adapter teams configured for Static Link Aggregation also provide the benefits of fault tolerance and load balancing.



NOTE: You cannot use an Intel AMT enabled adapter in an SLA team

IEEE 802.3ad Dynamic Link Aggregation

802.3ad is an adopted IEEE standard. Teams can contain two to eight adapters, and you can have a maximum of two IEEE 802.3ad dynamic teams per server. 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 1Gbps and 10Gbps ports connected to a second switch, three aggregators would be formed. One containing all the ports connected to the first switch, one containing the 1Gbps ports connected to the second switch, and the third containing the 10Gbps ports connected to the second switch.



NOTES:

- Once you choose an aggregator, it remains in force until all adapters in that aggregator 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 copper *or* fiber-based adapters in a system.
- If multiple switches are used, all team members connected to the same switch must operate at the same speed.
- You cannot use an Intel AMT enabled adapter 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 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.

Multi-Vendor Teaming

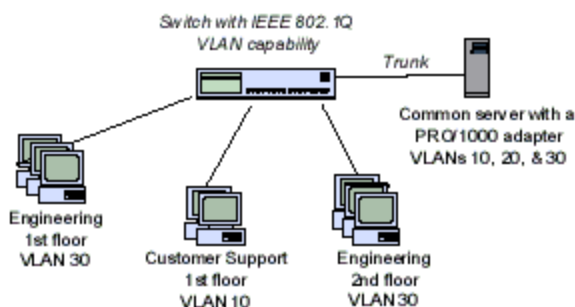
MVT allows teaming with a combination of Intel adapters that support Intel PROSet, Intel adapters that do not support Intel PROSet, and non-Intel adapters. This feature is currently available under Windows Server. All adapters that appear in the Intel PROSet teaming wizard can be included in a team.

MVT Design Considerations

- In order to activate MVT, you must have at least one Intel adapter or integrated connection that supports Intel PROSet in the team. That adapter or connection must be designated as the primary adapter.
- A multi-vendor team can be created for any team type.
- All members in a MVT must operate on a common feature set (lowest common denominator).
- Manually verify that the frame setting for all adapters in the team is the same.
- Verify that the RSS settings for all adapters in the team are the same.

Virtual LANs

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.

- VLANs are not supported on Microsoft* Windows* 10. Any VLANs created with Release 20.1, 20.2 or 20.3 on a Windows 10 system will be corrupted and cannot be upgraded to version 20.4. The version 20.4 installer will remove existing VLANs.
- To set up IEEE VLAN membership (multiple VLANs), the adapter must be attached to a switch with IEEE 802.1Q VLAN capability.
- A maximum of 64 VLANs per network port or team are supported by Intel software.
- 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.
- The Intel PRO/100 VE and VM Desktop Adapters and Network Connections can be used in a switch based VLAN but do not support IEEE Tagging.
- 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.



CAUTION: When using IEEE 802 VLANs, settings must match between the switch and those adapters using the VLANs.



NOTE: 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.

Configuring VLANs in Microsoft* Windows*

In Microsoft* Windows*, you must use Intel® PROSet to set up and configure VLANs. For more information, select Intel PROSet in the Table of Contents (left pane) of this window.



NOTES:

- VLANs are not supported on Microsoft* Windows* 10. Any VLANs created with Release 20.1, 20.2 or 20.3 on a Windows 10 system will be corrupted and cannot be upgraded to version 20.4. The version 20.4 installer will remove existing VLANs.
- 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 [Microsoft Hyper-V virtual NICs on teams and VLANs](#).
- 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 [Microsoft Hyper-V virtual NICs on teams and VLANs](#).

Power Management

The Intel® PROSet Power Management tab replaces the standard Microsoft* Windows* Power Management tab in Device Manager. It includes the Power Saver and Wake on LAN* (WoL*) options that were previously included on the Advanced tab. The standard Windows power management functionality is incorporated 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.
- The following adapters support WoL only on Port A:
 - Intel® Ethernet Server Adapter I350-T2
 - Intel® Ethernet Server Adapter I350-T4
 - Intel® Ethernet Server Adapter I340-T2
 - Intel® Ethernet Server Adapter I340-T4
 - Intel® Ethernet Server Adapter I340-F4
 - Intel® Gigabit ET2 Quad Port Server Adapter
 - Intel® PRO/1000 PF Quad Port Server Adapter
 - Intel® PRO/1000 PT Quad Port LP Server Adapter
 - Intel® PRO/1000 PT Quad Port Server Adapter
 - Intel® PRO/1000 PT Dual Port Network Connection
 - Intel® PRO/1000 PT Dual Port Server Connection
 - Intel® PRO/1000 PT Dual Port Server Adapter
 - Intel® PRO/1000 PF Dual Port Server Adapter
 - Intel® Gigabit PT Quad Port Server ExpressModule
- The following adapters do not support WoL:
 - Intel® PRO/1000 MT Quad Port Server adapter
 - Intel® Gigabit VT Quad Port Server Adapter
 - Intel® Ethernet Server Adapter X520-2
 - Intel® Ethernet Server Adapter X520-1
 - Intel® Ethernet Server Adapter X540-T1
 - Intel® Ethernet Converged Network Adapter X540-T2
 - Intel® Ethernet Converged Network Adapter X540-T1
- Most Intel 10GbE Network Adapters do not support Wake on LAN on any port.



NOTE: If your system has a Manageability Engine, the Link LED may stay lit even if WoL is disabled.

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.

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.

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 at 10Mbps.

Intel® Auto Connect Battery Saver

The Intel® Auto Connect Battery Saver (ACBS) feature turns off the adapter when link is down or the network cable is disconnected. After a timeout period, the adapter will power off. When the network cable is reconnected and link is restored, the NIC powers up and functionality is fully restored.

ACBS only functions when the system is on battery power. If the power cable is connected, ACBS will be automatically disabled. If ACBS is active, the adapter will appear to be powered off. If you have Intel® PROSet installed, on the Link Speed tab, the Link Status will indicate **Speed: Not connected. Power off.**



NOTE: ACBS will not function on an adapter if the adapter has forced speed or duplex settings. ACBS will only function if the adapter is set to auto-detect or auto-negotiate.

Intel® System Idle Power Saver

The Intel® System Idle Power Saver feature sets the adapter to negotiate the lowest possible speed setting when the system and network are idle. When the system activity is detected, the link will be negotiated to a higher speed.

To support this feature, the adapter must be

- configured to Auto Detect speed and
- connected to a link partner that can auto-negotiate speed

Remote Wake-Up and Wake on LAN*

Microsoft Windows and Windows Server do not support wake from a power-off (S5) state, only from standby (S3) or hibernate (S4). When shutting down the system, they shutdown ACPI devices, including Intel 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 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.

Wake on Intel® Ready Access

Intel® Ready Access keeps your network connection active when the rest of your system is in sleep or standby mode, so that content on your system is readily accessible. Requests from other computers will wake up your computer.

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.

Tagging is enabled and disabled in Microsoft® Windows® Server® using the "QoS Packet Tagging" field in the **Advanced** tab in Intel® PROSet. For other versions of the Windows operating system, tagging is enabled using the "Priority/VLAN Tagging" setting on the **Advanced** tab in Intel® PROSet.

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

The supported operating systems, including Microsoft® Windows Server®, have a utility for 802.1p packet prioritization. For more information, see the Windows system help and Microsoft's knowledge base.



NOTE: The first generation Intel® PRO/1000 Gigabit Server Adapter (PwLA 8490) does not support QoS frame tagging.

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/ldp tool are not supported.



NOTES:

- On X710 based devices running Microsoft Windows, Data Center Bridging (DCB) is only supported on NVM version 4.52 and newer. Older NVM versions must be updated before the adapter is capable of DCB support in Windows.
- XL710 based devices running Microsoft Windows do not support Data Center Bridging (DCB).

Microsoft* Hyper-V* Overview

Microsoft* Hyper-V* 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, Microsoft Hyper-V 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.
- See 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 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.
- While Microsoft supports Hyper-V on the Windows* 8 client OS, Intel® Ethernet adapters do not support virtualization settings (VMQ, SR-IOV) on Windows 8 client.
- ANS teaming of VF devices inside a Windows 2008 R2 guest running on an open source hypervisor is supported.

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(R) 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 the prosetcl.exe utility to set up the configuration. Use the prosetcl.exe utility to create the team or VLAN. See the prosetcl.txt file for installation and usage details.



NOTE: Support for the Intel PROSet command line utilities (prosetcl.exe and crashdmp.exe) is being removed. This functionality will be replaced by the Intel Netcmdlets for Microsoft* Windows PowerShell*. Please transition all of your scripts and processes to use the Intel Netcmdlets for Microsoft Windows PowerShell.

The following is an example of how to set up the configuration using prosetcl.exe.

1. Use prosetcl.exe to create a team.

```
prosetcl.exe Team_Create 1,2,3 TeamNew VMLB
```

(VMLB is a dedicated teaming mode for load balancing under Hyper-V.)

2. Create the virtual NIC by running a remote Hyper-V manager on a different machine. Please see Microsoft's documentation for instructions on how to do this.

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 Balan-

cing 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.

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. SR-IOV support was added in Microsoft Windows Server 2012. 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.
- SR-IOV is not supported with ANS teams.

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.

Intel® Active Management Technology

Intel® Active Management Technology (Intel® AMT) is a hardware-based solution that uses out-of-band communication for management access to networked client computers. Even when the client computer is powered down or has a non-operational OS, Intel AMT enables you to access and manage the system over the network. You can easily get accurate platform information, and can perform remote updating, diagnostics, debugging, and repair of a system, regardless of the state of the OS and the power state of the system. For example, if an OS has failed, you can establish a remote-control session to the failed system and then remotely reboot the failed system to a known good OS image on a remote drive. After the system reboots, you can remotely manage the reinstallation of the OS or repair.

For more information on Intel AMT features, see the documentation that came with your system.



NOTE: Intel Active Management Technology drivers are installed as part of the base driver installation on Intel AMT capable systems.

Locally Administered Address (LAA)

The Locally Administered Address feature allows you to override a device's MAC Address and assign an address of your choice. The address is a 12-digit hexadecimal number in the range: 0000 0000 0001 – FEFF FFFF FFFF.



CAUTION: Make sure no other systems on the network use this address.



NOTES:

- 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.)
- To restore the default MAC address, click **Use Default**.
- You cannot change the address if the adapter is part of a team.
- Changing this setting may cause a momentary loss of connectivity.

The LAA setting is disabled and cannot be changed because one or more of the following is true:

- The device is configured to iSCSI boot primary or secondary.
- The device or team is bound to the Microsoft Virtual Switch Protocol.

Low Latency Interrupts (LLI)

The LLI feature enables the network device to by-pass 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 Options:

You may evoke LLI for data packets containing a TCP PSH flag in the header or for specified TCP ports.

Use for 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.
Use for these TCP ports:	Every packet received on the specified ports will trigger an immediate interrupt. Up to 8 ports may be specified.

Direct Cache Access (DCA)

Direct Cache Access enables a capable I/O device such as a network controller to activate a pre-fetch engine in the CPU that loads arriving packet data into the CPU cache for immediate access by the network stack process. This reduces the number of memory access operations required to process each packet, reducing CPU load and increasing throughput.

DCA takes advantage of high-speed cache and eliminates processor cycles required to read packet headers and descriptors from system memory.



NOTE: DCA requires support from the I/O device, system chipset, and CPU.

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 internal system components to enter energy-saving states. 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.

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.

See [Direct Memory Access \(DMA\) Coalescing](#) for a list of supported devices, and information on BIOS, platform, and application settings that will affect your potential energy savings.

Receive Side Scaling

The phrase "Receive Side Scaling" (RSS) refers to the idea that all receive data processing is shared (scaled) across multiple processors or processor cores. Without RSS, all receive data 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 the following:

- RSS has no effect if your system has only one processing unit.
- RSS must be enabled for Intel® I/O Acceleration Technology to function.
- RSS is not supported on some adapters configured to use Virtual Machine Queues (VMQ). On these adapters VMQ will take precedence over RSS. RSS will appear disabled.

Configuration

LAN RSS is enabled on the Advanced tab of the adapter property sheet. If your adapter or operating system does not support it, the RSS settings will not be displayed. If your adapter does support it, the following settings will be displayed:

- **Port NUMA Node:** the NUMA node number of a device.
- **Receive Side Scaling Queues:** allocates queue space to buffer transactions between the network adapter and CPU(s). Range:

1 queue is used when low CPU utilization is required.

2 queues are used when good throughput and low CPU utilization are required.

4 or more queues are used for applications that demand maximum throughput and

- **Starting RSS CPU:** allows you to set the preferred starting LAN 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. In Microsoft* Windows Server* 2008 R2, LAN RSS will only use CPUs in group 0 (CPUs 0 through 63).
- **Preferred NUMA Node:** 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 LAN 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. Note that this setting only affects NUMA systems; it will have no effect on non-NUMA systems.

Teaming

If RSS is not enabled for all adapters in a team, RSS will automatically be disabled for the team. If an adapter that does not support RSS is added to a team, RSS will automatically be disabled for the team. If you create a Multi-Vendor Team, you must manually verify that the RSS settings for all adapters in the team are the same.

FCoE RSS

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

Configuration

If your adapter supports FCoE RSS, the following configuration settings can be viewed and changed on the Performance Options of the Advanced tab of the Network Adapter device properties:

- **FCoE NUMA Node Count:** The number of consecutive NUMA Nodes where the allocated FCoE queues will be evenly distributed.
- **FCoE Starting NUMA Node:** The NUMA Node representing the first node within the FCoE NUMA Node Count.
- **FCoE Starting Core Offset:** The offset to first NUMA Node CPU core that will be assigned to FCoE queue.
- **FCoE Port NUMA Node:** Indication from platform of optimal closest NUMA Node to physical port, if available. NOTE: This item is read only.

Performance Tuning

The Intel Network Controller provides a set of advanced FCoE performance tuning options. These options 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, and sets the relative locality of queue to available memory.

As indicated, these are intended as advanced tuning options for situations where you wish to maximize system performance. They are generally expected to be used to maximize performance for multi-port platform configurations. Because all ports share the same default installation directives ("Inf" file and so forth), the FCoE queues for every port will be associated with the same set of NUMA CPUs, which may result in CPU contention.

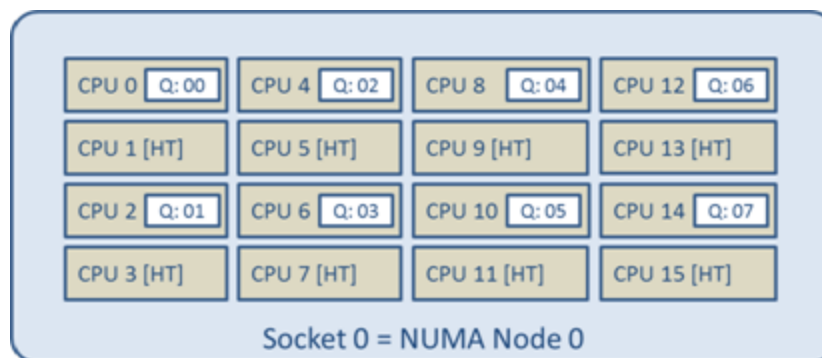
The SW exporting these tuning options defines a NUMA node to be equal or equivalent to an individual processor (socket). Platform ACPI information presented by the BIOS to the OS helps to indicate the relation of PCI devices to individual processors. This detail is not currently fully supported in all platforms however, so using the tuning options may produce unexpected results.

The performance tuning options are listed in the "Configuration" section above.

Example 1:

A Platform is known to have two physical sockets, each socket processor providing 8 core CPUs (16 when hyper threading is enabled). You have also installed a dual port Intel NIC 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. You can see that both ports would then be competing for CPU cycles from the same set of CPUs on socket 0.



Socket Queue to CPU Allocation

Using the performance tuning options, you can direct association of the FCoE queues for the second port 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-HT cores):

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

Example 2:

You would like to experiment with having one or more ports with queues allocated across multiple NUMA nodes. In this case, for each NIC port you would set FCoE NUMA Node Count 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

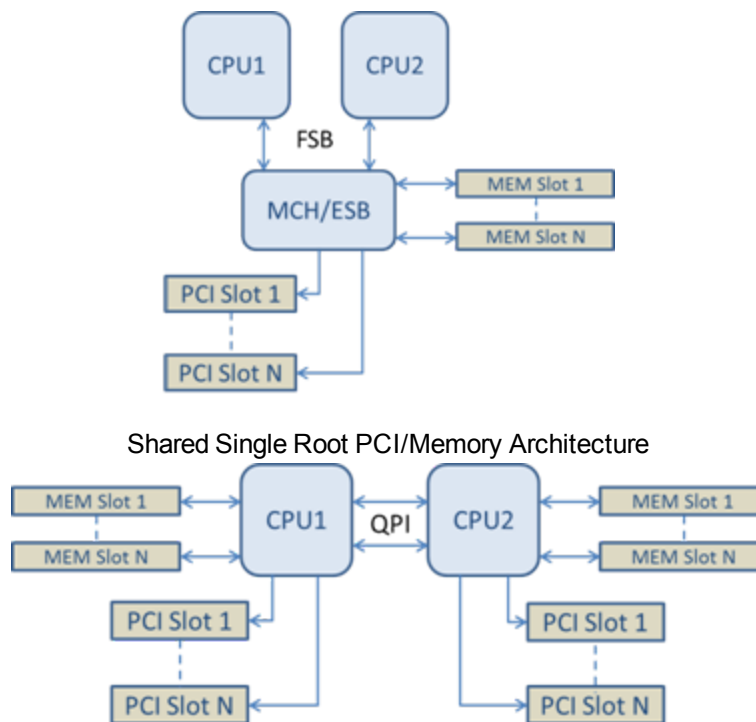
Example 3:

You learn that the FCoE Port NUMA Node setting is **2** for a given NIC 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. Yet 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. To help understand this, 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. So, as hinted at in this example, having the port's queues using CPUs and memory from one socket when the PCI device is actually hanging off of another socket could result in undesirable QPI processor-to-processor bus bandwidth being consumed. This highlights the need for you to understand the specific platform architecture you are working with when you are utilizing these performance options.



Distributed Multi-Root PCI/Memory Architecture

Example 4:

Consider what happens if 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 if SW runs out of CPUs on one socket during queue allocation 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, and there is only a single NUMA node, the SW will only allocate 4 FCoE queues. If there are multiple NUMA nodes, you have the option to change NUMA node count to be ≥ 2 in order to have all 8 queues created.

Determining Active Queue Location

When you are using these performance options you will want to determine the affinity of FCoE queues to CPUs in order to verify their actual effect on queue allocation. You can do this by using a fairly heavy small packet workload and an I/O application such as IoMeter: by monitoring the per-CPU utilization using the built-in performance monitor provided by the OS, the CPUs that are supporting the queue activity should stand out. Again, they should be the first non-hyper thread CPUs available on the processor, unless you have specifically directed allocation to be shifted via the performance options discussed above.

To make the locality of the FCoE queues even more obvious, you can also experiment with assigning the application affinity to an isolated set of CPUs on the same or another processor socket. For example, you could set the IoMeter application to run only on a finite number of hyperthread CPUs for any processor. Or, if you have used the performance options to direct that queues be allocated on a specific NUMA node, you could set application affinity 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.

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 Manger. 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.



NOTE: Devices based on the Intel® X540 Ethernet Controller and Intel® 82599 10 Gigabit Ethernet Controller do not support link speed reduction.

- 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 occurs, the device driver writes a message to the system event log.

Simple Network Management Protocol

The Simple Network Management Protocol (SNMP) is a network protocol used to manage TCP/IP networks. SNMP-compliant devices (agents) communicate with management applications (consoles) to send alerts and updates and allow configuration changes.

The Intel® SNMP Agent translates event notices from the adapter and sends them to specified SNMP management stations. The SNMP agent provides information on Intel® network adapters as well as information about advanced features, such as teaming and VLANs.

Using the Intel SNMP Agent

- Before you install the Intel SNMP Agent on a computer, you must install SNMP on the computer. See your operating system documentation for more information.
- To use the Intel SNMP Agent with an SNMP management application, you must first compile the Intel MIB (Management Information Base) into the management application's database. This allows the management application to recognize and support the adapter.

Installing the SNMP Agent on Microsoft* Windows* Operating Systems

This utility should only be employed by experienced network administrators. Additional software/services must be installed on your network prior to installing the Intel® SNMP Agent.

To install the SNMP Agent, start the autorun menu from the Product CD or download directory and click **Install Drivers and Software**. Follow the instructions on the screen.

IP Security Offloading

Internet Protocol (IP) Security (IPSec) is a set of protocols used to help secure the exchange of IP data. IP Security offloading is the assignment of algorithm computations from software to hardware. Generally, CPU utilization decreases and network performance increases when offloading takes place.

On Intel devices that support IPSec offloading features, you can configure those features through Intel® PROSet. For more information, select Intel PROSet in the Table of Contents (left pane) of this window.



NOTE: Large Send Offload (LSO) and IPSec Offload are not compatible. LSO is automatically disabled when IPSec Offload is enabled. This may reduce the performance of non-IPSec traffic. Confining all of your IPSec traffic to one port and enabling IPSec Offload only on that port may mitigate this issue. On Microsoft Windows 8/Server 2012 and later, devices based on the 82576, 82599, and X540 controllers are not affected by this issue.

IPMI Manageability

The Intelligent Platform Management Interface (IPMI) allows you to monitor server physical health characteristics, such as temperature, voltage, fans, power supplies, and chassis intrusion. These monitoring capabilities provide information that enables system management, recovery and asset tracking.

IPMI and Adapter Teaming

If an adapter is TCO-enabled and connected to a Baseboard Management Controller (BMC), you can add it to any type of iANS team. However, if you add it to a Static Link Aggregation (SLA) or an IEEE 802.3ad Dynamic Link Aggregation Team the system management capabilities will be non-functional. This is due to load balancing requirements within a team and the fact that manageability traffic is restricted to a single port on a specific adapter. Also, if the adapter is connected to a BMC device that does not use a dedicated MAC address, Receive Load balancing and Adaptive Load Balancing teams will lose manageability traffic like SLA and Dynamic Link Aggregation Teams mentioned above.

IPMI and VLANs

If you are using an 82541 or 82547-based network connection and plan to configure a VLAN dedicated to IPMI manageability traffic, you must configure the IPMI-enabled port of the system and the BMC to use the same VLAN ID. If the port will pass only non-manageability traffic, you do not need to configure a VLAN on the BMC.

Microsoft* Windows* Installation and Configuration

Intel Network Drivers for Microsoft* Windows* Operating Systems

Before you begin

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



NOTES:

- If you are using an Intel® 10GbE Server Adapter and an Intel Gigabit adapter in the same machine, the driver for the Gigabit adapter must be running with the Gigabit drivers found on this Intel software CD (or respective download package).
- If you are installing a driver in a computer with existing Intel adapters, be sure to update all the adapters (and additional adapter ports, if applicable) with the same Intel driver and supplemental software. This ensures that all adapters will function and interoperate correctly.

Install the Drivers in Microsoft Windows



NOTE: This will update the drivers for all supported Intel® network adapters in your system.

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. If you are installing drivers from the Product CD, insert the CD. If you do not have the Product CD, download drivers from the [support website](#) and transfer them to the system.
2. If the Found New Hardware Wizard screen is displayed, click **Cancel**.
3. Start the autorun located on the CD. If you downloaded the software package from the support website, the autorun automatically runs after you have extracted the files.
4. Click **Install Drivers and Software**.
5. Follow the instructions in the install wizard.

Uninstalling the Driver

These instructions uninstall the drivers for all Intel network adapters in a system.

1. From the Control Panel, double-click **Add/Remove Programs**.
2. Select **Intel(R) Network Connections Drivers**.
3. Click **Add/Remove**.
4. When the confirmation dialog displays, click **OK**.

Configuring with Intel® PROSet for Windows* Device Manager

Intel® PROSet for Windows* Device Manager is an extension to the Windows Device Manager. When you install the Intel PROSet software, additional tabs are automatically added to Device Manager.



NOTES:

- You must have administrator rights to install or use Intel PROSet for Windows Device Manager.
- Intel PROSet for Windows Device Manager and the IntelNetCmdlets module for Windows PowerShell* require the latest driver and software package for your Intel Ethernet devices. Please download the most recent driver and software package for your operating system from www.intel.com.
- On recent operating systems, older hardware may not support Intel PROSet for Windows Device Manager and the IntelNetCmdlets module for Windows PowerShell. In this case, the Intel PROSet tabs may not be displayed in the Windows Device Manager user interface, and the IntelNetCmdlets may display an error message stating that the device does not have an Intel driver installed.

Installing Intel PROSet for Windows Device Manager

Intel PROSet for Windows Device Manager is installed from the Product CD with the same process used to install drivers. Select **Intel(R) PROSet** and **Advanced Network Services** on the Setup Options dialog of the Install Wizard.



NOTE: Upgrading PROSet for Windows Device Manager may take a few minutes.

Removing Intel PROSet for Windows Device Manager

Use Add/Remove programs from the Control Panel to uninstall Intel PROSet for Windows Device Manager.

Changing Intel PROSet Settings Under Windows Server Core

You can use the command line utility `prosetcl.exe` to change most Intel PROSet settings under Windows Server Core. Please refer to the help file `prosetcl.txt` located in the `\Program Files\Intel\DMIX\CL` directory.

For iSCSI Crash Dump configuration, use the Intel NetCmdlets for Microsoft* Windows PowerShell* and refer to the `aboutIntelNetCmdlets.help.txt` help file.



NOTE: Support for the Intel PROSet command line utilities (`prosetcl.exe` and `crashdmp.exe`) is being removed. The `crashdmp.exe` functionality is now available in the Intel Netcmdlets for Microsoft* Windows PowerShell*. The `prosetcl.exe` functionality is superseded by the Intel Netcmdlets for Microsoft Windows PowerShell in the future. Please transition all of your scripts and processes to use the Intel Netcmdlets for Microsoft Windows PowerShell. Microsoft* Windows* 8.1 and Windows Server* 2012 R2 are the last operating systems to support the Intel PROSet command line utilities.

Compatibility Notes

The following devices do not support Intel PROSet for Windows Device Manager

- Intel® 82552 10/100 Network Connection
- Intel® 82567V-3 Gigabit Network Connection

Set Up Speed and Duplex

In addressing speed and duplex configuration issues, you need to distinguish between copper-based adapters and fiber-based adapters.

In the default mode, an Intel® Network Adapter using copper-based 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.



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.

An Intel® Network Adapter using fiber-based connections, however, will not attempt auto-negotiate with its link partner since those adapters operate only in full duplex, and only at their native speed.

Configuring Speed and Duplex in Microsoft* Windows*

By default, auto-negotiation is enabled. Change this setting only to match your link partner.

1. Navigate to the Device Manager.
2. Open Properties on the adapter you would like to configure.
3. Click the **Link Speed** tab.
4. Select the appropriate speed and duplex from the Speed and Duplex pull down menu.
5. Click **OK**.

10 Gigabit Network Device Considerations

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.

2.5 Gigabit Network Device Considerations

2.5 gigabit speed is available only in full duplex.

Gigabit Network Device Considerations

Per the IEEE specification, gigabit speed is available only in full duplex.

The settings available when auto-negotiation is disabled are:

- **10 Mbps or 100 Mbps Full duplex** (requires a full duplex capable link partner set to full duplex). The adapter can send and receive packets at the same time. You must set this mode manually.
- **10 Mbps or 100 Mbps Half duplex** (requires a link partner set to half duplex). The adapter performs one operation at a time; it either sends or receives. You must set this mode manually.
- **Auto-Negotiation 1000 Mbps**. The adapter only advertises gigabit speed at full duplex.

Intel® PRO/100 Network Adapter Considerations

The settings available when auto-negotiation is disabled are:

- **10 Mbps or 100 Mbps Full duplex** (requires a full duplex capable link partner set to full duplex). The adapter can send and receive packets at the same time. You must set this mode manually.
- **10 Mbps or 100 Mbps Half duplex** (requires a link partner set to half duplex). The adapter performs one operation at a time; it either sends or receives. You must set this mode manually.

Performance Profiles

Performance profiles 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.

Profile Descriptions

- Standard Server – This profile is optimized for typical servers.
- Web Server – This profile is optimized for IIS and HTTP based web servers.
- Virtualization Server – This profile is optimized for Microsoft's Hyper-V virtualization environment. Selecting this profile will disable Data Center Bridging (DCB).
- Storage Server – This profile is optimized for Fibre Channel over Ethernet and iSCSI over DCB performance. Selecting this profile will disable SR-IOV and VMQ.
- Storage + Virtualization – This profile is optimized for a combination of storage and virtualization requirements.
- Low Latency – This profile is optimized to minimize network latency.



NOTES:

- Not all profiles are available on all operating systems or with all adapters.
- 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.

Supported Adapters

Performance Profiles are supported on Intel® 10GbE adapters.

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.

Configuring with IntelNetCmdlets Module for Windows PowerShell*

The IntelNetCmdlets module for Windows PowerShell 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.

Install the IntelNetCmdlets module by checking the Windows PowerShell Module checkbox during the driver and PROSet installation process. Then 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 and the name of the module. For example:

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

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

System requirements for using IntelNetCmdlets:

- 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 IntelNetCmdlets module for Windows PowerShell to change most Intel PROSet settings.



NOTE: 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.

Installing the Base Driver and Intel® PROSet via the Command Line

Installation Methods

DxSetup.exe is the preferred installation method. You can use it to install the Windows base drivers and Intel® PROSet for Windows* Device Manager. DxSetup.exe detects the system's language, searches for the appropriate transform file, and applies it to MSI package. The transform file translates the installation instructions to the language associated with your operating system.



NOTES:

- Intel® 10GbE Network Adapters do not support unattended driver installation.
- Intel PROSet cannot be installed with msiexec.exe. You must use DxSetup.exe.

You can use the base driver install utility (SetupBD.exe) to install Microsoft Windows base drivers from a command line. If you use SetupBD.exe to install base drivers, you will not be able to use the advanced features in Intel PROSet.

Installing with DxSetup.exe

DxSetup.exe is a setup utility used for installing Intel PROSet. It detects the system language, searches for the appropriate transform file in the same folder, and then launches PROSETDX.msi in the language specific to the operating system. The transform file translates the installation instructions to the language associated with your operating system.

DxSetup.exe also takes the install options from the command line and applies them to the PROSETDX.msi command line installation.

DxSetup.exe command line switches:

Switch	Description								
/q[r n]	silent install options.								
	<table border="1"><tr><td>r</td><td>Reduced GUI Install</td></tr><tr><td>n</td><td>Silent install</td></tr></table>	r	Reduced GUI Install	n	Silent install				
	r	Reduced GUI Install							
n	Silent install								
/l[i w e a]	log file option.								
	<table border="1"><tr><td>i</td><td>log status messages.</td></tr><tr><td>w</td><td>log non-fatal warnings.</td></tr><tr><td>e</td><td>log error messages.</td></tr><tr><td>a</td><td>log the start of all actions.</td></tr></table>	i	log status messages.	w	log non-fatal warnings.	e	log error messages.	a	log the start of all actions.
	i	log status messages.							
	w	log non-fatal warnings.							
e	log error messages.								
a	log the start of all actions.								
/uninstall /x	uninstalls Intel PROSet and drivers.								

DxSetup.exe Public Properties

Property	Definition
BD	"0", do not install base drivers. "1", install the base drivers (default). NOTE: BD should only be set to 0 if the Base Drivers have already been installed prior to running DxSetup.exe
DMIX	"0", do not install Intel PROSet. "1", install Intel PROSet (default). The DMIX property requires BD=1. NOTE: Selecting the DMIX property also installs the IntelNetCmdlets module for Microsoft* Windows PowerShell*.
ANS	"0", do not install ANS. "1", install ANS (default). The ANS property requires DMIX=1.
FCOE	"0", do not install Fibre Channel Over Ethernet (FCoE) using DCB (default). "1", install FCoE using DCB. The FCOE property requires DMIX=1.
ISCSI	"0", do not install iSCSI using DCB (default). "1", install ISCSI using DCB. The ISCSI property requires DMIX=1.
SNMP	"0", do not install the SNMP Agent (default). "1", install the SNMP Agent. The SNMP property requires BD=1.
FORCE	"0", check that the installed device supports a feature (FCOE, iSCSI) and only install the feature if such a device is found (default). "1", install the specified features regardless of the presence of supporting devices.



NOTES:

- If you specify a path for the log file, the path must exist. If you do not specify a complete path, the install log will be created in the current directory.
- You do not need to specify default values. To install the base drivers, Intel PROSet, and ANS, the following examples are equivalent:

```
DxSetup.exe
```

```
DxSetup.exe BD=1 DMIX=1 ANS=1
```

- The ANS property should only be set to ANS=1 if DMIX=1 is set. If DMIX=0 and ANS=1, the ANS=1 is ignored and only the base driver will be installed.
- Even if FCOE=1 is passed, FCoE using DCB will not be installed if the operating system and installed adapters do not support it. If FORCE=1 is also passed, FCoE will be installed if the operating system supports it.
- Even if ISCSI=1 is passed, iSCSI using DCB will not be installed if the operating system and installed adapters do not support it. If FORCE=1 is also passed, iSCSI will be installed if the operating system supports it.
- Public properties are not case sensitive. No white space is allowed between characters. For example:

```
DxSetup.exe /qn DMIX=1
```

Any white space in "DMIX=1" makes the setting invalid.

Modify and Upgrade

You can use DxSetup.exe to modify or upgrade your drivers and software. If a feature is already installed, the public property for that feature will default to 1 and if a feature is not installed, the public property for that feature will default to 0. Running DxSetup.exe without specifying properties will upgrade all installed software. You can remove installed software (except for base drivers) by setting the property to 0. If you uninstall PROSet (DMIX=0), all features that rely on PROSet will also be removed.

Command line examples

You can modify the paths for different operating systems and CD layouts and apply the command line examples.

1. The following launches a typical install silently:

```
DxSetup.exe /qn /liew install.log
```



NOTE: BD, ANS and DMIX are selected by default.

2. How to install components but deselect ANS. Set the ANS=0 in the command line:

```
DxSetup.exe /qn ANS=0 /liew install.log
```

Using SetupBD.exe to Install Base Drivers on Windows Server* Core Operating Systems



NOTE: If you want to use prosetcl.exe to configure your adapters, you must use DxSetup.exe to install drivers and Intel PROSet. SetupBD.exe only installs the base drivers. Please note that support for the Intel PROSet command line utilities (prosetcl.exe and crashdmp.exe) is being removed. This functionality will be replaced by the [Intel Netcmdlets for Microsoft* Windows PowerShell*](#). Please transition all of your scripts and processes to use the Intel Netcmdlets for Microsoft Windows PowerShell.

Command Line Options

SetupBD.exe supports the following command line switches.



NOTE: You must include a space between switches.

Switch	Description
/s	silent install
/r	force reboot (must be used with the /s switch)
/nr	no reboot (must be used with the /s switch. This switch is ignored if it is included with the /r switch)

Examples:

Option	Description
SetupBD	Installs and/or updates the driver(s) and displays the GUI.
SetupBD /s	Installs and/or updates the driver(s) silently.
SetupBD /s /r	Installs and/or updates the driver(s) silently and forces a reboot.
SetupBD /s /r /nr	Installs and/or updates the driver(s) silently and forces a reboot (/nr is ignored).

Other information



NOTES:

- If you install drivers on a system based on a server chipset and BIOS that are Intel I/OAT capable, the **/s** switch (silent install) forces a reboot without the **/r** switch. If you do not want the system to reboot, use the **/nr** switch.
- For Intel® I/O Acceleration Technology to function properly, you must reboot after driver installation.

You can use the **/r** and **/nr** switches only with a silent install (i.e. with the **/s** option).

Uninstalling Drivers and Intel PROSet

Intel recommends you use Add/Remove Programs to uninstall Intel PROSet and the base drivers. If your operating system does not have a GUI installed, you can use [DxSetup.exe](#) to uninstall the base drivers and Intel PROSet.

If you only installed base drivers, you can use the PROUnstl.exe utility to remove them.



NOTE: PROUnstl.exe only removes the base drivers. Do not use this utility if Intel PROSet is installed on your system. Removing the base drivers without removing Intel PROSet will result in system instability.

PROUnstl.exe supports the following command line switch:

Switch	Description
/nogui	silent uninstall.

Microsoft* Windows* Push Install Instructions

A "Push," or unattended, installation provides a means for network administrators to easily install the drivers on systems that have similar equipment. The following document provides instructions for a basic unattended installation of Microsoft* Windows* that includes the installation of drivers for Intel® Network Adapters.

For 32-bit Microsoft Windows operating systems, see the Push32.txt file in the APPS\SETUP\PUSH\WIN32 directory on the Product CD or in the download directory.

For x64 Microsoft Windows operating systems, see the Pushx64.txt file in the APPS\SETUP\PUSH\WINX64 directory on the Product CD or in the download directory.

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.


**NOTES:**

- You must have Administrator privileges to run scripts. If you do not have Administrator privileges, you will not receive an error, the script just will not run.
- 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.
- The Restore operation requires the same OS as when the configuration was Saved.
- Intel® PROSet for Windows* Device Manager 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 save 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 restore 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> NOTES:</p> <ul style="list-style-type: none"> • If the restore system is not identical to the saved system, the script may not restore any settings when the -BDF option is specified. • Virtual Function devices do not support the -BDF option.

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\DMIX).
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\DMIX).
3. Type the following:

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

Intel® Network Adapters WMI Provider

Overview

The Intel® Network Adapters Windows Management Instrumentation (WMI) Provider enables WMI-based management applications such as Intel® PROSet for Windows Device Manager to monitor and configure the status of PCI network adapters. Intel Network Adapters WMI Provider uses WMI, a user-level instrumentation technology for the Microsoft Windows* platform.

WMI is a middleware layer that allows measurement and instrumentation information to be collected from kernel mode data providers. This information can then be provided to local or remote user-mode data consumers through the use of a common set of interfaces (Web-based Enterprise Management called WBEM). WMI is a data-independent pipeline between the data consumer and the data provider that makes no assumptions about the format of the data.

A guide is available on this distribution, which contains detailed information on the Intel Network Adapters WMI Provider, also referred to as Network Configuration Services (NCS2) WMI Providers. This guide is located in \APPS\WMI\DOCS. The technical reference paper describes the external view of NCS2 WMI providers so WMI-based management applications could use it to manage the network configuration for the Intel adapters.

System Requirements

- Any Intel® PRO/100, Intel® Gigabit Network Adapter, or Intel® 10GbE Network Adapter
- related driver software
- a supported Microsoft* Windows* operating system. Please refer to the System Requirements page for a list of supported operating systems.

The Intel Network Adapters WMI Provider supports all Intel PRO/100, Gigabit, and 10GbE network adapters.

Installation

The Intel Network Adapters WMI Provider are installed as part of Intel® PROSet for Windows Device Manager software installation. See the Installing Intel PROSet for Windows Device Manager section for more information on how to install Intel PROSet for Windows Device Manager.

Intel PROSet for Windows Device Manager **Typical** Setup Type registers the Intel Network Adapters WMI Provider into the root\Intel\NCS2 namespace.

Supported Standards

The Intel Network Adapters WMI Provider supports the standards-based CIM 2.6 specification.

Known Issues

DMI-SNMP Instrumentation

This Intel Network Adapters WMI Provider cannot jointly operate with the Intel® DMI-SNMP instrumentation.

Intel Network Drivers for DOS

The NDIS2 (DOS) driver is provided solely for the purpose of loading other operating systems – for example, during RIS or unattended installations. It is not intended as a high-performance driver.

You can find adapter drivers, PROTOCOL.INI files, and NET.CFG files in the PRO100\DOS or PRO1000\DOS directory on the Product CD or download folder. For additional unattended install information, see the text files in the operating system subdirectories under the APPS\SETUP\PUSH directory.

Automatic or Explicit Configuration of a Single NIC or Multiple NICs

When the driver finds that only one adapter is installed in the system, it will use that adapter regardless of whether or not parameters in PROTOCOL.INI are present or correct. If the parameters do not match the actual configuration, the driver will display warning messages indicating that the parameter was not used.

One instance of the driver must be loaded for each adapter that is activated. When multiple adapters are installed, the SLOT parameter becomes advisable but not required.

The determination as to which adapter each driver will control should be made by the user based on the protocol stack(s) bound to each driver, and based on the network that is connected to each adapter. The “BINDINGS” list in each protocol stack’s PROTOCOL.INI section establishes the relationship between protocol stacks and drivers. The SLOT parameter in the driver’s PROTOCOL.INI section establishes the relationship between drivers and adapters, and a value can be provided for each driver loaded. If a SLOT parameter is not specified, the first driver instance will load on the first NIC/Port found in the scanning list, the second driver instance will load on the second NIC/Port found in the scanning list, etc. When the driver detects multiple NICs/Ports it will report all of the possible slots. The only way for the driver to know which driver instance is being loaded is to use the DRIVERNAME parameter instance number. Therefore, it is essential that the DRIVERNAME parameter instance syntax defined below be used correctly.

The adapters are automatically configured by the PCI system BIOS when the system boots. The driver queries the PCI BIOS and obtains all of the adapter’s configuration information. BIOS scanning using mechanisms 1 and 2, as defined in the PCI BIOS specification, are supported. The SLOT number is actually the encoded value of the PCI adapter’s device location, which is defined as shown below. The SLOT value reported by the driver and entered by the user is the value of bits 0 through 15. In versions of the driver prior to 2.01, the SLOT value reported by the driver and entered by the user was shifted right by 3 bits (divided by 8) so that SLOT 0x0088 was actually entered into PROTOCOL.INI as 0x0011. This doesn’t allow for multi-function devices to be specified with this SLOT parameter. So starting with v2.01, the driver does not shift the input parameter by 3 bits and SLOT 0x0088 would be entered as 0x0088. This also allows for specifying slot 0x0081 = Bus 0 Device 16 Function 1. If the driver finds that the entered SLOT number is not found in its slot list table, it may be because the SLOT uses the older convention (shifted right). The driver then tries to match this old style slot parameter to a slot in the slot list and loads on that slot if it finds a match. This is done for backward compatibility.

Configuring with the PROTOCOL.INI File

The configuration parameters listed below are supported through the PROTOCOL.INI file. When the machine has a single adapter, all the parameters (except DRIVERNAME) are optional; when the machine has multiple adapters, some of the parameters are required.

DRIVERNAME

This is the only parameter required for all configurations. This parameter is essentially an "instance ID". Each instance of the driver must create a unique instance name, both to satisfy DOS driver requirements, and to make it possible to find the parameters for the instance in the PROTOCOL.INI file.

When the driver initializes, it tries to find previously loaded instances of itself. If none are found, the driver calls itself "E1000\$", and looks for that name in the PROTOCOL.INI file to find its parameters. If one or more instances are found, the driver calls itself "E100x\$", where 'x' is one more than the value used by the most recently loaded instance. So, in this scenario, the second driver calls itself "E1002\$", the third calls itself "E1003\$", and so on; there is no driver called "E1001\$". Up to 10 drivers can be loaded in a single system in this way.

Syntax:	DRIVERNAME = [E1000\$ E1002\$ etc.]
Example:	DRIVERNAME = E1000\$
Default:	None, this is a required parameter.
Normal Behavior:	The driver finds its section in PROTOCOL.INI by matching its instance ID to the value for this parameter.
Possible Errors:	The device driver uses a DOS function to display the name of the driver it is expecting. This function cannot display a '\$' character. For this reason, the user may see a message referring to this value without the '\$'; the user must remember to enter the '\$' character as part of the parameter's value.

SPEEDDUPLEX

The parameter disables Auto-Speed-Detect and causes the adapter to function at the speed indicated. Do not include this parameter if you want your Gigabit adapter to connect at 1000Mbps.

Syntax:	SPEEDDUPLEX = [0 1 2 3]
Example:	SPEEDDUPLEX = 2
Default:	Parameter not included in PROTOCOL.INI
Normal Behavior:	0 = 10Mbps half duplex 1 = 10Mbps full duplex 2 = 100Mbps half duplex 3 = 100Mbps full duplex
Possible Errors:	If the SPEEDDUPLEX parameter is set to an invalid value: <ul style="list-style-type: none">• The parameter is ignored and the default (Auto-Speed-Detect) is used• A message indicates a "Parameter value out of range" error

SLOT

This parameter makes it possible for the driver to uniquely identify which of the adapters is to be controlled by the driver. The parameter can be entered in hexadecimal or decimal.

Syntax:	SLOT = [0x0..0x1FFF] SLOT = [0..8191]
Examples:	SLOT = 0x1C SLOT = 28
Default:	The driver will Auto-Configure if possible.
Normal Behavior:	The driver uses the value of the parameter to decide which adapter to control.
Possible Errors:	<p>If only one adapter is installed, and the value does not correctly indicate the adapter slot:</p> <ul style="list-style-type: none"> • A message indicates that the value does not match the actual configuration • The driver finds the adapter and uses it <p>If more than one adapter is installed, and the value does not correctly indicate an adapter slot:</p> <ul style="list-style-type: none"> • A message indicates possible slots to use • The driver loads on the next available slot

NODE

This parameter sets the Individual Address of the adapter, overriding the value read from the EEPROM.

Syntax:	<p>NODE = "12 hexadecimal digits"</p> <ul style="list-style-type: none"> • The value must be exactly 12 hexadecimal digits, enclosed in double quotes. • The value can not be all zeros. • The value can not have the Multicast bit set (LSB of 2nd digit = 1).
Example:	NODE = "00AA00123456"
Default:	Value from EEPROM installed on adapter
Normal Behavior:	The Current Station Address in the NDIS MAC Service-Specific Characteristics (MSSC) table is assigned the value of this parameter. The adapter hardware is programmed to receive frames with the destination address equal to the Current Station Address in the MSSC table. The Permanent Station Address in the MSSC table will be set to reflect the node address read from the adapter's EEPROM.
Possible Errors:	If any of the rules described above are violated, the driver treats this as a fatal error and an error message occurs, indicating the correct rules for forming a proper address.

ADVERTISE

This parameter can be used to restrict the speeds and duplexes advertised to a link partner during auto-negotiation. If AutoNeg = 1, this value is used to determine what speed and duplex combinations are advertised to the link partner. This field is treated as a bit mask.

Syntax:	ADVERTISE = [1 2 4 8 0x20 0x2F]: 0x01 = 10 Half, 0x02 = 10 Full, 0x04 = 100 Half, 0x08 = 100 Full, 0x20 = 1000 Full, 0x2F = all rates
Example:	ADVERTISE = 1
Default:	0x2F (all rates are supported)
Normal Behavior:	By default all speed/duplex combinations are advertised.
Possible Errors:	An error message is displayed if the value given is out of range.

FLOWCONTROL

This parameter, which refers to IEEE 802.3x flow control, helps prevent packets from being dropped and can improve overall network performance. Specifically, the parameter determines what flow control capabilities the adapter advertises to its link partner when auto negotiation occurs. This setting does NOT force flow control to be used. It only affects the advertised capabilities.



NOTES:

- Due to errata in the 82542 silicon, the chip is not able to receive PAUSE frames if the ReportTxEarly parameter is set to 1. Thus, if ReportTxEarly = 1 and the driver is running on an adapter using this silicon (such as the PWLA8490), the driver will modify the FlowControl parameter to disable the ability to receive PAUSE frames.
- If half-duplex is forced or auto-negotiated, the driver will completely disable flow control.

Syntax:	FLOWCONTROL = [0 1 2 3 0xFF]
Example:	FLOWCONTROL = 1
Default:	3
Normal Behavior:	0 = Disabled (No flow control capability) 1 = Receive Pause Frames (can receive and respond to PAUSE frames) 2 = Transmit Pause Frames (can send PAUSE frames) 3 = Both Enabled (can send and receive PAUSE frames) 0xFF = Hardware Default.
Possible Errors:	An error message is displayed if the value given is out of range.

USELASTSLOT

This parameter causes the driver to load on the device in the last slot found in the slot scan. The default behavior of the driver is to load on the first adapter found in the slot scan. This parameter forces the driver to load on the last one found instead.

Syntax:	UseLastSlot = [0 any other value]
Example:	USELASTSLOT = 1
Default:	0
Normal Behavior:	0 = Disabled, any other value = Enabled
Possible Errors:	None

TXLOOPCOUNT

This parameter controls the number of times the transmit routine loops while waiting for a free transmit buffer. This parameter can affect Transmit performance.

Syntax:	TXLOOPCOUNT = <32-bit value>
Example:	TXLOOPCOUNT = 10000
Default:	1000
Normal Behavior:	Default
Possible Errors:	None

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.
 - 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"> • PCI Express v1.0 (or newer) • PCI-X v2.0 • PCI slots are v2.2
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. 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	Make sure your PCI BIOS is current. See PCI / PCI-X / PCI Express Configuration. Check for interrupt conflicts and sharing problems. Make sure the other adapter supports shared interrupts. Also, make sure your operating system supports shared interrupts. Unload all PCI device drivers, then reload all drivers.
Adapter unable to connect to switch at correct speed. Gigabit adapter connects at 100 Mbps and 10 gigabit adapter connects at 1000 Mbps.	<i>This is applicable only to copper-based connections.</i> Make sure the adapter and the link partner are set to auto-negotiate. Verify that you are running the latest operating system revision for your switch and that the switch is compliant with the proper IEEE standard: <ul style="list-style-type: none"> • IEEE 802.3ad-compliant (gigabit over copper) • IEEE 802.3an-compliant (10 gigabit over copper)
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".

Problem	Solution
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> NOTE: 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.
The Fan Fail LED of the 10 Gigabit AT Server Adapter is on (red)	The fan cooling solution is not functioning properly. Contact customer support for further instructions.

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 over-draw 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).

PCI / PCI-X / PCI Express Configuration

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.

- Check to see that the "Plug-and-Play" setting is compatible with the operating system you are using.
- Make sure the slot is enabled.
- Install the adapter in a bus-master slot.
- Configure interrupts for level-triggering, as opposed to edge-triggering.
- 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.

Here are some examples of BIOS parameters:

PCI / PCI-X / PCIe slot #: Slot where the adapter is installed
Master: ENABLED
Slave: ENABLED
Latency timer: 40 - 80
Interrupt: Choose any one of several that the BIOS provides.
Edge-level: Level

The exact wording of the parameters varies with different computers.

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 offloading and multiprocessor threading.

Microsoft* Windows*-Specific Issues

Use the information in this table after you have reviewed [common problems and solutions](#).

Problem	Solution
Event viewer message: A device attached to the system is not functioning	If there is a BIOS setting for "Plug and Play OS", it should be set to "NO" for all versions of Microsoft* Windows*.
After upgrading operating systems, Intel® PROSet is no longer available	If you are upgrading a Microsoft Windows operating system and you have Intel PROSet software installed, it will be deleted in the process. You will need to reinstall Intel PROSet.
Terminal Server support	When using Terminal Server, make sure only one session of Intel PROSet is open at any one time. Simultaneous sessions are not supported in Intel PROSet.
Non-volatile memory integrity check fails	Hardware diagnostics verify the authenticity of the non-volatile memory (NVM), and return a "Pass/Fail" message. If the test fails, contact Intel Customer Support.

Test the Adapter from Microsoft* Windows*

Intel® PROSet allows you to run several diagnostic tests, including:

- **Connection Test:** Tests the adapter's connection to the network. If the adapter connects below its maximum speed, the connection test reports the reason for this lower speed. If the adapter has link but does not have an IP address, the test reports whether the adapter can communicate with the link partner. If the adapter has link and has an IP address, ping tests are performed.
- **Link Test:** Tests the link speed and duplex capabilities of the link partner and reports the optimum settings.
- **Cable Tests:** Provide information about cable properties.
- **Hardware Tests:** Determines if the adapter is functioning properly.

To access these tests, select the adapter in Windows* Device Manager, click the **Link Speed** tab, and click **Diagnostics**. A Diagnostics window displays tabs for each type of test. Click the tab and run the test.

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 management port.
- The tests are being run from a virtual machine.

Test the Adapter from Microsoft* 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.

DOS Troubleshooting

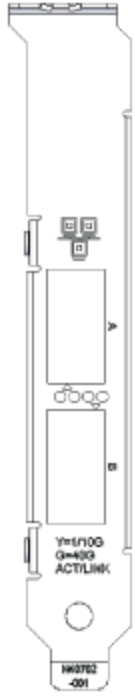
- Make sure you're using the correct and most recent drivers for this adapter.
- If you're replacing an existing adapter, make sure the LINK statement in your NET.CFG is correct for the new adapter.
- Verify that the frame type in your NET.CFG file matches your network.
- Test the adapter by running the DIAGS.EXE diagnostics program. Additional testing is available by using a responder.

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 40Gb
		Yellow	Linked at 1/10Gb
		Blinking On/OFF	Actively transmitting or receiving data
		Off	No link.

Single Port QSFP+ Adapters

The Intel® Ethernet Converged Network Adapter **XL710-Q1** has the following indicator lights:


	Label	Indication	Meaning
	ACT/LNK	Green	Linked at 40Gb
		Yellow	Linked at 1/10Gb
		Blinking On/OFF	Actively transmitting or receiving data
		Off	No link.

The Intel® Ethernet Converged Network Adapter **X520-Q1** has the following indicator lights:

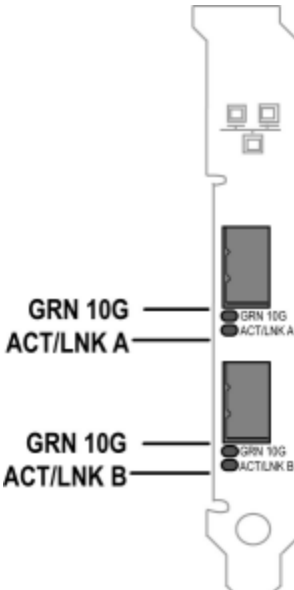
	Label	Indication	Meaning
	ACT/LNK	Green	Linked at 10Gb
		Yellow	Linked at 1Gb
		Blinking On/OFF	Actively transmitting or receiving data
		Off	No link.

Dual Port SFP/SFP+ Adapters

The Intel® Ethernet Converged Network Adapter X710-2 has the following indicator lights:

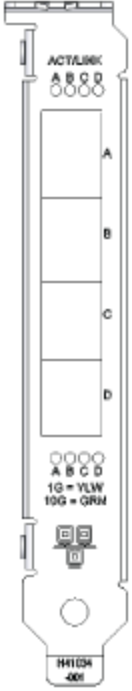
	Label	Indication	Meaning
LNK		Green	Linked at 10Gb
		Yellow	Linked at 1Gb
ACT		Blinking On/OFF	Actively transmitting or receiving data
		Off	No link.

The Intel® 10 Gigabit AF DA Dual Port Server Adapter and Intel® Ethernet Server Adapter X520 series of adapters have the following indicator lights:

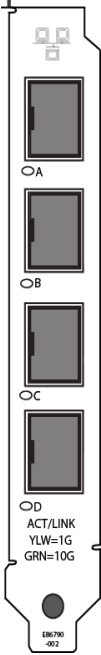
	Label	Indication	Meaning
GRN 10G (A or B): Green		Off	Not linked to the LAN.
		On	Linked to the LAN.
ACT/LNK (A or B): Green		Off	No link.
		Blinking On/OFF	Actively transmitting or receiving data.

Quad Port SFP/SFP+ Adapters

The Intel® Ethernet Converged Network Adapter X710-4 has the following indicator lights:

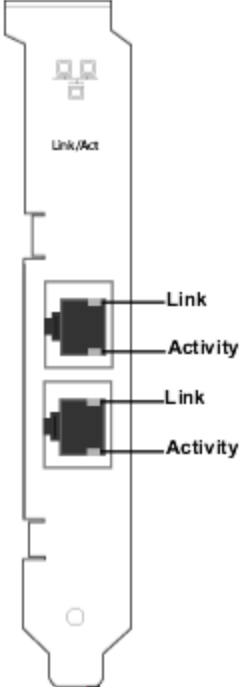
	Label	Indication	Meaning
	LNK	Green	Linked at 10Gb
		Yellow	Linked at 1Gb
	ACT	Blinking On/OFF	Actively transmitting or receiving data
		Off	No link.

The Intel® Ethernet Converged Network Adapter X520-4 has the following indicator lights:

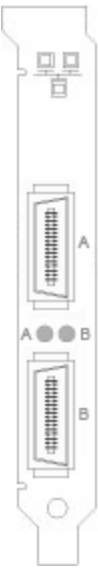
	Label	Indication	Meaning
	ACT/LNK	Green	Linked at 10Gb
		Yellow	Linked at 1Gb
		Blinking On/OFF	Actively transmitting or receiving data
		Off	No link.

Dual Port Copper Adapters

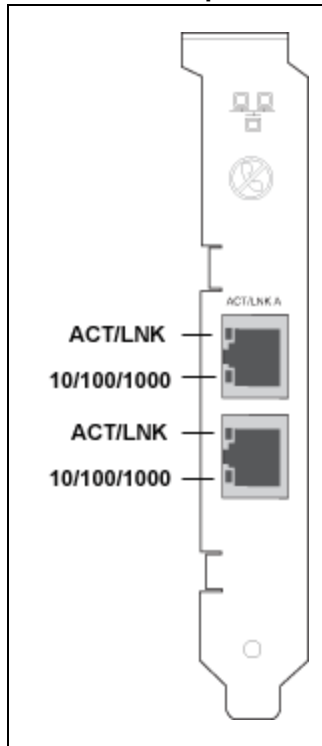
The Intel® Ethernet Server Adapter X520-T2 has the following indicator lights:

	Label	Indication	Meaning
	Link	Off	No link.
		Yellow	Linked at 1 Gb.
		Green	Linked at 10 Gb.
	Activity	Off	No link.
		Blinking On/Off	Actively transmitting or receiving data.

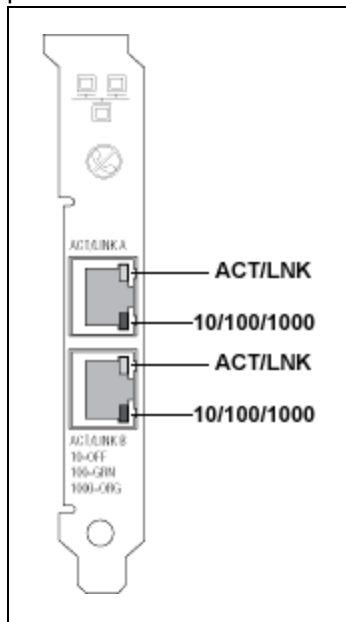
The Intel® 10 Gigabit CX4 Dual Port Server Adapter has the following indicator lights:

	Label	Indication	Meaning
	A or B	On	The adapter is connected to a valid link partner.
		Blinking	Adapter is actively passing traffic. Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.
		Off	No link.

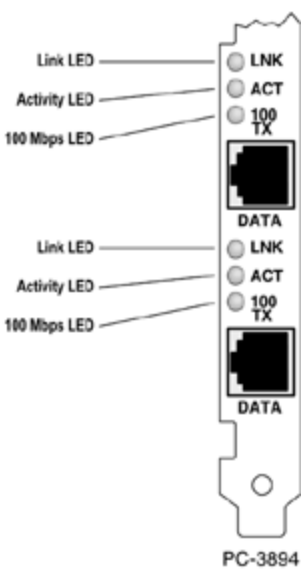
The Intel® Ethernet Server Adapter I350-T2, I340-T2, PRO/1000 P, PT Dual Port, and Gigabit ET Dual Port Server Adapters have the following indicator lights:

	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.

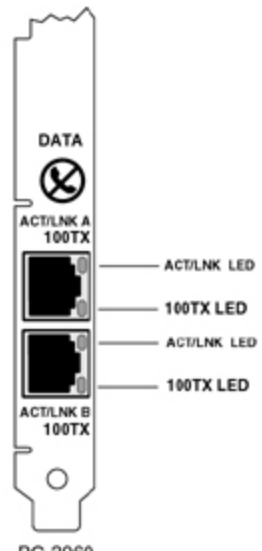
The Intel® PRO/1000 MT and GT Dual Port Server Adapters have the following indicator lights for each port:

	Label	Indication	Meaning
	ACT/LNK	Green on	The port is connected to a valid link partner.
		Green flashing	Data activity
		Off	No link.
	10=OFF 100=GRN 1000=ORG	Yellow flashing	Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.
		Off	10 Mbps
		Green	100 Mbps
		Orange	1000 Mbps

The **PRO/100+ Dual Port Server adapter** (with three LEDs per port) has the following indicator lights:

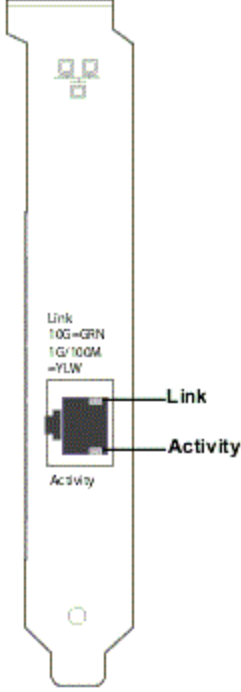
 <p>Link LED — LNK Activity LED — ACT 100 Mbps LED — 100 TX</p> <p>DATA</p> <p>Link LED — LNK Activity LED — ACT 100 Mbps LED — 100 TX</p> <p>DATA</p> <p>PC-3894</p>	Label	Indication	Meaning
	LNK	On	The adapter and switch are receiving power; the cable connection between the switch and adapter is good.
		Off	The adapter and switch are not receiving power; the cable connection between the switch and adapter is faulty; or you have a driver configuration problem.
	ACT	On or flashing	The adapter is sending or receiving network data. The frequency of the flashes varies with the amount of network traffic.
		Off	The adapter is not sending or receiving network data.
	100	On	Operating at 100 Mbps.
		Off	Operating at 10 Mbps.

The Intel® **PRO/100 S Dual Port Server adapter** (with 64 bit PCI Connector) has the following indicator lights:

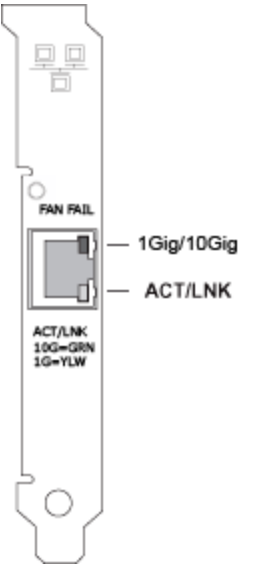
 <p>DATA</p> <p>ACT/LNK A 100TX</p> <p>ACT/LNK LED</p> <p>100TX LED</p> <p>ACT/LNK LED</p> <p>100TX LED</p> <p>ACT/LNK B 100TX</p> <p>PC-3960</p>	Label	Indication	Meaning
	ACT/LNK	On	<p>The adapter and switch are receiving power; the cable connection between the switch and adapter is good.</p> <p>NOTE: if only one port appears to be operating, go into the Network control panel (Windows) or a configuration file for other operating system, and check the status of the second port.</p>
		Off	The adapter and switch are not receiving power, or you have a driver configuration problem.
		Flashing	The adapter is sending or receiving network data. The frequency of the flashes varies with the amount of network traffic.
	100TX	On	Operating at 100 Mbps.
		Off	Operating at 10 Mbps.

Single Port Copper Adapters

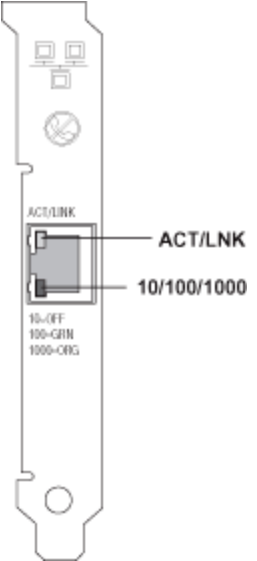
The Intel® Ethernet Converged Network Adapter X540-T1 has the following indicator lights:

	Label	Indication	Meaning
	Link	Off	No link.
		Green	Linked at 10Gb
		Yellow	Linked at 1Gb
	Activity	Off	No link.
		Blinking On/Off	Actively transmitting or receiving data.

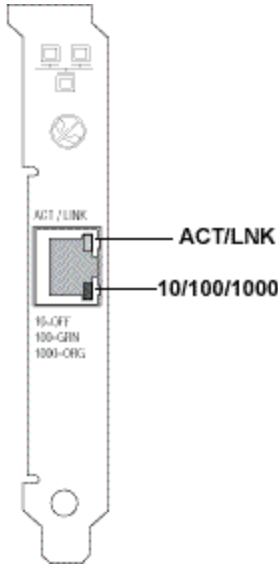
The Intel® 10 Gigabit AT Server Adapter has the following indicator lights:

	Label	Indication	Meaning
	ACT/LNK	Green on	The adapter is connected to a valid link partner.
ACT/LNK	Green blinking	Data activity	
ACT/LNK	Off	No link	
ACT/LNK	Green blinking	Identify. Use the "Identify Adapter" button in Intel PROSet or the BLINK command in IBAUtil to control blinking. See Intel PROSet Help for more information.	
1Gig/10Gig	Off	No link	
1Gig/10Gig	Green	10 Gbps	
1Gig/10Gig	Yellow	1 Gbps	
FAN FAIL	Red	Over temperature event occurred. The adapter will be shut down to avoid damage.	

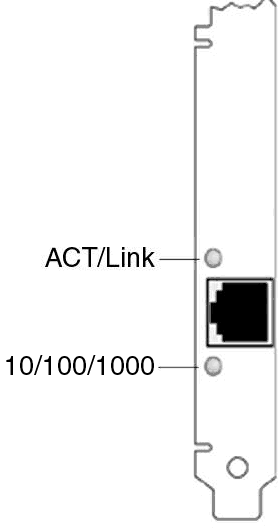
The Intel® PRO/1000 PT Server Adapter has the following indicator lights:

	Label	Indication	Meaning
	ACT/LNK	Green on	The adapter is connected to a valid link partner.
ACT/LNK	Green flashing	Data activity	
ACT/LNK	Off	No link.	
10=OFF	Off	10 Mbps	
100=GRN	Green	100 Mbps	
1000=ORG	Orange	1000 Mbps	
1000=ORG	Orange flashing	Identify. Use the "Identify Adapter" button in Intel® PROSet to control blinking. See Intel PROSet Help for more information.	

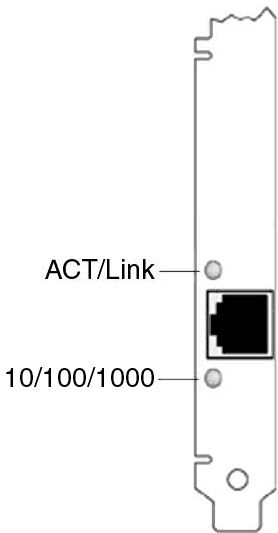
The Intel® **PRO/1000 MT Server Adapter** has the following indicator lights:

	Label	Indication	Meaning
 <p data-bbox="397 472 503 493">ACT/LNK</p> <p data-bbox="397 525 503 546">10/100/1000</p> <p data-bbox="251 577 324 609">10=OFF 100=GRN 1000=ORG</p>	ACT/LNK	Green on	The adapter is connected to a valid link partner.
		Green flashing	Data activity
		Off	No link.
		Yellow flashing	Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.
<p data-bbox="560 682 673 787">10=OFF 100=GRN 1000=ORG</p>		Off	10 Mbps
		Green	100 Mbps
		Orange	1000 Mbps

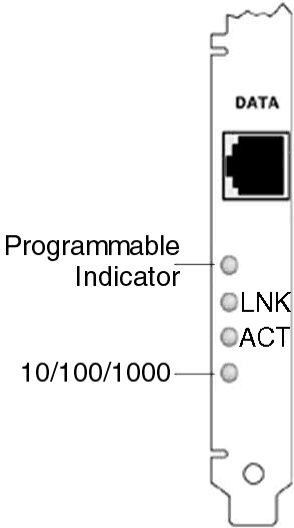
The Intel® **Gigabit CT2, Gigabit CT, PRO/1000 T, and PRO/1000 MT Desktop Adapters** have the following indicator lights:

	Label	Indication	Meaning
 <p data-bbox="276 1239 389 1270">ACT/Link</p> <p data-bbox="235 1344 389 1375">10/100/1000</p>	ACT/LNK	Green on	The adapter is connected to a valid link partner.
		Green flashing	Data activity
		Off	No link.
		Yellow flashing	Identity. Use the "Identify Adapter" button in Intel® PROSet to control blinking. See Intel PROSet Help for more information.
<p data-bbox="560 1438 673 1501">10/100/ 1000</p>		Off	10 Mbps
		Green	100 Mbps
		Yellow	1000 Mbps


The Intel® PRO/1000 XT Server 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.			
Yellow flashing	Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.			
10/100/1000	Off	10 Mbps		
	Green	100 Mbps		
	Yellow	1000 Mbps		

The Intel® PRO/1000 T Server Adapter has the following indicator lights:

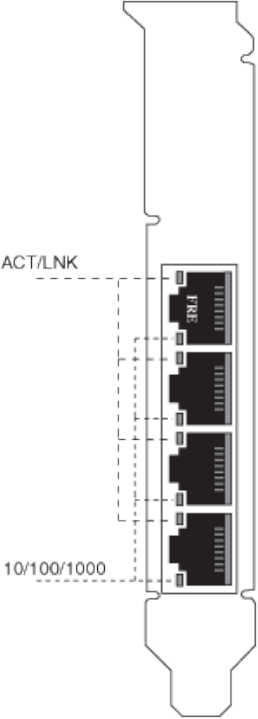
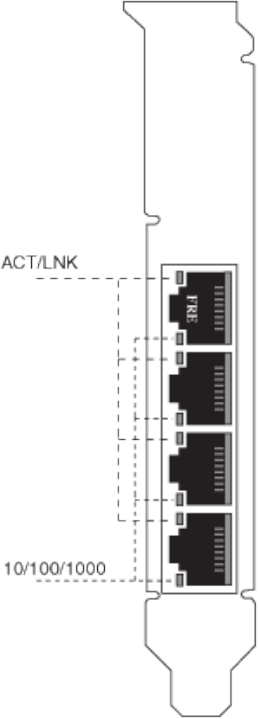
		Label	Indication	Meaning
		<i>not labeled</i>	Flashing	Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.
LNK	On	The adapter is connected to a valid link partner.		
	Off	No link.		
ACT	On	Data is being transmitted or received.		
	Off	No data activity.		
10/100/1000	Off	10 Mbps		
	Green	100 Mbps		
	Yellow	1000 Mbps		

The Intel® PRO/100+, PRO/100 M, PRO/100 S , and PRO/100 VE and VM Desktop adapters and Network Connections have the following indicator lights:

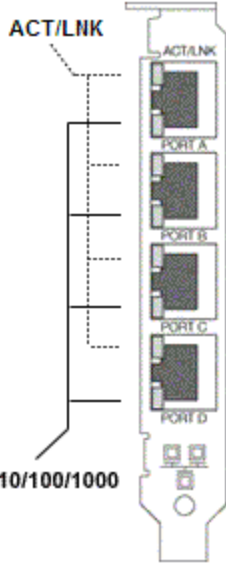
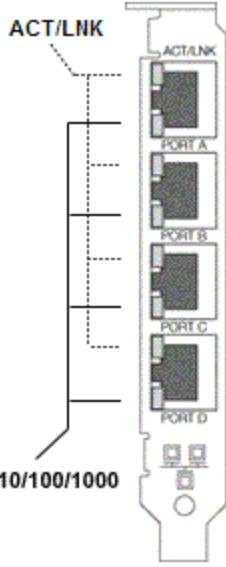
	Label	Indication	Meaning
	ACT/LNK	On	The adapter and switch are receiving power; the cable connection between the switch and adapter is good.
		Off	The adapter and switch are not receiving power, or you have a driver configuration problem.
		Flashing	The adapter is sending or receiving network data. The frequency of the flashes varies with the amount of network traffic.
	100TX	On	Operating at 100 Mbps.
		Off	Operating at 10 Mbps.

Quad Port Copper Adapters

The Intel® Ethernet Server Adapter I350-T4, I340-T4, Gigabit ET and PRO/1000 PT Quad Port LP Server Adapters have the following indicator lights:

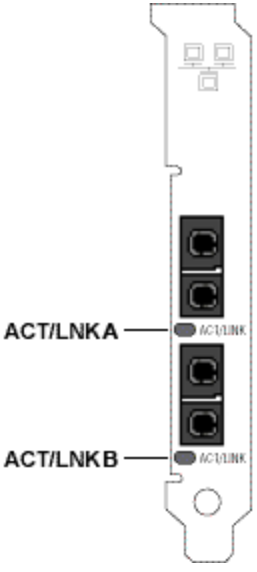
	Label	Indication	Meaning
	ACT/LNK	Green on	The adapter is connected to a valid link partner.
		Green flashing	Data activity
		Off	No link.
	10/100/ 1000	Off	10 Mbps
		Green	100 Mbps
		Yellow	1000 Mbps
		Orange flashing	Identity. Use the "Identify Adapter" button in Intel® PROSet to control blinking. See Intel PROSet Help for more information.

The Intel® PRO/1000 MT, GT and PT Quad Port Server Adapters have the following indicator lights for each port:

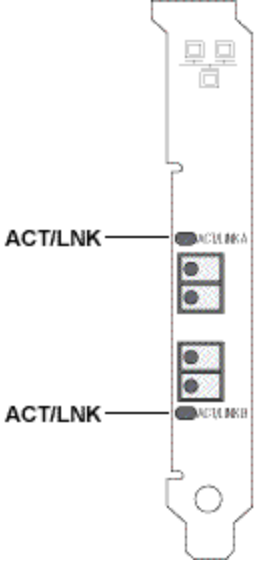
	Label	Indication	Meaning
	Top LED ACT/LNK	Green on	The port is connected to a valid link partner.
		Green flashing	Data activity
		Off	No link.
		Orange flashing	Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.
	Bottom LED 10/100/ 1000	Off	10 Mbps
		Green	100 Mbps
		Orange	1000 Mbps

Dual Port Fiber Adapters

The Intel® 10 Gigabit XF SR Dual Port Server Adapters has the following indicator lights:

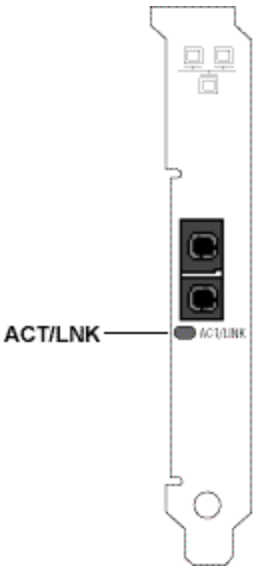
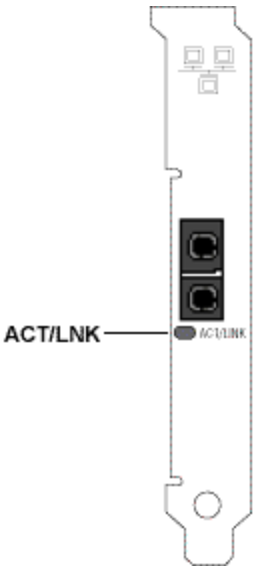
	Label	Indication	Meaning	
	ACT/LNK		On	The adapter is connected to a valid link partner.
			Blinking	Adapter is actively passing traffic. Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.
			Off	No link.

The Intel® PRO/1000 MF, PF, and Gigabit EF Dual Port Server Adapters have the following indicator lights for each port:

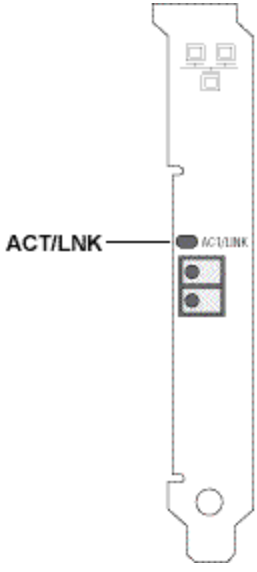
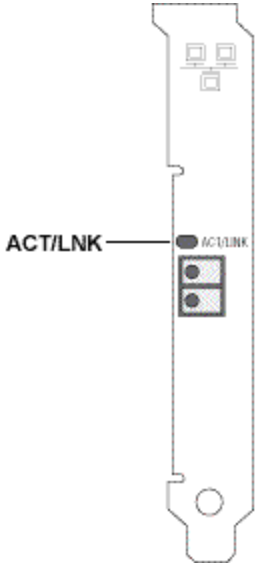
	Label	Indication	Meaning	
	ACT/LNK		On	The adapter is connected to a valid link partner.
			Blinking	Adapter is actively passing traffic. Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.
			Off	No link.

Single Port Fiber Adapters

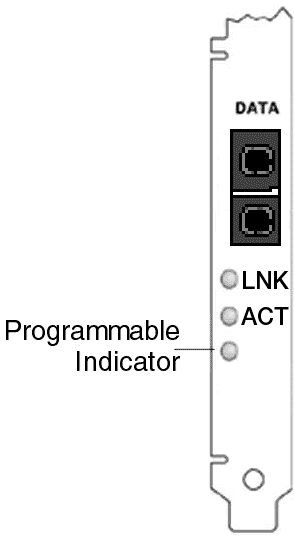
The Intel® 10 Gigabit XF SR and LR Server Adapters has the following indicator lights:

	Label	Indication	Meaning
	ACT/LNK	On	The adapter is connected to a valid link partner.
		Blinking	Adapter is actively passing traffic. Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.
		Off	No link.

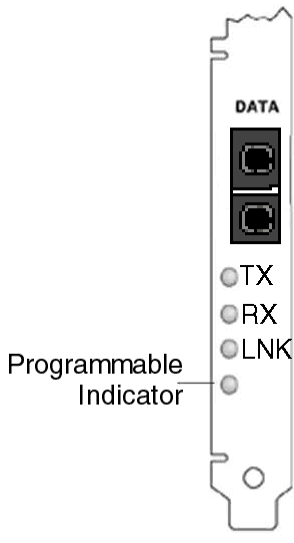
The Intel® PRO/1000 MF and PF Server Adapters have the following indicator lights:

	Label	Indication	Meaning
	ACT/LNK	On	The adapter is connected to a valid link partner.
		Blinking	Adapter is actively passing traffic. Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.
		Off	No link.

The Intel® PRO/1000 XF Server Adapter has the following indicator lights:

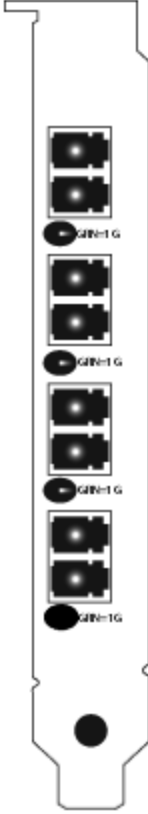
		Label	Indication	Meaning
		LNK	On	The adapter is connected to a valid link partner.
Off	No link.			
ACT	On	Data is being transmitted or received.		
	Off	No data activity.		
<i>not labeled</i>	Flashing	Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.		

The Intel® PRO/1000F Server adapter has the following indicator lights:

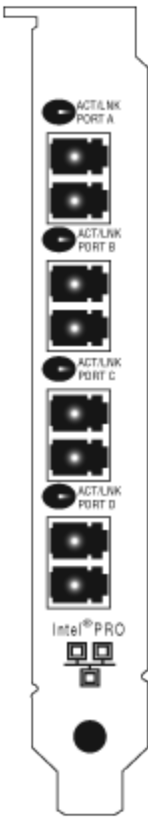
		Label	Indication	Meaning
		TX	On	The adapter is sending data.
RX	On	The adapter is receiving data.		
LNK	On	The adapter is connected to a valid link partner and is receiving link pulses.		
	Off	No link.		
<i>not labeled</i>	Flashing	Identity. Use the "Identify Adapter" button in Intel PROSet to control blinking. See Intel PROSet Help for more information.		

Quad Port Fiber Adapters

The Intel® Ethernet Server Adapter I340-F4 has the following indicator lights:

	Label	Indication	Meaning
	GRN=1G	Green on	The adapter is connected to a valid link partner.
		Green flashing	Data activity
		Off	No link.

The Intel® PRO/1000 PF Quad Port Server 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.

Regulatory Compliance Statements

FCC Class A Products

- Intel® Ethernet I/O Module XL710-Q1
- Intel® Ethernet I/O Module XL710-Q2
- Intel® Ethernet OCP Server Adapter X520-1
- Intel® Ethernet OCP Server Adapter X520-2
- Intel® Ethernet Server Bypass Adapter X540-T2
- Intel® Ethernet Converged Network Adapter X540-T1
- Intel® Ethernet Server Bypass Adapter X520-SR2
- Intel® Ethernet Converged Network Adapter X540-T2
- Intel® Ethernet Server Adapter X520-T2
- Intel® Ethernet X520 10GbE Dual Port KX4 Mezz
- Intel® 10 Gigabit AT2 Server Adapter
- Intel® 10 Gigabit SR Dual Port Express Module
- Intel® 10 Gigabit AT Server Adapter
- Intel® Gigabit ET Quad Port Mezzanine Card
- Intel® PRO/1000 MT Quad Port Server Adapter

FCC Class B Products

- Intel® Ethernet Converged Network Adapter X710-2
- Intel® Ethernet Converged Network Adapter X710-4
- Intel® Ethernet Converged Network Adapter XL710-Q1
- Intel® Ethernet Converged Network Adapter XL710-Q2
- Intel® Ethernet Server Adapter X520-1
- Intel® Ethernet Server Adapter X520-2
- Intel® Ethernet SFP+ LR Optics RMN FTLX1471
- Intel® Ethernet Converged Network Adapter X520-4
- Intel® Ethernet Converged Network Adapter X520-Q1
- Intel® 10 Gigabit AF DA Dual Port Server Adapter
- Intel® 10 Gigabit CX4 Dual Port Server Adapter
- Intel® 10 Gigabit XF SR Dual Port Server Adapter
- Intel® 10 Gigabit XF SR Server Adapter
- Intel® 10 Gigabit XF LR Server Adapter
- Intel® Ethernet Server Adapter I340-T2
- Intel® Ethernet Server Adapter I340-T4
- Intel® Ethernet Server Adapter I350-T2
- Intel® Ethernet Server Adapter I350-T4
- Intel® Ethernet Server Adapter I210-T1

- Intel® Ethernet Server Adapter I340-F4
- Intel® Gigabit ET Dual Port Server Adapter
- Intel® Gigabit ET Quad Port Server Adapter
- Intel® Gigabit EF Dual Port Server Adapter
- Intel® Gigabit CT Desktop Adapter
- Intel® PRO/1000 MT Server Adapter
- Intel® PRO/1000 MT Dual Port Server Adapter
- Intel® PRO/1000 GT Dual Port Server Adapter
- Intel® PRO/1000 PT Server Adapter
- Intel® PRO/1000 PT Dual Port Server Adapter
- Intel® PRO/1000 GT Quad Port Server Adapter
- Intel® PRO/1000 PT Quad Port Server Adapter
- Intel® PRO/1000 PT Quad Port LP Server Adapter
- Intel® PRO/1000 GT Desktop Adapter
- Intel® PRO/1000 PT Desktop Adapter
- Intel® PRO/1000 MF Server Adapter
- Intel® PRO/1000 MF Dual Port Server Adapter
- Intel® PRO/1000 PF Server Adapter
- Intel® PRO/1000 PF Dual Port Server Adapter
- Intel® PRO/1000 PF Quad Port Server Adapter
- Intel® PRO/100 M Desktop Adapter
- Intel® PRO/100 S Desktop Adapter
- Intel® PRO/100 S Server Adapter
- Intel® PRO/100 S Dual Port Server 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)
- NRRA No. 2012-13 (2012.06.28), NRRA 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
- NRRA No. 2012-13 (2012.06.28), NRRA 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

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V C C I - A

BSMI Class A Statement

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KCC Notice Class A (Republic of Korea Only)

<p>A급 기기 (업무용 방송통신기기)</p> <p>CLASS A device (commercial broadcasting and communication equipment)</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)

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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)

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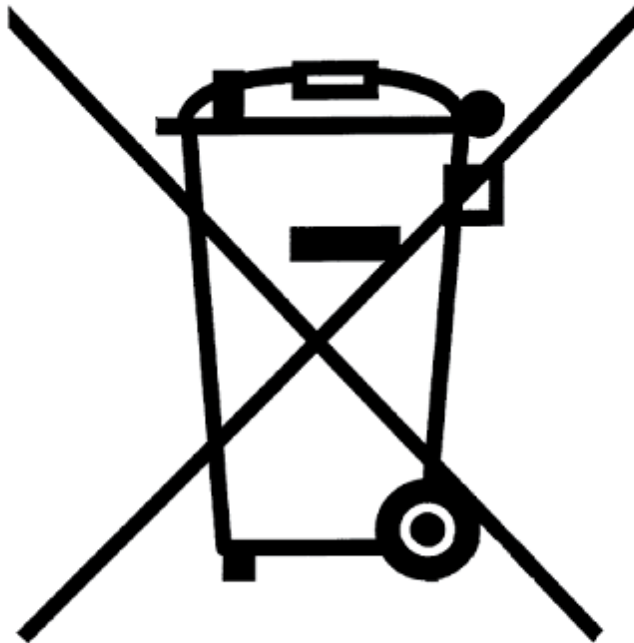
取扱説明書に従って正しい取り扱いをして下さい。

VCCI-B

KCC Notice Class B (Republic of Korea Only)

<p>B급 기기 (가정용 방송통신기기)</p> <p>CLASS B device 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.

Pessi 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.

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Returning a defective product

From North America:

Before returning any adapter product, contact Intel Customer Support and obtain a Return Material Authorization (RMA) number by calling +1 916-377-7000.

If the Customer Support Group verifies that the adapter product is defective, they will have the RMA department issue you an RMA number to place on the outer package of the adapter product. Intel cannot accept any product without an RMA number on the package.

All other locations:

Return the adapter product to the place of purchase for a refund or replacement.

Intel Adapter Money-back Guarantee (North America Only)

Intel wants you to be completely satisfied with the Intel adapter product that you have purchased. Any time within ninety (90) days of purchase, you may return your Intel adapter to the original place of purchase for a full refund of the purchase price from your dealer. Resellers and distributors, respectively, accepting returns and refunding money back to their customers may return Intel adapters to their original place of purchase. Intel guarantees that it will accept returns under this policy and refund the original purchase price to customers purchasing directly from Intel.

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Customer Support

Intel support is available on the web or by phone. Support offers the most up-to-date information about Intel products, including installation instructions, troubleshooting tips, and general product information.

Web and Internet Sites

Support: <http://www.intel.com/support>

Corporate Site for Network Products: <http://www.intel.com/products/ethernet/overview.htm>