



Platform Notes: The Sun™ GigabitEthernet Device Driver

Solaris™ 7

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Installing and Configuring the ge Device Driver

These Platform Notes include instructions for installing and configuring the software used by the Sun GigabitEthernet adapter. It also contains information for configuring the network. Unless otherwise noted, all instructions apply to both the Sun GigabitEthernet/P adapter and the Sun GigabitEthernet/S adapter.

The document is organized as follows:

- Installing the Driver Software
- Configuring the Driver Parameters
- Setting ge Driver Parameters
- Network Configuration

Installing the Driver Software

The software required to use the Sun GigabitEthernet adapters is on the Solaris CD that accompanies these Platform Notes.

▼ To Install the Driver Software

1. **Become superuser.**

2. Use the `prtconf -pv` command to determine if the system already contains a GigabitEthernet (ge) device.

For Sun GigabitEthernet/S:

```
# prtconf -pv | grep SUNW,sbus-gem
compatible: 'SUNW,sbus-gem'
model: 'SUNW,sbus-gem'
```

For Sun GigabitEthernet/P:

```
# prtconf -pv | grep SUNW,pci-gem
model: 'SUNW,pci-gem'
```

3. Install the software.

- **If your system contains a ge device**, install the software as described in the *Solaris 7 3/99 Sun Hardware Platform Guide*.
- **If your system does not contain a ge device**, shut down the system and install the adapter, then install the driver software as described in the *Solaris 7 3/99 Sun Hardware Platform Guide*

Note – If your system supports Dynamic Reconfiguration (DR), do not shut down or reboot. Refer to the installation manual that shipped with your system for further installation instructions.

▼ Set Up the Software on Solaris Systems

1. Create an entry in the `/etc/hosts` file for each active ge interface.

```
# cat /etc/hosts
#
# Internet host table
#
127.0.0.1    localhost
129.144.10.57 zardoz    loghost
129.144.11.83 zardoz-11
```

2. Use the `grep` command to search the `/etc/path_to_inst` file for `ge` instances.

For Sun GigabitEthernet/P:

```
# grep ge /etc/path_to_inst
"/pci@1f,4000/pci@1/network@1" 1 "ge"
```

For Sun GigabitEthernet/S:

```
# grep ge /etc/path_to_inst
"/sbus@1f,0/network@1,100000" 1 "ge"
```

In these examples, the 0 instance is for the first GigabitEthernet adapter installed in each system.

3. Set up each `hostname.genum` file to correspond with each `ge` device in the `path_to_inst` file.

The following example shows the `/etc/hostname.genum` file required for a system that has a `ge` interface with the host name `zardoz-11`.

```
# cat /etc/hostname.ge1
zardoz-11
```

4. Set up the `ge` adapter using the `ifconfig` command, where `ip_address` is the system IP address of the machine that will use the adapter without first rebooting.

```
# ifconfig ge0 plumb
# ifconfig ge0 ip_address up
```

Note – After installing the software, refer to the *Sun GigabitEthernet/S 2.0 Adapter Installation and User's Guide* or the *Sun GigabitEthernet/P 2.0 Adapter Installation and User's Guide* for further information about how to configure the software.

Configuring the Driver Parameters

This section provides an overview of the capabilities of the GigabitEthernet ASIC used in the adapters, lists the available `ge` driver parameters, and describes how to configure these parameters.

The `ge` driver controls the Sun GigabitEthernet adapter devices. The Sun GigabitEthernet device is identified as `network` with the model property `SUNW,sbus-gem` or `SUNW,pci-gem` node. The `ge` driver is attached to the device with the compatible property `pci108e,2bad` for the Sun GigabitEthernet/P adapter or `SUNW,sbus-gem` for the Sun GigabitEthernet/S adapter. You can manually configure the parameters to customize each Sun GigabitEthernet adapter in your system.

GigabitEthernet MAC

The GigabitEthernet MAC (GEM) provides 1000BASE-SX networking interfaces. The driver automatically sets the link speed to 1000 Mbps and conforms to the IEEE 802.3z Ethernet standard. The GEM PCI ASIC provide the PCI interface, Media Access Control (MAC) functions, and Physical Code Sublayer (PCS) functions. The GEM SBus ASIC provides the SBus interface, MAC functions, and PCS functions. The External SERDES, which connects the 1000BASE-SX Compliant SC connector to the ASIC, provides the physical layer functions.

The GEM MAC and PCS are capable of all the operating speeds and modes listed in “Autonegotiation Mode” on page 13. The PCS performs autonegotiation with the remote end of the link (link partner) to select a common mode of operation.

The PCS also supports a forced mode of operation. You can select the speed and mode by creating a `ge.conf` file.

Driver Parameter Values and Definitions

TABLE 1 describes the parameters and settings for the `ge` driver.

TABLE 1 `ge` Driver Parameters, Status, and Descriptions

Parameter	Status	Description
<code>link_status</code>	Read only	Defines the current status
<code>link_speed</code>	Read only	Defines the current status
<code>link_mode</code>	Read only	Defines the current status
<code>ipg1</code>	Read and write	Interpacket gap parameter
<code>ipg2</code>	Read and write	Interpacket gap parameter
<code>instance</code>	Read and write	Device instance
<code>lance_mode</code>	Read and write	Enable additional delay before transmitting a packet
<code>ipg0</code>	Read and write	Additional delay before transmitting a packet
<code>adv_1000autoneg_cap</code>	Read and write	Operational mode parameter
<code>adv_1000fdx_cap</code>	Read and write	Operational mode parameter
<code>adv_1000hdx_cap</code>	Read and write	Operational mode parameter
<code>adv_pauseTX</code>	Read and write	Operational mode parameter
<code>adv_pauseRX</code>	Read and write	Operational mode parameter
<code>1000autoneg_cap</code>	Read only	PCS autonegotiation capability
<code>1000fdx_cap</code>	Read only	PCS full duplex capability
<code>1000hdx_cap</code>	Read only	PCS half duplex capability
<code>asm_dir_cap</code>	Read only	PCS ASM_DIR capability
<code>pause_cap</code>	Read only	PCS Symmetric PAUSE capability
<code>lp_1000autoneg_cap</code>	Read only	Link partner autonegotiation capability
<code>lp_1000fdx_cap</code>	Read only	Link partner capability
<code>lp_1000hdx_cap</code>	Read only	Link partner capability
<code>lp_asm_dir_cap</code>	Read only	Link partner capability
<code>lp_pause_cap</code>	Read only	Link partner capability

Defining the Current Status

The read-only parameters described in TABLE 2 explain the operational mode of the interface. Based on the value of these parameters, you can determine the current status of a link.

TABLE 2 Read-Only Parameters Defining the Current Status

Parameter	Values and Description
link_status	Current link status 0 = Link down 1 = Link up
link_speed	Valid only if the link is up 0 = Link is not up 1000 = 1000 Mbps
link_mode	Valid only if the link is up 0 = Half duplex 1 = Full duplex

Flow Control Parameters

The GEM ASIC is capable of sourcing (transmitting) and terminating (receiving) pause frames conforming to IEEE 802.3x Frame Based Link Level Flow Control Protocol. In response to received flow control frames, the GEM can slow down its transmit rate. On the other hand, GEM is capable of sourcing flow control frames, requesting the link partner to slow down, provided that the link partner supports this feature. By default, GEM advertises Receive PAUSE capability during autonegotiation.

TABLE 3 Read-Write Flow Control Parameters Values and Descriptions

Parameter	Values (on/off)	Description
adv_pauseTX	0, 1	Transmit PAUSE Capable (default: not capable)
adv_pauseRX	0, 1	Receive PAUSE Capable (default: capable)

For normal operations, GEM doesn't need to source flow control frames. However, if GEM is operating on a slow bus (for instance, a 33-MHz PCI bus slot), and there is a lot of frame reception activity, there could be a performance degradation due to Receive FIFO overflow. If the link partner is capable of terminating PAUSE flow control frames, the performance of GEM could be improved by enabling `adv_pauseTX` and restarting autonegotiation.

Interpacket Gap Parameters

The GEM ASIC supports the programmable Interpacket Gap (IPG) parameters `ipg1` and `ipg2`. The total IPG is the sum of `ipg1` and `ipg2`: 0.096 microseconds for the link speed of 1000 Mbps.

TABLE 4 lists the default values and allowable values for the IPG parameters, `ipg1` and `ipg2`.

TABLE 4 Read-Write Interpacket Gap Parameter Values and Descriptions

Parameter	Values (Byte-time)	Description
<code>ipg1</code>	0, 255	<code>ipg1</code> = 8 (default at initialization)
<code>ipg2</code>	0, 255	<code>ipg2</code> = 4 (default at initialization)

By default, the driver sets `ipg1` to 8-byte time and `ipg2` to 4-byte time, which are the standard values. (Byte time is the time it takes to transmit one byte on the link, with a link speed of 1000 Mbps.)

If your network has systems that use longer IPG (the sum of `ipg1` and `ipg2`) and if those machines seem to be slow in accessing the network, increase the values of `ipg1` and `ipg2` to match the longer IPGs of other machines.

Defining an Additional Delay Before Transmitting a Packet Using `lance_mode` and `ipg0`

The GEM ASIC supports a programmable mode called `lance_mode`. The `ipg0` parameter is associated with `lance_mode`.

If `lance_mode` is enabled (the default), an additional delay is added by setting the `ipg0` parameter before transmitting the packet. This delay is in addition to the delay set by the `ipg1` and `ipg2` parameters. The additional delay set by `ipg0` helps to reduce collisions. Systems that have `lance_mode` enabled might not have enough transmission time on the network.

If `lance_mode` is disabled, the value of `ipg0` is ignored and no additional delay is set. Only the delays set by `ipg1` and `ipg2` are used. Disable `lance_mode` if other systems keep sending a large number of back-to-back packets.

You can add the additional delay by setting the `ipg0` parameter from 0 to 31, which is the media byte time delay.

TABLE 5 defines the `lance_mode` and `ipg0` parameters.

TABLE 5 Parameters Defining `lance_mode` and `ipg0`

Parameter	Values and Descriptions
<code>lance_mode</code>	0 = <code>lance_mode</code> disabled 1 = <code>lance_mode</code> enabled (default)
<code>ipg0</code>	0 to 30 = Additional IPG before transmitting a packet (after receiving a packet)

Operational Mode Parameters

TABLE 6 describes the operational mode parameters and their default values.

TABLE 6 Operational Mode Parameters

Parameter	Values and Description
<code>adv_1000autoneg_cap</code>	Local PCS capability advertised by the hardware 0 = Forced mode 1 = Autonegotiation (default)
<code>adv_1000fdx_cap</code>	Local PCS capability advertised by the hardware 0 = Not 1000 Mbits/sec full duplex capable 1 = 1000 Mbits/sec full duplex capable (default)
<code>adv_1000hdx_cap</code>	Local PCS capability advertised by the hardware 0 = Not 1000 Mbits/sec half duplex capable 1 = 1000 Mbits/sec half duplex capable (default)
<code>adv_pauseTX</code>	Local PCS capability advertised by the hardware 0 = Not Pause TX capable (default) 1 = Pause TX capable
<code>adv_pauseRX</code>	Local PCS capability advertised by the hardware 0 = Not Pause RX capable 1 = Pause RX capable (default)

Reporting Local PCS Capabilities

TABLE 7 describes the read-only PCS capabilities that GEM PCS supports. These parameters define the capabilities of the hardware.

TABLE 7 Read-Only PCS Capabilities

Parameter	Description (Local PCS Capabilities)
1000autoneg_cap	0 = Not capable of autonegotiation 1 = Autonegotiation capable
1000fdx_cap	Local PCS Full Duplex capability 0 = Not 1000 Mbits/sec full-duplex capable 1 = 1000 Mbits/sec full-duplex capable
1000hdx_cap	Local PCS Half Duplex capability 0 = Not 1000 Mbits/sec half-duplex capable 1 = 1000 Mbits/sec half-duplex capable
asm_dir_cap	Local PCS Flow Control capability 0 = Not Asymmetric Pause capable 1 = Asymmetric Pause (from Local Device) capable
pause_cap	Local PCS Flow Control capability 0 = Not Symmetric Pause capable 1 = Symmetric Pause capable

Reporting the Link Partner Capabilities

TABLE 8 describes the read-only link partner capabilities.

TABLE 8 Read-Only Link Partner Capabilities

Parameter	Description
lp_1000autoneg_cap	0 = No autonegotiation 1 = Autonegotiation
lp_1000fdx_cap	0 = No 1000 Mbits/sec full duplex transmission 1 = 1000 Mbits/sec full duplex

TABLE 8 Read-Only Link Partner Capabilities (Continued)

Parameter	Description
<code>lp_1000hdx_cap</code>	0 = No 1000 Mbits/sec half duplex transmission 1 = 1000 Mbits/sec half duplex
<code>lp_asm_dir_cap</code>	0 = Not Asymmetric Pause capable 1 = Asymmetric Pause toward link partner capability
<code>lp_pause_cap</code>	0 = Not Symmetric Pause capable 1 = Symmetric Pause capable

If the link partner is not capable of autonegotiation (when `lp_1000autoneg_cap` is 0) the remaining information described in TABLE 8 is not relevant and the parameter value = 0.

If the link partner is capable of autonegotiation (when `lp_autoneg_cap` is 1), the speed and mode information is displayed when you use autonegotiation and get the link partner capabilities.

Setting `ge` Driver Parameters

You can set the `ge` driver parameters in two ways, depending on your needs:

- Using the `ndd` utility
- Using the `ge.conf` file

Use the `ndd` utility to set parameters that are valid until you reboot the system. It is also a good way to test parameter settings.

Use the `ge.conf` file to set parameters so they remain in effect after you reboot the system. Create a `/kernel/drv/ge.conf` file and add parameter values to this file when you need to set a particular parameter for a device in the system.

Setting Parameters Using the `ndd` Utility

Use the `ndd` utility to configure parameters that are valid until you reboot the system. The `ndd` utility supports any networking driver that implements the Data Link Provider Interface (DLPI).

The following sections describe how you can use the `ge` driver and the `ndd` utility to modify (with the `-set` option) or display (without the `-set` option) the parameters for each `ge` device.

▼ To Specify the Device Instance for the `ndd` Utility

Before you use the `ndd` utility to get or set a parameter for a `ge` device, you must specify the device instance for the utility.

1. **Check the `/etc/path_to_inst` file to identify the instance associated with a particular device.**

For Sun GigabitEthernet/P:

```
# grep ge /etc/path_to_inst
"/pci@4,4000/network@4" 2 "ge"
"/pci@6,2000/network@1" 1 "ge"
"/pci@4,2000/network@1" 0 "ge"
```

In this example, the three GigabitEthernet instances are from the adapters installed in perspective PCI slots.

For Sun GigabitEthernet/S:

```
# grep ge /etc/path_to_inst
"/sbus@b,0/network@2,100000" 0 "ge"
```

In this example, the GigabitEthernet instance is from an adapter installed in a perspective SBus slot.

2. **Use the instance number to select the device.**

```
# ndd -set /dev/ge instance instance_number
```

The device remains selected until you change the selection.

Non-Interactive and Interactive Modes

You can use the `ndd` utility in two modes:

- Non-interactive
- Interactive

In non-interactive mode, you invoke the utility to execute a specific command. Once the command is executed, you exit the utility. In interactive mode, you can use the utility to get or set more than one parameter value. (Refer to the `ndd (1M)` man page for more information.)

▼ To Use the `ndd` Utility in Non-Interactive Mode

This section describes how to modify and to display parameter values.

1. To modify a parameter value, use the `-set` option.

If you invoke the `ndd` utility with the `-set` option, the utility passes *value*, which must be specified down to the named `/dev/ge` driver instance, and assigns it to the parameter:

```
# ndd -set /dev/ge parameter value
```

2. To display the value of a parameter, specify the parameter name (and omit the value).

When you omit the `-set` option, a query operation is assumed and the utility queries the named driver instance, retrieves the value associated with the specified parameter, and prints it:

```
# ndd /dev/ge parameter
```

▼ To Use the `ndd` Utility in Interactive Mode

● To modify a parameter value in interactive mode, specify `ndd /dev/ge`, as shown below.

The `ndd` utility then prompts you for the name of the parameter:

```
# ndd /dev/ge  
name to get/set? (Enter the parameter name or ? to view all  
parameters)
```

▼ To View the `ge` Driver Parameters

After entering the parameter name, the `ndd` utility prompts you for the parameter value (see TABLE 1 through TABLE 8).

- To list all the parameters supported by the `ge` driver, type `ndd /dev/ge \?`. (See TABLE 1 through TABLE 8 for parameter descriptions.)

```
# ndd /dev/ge \?
?                (read only)
link_status      (read only)
link_speed       (read only)
link_mode        (read only)
ipg1             (read and write)
ipg2             (read and write)
instance         (read and write)
lance_mode       (read and write)
ipg0             (read and write)
adv_1000autoneg_cap (read and write)
adv_1000fdx_cap  (read and write)
adv_1000hdx_cap  (read and write)
adv_pauseTX     (read and write)
adv_pauseRX     (read and write)
1000autoneg_cap (read only)
1000fdx_cap     (read only)
1000hdx_cap     (read only)
asm_dir_cap     (read only)
pause_cap       (read only)
lp_1000autoneg_cap (read only)
lp_1000fdx_cap  (read only)
lp_1000hdx_cap  (read only)
lp_asm_dir_cap  (read only)
lp_pause_cap    (read only)
#
```

Autonegotiation Mode

By default, autonegotiation is set to `on`. This means that the adapter will communicate with its link partner to determine a compatible network speed, duplex mode, and flow control capability.

If your network equipment does not support autonegotiation, or if you want to specify your network speed, you can set autonegotiation to `off` on the `ge` device.

▼ To Set Autonegotiation to Off (Forced Mode)

1. **Select the following parameters:** `adv_1000fdx_cap`, `adv_1000hdx_cap`, `adv_pauseTX` and `adv_pauseRX`, and set those values according to the user's manual that shipped with your link partner device (for example, switch). See TABLE 6 for parameter values.

2. Set `adv_1000autoneg_cap` to 0.

Setting Parameters Using the `ge.conf` File

You can also specify the properties described in this section on a per-device basis by creating a `ge.conf` file in the `/kernel/drv` directory. Use a `ge.conf` file when you need to set a particular parameter for a device in the system. The parameters you set are read and write parameters that are listed in “Driver Parameter Values and Definitions” on page 5.

The man pages for `prtconf(1M)` and `driver.conf(4)` include additional details.

Understanding the `ge.conf` File

- Obtain the hardware path names for the `ge` devices in the device tree.

Typically the path names and the associated instance numbers will be present in the `/etc/path_to_inst` file.

```
# grep ge /etc/path_to_inst
"/sbus@b,0/network@2,100000" 0 "ge"
```

- where:
 - `"/sbus@b,0/network@2,100000"` specifies the hardware node name in the device tree.
 - `"0"` is the instance number.
 - `"ge"` is the driver name.
- In the device path name, the last component after the last `/` character and before the `@` character (`network`) is the device name.
- The path name before the last component (`sbus@b,0`) is the parent name.

For Sun GigabitEthernet/S:

To identify an SBus device unambiguously in the `ge.conf` file, use the name and parent name of the device. Refer to the `sbus(4)` man page for more information about the SBus device specification.

In the previous example:

- Name = `SUNW,sbus-gem`
- Class = `"sbus"`

Note – The “name” property in the `ge.conf` file should be the same value as the “compatible” property. In this case, the value is `SUNW,sbus-gem`. See page 7 for more information about the `.properties` file.

For Sun GigabitEthernet/P:

To identify a PCI device unambiguously in the `ge.conf` file, use the name, parent name, and the unit-address for the device. Refer to the `pci(4)` man page for more information about the PCI device specification.

In the first line of the previous example:

- Name = `pci108e,2bad`
- Parent = `/pci@4,4000`
- Unit-address = 4

In the second line in the previous example:

- Name = `pci108e,2bad`
- Parent = `/pci@6,2000`
- Unit-address = 1

In the third line in the previous example:

- Name = `pci108e,2bad`
- Parent = `/pci@4,2000`
- Unit-address = 1

▼ To Set Parameters Using the `ge.conf` File on an SBus adapter

1. Set the `ipg1` and `ipg2` parameters for the above devices in the `kernel/drv/ge.conf` file.

```
name = "SUNW,sbus-gem" class = "sbus"  
reg=0x2,0x100000,0x14,0x2,0x200000,0x9060 ipg1=20 ipg2=10 ;
```

2. Save the `ge.conf` file.
3. Save and close all files and programs, and exit the windowing system.
4. If your system doesn't support DR, reboot by typing the `init 6` command at the superuser prompt.

▼ To Set Parameters Using the `ge.conf` File on a PCI adapter

1. Set the `ipg1` and `ipg2` parameters for the above devices in the

`kernel/drv/ge.conf` file.

```
name="pci108e,2bad" parent="/pci@4,4000" unit-address="4" ipg1=20
ipg2=10;
name="pci108e,2bad" parent="/pci@6,2000" unit-address="1" ipg1=20
ipg2=10;
name="pci108e,2bad" parent="/pci@4,2000" unit-address="1" ipg1=20
ipg2=10;
```

2. Save the `ge.conf` file.

3. Save and close all files and programs, and exit the windowing system.

4. Halt and reboot the system by typing the `init 6` command at the superuser prompt.

Network Configuration

This section describes how to configure the driver after it has been installed on your system.

▼ To Configure the Host Files

After installing the Sun GigabitEthernet adapter driver software, you must create a file for the adapter's Ethernet interface. You must also create both an IP address and a host name for the Ethernet interface in the `/etc/hosts` file.

1. **At the command line, use the `grep` command to search the `/etc/path_to_inst` file for `ge` interfaces.**

For Sun GigabitEthernet/P:

The following example shows the device instance from an adapter installed in slot 1.

```
# grep ge /etc/path_to_inst
"/pci@1f,4000/network@1" 0 "ge"
```

For Sun GigabitEthernet/S:

The following example shows the device instance from an adapter installed in slot 0.

```
# grep ge /etc/path_to_inst
"/sbus@1f,0/network@1" 0 "ge"
```

2. **Create an `/etc/hostname.ge<num>` file, where `num` is the instance number of the `ge` interface you plan to use.**

If you wanted to use the adapter's `ge` interface in the Step 1 example, you would need to create a `/etc/hostname.ge0` file, where 0 is the number of the `ge` interface. If the instance number were 1, the file name would be `/etc/hostname.ge1`.

- Do not create an `/etc/hostname.genum` file for a Sun GigabitEthernet adapter interface you plan to leave unused.
- The `/etc/hostname.genum` file must contain the host name for the appropriate `ge` interface.
- The host name should have an IP address and should be entered in the `/etc/hosts` file.
- The host name should be different from any other host name of any other interface: for example, `/etc/hostname.ge0` and `/etc/hostname.ge1` cannot share the same host name.

The following example shows the `/etc/hostname.genum` file required for a system called `zardo` that has a Sun GigabitEthernet adapter (`zardo-11`).

```
# cat /etc/hostname.ge0
zardo
# cat /etc/hostname.ge1
zardo-11
```

3. Create an appropriate entry in the `/etc/hosts` file for each active `ge` interface.

For example:

```
# cat /etc/hosts
#
# Internet host table
#
127.0.0.1    localhost
129.144.10.57 zardozi   loghost
129.144.11.83 zardozi-11
```

4. If your system does not support Dynamic Reconfiguration (DR), reboot.

▼ To Set Up a Diskless Client on a Server

You can set up a server so that you can boot and run diskless clients across a GigabitEthernet network.

1. Determine the client's root directory onto which you want to install the `ge` driver.

For the following example, the root directory is

```
# /export/root/client_name
```

2. Use `pkgadd` to install the `ge` driver in the root partition of the diskless client on the server, where `x` is 5.1+ for Solaris 2.5.1+, 6 for Solaris 2.6, or 7 for Solaris 7.

```
# pkgadd -R /export/root/client_name -d \
/cdrom/sun_gigabitethernet_2_0/Sol_2.x
```

3. Set up the `/export/root/client_name/hostname.genum` file. See “Network Configuration” on page 16.
4. Set up the `/export/root/client_name/hosts` file. See “Network Configuration” on page 16.

▼ To Perform a Net-Install of the Solaris Environment Over the `ge` Interface

This procedure is applicable only if you are installing the Solaris operating environment over the network using the `ge` interface.

Note – The Solaris CD-ROM cannot be used to perform a net-install since it is a read-only medium. You must use the Solaris CD image archive to update certain software files.

1. Determine the root directory of the system that will be net-installed.

For example, if the Solaris software is located within a directory named `DIR`, and the system being net-installed is already configured, then find the root directory with the `/etc/bootparams` file.

```
# grep client_name /etc/bootparams
```

If the system being net-installed is not already configured, refer to the Solaris documentation that shipped with your system for configuration instructions.

2. Install the appropriate OS driver support in the client's root directory.

For example, if you are adding the `ge` driver to the Solaris 2.5.1+ net-install client's root directory, type:

```
# pkgadd -R /DIR/export/exec/kvm/sparc.Solaris_2.5.1+ -d \  
/cdrom/sun_gigabitethernet_2_0/Sol_2.x
```

For example, if you are adding the `ge` driver to the Solaris 2.6 or 7 net-install client's root directory, type (where `x` is 6 for Solaris 2.6 or 7 for Solaris 7):

```
# pkgadd -R /DIR/Sol_2.x/etc/Tools/Boot -d \  
/cdrom/sun_gigabitethernet_2_0/Sol_2.x
```

3. At the ok prompt, type:

```
ok show-nets
```

The show-nets command lists the system devices. You should see the full path name of the network device, similar to the examples below.

For Sun GigabitEthernet/P:

```
a) /pci@1f,0/pci@1/network@3
b) /pci@1f,0/pci@1,1/network@1,1
q) NO SELECTION
Enter Selection, q to quit:
```

For Sun GigabitEthernet/S:

```
a) /sbus@1f,0/network@1,100000
b) /sbus@1f,0/SUNW,hme@e,8c00000
q) NO SELECTION
Enter Selection, q to quit:
```

4. At the ok prompt, type boot full path name of the network device.

For Sun GigabitEthernet/P:

```
ok boot /pci@1f,0/pci@1/network@3
```

For Sun GigabitEthernet/S:

```
ok boot /sbus@1f,0/network@1,100000
```

5. Proceed with the OS installation according to the instructions provided with your Solaris CD.