

Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF

User's Guide



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Using This Documentation

This guide provides hardware and software installation instructions for the Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF (multi-mode fiber), from Oracle. The instructions are meant for enterprise system administrators who have experience installing network hardware and software.

Note – In this document, the term “x86” refers to 64-bit and 32-bit systems manufactured using processors compatible with the AMD64, Intel Xeon, or Intel Pentium product families.

- “Product Notes” on page viii
- “Related Documentation” on page viii
- “Feedback” on page viii
- “Support and Accessibility” on page ix

Product Notes

For late-breaking information and known issues about this product, refer to the product notes at:

http://www.oracle.com/pls/topic/lookup?ctx=SDP_GbE-PCIE2.0-LP_MMF

Related Documentation

Documentation	Links
All Oracle products	http://www.oracle.com/documentation
Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF	http://www.oracle.com/pls/topic/lookup?ctx=SDP_GbE-PCIE2.0-LP_MMF
Oracle Solaris 10 OS	http://docs.oracle.com/cd/E23823_01/index.html
Oracle Solaris 11 OS	http://docs.oracle.com/cd/E23824_01/index.html
Oracle Solaris OS and systems software library	http://www.oracle.com/technetwork/indexes/documentation/index.html#sys_sw

Feedback

Provide feedback on this documentation at:

<http://www.oracle.com/goto/docfeedback>

Support and Accessibility

Description	Links
Access electronic support through My Oracle Support	http://support.oracle.com For hearing impaired: http://www.oracle.com/accessibility/support.html
Learn about Oracle's commitment to accessibility	http://www.oracle.com/us/corporate/accessibility/index.html

Understanding the Installation Process

These topics provide an overview of the installation process for the Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF:

- [“Installation Overview \(Oracle Solaris 10\)” on page 2](#)
- [“Installation Overview \(Oracle Solaris 11\)” on page 3](#)
- [“Installation Overview \(Linux\)” on page 4](#)
- [“Installation Overview \(Windows\)” on page 5](#)

Related Information

- [“Understanding the Adapter” on page 7](#)
- [“Installing the Driver” on page 17](#)
- [“Installing the Adapter” on page 23](#)
- [“Configuring the Network” on page 29](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 39](#)
- [“Configuring Link Aggregation” on page 47](#)
- [“Configuring VLANs” on page 53](#)
- [“Troubleshooting the Adapter” on page 63](#)

Installation Overview (Oracle Solaris 10)

Follow these steps to install the adapter on an Oracle Solaris 10 platform.

Step	Description	Links
1.	Understand the adapter.	“Understanding the Adapter” on page 7
2.	Verify the driver installation.	“Verify the Driver Version (Oracle Solaris 10)” on page 18
3.	Install the adapter.	“Install the Adapter” on page 23
4.	Verify the adapter installation.	“Verify the Installation (Oracle SPARC)” on page 25 “Verify the Installation (Oracle Solaris x86)” on page 27
5.	Configure the network.	“Create Driver Instance Files (Oracle Solaris 10)” on page 30 “Configure the Network Host Files (Oracle Solaris 10)” on page 30
6.	Configure the driver parameters.	“Driver Parameters (Oracle Solaris OS)” on page 40 “Set Driver Parameters (Oracle Solaris OS)” on page 41
7.	(Optional) Boot over the network.	“Boot Over the Network (PXE)” on page 32 “Boot Over a GbE Network (Oracle Solaris x86 and Linux)” on page 32
8.	(Optional) Install the OS over the network.	“Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 34
9.	(Optional) Configure jumbo frames.	“Change the MTU Permanently” on page 44
10.	(Optional) Configure link aggregation.	“Link Aggregation Overview” on page 48 “Configure Link Aggregations (Oracle Solaris 10)” on page 48 “Display Information About Link Aggregations (Oracle Solaris 10)” on page 49 “Delete Link Aggregations (Oracle Solaris 10)” on page 50
11.	(Optional) Configure VLANs.	“VLAN Overview” on page 54 “VLAN Configuration” on page 57 “Configure Static VLANs (Oracle Solaris 10)” on page 58

Installation Overview (Oracle Solaris 11)

The installation, configuration, and administration of software packages, driver parameters, and network layers have changed in the Oracle Solaris 11 OS. The instructions for these procedures are in the Oracle Solaris 11 documentation, located here:

http://docs.oracle.com/cd/E23824_01/index.html

Follow these steps to install the adapter on an Oracle Solaris 11 platform.

Step	Description	Links
1.	Understand the adapter.	“Understanding the Adapter” on page 7
2.	Verify the driver installation.	“Verify the Driver Version (Oracle Solaris 11)” on page 19
3.	Install the adapter.	“Install the Adapter” on page 23
4.	Verify the adapter installation.	Refer to <i>Adding and Updating Oracle Solaris 11 Software Packages</i> .
5.	Configure the network.	Refer to <i>Creating and Administering Oracle Solaris 11 Boot Environments</i> .
6.	Configure the driver parameters.	“Administering Driver Parameters and Jumbo Frames” on page 39
7.	(Optional) Boot over the network.	Refer to <i>Creating and Administering Oracle Solaris 11 Boot Environments</i> .
8.	(Optional) Install the OS over the network.	Refer to <i>Adding and Updating Oracle Solaris 11 Software Packages</i> .
9.	(Optional) Configure jumbo frames.	“Configuring Jumbo Frames (Oracle Solaris OS)” on page 44
10.	(Optional) Configure link aggregation.	“Link Aggregation Overview” on page 48 Refer to <i>Oracle Solaris Administration: Network Interfaces and Network Virtualization</i> .
11.	(Optional) Configure VLANs.	“VLAN Overview” on page 54 “VLAN Configuration” on page 57 Refer to <i>Oracle Solaris Administration: Network Interfaces and Network Virtualization</i> .

Installation Overview (Linux)

Follow these steps to install the adapter on a Linux platform.

Step	Description	Links
1.	Understand the adapter.	“Understanding the Adapter” on page 7
2.	Install the driver.	“Download and Install the Driver (Linux)” on page 20
3.	Install the adapter.	“Install the Adapter” on page 23
4.	Verify the adapter installation.	“Verify the Installation (Linux)” on page 28
5.	Boot over the network.	“Boot Over a GbE Network (Oracle Solaris x86 and Linux)” on page 32 “Boot Over the Network (PXE)” on page 32
6.	Configure the driver parameters.	“Driver Parameters (Linux)” on page 42 “Set Driver Parameters (Linux)” on page 43
7.	(Optional) Configure jumbo frames.	“Configure Jumbo Frames (Linux)” on page 46
8.	(Optional) Configure VLANs.	“VLAN Overview” on page 54 “VLAN Configuration” on page 57 “Configure VLANs (Linux)” on page 59

Installation Overview (Windows)

Follow these steps to install the adapter on a Windows platform.

Step	Description	Links
1.	Understand the adapter.	“Understanding the Adapter” on page 7
2.	Install the driver.	“Download and Install the Driver (Windows)” on page 22
3.	Install the adapter.	“Install the Adapter” on page 23
4.	Verify the adapter installation.	“Verify the Installation (Windows)” on page 28
5.	(Optional) Configure VLANs.	“VLAN Overview” on page 54 “VLAN Configuration” on page 57 “Configure VLANs (Windows)” on page 60

Understanding the Adapter

These topics provide an overview of the Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF.

Description	Links
Understand the adapter.	“Shipping Kit Contents” on page 8 “Product Description” on page 8 “Front Panel Connectors and LEDs” on page 11 “Physical Characteristics” on page 13 “Performance Specifications” on page 14 “Power and Environmental Requirements” on page 14
Understand the hardware and software requirements.	For lists of the supported platforms, operating systems, and applications, go here: http://www.oracle.com/us/products/servers-storage/networking/ethernet/index.html
Understand the maintenance requirements.	“OS Patches and Updates” on page 15

Related Information

- [“Installing the Driver” on page 17](#)
- [“Installing the Adapter” on page 23](#)
- [“Configuring the Network” on page 29](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 39](#)
- [“Configuring Link Aggregation” on page 47](#)
- [“Configuring VLANs” on page 53](#)
- [“Troubleshooting the Adapter” on page 63](#)

Shipping Kit Contents

The carton in which your Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF, was shipped should contain the following items:

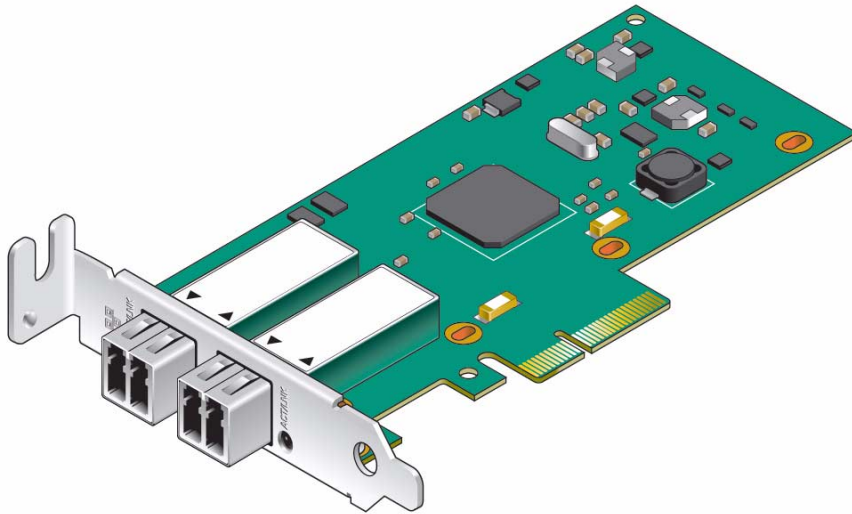
- Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF, with a low-profile bracket attached
- Standard height bracket, screws, and washer
- *Sun Network Interface Card Products Getting Started Guide*

Related Information

- [“Product Description” on page 8](#)
- [“Front Panel Connectors and LEDs” on page 11](#)
- [“Physical Characteristics” on page 13](#)
- [“Performance Specifications” on page 14](#)
- [“Power and Environmental Requirements” on page 14](#)
- [“OS Patches and Updates” on page 15](#)

Product Description

The Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF, is a 1-GbE NIC for PCIe systems. The adapter offers a high density multi-port design for Sun racks and blade servers. This adapter addresses the multi-port network connectivity needs of data center environments. The adapter is ideal for slot-constrained servers, providing a simplified low-cost alternative to multiple 1-GbE server adapters for Oracle’s Sun portfolio of SPARC and x86 servers.



For the current list of product features, platform and software support, and data sheets, go to the Sun Quad Port GbE PCIe 2.0 Gigabit Ethernet Networking Cards website:

<http://www.oracle.com/us/products/servers-storage/networking/ethernet/index.html>

Related Information

- “Shipping Kit Contents” on page 8
- “Configuration Options” on page 10
- “Front Panel Connectors and LEDs” on page 11
- “Physical Characteristics” on page 13
- “Performance Specifications” on page 14
- “Power and Environmental Requirements” on page 14
- “OS Patches and Updates” on page 15

Configuration Options

You can use these networking cards in various server system configurations, such as:

- Rackmounted or pedestal servers
- Blade servers
- Add-on NIC or LAN-on-Motherboard (LOM) design
- Switch add-on cards and network applications

The following block diagram shows various network configuration options available with the Sun Quad Port GbE PCIe 2.0 Gigabit Ethernet Networking Cards.

FIGURE: NIC Example Configuration Options

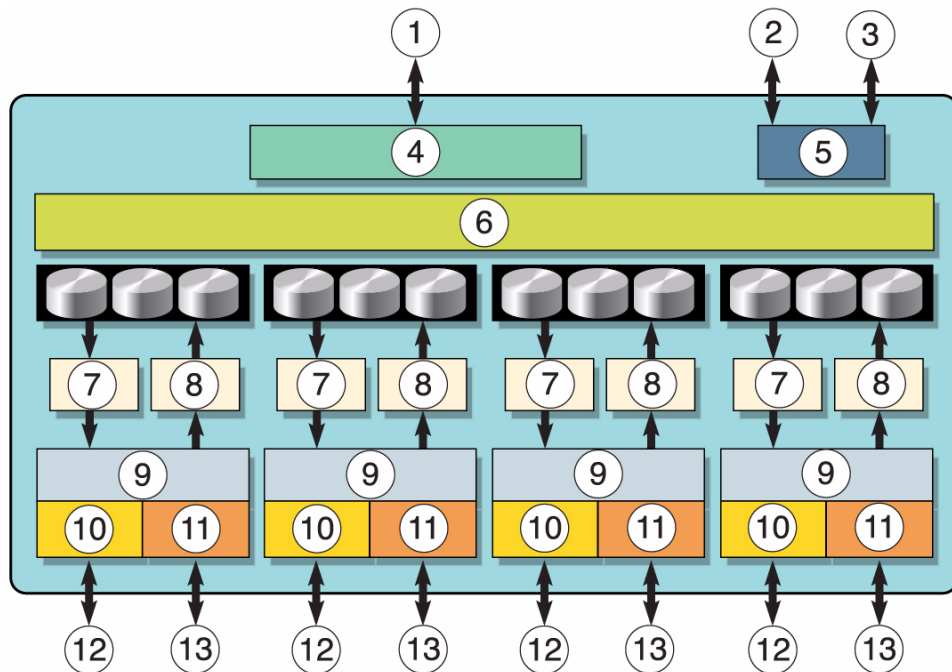


Figure Legend

1	PCIe 2.0 (5 Gb/s)	8	RX FIFO
2	NC-SI	9	GbE MAC
3	SMBus	10	SerDes
4	PCIe	11	PHY

Figure Legend *(Continued)*

5	Management	12	SerDes/SGMII
6	Queue management and DMA	13	1000BASE-T
7	TX FIFO		

Related Information

- [“Shipping Kit Contents” on page 8](#)
- [“Front Panel Connectors and LEDs” on page 11](#)
- [“Physical Characteristics” on page 13](#)
- [“Performance Specifications” on page 14](#)
- [“Power and Environmental Requirements” on page 14](#)
- [“OS Patches and Updates” on page 15](#)

Front Panel Connectors and LEDs

The front panel contains two ports with one port-status LED assigned to each port, labeled [ACT/LNK](#).

FIGURE: Front Face of the Adapter

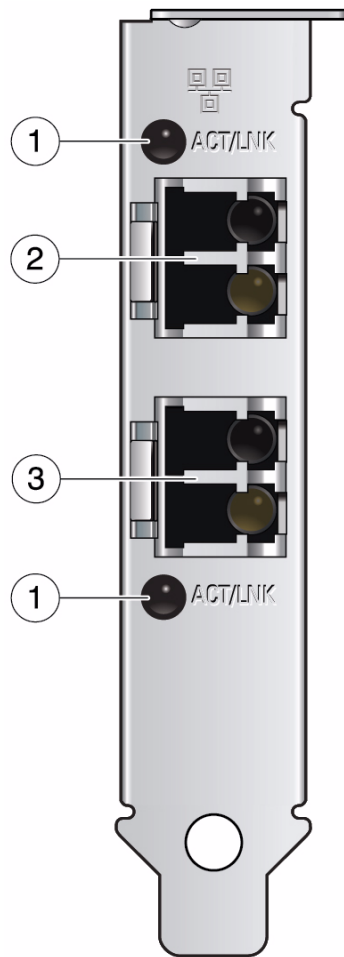


Figure Legend

1	ACT/LNK (activity/link) LED
2	Port 0
3	Port 1

LED	Color	State	Meaning
ACT/LNK	None	Off	Link is down.

LED	Color	State	Meaning
	Green	Blinking	Activity is occurring on the link.
	Green	Steady on	Link is up.

Related Information

- [“Install the Adapter” on page 23](#)
- [“Shipping Kit Contents” on page 8](#)
- [“Product Description” on page 8](#)
- [“Configuration Options” on page 10](#)
- [“Performance Specifications” on page 14](#)
- [“Power and Environmental Requirements” on page 14](#)
- [“OS Patches and Updates” on page 15](#)

Physical Characteristics

Dimension	Measurement
Length	13.54 cm (5.3 in.)
Height	6.89 cm (2.71 in.)

Related Information

- [“Shipping Kit Contents” on page 8](#)
- [“Product Description” on page 8](#)
- [“Configuration Options” on page 10](#)
- [“Front Panel Connectors and LEDs” on page 11](#)
- [“Performance Specifications” on page 14](#)
- [“Power and Environmental Requirements” on page 14](#)
- [“OS Patches and Updates” on page 15](#)

Performance Specifications

Feature	Specification
Data rate supported per port	1 Gbps (1000 Mbps)
Bus type	PCIe V2.0, 5.0 GTps
Bus width	x4 lane PCIe
Conforms to Ethernet standard	802.3
Boot ROM	4 Mb (512 KB) SPI Flash
EMI	FCC Class A

Related Information

- [“Shipping Kit Contents” on page 8](#)
- [“Product Description” on page 8](#)
- [“Configuration Options” on page 10](#)
- [“Front Panel Connectors and LEDs” on page 11](#)
- [“Power and Environmental Requirements” on page 14](#)
- [“OS Patches and Updates” on page 15](#)

Power and Environmental Requirements

Specification	Operation	Storage
Typical power consumption	4.4W (1.17A at 12V)	
Main host power supply	12V ± 15%	
Temperature	-5°C to 55°C (-5°F to 131°F)	-40°C to 70°C (-40°F to 158°F), noncondensing
Humidity	10% to 90% noncondensing relative humidity at 27°C (80.6°F) maximum wet bulb	93% noncondensing relative humidity at 38°C (100.4°F) maximum wet bulb

Specification	Operation	Storage
Altitude	3,302 meters (10,833.3 feet) at 35°C (95°F) ambient	12,000 meters (39,370.1 feet)
Vibration	0.20G in all axes (5-500 Hz sine)	1.0G in all axes (5-500 Hz sine)
Shock	5G (11 ms half-sine)	30G (11 ms half-sine)
Airflow	100 LFM at 50°C (122°F)	

Related Information

- “Shipping Kit Contents” on page 8
- “Product Description” on page 8
- “Configuration Options” on page 10
- “Front Panel Connectors and LEDs” on page 11
- “Physical Characteristics” on page 13
- “Performance Specifications” on page 14
- “OS Patches and Updates” on page 15

OS Patches and Updates

Before you patch the current OS due to version differences, you should update the entire OS image, if possible, on both the client system and the server system. If you cannot update the entire OS image, download the latest patch that contains the software driver from:

<http://support.oracle.com/>

To find the latest patch associated with the Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF, go to Patches & Updates and search on bug number 7157617.

For additional information, check the product web page at:

<http://www.oracle.com/us/products/servers-storage/networking/ethernet/sun-quad-port-pcie-20-gigabit>

Related Information

- “Shipping Kit Contents” on page 8
- “Product Description” on page 8

- “Configuration Options” on page 10
- “Front Panel Connectors and LEDs” on page 11
- “Physical Characteristics” on page 13
- “Performance Specifications” on page 14
- “Power and Environmental Requirements” on page 14

Installing the Driver

The SUNW`igb` software package comes bundled in the Oracle Solaris software. These topics explain how to verify the `igb(7D)` device driver on an Oracle x86 or Oracle SPARC system that uses the Oracle Solaris OS. The topics also explain how to download and install the `igb(7D)` driver on Linux and Windows systems.

Note – Oracle Solaris 10 8/11 and Oracle Solaris 11 are the first releases to support the Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF. You can upgrade to or install either one of these releases, but the version of the driver must be the same on both the client system and the server system.

Description	Links
Verify or remove the driver on an Oracle Solaris platform.	“Verify the Driver Version (Oracle Solaris 10)” on page 18 “Verify the Driver Version (Oracle Solaris 11)” on page 19 “Remove the Driver (Oracle Solaris OS)” on page 19
Download, install, or remove the driver on a Linux platform.	“Download and Install the Driver (Linux)” on page 20 “Remove the Driver (Linux)” on page 21
Download, install, or remove the driver on a Windows platform.	“Download and Install the Driver (Windows)” on page 22 “Remove the Driver (Windows)” on page 22

Related Information

- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the Adapter” on page 7](#)
- [“Installing the Adapter” on page 23](#)
- [“Configuring the Network” on page 29](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 39](#)
- [“Configuring Link Aggregation” on page 47](#)
- [“Configuring VLANs” on page 53](#)
- [“Troubleshooting the Adapter” on page 63](#)

▼ Verify the Driver Version (Oracle Solaris 10)

Oracle Solaris 10 8/11 is the first release of Oracle Solaris 10 to support the Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF. Depending on your version of Oracle Solaris 10, you might or might not need to download the updated driver.

1. Check the version of the installed driver.

```
# modinfo | grep igb
162 7b210000 1e0b8 100      1      igb (Intel 1Gb Ethernet 1.1.24)
```

If the version number is not 1.1.24 or later, you must install the latest driver, or you can reinstall the OS. See [“OS Patches and Updates” on page 15](#).

Note – If the `igb(7D)` driver is not listed, the driver might not be loaded. You can use the `modload(1M)` command to load the driver if needed.

2. Manually load the module.

```
# modload /kernel/drv/arch/igb
```

where *arch* is `amd64` for 64-bit Intel systems or `sparcv9` for Oracle SPARC systems.

Related Information

- [“Verify the Driver Version \(Oracle Solaris 11\)” on page 19](#)
- [“Remove the Driver \(Oracle Solaris OS\)” on page 19](#)

▼ Verify the Driver Version (Oracle Solaris 11)

1. Check the version of the installed driver.

```
# strings /kernel/drv/arch/igb | grep igb
...
igb 2.2.2
```

If the version number is not 2.2.2 or later, you must install the latest driver, or you can reinstall the OS. See [“OS Patches and Updates” on page 15](#).

Note – If the `igb(7D)` driver is not listed, the driver might not be loaded. You can use the `modload(1M)` command to load the driver if needed.

2. Manually load the module.

```
# modload /kernel/drv/arch/igb
```

where *arch* is `amd64` for 64-bit Intel systems or `sparcv9` for Oracle SPARC systems.

Related Information

- [“Verify the Driver Version \(Oracle Solaris 10\)” on page 18](#)
- [“Remove the Driver \(Oracle Solaris OS\)” on page 19](#)

▼ Remove the Driver (Oracle Solaris OS)

It is not necessary to remove a driver when its associated device is removed from a system. However, if you want to clean up your file systems or conserve space, you can easily remove a driver.

- Remove the driver.

```
# pkgrm SUNWigb*
```

See the `pkgrm(1M)` man page for more information.

Related Information

- “Verify the Driver Version (Oracle Solaris 10)” on page 18
- “Verify the Driver Version (Oracle Solaris 11)” on page 19

▼ Download and Install the Driver (Linux)

If your system uses the Red Hat or [SUSE](#) Linux operating system, you must download the `igb` device driver to install it.

1. Log in to your system.
2. In a browser, go to this location:
<http://support.intel.com/support/network/adapter/>
3. Select I350-F2 from the list of adapters.
4. Download the driver package, and follow the instructions on how to install the driver software.

Note – The primary driver link is a buildable source archive that works with Linux 2.6.x kernels only and requires that the currently running kernel match the [SRC RPM](#) kernel files and headers in order to build the driver. See the bundled `README` file in the unpacked archive from Intel for more information.

5. Load the `igb(7D)` driver.

```
# modprobe igb
```

6. Verify that the `igb(7D)` driver has been successfully installed.

```
# lsmod | grep igb
```

The output should be similar to the following:

```
igb                118052  0
```

7. Check the `igb` driver version.

```
# modinfo igb | grep ver
```

For example, in the output, the version should be similar to the following:

```
version:           3.0.6-k2
```

Related Information

- [“Remove the Driver \(Linux\)” on page 21](#)

▼ Remove the Driver (Linux)

It is not necessary to remove a driver when its associated device is removed from a system. However, if you want to clean up your file systems or conserve space, you can easily remove a driver.

- Use the `rmmod` command.

```
# rmmod igb
```

Related Information

- [“Download and Install the Driver \(Linux\)” on page 20](#)

▼ Download and Install the Driver (Windows)

If your system uses the Windows Server 2003 or 2008 operating system, perform the following procedure to download and install the device driver.

1. **Log in to your system.**
2. **In a browser, go to this location:**
<http://support.intel.com/support/network/adapter/>
3. **Select I350-F2 from the list of adapters.**
4. **Download the driver package.**
5. **Follow the instructions in the installation wizard.**
6. **If the Found New Hardware Wizard screen is displayed, click Cancel.**
The autorun utility automatically runs after you have extracted the files.

Related Information

- [“Remove the Driver \(Windows\)” on page 22](#)

▼ Remove the Driver (Windows)

It is not necessary to remove a driver when its associated device is removed from a system. However, if you want to clean up your file systems or conserve space, you can easily remove a driver.

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

Related Information

- [“Download and Install the Driver \(Windows\)” on page 22](#)

Installing the Adapter

These topics describe how to install the adapter.

Description	Links
Understand the connectors.	“Front Panel Connectors and LEDs” on page 11
Install the adapter.	“Install the Adapter” on page 23
Verify the adapter installation.	“Verify the Installation (Oracle SPARC)” on page 25 “Verify the Installation (Oracle Solaris x86)” on page 27 “Verify the Installation (Linux)” on page 28 “Verify the Installation (Windows)” on page 28

Related Information

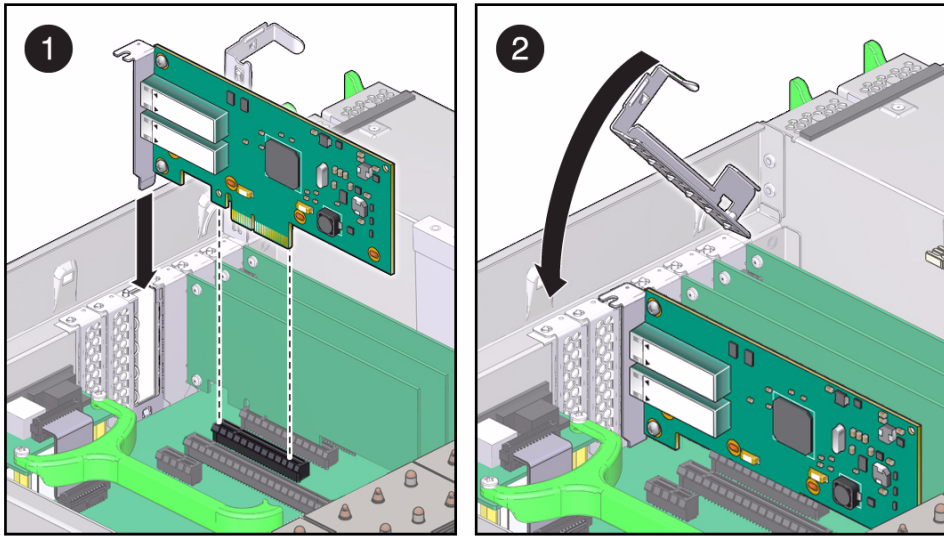
- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the Adapter” on page 7](#)
- [“Installing the Driver” on page 17](#)
- [“Configuring the Network” on page 29](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 39](#)
- [“Configuring Link Aggregation” on page 47](#)
- [“Configuring VLANs” on page 53](#)
- [“Troubleshooting the Adapter” on page 63](#)

▼ Install the Adapter

The following instructions describe the basic tasks required to install the adapter. Refer to your system installation or service manual for specific PCIe installation instructions.

1. **Halt and power off your system.**

2. Power off all of the peripherals connected to your system.
3. Open the system unit.
4. Attach an antistatic wrist strap to the chassis of the server.
5. Remove the slot cover from the chassis.
6. Holding the adapter by the edges, align the adapter edge connector with the PCIe slot.



7. Slide the adapter face plate into the small slot at the end of the PCIe opening.
8. Applying even pressure at both corners of the adapter, push the adapter until it is firmly seated in the slot.



Caution – Do not use excessive force when installing the adapter into the PCIe slot. You might damage the adapter's PCIe connector. If the adapter does not seat properly when you apply even pressure, remove the adapter, and carefully reinstall it.

9. Detach the wrist strap and close the system unit.
10. Connect the cables to the ports.
11. Power on the system.

Related Information

- “Verify the Installation (Oracle SPARC)” on page 25
- “Verify the Installation (Oracle Solaris x86)” on page 27
- “Verify the Installation (Linux)” on page 28
- “Verify the Installation (Windows)” on page 28

▼ Verify the Installation (Oracle SPARC)

Note – Verification is not required if your system supports [DR](#).

1. Power on the system.
2. When the banner appears, press the Stop-A key sequence to interrupt the boot process and display the OpenBoot (ok) prompt.
3. List the network devices on your system.

```
ok show-nets
a) /niu@480/network@0
b) /pci@400/pci@2/pci@0/pci@c/network@0,3
c) /pci@400/pci@2/pci@0/pci@c/network@0,2
d) /pci@400/pci@2/pci@0/pci@c/network@0,1
e) /pci@400/pci@2/pci@0/pci@c/network@0
f) /pci@400/pci@2/pci@0/pci@a/network@0,1
g) /pci@400/pci@2/pci@0/pci@a/network@0
q) NO SELECTION
Enter Selection, q to quit: q
```

Note – Checking the `.properties` output for each device is the surest way to identify the device.

4. Check the `.properties` output for each device.

The following examples assume that

`/pci@400/pci@2/pci@0/pci@a/network@0,1` is a port on the adapter.

- a. Move to the device directory.

```
ok cd /pci@400/pci@2/pci@0/pci@a/network@0,1
```

b. Display properties for the device.

```
ok .properties
```

The output should be similar to the following:

```
ok .properties
assigned-addresses      82030010 00000000 00100000 00000000 00100000
                        8203001c 00000000 00200000 00000000 00004000
                        82030030 00000000 00200000 00000000 00080000
local-mac-address       a0 36 9f 02 30 f6
version                 Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF
                        FCode version 3.11 1/25/12
phy-type                pcs
reg                     00030000 00000000 00000000 00000000 00000000
                        02030010 00000000 00000000 00000000 00100000
                        0203001c 00000000 00000000 00000000 00004000
                        02030030 00000000 00000000 00000000 00080000
board-model             7014747
model                  SUNW,pcie-igb
compatible              pciex8086,1522.108e.7b19.1
                        pciex8086,1522.108e.7b19
                        pciex8086,1522.1
                        pciex8086,1522
                        pciexclass,020000
                        pciexclass,0200
address-bits            00000030
max-frame-size          00002400
network-interface-type  ethernet
device_type            network
name                   network
fcode-rom-offset        00000000
interrupts              00000001
cache-line-size         00000010
class-code              00020000
subsystem-id            00007b19
subsystem-vendor-id     0000108e
revision-id             00000001
device-id               00001522
vendor-id               00008086
```

If you do not see the device listed, check that the adapter is properly seated. If necessary, reinstall the adapter (see [“Install the Adapter” on page 23](#)).

c. Type the following when you finish looking at the .properties values.

```
ok device-end
```

Related Information

- [“Install the Adapter” on page 23](#)
- [“Verify the Installation \(Oracle Solaris x86\)” on page 27](#)

▼ Verify the Installation (Oracle Solaris x86)

1. Power on the associated server, and boot the server, if needed.
2. Check the driver version.

```
# modinfo|grep igb
162 7b762000 1e0b8 100 1 igb (Intel 1Gb Ethernet 1.1.24)
```

If the version number is not 1.1.24 or newer, you must install the latest driver patch or reinstall the OS. See [“OS Patches and Updates” on page 15](#).

3. Check to see if the adapter is properly installed and recognized by the OS.

```
# grep igb /etc/path_to_inst
```

If the adapter is properly installed, you should see output similar to the following:

```
# grep igb /etc/path_to_inst
"/pci@0,0/pci8086,3c0a@3,2/pci108e,7b19@0" 0 "igb"
"/pci@0,0/pci8086,3c0a@3,2/pci108e,7b19@0,1" 1 "igb"
```

Related Information

- [“Install the Adapter” on page 23](#)
- [“Verify the Installation \(Oracle SPARC\)” on page 25](#)

▼ Verify the Installation (Linux)

- Verify the new network interface instances corresponding to the adapter.

```
# ifconfig -a | grep eth
eth3   Link encap:Ethernet  HWaddr 00:1B:21:17:67:B0
eth4   Link encap:Ethernet  HWaddr 00:1B:21:17:67:9B
```

Related Information

- [“Install the Adapter” on page 23](#)

▼ Verify the Installation (Windows)

1. Click Control Panel.
2. Click Network Connection.
If the driver is installed correctly, the Ethernet adapter interfaces labeled as “Intel(R) I350 Gigabit Quad Port Network Connection” will be displayed at the Network Connection window screen.
3. In the Administration Tool, click Computer Management, Device Manager, and Network Adapter.
4. Check the driver version.
The minimum Windows Server 2003 and 2008 driver version is 14.3.

Related Information

- [“Install the Adapter” on page 23](#)

Configuring the Network

These topics describe how to configure the network in Oracle Solaris 10 OS.

Description	Links
Configure the network for an Oracle Solaris system.	“Create Driver Instance Files (Oracle Solaris 10)” on page 30 “Configure the Network Host Files (Oracle Solaris 10)” on page 30
Boot over the network.	“Boot Options” on page 31 “Boot Over the Network (PXE)” on page 32 “Boot Over a GbE Network (Oracle Solaris x86 and Linux)” on page 32
Install the Oracle Solaris OS over the network.	“Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 34

Related Information

- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the Adapter” on page 7](#)
- [“Installing the Driver” on page 17](#)
- [“Installing the Adapter” on page 23](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 39](#)
- [“Configuring Link Aggregation” on page 47](#)
- [“Configuring VLANs” on page 53](#)
- [“Troubleshooting the Adapter” on page 63](#)

▼ Create Driver Instance Files (Oracle Solaris 10)

Use this procedure to configure the network host files permanently. The new settings will be restored at each reboot.

1. **Create a file named `/etc/hostname.igb#` for each `igb(7D)` interface.**
where # is the interface's instance number. In the new files, only insert a text hostname, then save and exit.
2. **Edit the `/etc/hosts` file to include an IP address and host name for each `igb(7D)` interface (that is, for each `/etc/hostname.igb#` file).**
3. **Boot Oracle Solaris 10.**

Now the `igb(7D)` interfaces will be plumbed up automatically when you boot.

Related Information

- [“Configure the Network Host Files \(Oracle Solaris 10\)” on page 30](#)
- [“Boot Options” on page 31](#)
- [“Boot Over the Network \(PXE\)” on page 32](#)
- [“Boot Over a GbE Network \(Oracle Solaris x86 and Linux\)” on page 32](#)
- [“Install Oracle Solaris 10 Over a Network \(Oracle SPARC\)” on page 34](#)

▼ Configure the Network Host Files (Oracle Solaris 10)

Use this procedure to configure the network host files dynamically on the command line. At reboot, the settings will revert.

1. **Create a file named `/etc/hostname.igb#` for each `igb(7D)` interface.**

where # is the `igb(7D)` interface instance number you plan to use.

For example, to bring up `igb0` at boot, create a file called `/etc/hostname.igb0`, where 0 is the number of the `igb(7D)` interface. If the instance number were 1, the file name would be `/etc/hostname.igb1`. The `/etc/hostname.igb#` file must contain the host name for the appropriate `igb(7D)` interface.

2. Get the `igb(7D)` instances.

```
# dladm show-dev
```

The output should include lines similar to the following:

igb0	link: up	speed: 1000	Mbps duplex: full
igb1	link: up	speed: 1000	Mbps duplex: full

3. Use the `ifconfig(1M)` command to set up the `igb(7D)` interfaces.

Your `ifconfig` command might look similar to the following:

```
# ifconfig igb0 plumb ip-address netmask 255.255.255.0 broadcast + up
```

Related Information

- [“Create Driver Instance Files \(Oracle Solaris 10\)” on page 30](#)
- [“Boot Options” on page 31](#)
- [“Boot Over the Network \(PXE\)” on page 32](#)
- [“Boot Over a GbE Network \(Oracle Solaris x86 and Linux\)” on page 32](#)
- [“Install Oracle Solaris 10 Over a Network \(Oracle SPARC\)” on page 34](#)

Boot Options

The adapter supports several boot options:

- [UEFI](#) with PXE with option ROM (x86/x64)
- UEFI with iSCSI with option ROM (x86/x64)
- OpenBoot PROM (`bootp`) with PF (Oracle SPARC systems supporting LDOMs)

The *Oracle Solaris Advanced Installation Guide* includes more information about boot options and describes how to create a boot server.

Related Information

- [“Create Driver Instance Files \(Oracle Solaris 10\)” on page 30](#)
- [“Configure the Network Host Files \(Oracle Solaris 10\)” on page 30](#)
- [“Boot Over the Network \(PXE\)” on page 32](#)
- [“Boot Over a GbE Network \(Oracle Solaris x86 and Linux\)” on page 32](#)

- “Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 34

▼ Boot Over the Network (PXE)

PXE network boot is an environment to boot computers using a network interface independently of available data storage devices (such as hard disks) or installed operating systems. No boot media is required on the client system. With PXE, you can install an x86-based client over the network by using [DHCP](#).

- **Boot over the network using PXE.**

Refer to the booting with PXE instructions in the *Oracle Solaris 10 Installation Guide: Network-Based Installations* for more information at:

http://docs.oracle.com/cd/E23823_01/index.html

Related Information

- “Create Driver Instance Files (Oracle Solaris 10)” on page 30
- “Configure the Network Host Files (Oracle Solaris 10)” on page 30
- “Boot Options” on page 31
- “Boot Over a GbE Network (Oracle Solaris x86 and Linux)” on page 32
- “Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 34

▼ Boot Over a GbE Network (Oracle Solaris x86 and Linux)

1. **Obtain the MAC address of the first adapter port by checking the label of the adapter.**

For the adapter, the MAC address on the label is for the first port. The second port’s MAC address is the MAC address from the label, plus 1.

2. **Set up the PXE boot server with the MAC addresses.**
3. **Plug the Ethernet cable into the adapter’s port.**
4. **Power on the system.**
5. **Press the F2 key or the Control-E keys to go to the [BIOS](#) menu.**

6. Go to the Boot - Boot Device Priority screen and ensure that the boot order of the network devices is higher than the hard drive.

7. Press the F10 key to save the boot configuration changes and exit BIOS.

The system should reboot after saving the boot configuration.

8. On Oracle platforms, press the F12 key to install the OS from the network.

If the cable is connected to the correct port, you should see the MAC address that you assigned to your PXE server displayed by BIOS. If your platform does not support the F12 key, you might need to boot from the BIOS.

```
Intel(R) Boot Agent GE v1.3.31
Copyright (C) 1997-2009, Intel Corporation

Initializing and establishing link...

*****
*                               *
*       Please select boot device:       *
*                               *
*****
* HDD:P1-SEAGATE ST95001NSSUN500G 111      *
* PXE:Slot1.F0:IBA XE Slot 0700 v2193      *
* PXE:Slot1.F1:IBA XE Slot 0701 v2193      *
* PXE:Slot0.F0:IBA XE Slot 0D00 v2193      *
* PXE:Slot0.F1:IBA XE Slot 0D01 v2193      *
* PXE:IBA GE Slot 1F00 v1331               *
* PXE:IBA GE Slot 1F01 v1331               *
*                                           *
*                                           *
*                                           *
*****
* * and * to move selection                *
* ENTER to select boot device              *
* ESC to boot using defaults               *
*****

Intel(R) Boot Agent XE v2.1.93
Copyright (C) 1997-2011, Intel Corporation

CLIENT MAC ADDR: A0 36 9F 02 37 A4  GUID: FF200008 FFFF FFFF FFFF
CE8C75282100
CLIENT IP: 10.134.155.174  MASK: 255.255.255.0  DHCP IP:
10.134.155.4
```

9. Install the `igb(7D)` driver, and configure the adapter.

10. After the OS installation completes, use the BIOS to change the boot device priority to Boot from Hard Disk to boot up the newly installed OS.

Unless the boot device priority is changed, the OS installation process will repeat.

Related Information

- “Create Driver Instance Files (Oracle Solaris 10)” on page 30
- “Configure the Network Host Files (Oracle Solaris 10)” on page 30
- “Boot Options” on page 31
- “Boot Over the Network (PXE)” on page 32
- “Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 34

▼ Install Oracle Solaris 10 Over a Network (Oracle SPARC)

The *Oracle Solaris 10 8/11 Installation Guide: Network-Based Installations* describes the full procedure for installing Oracle Solaris 10 over the network.

1. Prepare an installation server and a client system for installing Oracle Solaris 10 over the network.

- a. Create an installation server that contains the image of the Oracle Solaris 10 CD.

- b. Set up the client system to be installed over the network.

The *Oracle Solaris 10 8/11 Installation Guide: Network-Based Installations* describes how to create the installation server and set up the client systems

Note – To install the client system over a network that is not part of the same subnet, you must also create a boot server. The *Oracle Solaris Advanced Installation Guide* describes how to create a boot server.

2. On the client system, shut down and halt the system to get to the OpenBoot (ok) prompt.

```
# shutdown -i0 -g0 -y. . .  
(shutdown command messages omitted)  
. . .  
ok
```

3. At the `ok` prompt, display the device paths.

You should see the full paths for all of the network interfaces, including four ports for the adapter, similar to this example.

```
ok show-nets
a) /niu@480/network@0
b) /pci@400/pci@2/pci@0/pci@c/network@0,3
c) /pci@400/pci@2/pci@0/pci@c/network@0,2
d) /pci@400/pci@2/pci@0/pci@c/network@0,1
e) /pci@400/pci@2/pci@0/pci@c/network@0
f) /pci@400/pci@2/pci@0/pci@a/network@0,1
g) /pci@400/pci@2/pci@0/pci@a/network@0
q) NO SELECTION
Enter Selection, q to quit: q
```

4. Check the `.properties` output for each device.

Note – Checking the `.properties` output for each device is the surest way to identify the adapter device.

The following examples assume that
`/pci@400/pci@2/pci@0/pci@a/network@0,1` is a port on the adapter.

a. Move to the device directory.

```
ok cd /pci@400/pci@2/pci@0/pci@a/network@0,1
```

b. Display the properties for the device.

```
ok .properties
```

The output should be similar to the following:

```
ok .properties
assigned-addresses      82050010 00000000 00500000 00000000 00100000
                        81050018 00000000 00001000 00000000 00000020
                        8205001c 00000000 00380000 00000000 00004000
local-mac-address       a0 36 9f 02 33 cc
version                 Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF
                        Fcode 3.11 2/16/12
phy-type                pcs
reg                     00050000 00000000 00000000 00000000 00000000
                        02050010 00000000 00000000 00000000 00100000
                        0205001c 00000000 00000000 00000000 00004000
                        02050030 00000000 00000000 00000000 00080000
board-model             7014763
model                   SUNW,pcie-igb
compatible               pciex8086,1522.108e.7b19.1
                        pciex8086,1522.108e.7b19
                        pciex8086,1522.1
                        pciex8086,1522
                        pciexclass,020000
                        pciexclass,0200
address-bits             00000030
max-frame-size           00002400
network-interface-type   ethernet
device_type             network
name                    network
fcode-rom-offset         00000000
interrupts               00000001
cache-line-size          00000010
class-code               00020000
subsystem-id             00007b19
subsystem-vendor-id      0000108e
revision-id              00000001
device-id                00001522
vendor-id                00008086
```

If you do not see the adapter device listed, check that the adapter is properly seated. If necessary, reinstall the adapter.

c. Type the following when you finish looking at the .properties values.

```
ok device-end
```

5. At the `ok` prompt, boot the client system using the full device path of the 1-GbE device, for example:

```
ok boot /pci@400/pci@2/pci@0/pci@a/network@0,1
```

The boot takes about several minutes to complete. Then, you should see a menu for continuing to install the Oracle Solaris 10 OS.

6. Proceed with Oracle Solaris 10 installation.

Refer to the *Oracle Solaris 10 8/11 Installation Guide: Network-Based Installations* for more information about installing Oracle Solaris 10 over the network.

7. Install the adapter software on the client system, if necessary.

The software installed in [Step 5](#) is required to boot the client system over the 1-GbE interface. You now must install the software in order for the operating system to use the client's 1-GbE interfaces in normal operation.

Before installing the `SUNWigb` driver, ensure that the client system does not already have the driver installed.

```
# pkginfo | grep SUNWigb*
```

- If the software is installed, this command will return the package name you typed in. In that case, skip to [Step 8](#).
- If the software is not installed, install the software from the download center at: <http://support.oracle.com>

8. Confirm that the network host files have been configured correctly during the Oracle Solaris 10 installation.

Although the Oracle Solaris 10 software installation creates the client's network configuration files, you might need to edit these files to match your specific networking environment. See "[Configure the Network Host Files \(Oracle Solaris 10\)](#)" on [page 30](#) for more information about editing these files.

9. Display the configuration information for all datalinks or the specified datalink.

By default, the system is configured to have one datalink for each known network device.

```
# dladm show-dev
e1000g0      link: up      speed: 1000   Mbps      duplex: full
e1000g1      link: down    speed: 0      Mbps      duplex: half
igb0         link: up      speed: 1000   Mbps      duplex: full
igb1         link: up      speed: 1000   Mbps      duplex: full
```

Related Information

- [“Create Driver Instance Files \(Oracle Solaris 10\)” on page 30](#)
- [“Configure the Network Host Files \(Oracle Solaris 10\)” on page 30](#)
- [“Boot Options” on page 31](#)
- [“Boot Over the Network \(PXE\)” on page 32](#)
- [“Boot Over a GbE Network \(Oracle Solaris x86 and Linux\)” on page 32](#)

Administering Driver Parameters and Jumbo Frames

The `igb(7D)` device driver controls the adapter's interfaces. You can manually set the `igb(7D)` device driver parameters to customize each device in your system.

These topics describe how to administer driver parameters.

Description	Links
Administrate driver parameters in Oracle Solaris.	"Driver Parameters (Oracle Solaris OS)" on page 40 "Set Driver Parameters (Oracle Solaris OS)" on page 41
Administrate driver parameters in Linux.	"Driver Parameters (Linux)" on page 42 "Set Driver Parameters (Linux)" on page 43
Configure jumbo frames.	"Configuring Jumbo Frames (Oracle Solaris OS)" on page 44 "Configure Jumbo Frames (Linux)" on page 46

Related Information

- ["Understanding the Installation Process" on page 1](#)
- ["Understanding the Adapter" on page 7](#)
- ["Installing the Driver" on page 17](#)
- ["Installing the Adapter" on page 23](#)
- ["Configuring the Network" on page 29](#)
- ["Configuring Link Aggregation" on page 47](#)
- ["Configuring VLANs" on page 53](#)
- ["Troubleshooting the Adapter" on page 63](#)

Driver Parameters (Oracle Solaris OS)

You can configure these parameters on each `igb(7D)` interface

Type	Keyword	Description
Jumbo frames	<code>default_mtu=<i>n</i></code>	Size of the default MTU (payload without the Ethernet header). Allowed values: 60 to 9216 (default = 1500)
Flow control	<code>flow_control</code>	Ethernet flow control. Allowed values: 0 - Disable 1 - Receive only 2 - Transmit only 3 - Receive and transmit (default) 4 - Use NVROM-programmed factory default setting
Transmit queues	<code>tx_queue_number</code>	1 to 8 (default = 1)
Transmit queue size	<code>tx_ring_size</code>	Number of the transmit descriptors per transmit queue. Allowed values: 64 to 4096 (default = 512)
Receive queues	<code>rx_queue_number</code>	1 to 4 (default = 1)
Receive queue size	<code>rx_ring_size</code>	Number of the receive descriptors per receive queue. Allowed values: 64 to 4096 (default = 512)

Related Information

- [“Set Driver Parameters \(Oracle Solaris OS\)” on page 41](#)
- [“Configuring Jumbo Frames \(Oracle Solaris OS\)” on page 44](#)

▼ Set Driver Parameters (Oracle Solaris OS)

1. **Locate the path names and the associated instance numbers in the `/etc/path_to_inst` file.**

For example, on an Oracle SPARC system, you should see output similar to the following:

```
# grep igb /etc/path_to_inst
"/pci@500/pci@2/pci@0/pci@a/network@0" 1 "igb"
"/pci@500/pci@2/pci@0/pci@a/network@0,1" 2 "igb"
```

On an Oracle Solaris x86 system, you should see output similar to the following:

```
# grep igb /etc/path_to_inst
"/pci@0,0/pci8086,3c0a@3,2/pci108e,7b19@0" 0 "igb"
"/pci@0,0/pci8086,3c0a@3,2/pci108e,7b19@0,1" 1 "igb"
```

In the preceding example:

- The first part within the double quotes specifies the hardware node name in the device tree.
- The number not enclosed in quotes is the instance number (shown in bold for emphasis).
- The last part in double quotes is the driver name.

Note – To identify a PCIe device unambiguously in the `igb.conf` file, use the name, parent name, and unit address for the device. In the example, the name is `pci108e,7b19`, the parent is `/pci@0,0/pci8086,3c0a@3,2`, and the unit address is 0. Refer to the `pci(4)` man page for more information about the PCIe device specification.

2. **Set the parameters for the `igb(7D)` devices in the `/kernel/drv/igb.conf` file.**

For example, to set the `flow_control` parameter to 3 for `igb0`:

```
name = "pci108e,7b19"
parent = "/pci@0,0/pci8086,3c0ad@3,2"
unit-address = "0"
flow_control = 3;
```

3. Save the `igb.conf` file.

4. Reboot the system.

Related Information

- [“Driver Parameters \(Oracle Solaris OS\)” on page 40](#)
- [“Configuring Jumbo Frames \(Oracle Solaris OS\)” on page 44](#)

Driver Parameters (Linux)

The following table lists the tunable `igb(7D)` driver parameters for Linux operating systems and describes their function.

Keyword	Valid Range	Default Value	Description
FlowControl	0 to 3 (0=none, 1=RX only, 2=TX only, 3=RX and TX)	Read from the EEPROM. If EEPROM is not detected, default is 3.	This parameter controls the automatic generation (TX) and response (RX) to Ethernet PAUSE frames.
RxDescriptors	64 to 512	512	This value is the number of receive descriptors allocated by the driver. Increasing this value allows the driver to buffer more incoming packets. Each descriptor is 16 bytes. A receive buffer is also allocated for each descriptor and can be either 2048, 4056, 8192, or 16384 bytes, depending on the MTU setting. When the MTU size is 1500 or less, the receive buffer size is 2048 bytes. When the MTU is greater than 1500, the receive buffer size will be either 4056, 8192, or 16384 bytes. The maximum MTU size is 16114.

Keyword	Valid Range	Default Value	Description
RxIntDelay	0 to 65535 (0=off)	72	This value delays the generation of receive interrupts in units of 0.8192 microseconds. Receive interrupt reduction can improve CPU efficiency if properly tuned for specific network traffic. Increasing this value adds extra latency to frame reception and can end up decreasing the throughput of TCP traffic. If the system is reporting dropped receives, this value might be set too high, causing the driver to run out of available receive descriptors.
TxDescriptors	80 to 4096	256	This value is the number of transmit descriptors allocated by the driver. Increasing this value allows the driver to queue more transmits. Each descriptor is 16 bytes.
XsumRX	0 to 1	1	A value of 1 indicates that the driver should enable IP checksum offload for received packets (both UDP and TCP) to the Ethernet adapter hardware.

Related Information

- [“Set Driver Parameters \(Linux\)” on page 43](#)
- [“Configure Jumbo Frames \(Linux\)” on page 46](#)

▼ Set Driver Parameters (Linux)

- Use the `ethtool` utility or the `configtool` utility to set parameters on a Linux platform.

Related Information

- [“Driver Parameters \(Linux\)” on page 42](#)
- [“Configure Jumbo Frames \(Linux\)” on page 46](#)

Configuring Jumbo Frames (Oracle Solaris OS)

Jumbo frames can support up to 9216 MTU. The default value is 1500 MTU. Use the following steps to set the size permanently.

- [“Change the MTU Permanently” on page 44](#)
- [“Change the MTU Temporarily \(Oracle Solaris 10\)” on page 44](#)
- [“Change the MTU Temporarily \(Oracle Solaris 11\)” on page 45](#)

▼ Change the MTU Permanently

1. Add the following line in the `/kernel/drv/igb.conf` file:

```
default_mtu = desired-frame-size
```

The *desired-frame-size* value can range from 60 to 9216.

2. Reboot the server.

Related Information

- [“Driver Parameters \(Oracle Solaris OS\)” on page 40](#)
- [“Set Driver Parameters \(Oracle Solaris OS\)” on page 41](#)
- [“Change the MTU Temporarily \(Oracle Solaris 10\)” on page 44](#)
- [“Change the MTU Temporarily \(Oracle Solaris 11\)” on page 45](#)

▼ Change the MTU Temporarily (Oracle Solaris 10)

- Use the `ifconfig(1M)` command to increase MTUs to allow transmission of jumbo frames.

For example, where the device name is `igb0`, the following command increases MTUs to the maximum:

```
# ifconfig igb0 plumb mtu 9000 up
```

The temporary setting lasts only until the next reboot of the server.

Related Information

- [“Driver Parameters \(Oracle Solaris OS\)” on page 40](#)
- [“Set Driver Parameters \(Oracle Solaris OS\)” on page 41](#)
- [“Change the MTU Permanently” on page 44](#)
- [“Change the MTU Temporarily \(Oracle Solaris 11\)” on page 45](#)

▼ Change the MTU Temporarily (Oracle Solaris 11)

- Use the `dladm(1M)` command to increase MTUs to allow transmission of jumbo frames.

For example, where the device name is `igb0`, the following command increases MTUs to the maximum:

```
# dladm set-linkprop -t -p mtu=9000 igb0
```

The temporary setting lasts only until the next reboot of the server.

Related Information

- [“Driver Parameters \(Oracle Solaris OS\)” on page 40](#)
- [“Set Driver Parameters \(Oracle Solaris OS\)” on page 41](#)
- [“Change the MTU Permanently” on page 44](#)
- [“Change the MTU Temporarily \(Oracle Solaris 10\)” on page 44](#)

▼ Configure Jumbo Frames (Linux)

Jumbo frames can support up to 9216 MTU. The default value is 1500 MTU.

- Use the **`ifconfig(1M)`** command to increase MTUs to allow transmission of jumbo frames.

For example, where the IP address for `eth7` is `192.1.1.200`, the following command increases MTUs to the maximum:

```
# ifconfig eth7 192.1.1.200 mtu 9000 up
```

Related Information

- [“Driver Parameters \(Linux\)” on page 42](#)
- [“Set Driver Parameters \(Linux\)” on page 43](#)

Configuring Link Aggregation

These topics describe how to configure link aggregation in the Oracle Solaris 10 OS. For instructions on how to configure link aggregations in the Oracle Solaris 11 OS, refer to *Oracle Solaris Administration: Network Interfaces and Network Virtualization* in the Oracle Solaris 11 documentation library.

Description	Links
Understand link aggregation.	“Link Aggregation Overview” on page 48
Manage link aggregations in Oracle Solaris.	“Configure Link Aggregations (Oracle Solaris 10)” on page 48 “Display Information About Link Aggregations (Oracle Solaris 10)” on page 49 “Delete Link Aggregations (Oracle Solaris 10)” on page 50

Related Information

- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the Adapter” on page 7](#)
- [“Installing the Driver” on page 17](#)
- [“Installing the Adapter” on page 23](#)
- [“Configuring the Network” on page 29](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 39](#)
- [“Configuring VLANs” on page 53](#)
- [“Troubleshooting the Adapter” on page 63](#)

Link Aggregation Overview

Link aggregation enables one or more network links to be aggregated together to form a link aggregation group. This link aggregation group appears to MAC clients as a regular link. Link aggregation, which is defined by IEEE 802.3ad, provides the following benefits:

- Increased bandwidth
- Linearly incremental bandwidth
- Load sharing
- Automatic configuration
- Rapid configuration and reconfiguration
- Deterministic behavior
- Low risk of duplication or misordering
- Support of existing IEEE 802.3ad MAC clients
- Single port failover

Related Information

- [“Configure Link Aggregations \(Oracle Solaris 10\)” on page 48](#)
- [“Display Information About Link Aggregations \(Oracle Solaris 10\)” on page 49](#)
- [“Delete Link Aggregations \(Oracle Solaris 10\)” on page 50](#)

▼ Configure Link Aggregations (Oracle Solaris 10)

The example in this procedure aggregates sample interfaces `igb0`, `igb1`, `igb2`, and `igb3`. Arbitrary key numbers (1 and 2) are used for each aggregation.

Note – These commands change the contents of the `/etc/aggregation.conf` file.

1. Unplumb the interfaces to be aggregated.

```
# ifconfig igb0 unplumb
# ifconfig igb1 unplumb
# ifconfig igb2 unplumb
# ifconfig igb3 unplumb
```

2. Create a link aggregation group with key 1 containing the first two interfaces, and bring up the link group.

In this example, the `-l active` option turns on [LACP](#) mode:

```
# dladm create-aggr -l active -d igb0 -d igb1 1
# ifconfig aggr1 plumb
# ifconfig aggr1 192.2.2.84 up
```

3. Create a link aggregation group with key 2 containing the other two interfaces, and bring up the link group.

No mode is specified for the link aggregation group in this example:

```
# dladm create-aggr -d igb2 -d igb3 2
# ifconfig aggr2 plumb
# ifconfig aggr2 193.2.2.84 up
```

Related Information

- [“Link Aggregation Overview” on page 48](#)
- [“Display Information About Link Aggregations \(Oracle Solaris 10\)” on page 49](#)
- [“Delete Link Aggregations \(Oracle Solaris 10\)” on page 50](#)

▼ Display Information About Link Aggregations (Oracle Solaris 10)

The `ifconfig(1M)` and `dladm(1M)` commands provide different details about link aggregations, as in the following examples.

- Use the appropriate command to obtain the desired results.
 - Use the `ifconfig(1M)` command to examine the details about a link aggregation.

The following examples display the information about the two link aggregations created in [“Configure Link Aggregations \(Oracle Solaris 10\)”](#) on [page 48](#).

```
# ifconfig aggr1
aggr1: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500 index 32
  inet 192.2.2.84 netmask ffffffff0 broadcast 192.2.2.255
  ether 0:15:17:75:ff:81
# ifconfig aggr2
aggr2: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500 index 33
  inet 193.2.2.84 netmask ffffffff0 broadcast 193.2.2.255
  ether 0:15:17:75:ff:83
```

- Use the `dladm show-aggr` command to show link aggregation status.
- Use the `dladm show-aggr -s` command to show link aggregation statistics.
- Use the `dladm show-aggr -L` command to display LACP-specific information.

Related Information

- [“Link Aggregation Overview”](#) on [page 48](#)
- [“Configure Link Aggregations \(Oracle Solaris 10\)”](#) on [page 48](#)
- [“Delete Link Aggregations \(Oracle Solaris 10\)”](#) on [page 50](#)

▼ Delete Link Aggregations (Oracle Solaris 10)

1. Use the `ifconfig(1M)` command to unplumb each link aggregation you want to delete.

For example:

```
# ifconfig aggr1 unplumb
# ifconfig aggr2 unplumb
```

2. Use the `dladm` command to delete each unwanted link aggregation.

For example:

```
# dladm delete-aggr 1  
# dladm delete-aggr 2
```

Related Information

- [“Link Aggregation Overview” on page 48](#)
- [“Configure Link Aggregations \(Oracle Solaris 10\)” on page 48](#)
- [“Display Information About Link Aggregations \(Oracle Solaris 10\)” on page 49](#)

Configuring VLANs

These topics describe how to configure VLANs in Oracle Solaris 10 OS. For instructions on how to configure VLANs in Oracle Solaris 11 OS, refer to *Oracle Solaris Administration: Network Interfaces and Network Virtualization* in the Oracle Solaris 11 OS documentation library.

Note – If you change any of the VLAN configuration parameters, you must reboot the system before the changes take effect. If you make changes and do not reboot, you might experience configuration problems.

Description	Links
Understand VLANs.	“VLAN Overview” on page 54 “VLAN Configuration” on page 57 “VLAN Naming Format” on page 57
Configure VLANs.	“Configure Static VLANs (Oracle Solaris 10)” on page 58 “Configure VLANs (Linux)” on page 59 “Configure VLANs (Windows)” on page 60

Related Information

- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the Adapter” on page 7](#)
- [“Installing the Driver” on page 17](#)
- [“Installing the Adapter” on page 23](#)
- [“Configuring the Network” on page 29](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 39](#)
- [“Configuring Link Aggregation” on page 47](#)
- [“Troubleshooting the Adapter” on page 63](#)

VLAN Overview

With multiple VLANs on a single port, a server with a single adapter can have a logical presence on multiple IP subnets. By default, you can define 128 VLANs for each VLAN-aware adapter on your server. However, you can increase this number by changing the system parameters.

If your network does not require multiple VLANs, you can use the default configuration, in which case no further configuration is necessary.

VLANs enable you to split your physical LAN into logical subparts, providing an essential tool for increasing the efficiency and flexibility of your network.

VLANs are commonly used to separate groups of network users into manageable broadcast domains, to create logical segmentation of workgroups, and to enforce security policies among each logical segment. Each defined VLAN behaves as its own separate network, with its traffic and broadcasts isolated from the others, increasing the bandwidth efficiency within each logical group.

Although VLANs are commonly used to create individual broadcast domains or separate IP subnets, it can be useful for a server to have a presence on more than one VLAN simultaneously. Several Oracle Sun products support multiple VLANs on a per-port or per-interface basis, allowing very flexible network configurations.

The following figure shows an example network that uses VLANs.

FIGURE: Example VLAN Configuration

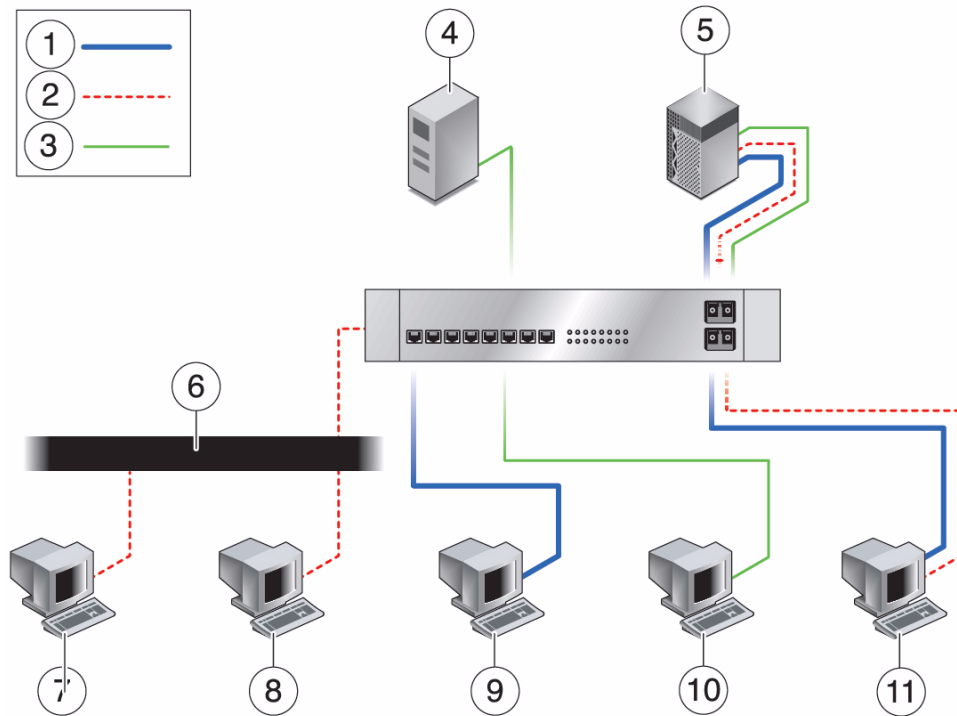


Figure Legend

-
- 1 VLAN 1
 - 2 VLAN 2
 - 3 VLAN 3
 - 4 Accounting server (VLAN 3)
 - 5 Main server with GbE-tagged adapter (all VLANs)
 - 6 Shared media segment
 - 7 PC 1: Software development (VLAN 2)
 - 8 PC 2: Software development (VLAN 2)
 - 9 PC 3: Engineering (VLAN 1)
 - 10 PC 4: Accounting (VLAN 3)
 - 11 PC 5: Software development and engineering with GbE-tagged adapter (VLAN 1 and VLAN 2)
-

The example network has the following features:

The physical LAN network consists of a switch, two servers, and five clients. The LAN is logically organized into three different VLANs, each representing a different IP subnet.

- VLAN 1 is an IP subnet consisting of the Main Server, Client 3, and Client 5. This VLAN represents an engineering group.
- VLAN 2 includes the Main Server, Clients 1 and 2 by means of a shared media segment, and Client 5. This VLAN is a software development group.
- VLAN 3 includes the Main Server, the Accounting Server, and Client 4. This VLAN is an accounting group.

The Main Server is a high-use server that must be accessed from all VLANs and IP subnets. The server has a Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF, installed. All three IP subnets are accessed by means of the single physical Ethernet adapter interface. The server is attached to one of the switch's Gigabit Ethernet ports, which is configured for VLANs 1, 2, and 3. Both the Ethernet adapter and the connected switch port have tagging turned on. Because of the tagging VLAN capabilities of both devices, the server is able to communicate on all three IP subnets in this network, but continues to maintain broadcast separation between all of those subnets. The following list describes the components of this network:

- The Accounting Server is available to only VLAN 3. The Accounting Server is isolated from all traffic on VLANs 1 and 2. The switch port connected to the server has tagging turned off.
- Clients 1 and 2 are attached to a shared media hub that is then connected to the switch. Clients 1 and 2 belong only to VLAN 2. Those clients are logically in the same IP subnet as the Main Server and Client 5. The switch port connected to this segment has tagging turned off.
- Client 3 is a member of VLAN 1. This client can communicate only with the Main Server and Client 5. Tagging is not enabled on Client 3's switch port.
- Client 4 is a member of VLAN 3. This client can communicate only with the servers. Tagging is not enabled on Client 4's switch port.
- Client 5 is a member of both VLANs 1 and 2. This client has a Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF, installed. Client 5 is connected to switch port 10. Both the Ethernet adapter and the switch port are configured for VLANs 1 and 2, and both have tagging enabled.

VLAN tagging must be enabled only on switch ports that:

- Create trunk links to other VLAN-aware Ethernet switches.
- Are connected to tag-capable end-stations, such as servers or workstations with VLAN-aware Ethernet adapters.

Related Information

- [“VLAN Configuration” on page 57](#)
- [“VLAN Naming Format” on page 57](#)
- [“Configure Static VLANs \(Oracle Solaris 10\)” on page 58](#)

VLAN Configuration

You can create VLANs according to various criteria, but each VLAN must be assigned a VLAN tag or VLAN ID (**VID**). The VID is a 12-bit identifier between 1 and 4094 that identifies a unique VLAN. For each network interface (`igb0`, `igb1`, `igb2`, and so on), 4094 possible VLAN IDs can be selected for each port.

Tagging an Ethernet frame requires the addition of a tag header to the frame. The header is inserted immediately following the destination MAC address and the source MAC address. The tag header consists of two bytes of Ethernet Tag Protocol identifier (**TPID**, 0x8100) and two bytes of **TCI**. The TCI consists of a user priority, the **CFI**, and the VID.

By default, a single VLAN is configured for every port, which groups all ports into the same broadcast domain, just as if there were no VLANs at all. This means that VLAN tagging for the switch port is turned off.

Note – If you configure a VLAN virtual device for an Ethernet adapter, all traffic sent or received by that Ethernet adapter must be in VLAN-tagged format.

Related Information

- [“VLAN Overview” on page 54](#)
- [“VLAN Naming Format” on page 57](#)
- [“Configure Static VLANs \(Oracle Solaris 10\)” on page 58](#)

VLAN Naming Format

When configuring VLANs, use the following naming format, which includes both the VID and the physical **PPA**:

VLAN logical PPA = 1000 * VID + Device-PPA

For example, if the virtual ID is 123 and the device PPA is 2, the VLAN interface would be `igb123002`. In another example, on a server with an adapter that has an instance number of 2, belonging to two VLANs with VID 123 and VID 224, the VLAN interfaces would be `igb123002` and `igb224002`, respectively.

This format limits the maximum number of PPAs (instances) that can be configured in the `/etc/path_to_inst` file to 1000.

Related Information

- [“VLAN Overview” on page 54](#)
- [“VLAN Configuration” on page 57](#)
- [“Configure Static VLANs \(Oracle Solaris 10\)” on page 58](#)

▼ Configure Static VLANs (Oracle Solaris 10)

1. **Create one `/etc/hostname.igb#` file for each VLAN that will be configured for each adapter on the server.**

See [“VLAN Naming Format” on page 57](#).

2. **Use the `ifconfig(1M)` command to configure each VLAN virtual device.**

Include the IP address in the command you type. For example, if the IP address is `192.2.2.84`, type:

```
# ifconfig igb123002 plumb 192.2.2.84 up
```

3. **Use the `ifconfig -a` command to see details about the VLAN devices.**

This example shows the output of `ifconfig -a` on a system having VLAN devices `igb123002` and `igb224002`:

```
igb123002: flags=201000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4,CoS>\
mtu 1500 index 4
inet 192.2.2.82 netmask ffffffff broadcast 192.2.2.255
ether 0:13:20:f5:f6:dc
igb224002: flags=201000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4,CoS>\
```

```
mtu 1500 index 5
inet 0.0.0.0 netmask ffffffff00
ether 0:13:20:f5:f6:dc
```

Note – In the preceding examples, the second NIC output for `igb224002` was plumbed and enabled (that is, used the `up` option), but had no IP address. By default, the netmask and broadcast addresses are set by the system, which uses IP class C to make that setting `255.255.255.0`. When the address is set, the `ifconfig(1M)` command by default does not display the broadcast address if the explicit IP address is not set.

Refer to the documentation that came with your switch for specific instructions for setting VLAN tagging and ports.

Related Information

- [“VLAN Overview” on page 54](#)
- [“VLAN Configuration” on page 57](#)
- [“VLAN Naming Format” on page 57](#)

▼ Configure VLANs (Linux)

1. Ensure that the `igb` module is loaded.

```
# modprobe igb
```

2. Plumb the adapter's interface.

```
# ifconfig eth6 xxx.xxx.xx.xxx up
```

where `xxx.xxx.xx.xxx` is the IP address of the interface.

3. Add the VLAN VID.

For example:

```
# vconfig add eth6 5
```

where `eth6` is the interface and `5` is the VID.

Note – In Linux systems, you can use any single digit as the VID.

4. Configure the igb VLAN (eth6 in this example).

```
# ifconfig eth6.5 xxx.xxx.xx.xxx up
```

where xxx.xxx.xx.xxx is the IP address of the interface.

Related Information

- [“VLAN Overview” on page 54](#)
- [“VLAN Configuration” on page 57](#)

▼ Configure VLANs (Windows)

1. Click Control Panel.
2. Click Network Connection.
3. Click the folder icon from the sub-manual bar.
4. Right-click the adapter port, then select Properties.
5. Click Configure.
6. Click VLAN, then click New.
7. Type VLAN with ID (for example, type VLAN10).
8. Click OK.
9. Open the Local Connections for VLAN window from the Network Connections window (Control Panel->Network Internet->Network Connections).
10. Right-click the Properties button, and select the TCP/IPv4 port in the list.
11. Click the Properties button, and fill in the desired IP address.
12. Click Subnet Mask.
The value 255.255.255.0 is displayed.
13. Click OK.
14. Repeat [Step 3](#) through [Step 10](#) until all the network ports are VLAN configured.

Note – Ensure that the firewall is configured to allow VLAN traffic. Otherwise, the VLAN might not operate properly.

Related Information

- [“VLAN Overview” on page 54](#)
- [“VLAN Configuration” on page 57](#)

Troubleshooting the Adapter

These topics describe how to troubleshoot the installation and operation of the adapter on an Oracle SPARC or x86 system running Oracle Solaris 10 or 11 OS. These topics are not intended to be comprehensive. They cover basic installation issues.

Description	Links
Troubleshoot <code>ifconfig(1M)</code> issues.	“Analyze Why the Device Link Is Missing” on page 64
Troubleshoot outages.	“Analyze a Port Hang” on page 65
Troubleshoot performance.	“Analyze Slow Network Performance” on page 66

Related Information

- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the Adapter” on page 7](#)
- [“Installing the Driver” on page 17](#)
- [“Installing the Adapter” on page 23](#)
- [“Troubleshooting the Adapter” on page 63](#)
- [“Configuring Link Aggregation” on page 47](#)
- [“Configuring VLANs” on page 53](#)

▼ Analyze Why the Device Link Is Missing

If the `ifconfig(1M)` command cannot find a device, the following message is displayed in the output:

```
...
cannot open igb0; link doesn't exist
...
```

1. Check the OS.

- If the OS is Oracle Solaris 10 8/11, skip to [Step 2](#).
- If the OS is Oracle Solaris 11, use the `dladm(1M)` command to plumb the driver. See the `dladm(1M)` man page for instructions.

2. Check that the adapter is seated properly in its slot, that the cables are properly attached, and that the LEDs are functioning.

3. Use the `prtconf(1M)` or `scanpci(1M)` command to ensure that the device is installed.

4. If the device exists, check the `/etc/driver_aliases` file to ensure that the file contains an `igb` entry that corresponds to the name for the device.

5. If the entry exists, check the `/etc/path_to_inst` file to ensure that the file contains an `igb` entry.

Removing a device and reseating it in another slot does not always clean up the device tree. If this is the case, you must remove the device tree and reboot the system. See *Oracle Solaris Administration: Network Interfaces and Network Virtualization* for more information.

Related Information

- [“Analyze a Port Hang” on page 65](#)
- [“Analyze Slow Network Performance” on page 66](#)

▼ Analyze a Port Hang

1. If the interface encounters a soft hang, replumb the device.

- For Oracle Solaris 10, use the `ifconfig(1M)` command.
- For Oracle Solaris 11, use the `dladm(1M)` command.

2. If the interface encounters a hard hang, reboot the system.

If the interface encounters another hard hang, try to capture the trace information by using the `dtrace(1M)` command, as in the following example.

```
# dtrace -F -m 'igb{trace(timestamp0)}' > /tmp/dtrace.out
```

3. If the system is panicked, retrieve the crash dump in `/var/crash/hostname`.

```
# mdb unix.0 vmcore.0 > $c
```

Note – If the interface encounters a hard hang or a panic, file a CR at Oracle Support. Attach the last page of the `dtrace(1M)` output or the crash dump to the CR.

Related Information

- [“Analyze Why the Device Link Is Missing”](#) on page 64
- [“Analyze Slow Network Performance”](#) on page 66

▼ Analyze Slow Network Performance

The adapter supports several driver parameters that affect the performance of the ports. See “[Driver Parameters \(Oracle Solaris OS\)](#)” on page 40 for more information about the default values.

1. Use the `truss(1M)` command against the process ID of the network application to view the network performance.

```
# truss -p PID
```

2. Look for [NIS](#), [DNS](#), and network routing outages.

If you find any issues, fix them before proceeding.

3. Use the `iostat(1M)` command to view the I/O statistics to ensure that there are no bottlenecks on the disk.

```
# iostat -xcn 5
```

If you discover a bottleneck, try setting logging to dump to the `/tmp` directory. Then, retest to ensure that the new configuration improved performance.

4. Use the `vmstat(1M)` and the `mpstat(1M)` commands to check that none of the following conditions exist:
 - CPU is pegged.
 - CPU is receiving too many interrupts.
 - Memory is low.
 - Page faults are occurring.
 - Contention for resources causes too many spins on mutex (`smtx`).

If the performance issue points to the driver, try to profile the call stack for `igb(7D)` by using the DTrace script. For more information about the DTrace script, go to:

<http://www.oracle.com/us/support/>

Related Information

- “[Analyze Why the Device Link Is Missing](#)” on page 64
- “[Analyze a Port Hang](#)” on page 65

Glossary

A

ACT (activity) Indicates that the port is up and running at 1-GbE speed.

B

BIOS (basic input/output system) In this guide, the term BIOS refers to the BIOS software on the client or server system.

C

CFI (canonical format indicator) A 1-bit field in the Ethernet header.

CR (change request)

D

DHCP (Dynamic Host Configuration Protocol) Part of the application layer in the Internet protocol suite.

DMA (direct memory access)

DNS (domain name system) Translates human-readable domain names into numerical identifiers.

DR (dynamic reconfiguration) Used to automatically reconfigure resources within a domain or from one domain to another domain.

E

EEE (energy efficient Ethernet)

EEPROM (electronically erasable programmable read-only memory)

EMI (electromagnetic interference) The interference caused by the magnetic fields of electronic components.

F

FCC (Federal Communications Commission)

FIFO (first-in-first-out)

G

GB (gigabyte)

GbE (Gigabit Ethernet)

Gbps (gigabits-per-second)

GT (gigabit-transfer)

GTps (GTs-per-second)

I

IEEE (Institute of Electrical and Electronics Engineers) Publishes standards that guide hardware and software development.

IP (Internet Protocol) The principal communications protocol in the IP suite.

iSCSI (Internet small computer system interface)

K

KB (kilobytes)

L

LACP (Link Aggregation Control Protocol) Enables several physical ports to be bundled into a single logical channel.

LAN (local area network) Two or more devices connected to each other either physically or logically.

LED (light-emitting diode)

LFM (linear feet per minute)

LNK (link) Indicates that the network link is up and running.

LOM (LAN-on-motherboard) A LAN design.

LPA (low profile adapter) Refers to the Sun Dual Port GbE PCIe 2.0 Low Profile Adapter, MMF, from Oracle.

M

MAC (media access control) Enables the use of a unique address for each device on a network.

Mb (megabit)

Mbps (megabits-per-second)

MTU (maximum transmission unit) The MTU (payload without the Ethernet header) affects how jumbo frames function.

N

- NIC** (network interface card) Connects clients and servers to a LAN, WAN, or VLAN.
- NIS** (network information service) Originally known as Yellow Pages, NIS is a protocol for distributed system configuration data.

P

- PCI** (Peripheral Component Interconnect)
- PCIe** (PCI Express)
- PF** (page fault)
- PHY** (physical layer) Controls the physical, analog signal access to a link.
- PPA** (physical point of attachment) Used in constructing VLAN IDs.
- PXE** (preboot execution environment) Enables clients to boot over a network interface, independent of the OS or other devices.

R

- ROM** (read-only memory)
- RPM** (RPM Package Manager)
- RSS** (really simple syndication)
- RX** (response) The automatic response mechanism used by Ethernet PAUSE frames.

S

SerDes	(serializer/deserializer) A mechanism used in high-speed connections to compensate for limited input or output.
SGMII	(Serial Gigabit Media Independent Interface) A standard interface used to connect an Ethernet MAC-block to a PHY.
SPI	(serial peripheral interface) A type of flash memory.
SRC	(source code) The SRC RPM is used in Linux to build the driver kernel files.
SUSE	(Stanford University School of Education)

T

TCI	(tag control information) Part of the Ethernet header.
TCP	(Transmission Control Protocol) Part of the transport layer of the Internet protocol suite.
TCP/IP	(Transmission Control Protocol and Internet Protocol) In this guide, TCP/IP refers to the TCP/IP model, which is a framework for the IP suite.
TPID	(tag protocol identifier) Two bytes of information in an Ethernet frame.
TX	(generation) The automatic generation mechanism used by the Ethernet PAUSE frames.

U

UDP	(User Datagram Protocol) Part of the transport layer of the Internet protocol suite.
UDP/IP	(User Datagram Protocol and Internet Protocol) In this guide, UDP/IP refers to the relationship between the two protocols, which are on different layers of the IP suite.
UEFI	(Unified Extensible Firmware Interface) Manages the operations between hardware firmware and the OS during the boot time.

V

- VID** (VLAN identifier) A 12-bit identifier in an Ethernet header.
- VLAN** (virtual LAN) Splits the physical LAN into logical subparts. Multiple VLANs are supported on a single port, enabling a server with a single adapter to have a logical presence on multiple IP subnets.

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