

Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP

User's Guide



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Using This Documentation

This guide provides hardware and software installation instructions for the Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP, 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 vii
- “Related Documentation” on page viii
- “Feedback” on page viii
- “Support and Accessibility” on page viii

Product Notes

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

http://www.oracle.com/pls/topics/lookup?ctx=SQP_GbE-PCIe2.0-EM_UTP

Related Documentation

Documentation	Links
All Oracle products	http://www.oracle.com/documentation
<i>Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP</i>	http://www.oracle.com/pls/topics/lookup?ctx=SQP_GbE-PCIe2.0-EM_UTP
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 Quad Port GbE PCIe 2.0 ExpressModule, UTP:

- [“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 EM”](#) on page 7
- [“Installing the Driver”](#) on page 19
- [“Installing the EM”](#) on page 25
- [“Configuring the Network”](#) on page 31
- [“Administering Driver Parameters and Jumbo Frames”](#) on page 41
- [“Configuring Link Aggregation”](#) on page 49
- [“Configuring VLANs”](#) on page 55
- [“Troubleshooting the EM”](#) on page 65

Installation Overview (Oracle Solaris 10)

Follow these steps to install the ExpressModule (EM) on an Oracle Solaris 10 platform.

Step	Description	Links
1.	Understand the EM.	“Understanding the Installation Process” on page 1
2.	Verify the driver installation.	“Verify the Driver Version (Oracle Solaris 10)” on page 20
3.	Install the EM.	“Install the ExpressModule” on page 25
4.	Verify the EM installation.	“Verify the Installation (Oracle SPARC)” on page 27 “Verify the Installation (Oracle Solaris x86)” on page 29
5.	Configure the network.	“Create Driver Instance Files (Oracle Solaris 10)” on page 32 “Configure the Network Host Files (Oracle Solaris 10)” on page 32
6.	Configure the driver parameters.	“Driver Parameters (Oracle Solaris OS)” on page 42 “Set Driver Parameters (Oracle Solaris OS)” on page 43
7.	(Optional) Boot over the network.	“Boot Over the Network (PXE)” on page 34 “Boot Over a GbE Network (Oracle Solaris x86 and Linux)” on page 34
8.	(Optional) Install the OS over the network.	“Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 36
9.	(Optional) Configure jumbo frames.	“Change the MTU Permanently” on page 46
10.	(Optional) Configure link aggregation.	“Link Aggregation Overview” on page 50 “Configure Link Aggregations (Oracle Solaris 10)” on page 50 “Display Information About Link Aggregations (Oracle Solaris 10)” on page 51 “Delete Link Aggregations (Oracle Solaris 10)” on page 52
11.	(Optional) Configure VLANs.	“VLAN Overview” on page 56 “VLAN Configuration” on page 59 “Configure Static VLANs (Oracle Solaris 10)” on page 60

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 OS documentation, located here:

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

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

Step	Description	Links
1.	Understand the EM.	“Understanding the EM” on page 7
2.	Verify the driver installation.	“Verify the Driver Version (Oracle Solaris 11)” on page 21
3.	Install the EM.	“Install the ExpressModule” on page 25
4.	Verify the EM 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 41
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 46
10.	(Optional) Configure link aggregation.	“Link Aggregation Overview” on page 50 Refer to <i>Oracle Solaris Administration: Network Interfaces and Network Virtualization</i> .
11.	(Optional) Configure VLANs.	“VLAN Overview” on page 56 “VLAN Configuration” on page 59 Refer to <i>Oracle Solaris Administration: Network Interfaces and Network Virtualization</i> .

Installation Overview (Linux)

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

Step	Description	Links
1.	Understand the EM.	“Understanding the EM” on page 7
2.	Install the driver.	“Download and Install the Driver (Linux)” on page 22
3.	Install the EM.	“Install the ExpressModule” on page 25
4.	Verify the EM installation.	“Verify the Installation (Linux)” on page 30
5.	Boot over the network.	“Boot Over a GbE Network (Oracle Solaris x86 and Linux)” on page 34 “Boot Over the Network (PXE)” on page 34
6.	Configure the driver parameters.	“Driver Parameters (Linux)” on page 44 “Set Driver Parameters (Linux)” on page 46
7.	(Optional) Configure jumbo frames.	“Configure Jumbo Frames (Linux)” on page 48
8.	(Optional) Configure VLANs.	“VLAN Overview” on page 56 “VLAN Configuration” on page 59 “Configure VLANs (Linux)” on page 61

Installation Overview (Windows)

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

Step	Description	Links
1.	Understand the EM.	“Understanding the EM” on page 7
2.	Install the driver.	“Download and Install the Driver (Windows)” on page 24
3.	Install the EM.	“Install the ExpressModule” on page 25
4.	Verify the EM installation.	“Verify the Installation (Windows)” on page 30
5.	(Optional) Configure VLANs.	“VLAN Overview” on page 56 “VLAN Configuration” on page 59 “Configure VLANs (Windows)” on page 62

Understanding the EM

These topics provide an overview of the Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP.

Description	Links
Understand the EM.	"Shipping Kit Contents" on page 8 "Product Description" on page 8 "Front Panel Connectors and LEDs" on page 11 "Physical Characteristics" on page 14 "Performance Specifications" on page 15 "Power and Environmental Requirements" on page 16
Understand the hardware and software requirements.	Refer to the product web page at: http://www.oracle.com/us/products/servers-storage/networking/ethernet/index.html
Understand the maintenance requirements.	"OS Patches and Updates" on page 17

Related Information

- ["Understanding the Installation Process"](#) on page 1
- ["Installing the Driver"](#) on page 19
- ["Installing the EM"](#) on page 25
- ["Configuring the Network"](#) on page 31
- ["Administering Driver Parameters and Jumbo Frames"](#) on page 41
- ["Configuring Link Aggregation"](#) on page 49
- ["Configuring VLANs"](#) on page 55

Shipping Kit Contents

The carton in which your Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP, was shipped should contain the following items:

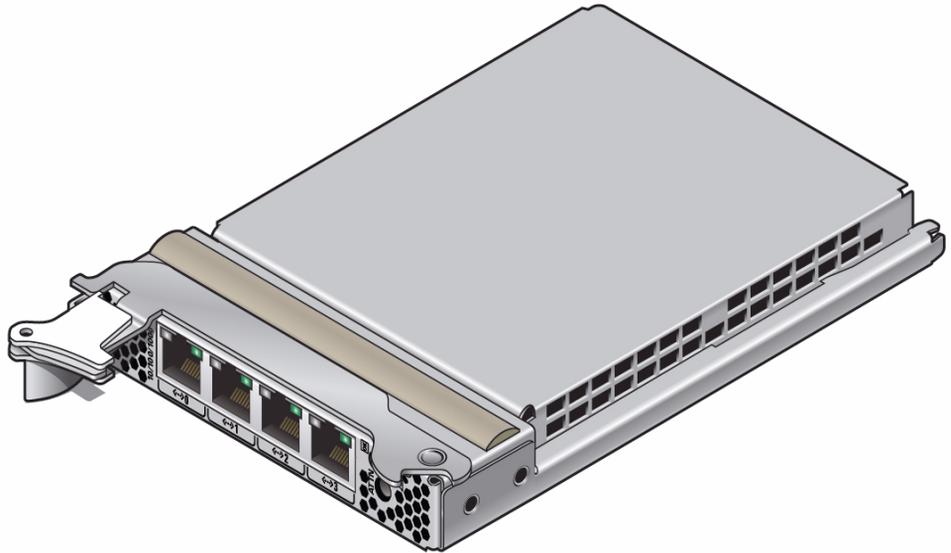
- Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP
- *Sun Network Interface Card Products Getting Started Guide*

Related Information

- [“Product Description” on page 8](#)
- [“Front Panel Connectors and LEDs” on page 11](#)
- [“Physical Characteristics” on page 14](#)
- [“Performance Specifications” on page 15](#)
- [“Power and Environmental Requirements” on page 16](#)
- [“OS Patches and Updates” on page 17](#)

Product Description

The Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP, is a 1-GbE NIC for PCIe systems. The module offers a high density mutli-port design for Sun racks and blade servers. This module addresses the multi-port network connectivity needs of data center environments. The module 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 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 14
- “Performance Specifications” on page 15
- “Power and Environmental Requirements” on page 16
- “OS Patches and Updates” on page 17

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 PCIe 2.0 Gigabit Ethernet Networking Cards.

FIGURE: NIC Configuration Example

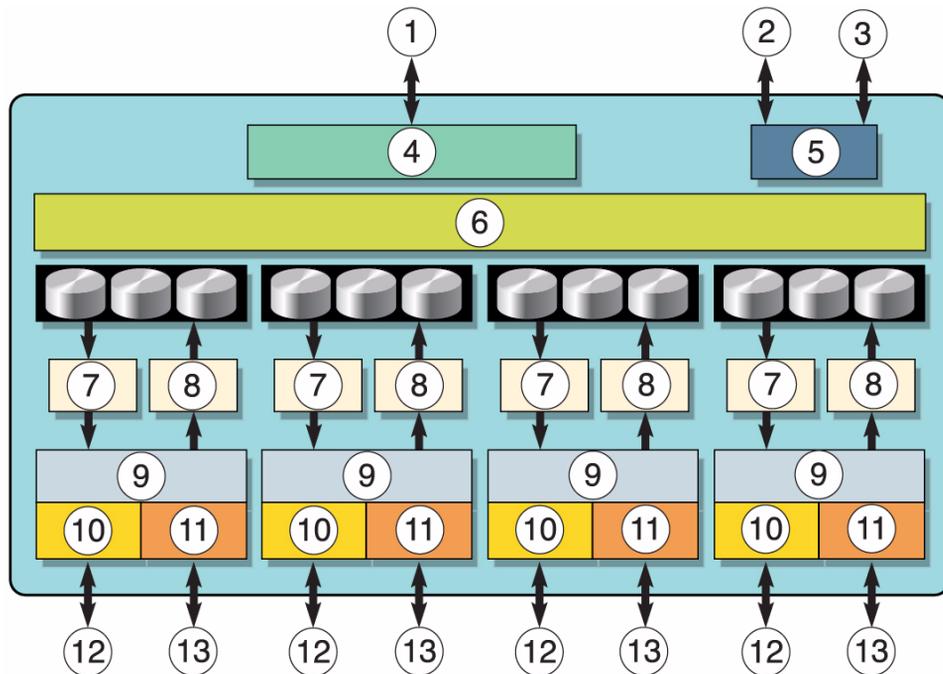


Figure Legend

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](#)
- [“Product Description” on page 8](#)
- [“Front Panel Connectors and LEDs” on page 11](#)
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Front Panel Connectors and LEDs

The front panel contains four ports with two port status LEDs assigned to each port. In addition, there is an Attention button (labeled ATTN) and two system-level LEDs located next to the ATTN button.

FIGURE: Front Face of the EM

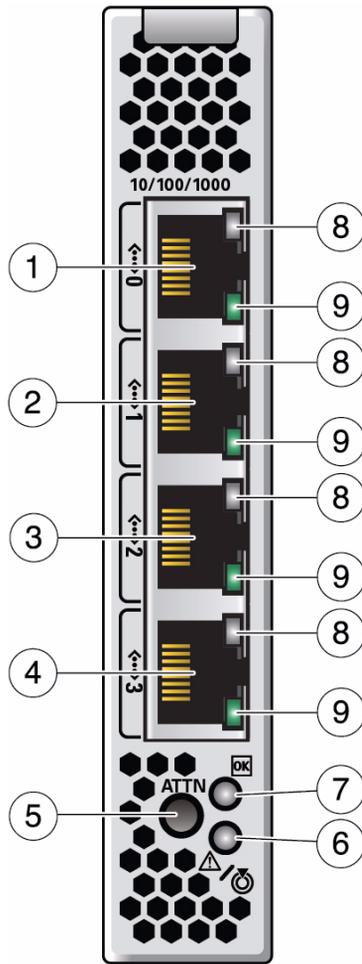


Figure Legend

-
- 1 Port 0
 - 2 Port 1
 - 3 Port 2
 - 4 Port 3
 - 5 ATTN (attention) button
 - 6 Attention LED
-

Figure Legend (Continued)

-
- 7 OK (power status) LED
 - 8 Link LED
 - 9 Activity LED
-

The following table explains how to interpret the behavior the activity and link LEDs.

LED	Color	State	Meaning
Activity	None	Off	Link is down.
	Green	Blinking	Activity is occurring on the link.
	Green	Steady on	No activity is occurring on the link.
Link	None	Off	Link is operating as a 10 Mbps connection.
	Green	Steady on	Link is operating as a 100 Mbps connection.
	Amber	Steady on	Link is operating as a gigabit connection (1000 Mbps).

When you want to perform a hot-plug operation with an EM, press the ATTN button. This removes power from the slot the EM is in so it can be removed while the chassis remains powered up.

Note – Power remains present at the slot for a period of time after the ATTN button is pressed. This is referred to as the power transition period.



Caution – Do not insert or remove the EM during the power transition phase of a hot-plug operation. This power transition phase is the period just after the ATTN button is pressed when the EM might not be fully isolated from the power source.

In addition to the port status LEDs, there are two LEDs next to the ATTN button. The following table explains their meaning.

LED	Color	State	Meaning	Allowed Action
OK (power status)	None	Off	All supply voltages (except Vaux) have been removed from the slot, except those required for card removal.	EM can be removed from the slot.
	Green	Blinking	Power transition/hot-plug operation is in progress.	EM <i>cannot</i> be removed.
	Green	Steady on	Power is present in the slot.	EM <i>cannot</i> be removed.
Attention	None	Off	Slot is operational.	This is the normal status when the slot is operating correctly.
	Amber	Blinking	LED has been activated by a user.	Note - The Attention LED is not used to report problems detected while validating a request for a hot-plug operation.
	Amber	Steady on	Slot needs attention.	The slot has an operational problem.

Related Information

- [“Shipping Kit Contents” on page 8](#)
- [“Configuration Options” on page 10](#)
- [“Product Description” on page 8](#)
- [“Physical Characteristics” on page 14](#)
- [“Performance Specifications” on page 15](#)
- [“Power and Environmental Requirements” on page 16](#)
- [“OS Patches and Updates” on page 17](#)

Physical Characteristics

Dimension	Measurement
Height	4.45 in. (112.5 mm)
Width	0.85 in. (21.5 mm)
Depth	7.80 in. (198.0 mm)

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 15](#)
- [“Power and Environmental Requirements” on page 16](#)
- [“OS Patches and Updates” on page 17](#)

Performance Specifications

Feature	Specification
Data rate supported per port	1 Gbps (1000 Mbps), 100 Mbps, 10 Mbps
Bus type	PCIe V2.0, 5.0 gigatransfers/sec
Bus width	x4 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](#)
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Power and Environmental Requirements

Specification	Measurement
Typical power consumption	4.4W (1.17A at 12V)
Main host power supply	12 V \pm 15%
Auxiliary power	3.3 V
Temperature (operating)	-5°C to 55°C (23°F to 131°F)
Temperature (storage)	-40 to 55°C (-40 to 131°F) noncondensing
Humidity (operating)	10% to 90 relative humidity, noncondensing at 27°C (80.6°F) maximum wet bulb
Humidity (storage)	93% relative humidity, noncondensing at 38°C (100.4°F) maximum wet bulb
Altitude (operating)	3,302 meters (10833.3 feet) at 35°C (95°F) ambient
Altitude (storage)	12,000 meters (39,370.1 feet)
Vibration (operating)	0.20G in all axes (5-500 Hz sine)
Vibration (storage)	1.0G in all axes (5-500 Hz sine)
Shock (operating)	5G (11 ms half-sine)
Shock (storage)	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](#)
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- [“OS Patches and Updates” on page 17](#)

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 Quad Port GbE PCIe 2.0 ExpressModule, UTP, 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 14
- “Performance Specifications” on page 15
- “Power and Environmental Requirements” on page 16

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 Quad Port GbE PCIe 2.0 ExpressModule, UTP. 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 20 “Verify the Driver Version (Oracle Solaris 11)” on page 21 “Remove the Driver (Oracle Solaris OS)” on page 21
Download, install, or remove the driver on a Linux platform.	“Download and Install the Driver (Linux)” on page 22 “Remove the Driver (Linux)” on page 23
Download, install, or remove the driver on a Windows platform.	“Download and Install the Driver (Windows)” on page 24 “Remove the Driver (Windows)” on page 24

Related Information

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- [“Configuring VLANs” on page 55](#)
- [“Troubleshooting the EM” on page 65](#)

▼ Verify the Driver Version (Oracle Solaris 10)

Oracle Solaris 10 8/11 is the first release of Oracle Solaris 10 to support the Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP. 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 7b762000 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 17.

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 21
- [“Remove the Driver \(Oracle Solaris OS\)”](#) on page 21

▼ 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 17.

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 20
- [“Remove the Driver \(Oracle Solaris OS\)”](#) on page 21

▼ 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 20
- “Verify the Driver Version (Oracle Solaris 11)” on page 21

▼ 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-T4 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 23](#)

▼ 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 22](#)

▼ 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-T4 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 24](#)

▼ 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 24](#)

Installing the EM

These topics describe how to install the EM.

Description	Links
Understand the connectors.	“Front Panel Connectors and LEDs” on page 11
Install the ExpressModule.	“Install the ExpressModule” on page 25
Verify the installation.	“Verify the Installation (Oracle SPARC)” on page 27 “Verify the Installation (Oracle Solaris x86)” on page 29 “Verify the Installation (Linux)” on page 30 “Verify the Installation (Windows)” on page 30

Related Information

- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the EM” on page 7](#)
- [“Installing the Driver” on page 19](#)
- [“Configuring the Network” on page 31](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 41](#)
- [“Configuring Link Aggregation” on page 49](#)
- [“Configuring VLANs” on page 55](#)

▼ Install the ExpressModule

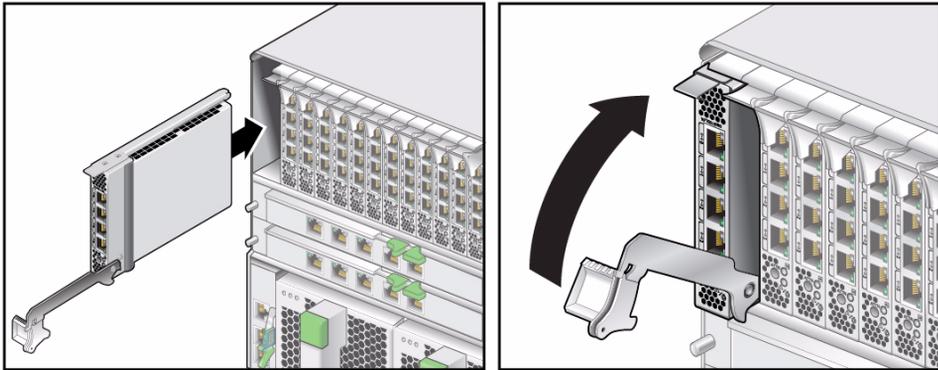
The following instructions describe the basic steps required to install the EM. You can install the EM on a powered-on system using a hot-swap procedure, as well as from powered-off system.

Note – To maintain proper cooling for the EM in your chassis, all EM slots must be filled with either operating EMs or filler panels.

1. Halt and power off your system.
2. Power off any peripherals connected to your system.
3. Remove the filler panel from the ExpressModule opening.
4. Open the latch on the EM.
5. Align the EM with the vacant EM slot and slide it into the slot until the ejector lever engages and starts to close.



Caution – Failure to align the EM correctly can result in damage to the EM's internal connection to the chassis midplane.



6. Swing the ejector lever up until its latch snaps into place.



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

7. Connect cables to the ports.
8. Power on the system.
9. Power on any peripherals that had been powered down in [Step 2](#).

Related Information

- “Verify the Installation (Oracle SPARC)” on page 27
- “Verify the Installation (Oracle Solaris x86)” on page 29
- “Verify the Installation (Linux)” on page 30
- “Verify the Installation (Windows)” on page 30

▼ Verify the Installation (Oracle SPARC)

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

1. **Power on and boot the blade server.**

2. **Display the `ok` prompt (OpenBoot prompt).**

Refer to the server’s Administration Guide for instructions on how to display the `ok` prompt.

3. **List the network devices on your system.**

```
ok show-nets
a) /pci@500/pci@0/pci@8/network@0,1
b) /pci@500/pci@0/pci@8/network@0
c) /pci@400/pci@0/pci@2/network@0,1
d) /pci@400/pci@0/pci@2/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@0/pci@2/network@0,1` is a port on the EM.

a. **Move to the device directory.**

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

b. Display properties for the device.

```
ok .properties
```

The output will be similar to the following:

```
ok .properties
assigned-addresses      82060010 00000000 10000000 00000000 00100000
                        81050018 00000000 00001000 00000000 00000020
                        8206001c 00000000 10100000 00000000 00004000
                        82060030 00000000 10180000 00000000 00080000
local-mac-address      a0 36 9f 01 b3 dc
version                 Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP
                        FCode 3.11 2/16/12
phy-type                mif
reg                    00060000 00000000 00000000 00000000 00000000
                        02060010 00000000 00000000 00000000 00100000
                        0206001c 00000000 00000000 00000000 00004000
                        02060030 00000000 00000000 00000000 00080000
board-model            7014759
model                  SUNW,pcie-igb
compatible              pciex8086,1521.108e.7b16.1
                        pciex8086,1521.108e.7b16
                        pciex8086,1521.1
                        pciex8086,1521
                        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           00007b16
subsystem-vendor-id    0000108e
revision-id            00000001
device-id              00001521
vendor-id              00008086
```

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

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

```
ok device-end
```

Related Information

- [“Install the ExpressModule” on page 25](#)

▼ Verify the Installation (Oracle Solaris x86)

1. Power on and boot the blade server.
2. Check the driver version on your system.

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

The version number should be 1.1.24 or newer. If it is not, install the latest driver patch. See [“OS Patches and Updates” on page 17](#).

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

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

If the EM is properly installed on an Oracle SPARC system, you should see output similar to the following:

```
# grep igb /etc/path_to_inst
"/pci@0,0/pci8086,3c0a@3,2/pci108e,7b16@0" 0 "igb"
"/pci@0,0/pci8086,3c0a@3,2/pci108e,7b16@0,1" 1 "igb"
```

Related Information

- [“Install the ExpressModule” on page 25](#)

▼ Verify the Installation (Linux)

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

```
# 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 ExpressModule” on page 25](#)

▼ Verify the Installation (Windows)

1. Click Control Panel.

2. Click Network Connection.

If the driver is installed correctly, the Ethernet interfaces labeled similar to the following are displayed at the Network Connection window screen: Intel(R) 82575, 82576, 82580, or i350 Gigabit Ethernet Controllers.

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 ExpressModule” on page 25](#)

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 32 “Configure the Network Host Files (Oracle Solaris 10)” on page 32
Boot over the network.	“Boot Options” on page 33 “Boot Over the Network (PXE)” on page 34 “Boot Over a GbE Network (Oracle Solaris x86 and Linux)” on page 34
Install the Oracle Solaris OS over the network.	“Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 36

Related Information

- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the EM” on page 7](#)
- [“Installing the Driver” on page 19](#)
- [“Installing the EM” on page 25](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 41](#)
- [“Configuring Link Aggregation” on page 49](#)
- [“Configuring VLANs” on page 55](#)
- [“Troubleshooting the EM” on page 65](#)

▼ 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 OS.**

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 32](#)
- [“Boot Options” on page 33](#)
- [“Boot Over the Network \(PXE\)” on page 34](#)
- [“Boot Over a GbE Network \(Oracle Solaris x86 and Linux\)” on page 34](#)
- [“Install Oracle Solaris 10 Over a Network \(Oracle SPARC\)” on page 36](#)

▼ 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:

nge0	link: up	speed: 1000	Mbps duplex: full
nge1	link: down	speed: 0	Mbps duplex: unknown
igb0	link: up	speed: 1000	Mbps duplex: full
igb1	link: up	speed: 1000	Mbps duplex: full
igb2	link: up	speed: 1000	Mbps duplex: full
igb3	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 32](#)
- [“Boot Options” on page 33](#)
- [“Boot Over the Network \(PXE\)” on page 34](#)
- [“Boot Over a GbE Network \(Oracle Solaris x86 and Linux\)” on page 34](#)
- [“Install Oracle Solaris 10 Over a Network \(Oracle SPARC\)” on page 36](#)

Boot Options

The EM 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 32](#)

- “Configure the Network Host Files (Oracle Solaris 10)” on page 32
- “Boot Over the Network (PXE)” on page 34
- “Boot Over a GbE Network (Oracle Solaris x86 and Linux)” on page 34
- “Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 36

▼ 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 32
- “Configure the Network Host Files (Oracle Solaris 10)” on page 32
- “Boot Options” on page 33
- “Boot Over a GbE Network (Oracle Solaris x86 and Linux)” on page 34
- “Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 36

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

1. **Obtain the MAC address of the first EM port by checking the label of the EM.**
For the EM, 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 EM’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 EM.

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 32
- “Configure the Network Host Files (Oracle Solaris 10)” on page 32
- “Boot Options” on page 33
- “Boot Over the Network (PXE)” on page 34
- “Install Oracle Solaris 10 Over a Network (Oracle SPARC)” on page 36

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

The *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 an image of the Oracle Solaris 10 CD.

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

The *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 devices, including the four the EM ports, similar to this example.

```
ok show-nets
a) /pci@500/pci@0/pci@8/network@0,1
b) /pci@500/pci@0/pci@8/network@0
c) /pci@400/pci@0/pci@2/network@0,1
d) /pci@400/pci@0/pci@2/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 EM device.

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

a. Move to the device directory.

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

b. Display properties for the device.

```
ok .properties
```

The output should be similar to the following:

```
ok .properties
assigned-addresses      82060010 00000000 10000000 00000000 00100000
                        8206001c 00000000 10100000 00000000 00004000
                        82060030 00000000 10180000 00000000 00080000
local-mac-address      a0 36 9f 01 b3 dc
version                 Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP
                        FCode 3.11 2/16/12
phy-type                mif
reg                    00060000 00000000 00000000 00000000 00000000
                        02060010 00000000 00000000 00000000 00100000
                        0206001c 00000000 00000000 00000000 00004000
                        02060030 00000000 00000000 00000000 00080000
board-model            7014759
model                  SUNW,pcie-igb
compatible              pciex8086,1521.108e.7b16.1
                        pciex8086,1521.108e.7b16
                        pciex8086,1521.1
                        pciex8086,1521
                        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           00007b16
subsystem-vendor-id    0000108e
revision-id             00000001
device-id               00001521
vendor-id               00008086
```

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

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@0/pci@2/network@0,1
```

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

6. Proceed with Oracle Solaris 10 installation.

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

7. Install the EM 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 32](#) 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
igb0          link: up      speed: 1000  Mbps      duplex: full
```

Related Information

- [“Create Driver Instance Files \(Oracle Solaris 10\)”](#) on page 32
- [“Configure the Network Host Files \(Oracle Solaris 10\)”](#) on page 32
- [“Boot Options”](#) on page 33
- [“Boot Over the Network \(PXE\)”](#) on page 34
- [“Boot Over a GbE Network \(Oracle Solaris x86 and Linux\)”](#) on page 34

Administering Driver Parameters and Jumbo Frames

The `igb(7D)` device driver controls the EM'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 42 "Set Driver Parameters (Oracle Solaris OS)" on page 43
Administrate driver parameters in Linux.	"Driver Parameters (Linux)" on page 44 "Set Driver Parameters (Linux)" on page 46
Configure jumbo frames.	"Configuring Jumbo Frames (Oracle Solaris OS)" on page 46 "Configure Jumbo Frames (Linux)" on page 48

Related Information

- ["Understanding the Installation Process" on page 1](#)
- ["Understanding the EM" on page 7](#)
- ["Installing the Driver" on page 19](#)
- ["Installing the EM" on page 25](#)
- ["Configuring the Network" on page 31](#)
- ["Configuring Link Aggregation" on page 49](#)
- ["Configuring VLANs" on page 55](#)
- ["Troubleshooting the EM" on page 65](#)

Driver Parameters (Oracle Solaris OS)

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

Type	Keyword	Description
Jumbo frames	<code>default_mtu=<i>u</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 43](#)
- [“Configuring Jumbo Frames \(Oracle Solaris OS\)” on page 46](#)

▼ 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,7b16@0" 0 "igb"
"/pci@0,0/pci8086,3c0a@3,2/pci108e,7b16@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, in the output for an Oracle x86 system, the name is `pci108e,7b16`, 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, add the following:

```
name = "pci108e,7b16"  
parent = "/pci@0,0/pci8086,3c0a@3,2"  
unit-address = "0"  
flow_control = 3;
```

Refer to the `driver.conf(4)` man page for more information about setting driver parameters in driver configuration files.

3. Save the igb.conf file.

4. Reboot the system.

Related Information

- [“Driver Parameters \(Oracle Solaris OS\)” on page 42](#)
- [“Configuring Jumbo Frames \(Oracle Solaris OS\)” on page 46](#)

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.
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 46](#)
- [“Configure Jumbo Frames \(Linux\)” on page 48](#)

▼ 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 44
- “Configure Jumbo Frames (Linux)” on page 48

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 46
- “Change the MTU Temporarily (Oracle Solaris 10)” on page 47
- “Change the MTU Temporarily (Oracle Solaris 11)” on page 47

▼ 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 42
- “Set Driver Parameters (Oracle Solaris OS)” on page 43
- “Change the MTU Temporarily (Oracle Solaris 10)” on page 47
- “Change the MTU Temporarily (Oracle Solaris 11)” on page 47

▼ 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 42](#)
- [“Set Driver Parameters \(Oracle Solaris OS\)” on page 43](#)
- [“Change the MTU Permanently” on page 46](#)
- [“Change the MTU Temporarily \(Oracle Solaris 11\)” on page 47](#)

▼ 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 42](#)
- [“Set Driver Parameters \(Oracle Solaris OS\)” on page 43](#)
- [“Change the MTU Permanently” on page 46](#)
- [“Change the MTU Temporarily \(Oracle Solaris 10\)” on page 47](#)

▼ 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 44](#)
- [“Set Driver Parameters \(Linux\)” on page 46](#)

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 50
Manage link aggregations in Oracle Solaris.	“Configure Link Aggregations (Oracle Solaris 10)” on page 50 “Display Information About Link Aggregations (Oracle Solaris 10)” on page 51 “Delete Link Aggregations (Oracle Solaris 10)” on page 52

Related Information

- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the EM” on page 7](#)
- [“Installing the Driver” on page 19](#)
- [“Installing the EM” on page 25](#)
- [“Configuring the Network” on page 31](#)
- [“Administering Driver Parameters and Jumbo Frames” on page 41](#)
- [“Configuring VLANs” on page 55](#)
- [“Troubleshooting the EM” on page 65](#)

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 50](#)
- [“Display Information About Link Aggregations \(Oracle Solaris 10\)” on page 51](#)
- [“Delete Link Aggregations \(Oracle Solaris 10\)” on page 52](#)

▼ 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 50](#)
- [“Display Information About Link Aggregations \(Oracle Solaris 10\)” on page 51](#)
- [“Delete Link Aggregations \(Oracle Solaris 10\)” on page 52](#)
- [ifconfig\(1M\) man page](#)
- [dladm\(1M\) man page](#)

▼ 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 50.

```
# ifconfig aggr1
aggr1: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500 index 32
inet 192.2.2.84 netmask ffffffff 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 ffffffff 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 50
- “[Configure Link Aggregations \(Oracle Solaris 10\)](#)” on page 50
- “[Delete Link Aggregations \(Oracle Solaris 10\)](#)” on page 52

▼ 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 50](#)
- [“Configure Link Aggregations \(Oracle Solaris 10\)” on page 50](#)
- [“Display Information About Link Aggregations \(Oracle Solaris 10\)” on page 51](#)

Configuring VLANs

These topics describe how to configure VLANs in the Oracle Solaris 10 OS. For instructions on how to configure VLANs in the 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 56 “VLAN Configuration” on page 59 “VLAN Naming Format” on page 59
Configure VLANs.	“Configure Static VLANs (Oracle Solaris 10)” on page 60 “Configure VLANs (Linux)” on page 61 “Configure VLANs (Windows)” on page 62

Related Information

- “Understanding the Installation Process” on page 1
- “Understanding the EM” on page 7
- “Installing the Driver” on page 19
- “Installing the EM” on page 25
- “Configuring the Network” on page 31
- “Administering Driver Parameters and Jumbo Frames” on page 41
- “Configuring Link Aggregation” on page 49
- “Troubleshooting the EM” on page 65

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

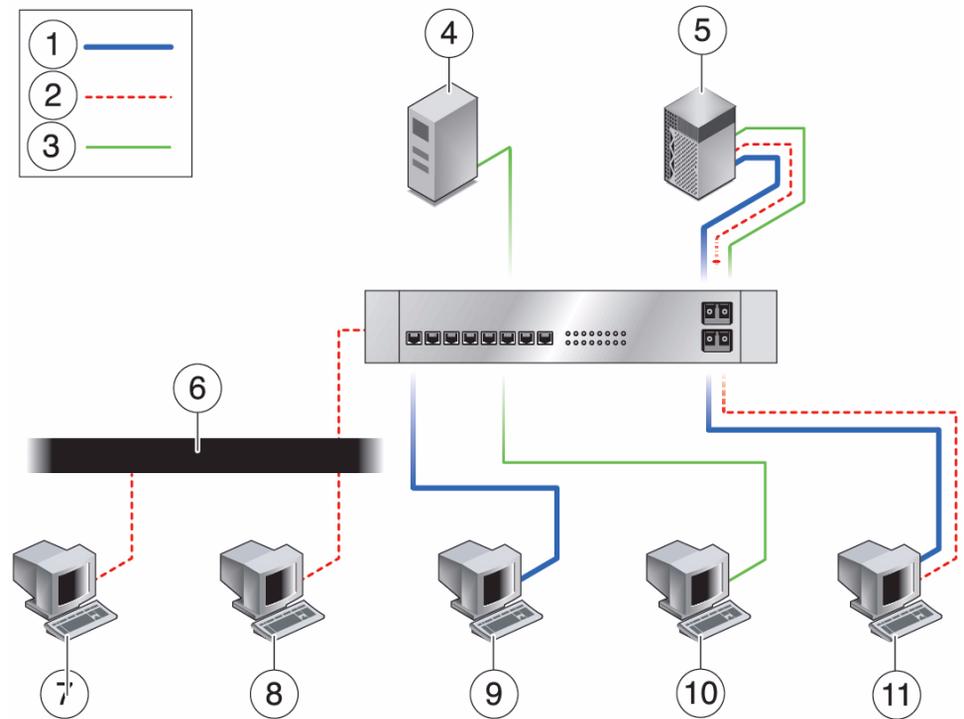


Figure Legend

-
- 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 Quad Port GbE PCIe 2.0 ExpressModule, UTP, 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 Quad Port GbE PCIe 2.0 ExpressModule, UTP, 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 59](#)
- [“VLAN Naming Format” on page 59](#)
- [“Configure Static VLANs \(Oracle Solaris 10\)” on page 60](#)

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 56](#)
- [“VLAN Naming Format” on page 59](#)
- [“Configure Static VLANs \(Oracle Solaris 10\)” on page 60](#)

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 56](#)
- [“VLAN Configuration” on page 59](#)
- [“Configure Static VLANs \(Oracle Solaris 10\)” on page 60](#)

▼ Configure Static VLANs (Oracle Solaris 10)

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

See [“VLAN Naming Format” on page 59](#).

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 56](#)
- [“VLAN Configuration” on page 59](#)
- [“VLAN Naming Format” on page 59](#)

▼ Configure VLANs (Linux)

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

```
# modprobe igb
```

2. Plumb the EM'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 – On 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 56](#)
- [“VLAN Configuration” on page 59](#)

▼ 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 EM 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 56](#)
- [“VLAN Configuration” on page 59](#)

Troubleshooting the EM

These topics describe how to troubleshoot the installation and operation of the EM on an Oracle SPARC or x86 system running the 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 66
Troubleshoot outages.	“Analyze a Port Hang” on page 67
Troubleshoot performance.	“Analyze Slow Network Performance” on page 67

Related Information

- [“Understanding the Installation Process” on page 1](#)
- [“Understanding the EM” on page 7](#)
- [“Installing the Driver” on page 19](#)
- [“Installing the EM” on page 25](#)
- [“Troubleshooting the EM” on page 65](#)
- [“Configuring Link Aggregation” on page 49](#)
- [“Configuring VLANs” on page 55](#)

▼ 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.

2. Check that the EM 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 67
- [“Analyze Slow Network Performance”](#) on page 67

▼ 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 the 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 66
- [“Analyze Slow Network Performance”](#) on page 67

▼ Analyze Slow Network Performance

The EM supports several driver parameters that affect the performance of the ports. See [“Driver Parameters \(Oracle Solaris OS\)”](#) on page 42 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 66
- [“Analyze a Port Hang”](#) on page 67

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)

EM (ExpressModule) Refers to the Sun Quad Port GbE PCIe 2.0 ExpressModule, UTP, from Oracle.

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.

M

- MAC** (media access control) Enables the use of a unique address for each device on a network.
- Mb** (megabit)
- Mbps** (megabits-per-second)

- MMF** (multi-mode fiber)
- 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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