Sun™ Trunking 1.3 Installation and User's Guide

Sun Microsystems, Inc.
www.sun.com

Part No. 817-3374-11
June 2007, Revision A

Submit comments about this document at: `http://www.sun.com/hwdocs/feedback`

Please
Recycle

Contents

Preface

The *SunTrunking 1.3 Installation and User's Guide* describes how to install and configure the Sun Trunking™ 1.3 software. These instructions are designed for an experienced system administrator with networking knowledge.

How This Document Is Organized

This manual describes how to install and configure the Sun Trunking 1.3 software on the supported adapters.

Chapter 1 provides an overview of Sun Trunking 1.3 software, including the hardware and software requirements for using this product.

Chapter 2 describes how to prepare for and install the Sun Trunking 1.3 software packages using the automated installation script.

Chapter 3 describes how to edit and create the Sun Trunking 1.3 configuration files.

Appendix A describes how to install the Sun Trunking 1.3 software and the driver software manually.

Appendix B describes the Link Aggregation Control Protocol (LACP), which has been added to this release.

Using UNIX Commands

This document might not contain information about basic UNIX® commands and procedures such as shutting down the system, booting the system, and configuring devices. Refer to the following for this information:

- Software documentation that you received with your system
- Solaris™ Operating System documentation, which is at:

  `http://docs.sun.com`

Shell Prompts

Shell	Prompt
C shell	*machine-name*%
C shell superuser	*machine-name*#
Bourne shell and Korn shell	$
Bourne shell and Korn shell superuser	#

Typographic Conventions

Typeface[1]	Meaning	Examples
`AaBbCc123`	The names of commands, files, and directories; on-screen computer output	Edit your `.login` file. Use `ls -a` to list all files. `% You have mail.`
`AaBbCc123`	What you type, when contrasted with on-screen computer output	`% su` `Password:`
AaBbCc123	Book titles, new words or terms, words to be emphasized. Replace command-line variables with real names or values.	Read Chapter 6 in the *User's Guide*. These are called *class* options. You *must* be superuser to do this. To delete a file, type `rm` *filename*.

1 The settings on your browser might differ from these settings.

Related Documentation

The documents listed as online are available at:

`http://www.sun.com/products-n-solutions/hardware/docs/`

TABLE P-1 Related Documentation

Application	Title	Part Number
Install	*Sun Quad FastEthernet SBus Adapter Installation and User's Guide*	805-0732
Install	*Sun Quad FastEthernet SBus Adapter Release Notes*	805-1444
Install	*Sun Quad FastEthernet PCI Adapter Installation and User's Guide*	805-1797
Install	*Sun Quad FastEthernet PCI Adapter Release Notes*	805-2901
Install	*Sun GigabitEthernet/S 2.0 Adapter Installation and User's Guide*	805-2784
Install	*Sun GigabitEthernet/S 2.0 Adapter Release Notes*	805-5937
Install	*Sun GigabitEthernet/P 2.0 Adapter Installation and User's Guide*	805-2785
Install	*Sun GigabitEthernet/P 2.0 Adapter Release Notes*	805-5938
Install	*Sun GigabitEthernet SBus Adapter 1.1 User's Guide*	805-1797

TABLE P-1 Related Documentation *(Continued)*

Application	Title	Part Number
Install	*Sun GigabitEthernet SBus Adapter 1.1 Product* Notes	805-3950
Install	*Sun GigabitEthernet PCI Adapter 1.1 User's Guide*	805-2901
Install	*Sun GigabitEthernet PCI Adapter 1.1 Product Notes*	805-3952
Install	*Sun GigaSwift Ethernet PCI Adapter Installation and User's Guide*	816-1702
Install	*Sun GigaSwift Ethernet PCI Adapter Product Notes*	816-1703

Documentation, Support, and Training

Sun Function	URL
Documentation	http://www.sun.com/documentation/
Support	http://www.sun.com/support/
Training	http://www.sun.com/training/

Third-Party Web Sites

Sun is not responsible for the availability of third-party web sites mentioned in this document. Sun does not endorse and is not responsible or liable for any content, advertising, products, or other materials that are available on or through such sites or resources. Sun will not be responsible or liable for any actual or alleged damage or loss caused by or in connection with the use of or reliance on any such content, goods, or services that are available on or through such sites or resources.

Sun Welcomes Your Comments

Sun is interested in improving its documentation and welcomes your comments and suggestions. You can submit your comments by going to:

http://www.sun.com/hwdocs/feedback

Please include the title and part number of your document with your feedback:

Sun Trunking 1.3 Installation and User's Guide, part number 817-3374-11

CHAPTER 1

Overview of Sun Trunking 1.3 Software

This chapter provides an overview of the Sun Trunking 1.3 software, including the hardware and software requirements for using this product. This chapter includes the following sections:

Note – Sun Trunking 1.3 has been substantially enhanced to provide full IEEE 802.3ad compliance for existing customers. Accordingly, the syntax has been extended to support this enhancement. This enhancement is provided through patches available through the SunSolve. For more information, see "Verifying and Installing Driver Patches" on page 47.

What is Sun Trunking?

Sun Trunking 1.3 software provides the ability to aggregate multiple links so that they work in parallel as if they were a single link. Once aggregated, these point-to-point links operate as a single highly available "fat pipe" providing increased network bandwidth as well as high availability. For a given link level connection, trunking enables you to add bandwidth up to the maximum number of network interface links supported.

Sun Trunking 1.3 provides trunking support for the following network interface cards:

- Sun Quad FastEthernet adapter
- Sun Quad GigaSwift Ethernet adapter
- Sun GigabitEthernet adapter
- Sun GigaSwift Ethernet adapter
- Sun Dual FastEthernet and Dual SCSI/P adapter
- Sun Dual Gigabit Ethernet and Dual SCSI/P adapter

Sun Trunking 1.3 provides support for these adapters for Solaris 7, 8, 9, and 10 operating environment. Refer to the product documentation for both your adapter and your version of Solaris.

Hardware and Software Requirements

Before installing the Sun Trunking 1.3 software, make sure your system meets the following hardware and software requirements:

TABLE 1-1 Hardware and Software Requirements

Hardware and Software	Requirements
Hardware	Sun Ultra 60, Sun Ultra Enterprise 3x00, 4x00, 5x00, 6x00, E250, E450, Sun Enterprise 10000, 12000, 15000 Sun Fire™ 4800, Netra T3, T4, Sun Blade™ 100, 150, 1500, 2500 Netra™ T4. Sun Fire™ v20Z and v40Z
Network Interface Cards and drivers	Sun Quad FastEthernet adapter (`qfe` driver), Sun GigabitEthernet adapter (`ge` driver), Sun GigaSwift Ethernet adapter (`ce` driver), Sun Dual FastEthernet Dual SCSI/P adapter (`ce` driver) Sun Quad GigaSwift Ethernet adapter (`ce` driver), and Sun Dual Gigabit Ethernet and Dual SCSI/P adapter (`ce` driver)
OpenBoot PROM	Revision 3.x for SPARC platforms
Software	Solaris SPARC 7, 8, 9, or 10 Operating System Solaris 9 x86 or Solaris 10 x86 Operating System

CPU Requirements

Multiple trunks can be configured per server. However the total number of links aggregated depends on the server capability. As a general guideline you need a minimum of 1.25 MHz of CPU speed for every 1 Mbps of NIC bandwidth capability. Any number of aggregations is supported within this guideline.

Key Features

Sun Trunking 1.3 software implements the following key features:

- Scalable, high density bandwidth
- Automatic link-level failover
- IEEE 802.3ad compliance with support for the Link Aggregation Control Protocol (LACP), which automatically detects and prevents illegal wiring configurations.
- Dynamically add or remove trunk members
- Load balancing based on policy: MAC address, Round Robin, IP Destination Address, or IP Source Address/IP Destination Address.
- Command line interface (CLI) backward compatibility with Sun Trunking 1.2.1
- Provides the ability to aggregate ports for the following drivers:
  - `ce`, `ge`—a maximum of four ports can be aggregated
  - `qfe`—a maximum of 16 ports can be aggregated

What is New in This Release?

- New underlying software architecture for Sun GigaSwift Ethernet adapter (`ce`) support (`ge` and `qfe` remain the same)
- Solaris 7, 8, 9, 10, Solaris 9 x86, and Solaris 10 x86 Operating System support
- IEEE 802.3ad compliance through LACP and Marker Protocols.
- Extended `nettr(1M)` interface:
  - add or remove individual links
  - modify trunking configuration parameters
  - `conf` option enhanced
  - `debug` option deprecated

- Capability for multiple-IP streams into the driver for a single MAC address.
- IPv6 support.
- DR capability without unaggregating entire trunk on non-head instance
- Four `ge` interfaces are supported (Trunking 1.2.1 supported only two interfaces.)
- Automatic installation and removal of Trunking 1.3 software

CHAPTER 2

Installing Sun Trunking 1.3 Software

This chapter describes how to prepare for and install the Sun Trunking 1.3 software packages using the automated installation script. This chapter includes the following sections:

Note – Sun Trunking Utility 1.3 Software for Solaris 10 is available under the Network Connectivity section at the Sun Download Center: `http://www.sun.com/download`.

Preparing for the Software Installation

Before installing the Sun Trunking 1.3 software, you should have already installed one or more of the following adapters:

- Sun Quad FastEthernet adapter
- Sun GigabitEthernet adapter
- Sun GigaSwift Ethernet adapter
- Sun Dual FastEthernet and Dual SCSI/P adapter

Refer to your product documentation for installation instructions.

Installing the Sun Trunking 1.3 Software

Sun Trunking 1.3 provides an automated installation script. In most cases, you can use the following procedure and execute the installation script. If you have any problems, see Appendix A for manual installation procedures.

▼ To Install the Sun Trunking 1.3 Software Packages

1. **At the system console, become superuser (root).**
2. **Change to the directory where the install script resides:**

```
# cd media_path
```

Where:

media_path = `/cdrom/cdrom0`, if you are installing from the Trunking 1.3 CD-ROM

or

unzipped Trunking_1_3_path`/Trunking_1_3`, if you are installing from a download file.

3. **Execute the install script:**

```
# ./install
```

The install script verifies that the Trunking software is current or needs to be removed before installation can begin, installs the Trunking software packages, verifies the current driver software and patch if necessary. Nothing will be installed until you are prompted to `continue`.

4. **When prompted by the script, press Return to continue, or *q* followed by Return to quit.**

   CODE EXAMPLE 2-1 shows the output from the Solaris 10 Sun Trunking installation script.

CODE EXAMPLE 2-1 Output from Solaris 10 Sun Trunking Installation Script

```
Sun Trunking 1.3 Utility for sparc Installation.

Copyright 2005 Sun Microsystems, Inc.  All rights reserved.
Use is subject to license terms.

*** Checking for existing Sun Trunking 1.3 Utility for sparc
packages...
*** Checking for supporting Ethernet drivers and patches...


This script is about to take the following actions:
- Install Sun Trunking 1.3 Utility for sparc packages.


Press return to continue, or 'Q' followed by a return to quit:


*** Installing Sun Trunking 1.3 Utility for sparc packages...
Copyright 2005 Sun Microsystems, Inc.  All rights reserved.
Use is subject to license terms.
================================================================
==
Please modify /etc/opt/SUNWconn/bin/nettr.sh to set up trunking
configuration.
Please create /etc/hostname.qfeN entries for QFE trunk heads.
Please create /etc/hostname.geN entries for GEM trunk heads.
Please create /etc/hostname.ceN entries for CE trunk heads.
Reboot your system.

================================================================
==

Installation of <SUNWtrku> was successful.
Copyright 2005 Sun Microsystems, Inc.  All rights reserved.
Use is subject to license terms.

Installation of <SUNWtrkm> was successful.
*** Installing any Ethernet Driver updates...
A log of this Install can be found at:
    /var/tmp/Trunking.install.2005.02.08.0903
```

CODE EXAMPLE 2-2 shows the output from the Solaris 9 Sun Trunking installation script.

CODE EXAMPLE 2-2 Output from Solaris 9 Sun Trunking Installation Script

```
Sun Trunking 1.3 Utility for sparc Installation.

Copyright 2005 Sun Microsystems, Inc.  All rights reserved.
Use is subject to license terms.

*** Checking for existing Sun Trunking 1.3 Utility for sparc
packages...
*** Checking for supporting Ethernet drivers and patches...


This script is about to take the following actions:
- Install Sun Trunking 1.3 Utility for sparc packages.



Press return to continue, or 'Q' followed by a return to quit:


*** Installing Sun Trunking 1.3 Utility for sparc packages...
Copyright 2003 Sun Microsystems, Inc.  All rights reserved.
Use is subject to license terms.
================================================================
==
Please modify /etc/opt/SUNWconn/bin/nettr.sh to set up trunking
configuration.
Please create /etc/hostname.qfeN entries for QFE trunk heads.
Please create /etc/hostname.geN entries for GEM trunk heads.
Please create /etc/hostname.ceN entries for CE trunk heads.
Reboot your system.

================================================================

Installation of <SUNWtrku> was successful.
Copyright 2003 Sun Microsystems, Inc.  All rights reserved.
Use is subject to license terms.

Installation of <SUNWtrkm> was successful.
*** Installing any Ethernet Driver updates...
A log of this Install can be found at:
    /var/tmp/Trunking.install.2005.02.08.1337
```

▼ To Verify that Sun Trunking 1.3 Packages Are Installed

1. **Verify the presence of the driver:**

```
# pkginfo -l package
```

Where *package* = SUNWtrku, SUNWtrkm

If the command responds with packaging information, the packages are installed. If the packages are not installed, refer to Appendix A.

▼ To Remove the Sun Trunking 1.3 Packages

- **As superuser, change to the directory where the trunking packages reside and remove them:**

```
# ./remove
Note, this script DOES NOT remove Network Ethernet Driver patches.
This should not be necessary.

Trunking 1.3 package removal script, please select an option:

1) Remove Sun Trunking 1.3 Software
2) Quit
Select an option: 1

application SUNWtrku       Sun Trunking Utility for Solaris 9
system      SUNWtrkm       Sun Trunking Man Pages
About to take the following actions:
- Remove Sun Trunking 1.3 Sofware
Press 'q' followed by the return key to quit, or press any other
key followed by
the return key to continue:

*** Removing packages...

Removal of <SUNWtrku> was successful.

Removal of <SUNWtrkm> was successful.
*** Done.  A log of this removal can be found at:
        /var/tmp/Trunking.remove.2003.06.27
```

CHAPTER 3

Configuring the Sun Trunking 1.3 Software

This chapter describes how to edit and create the Sun Trunking 1.3 configuration files. This chapter includes the following sections:

Preparing for Trunking Configuration

Before rebooting your system, you can edit and create configuration files to define how you will link the Ethernet network interfaces. To configure these files, you need to know the following for each Ethernet adapter:

- The device instance numbers of each Ethernet network interface.
- The device instance number for the trunk head.
- The trunking policy you want to use: MAC, Round Robin, IP Destination, or IP Source/IP Destination. (See "Trunking Policies" on page 32.)
- The `lacp` mode you want to set (See "To Edit the `nettr.sh` File" on page 18)

Checking for Link Mode

Always check to be sure the link mode is set to run full-duplex.

Use the `kstats` (See the `kstats` manual page: `kstats(1M)`) or the `ndd` command to verify link mode. If the information returned indicates that your trunking device is not running at full-duplex, refer to your networking device product documentation for information on setting the link mode.

Booting from the Network

Once you have installed the trunking software and connected the Ethernet interfaces to a switch that is configured for trunking, you *cannot* use that interface to boot from the network.

Determining Instance Numbers

Each network interface on an Ethernet adapter has a corresponding instance number. You must know the device instance numbers for each network interface before you can configure the Sun Trunking software files.

You can find the instance numbers by searching the `/etc/path_to_inst` file.

The file contains the physical name, the instance number, and driver name for each device on the system. By searching this file, you can find the instance numbers that will be used with the Sun Trunking 1.3 software.

Note – The following examples are for a GigaSwift Ethernet adapter. If you are using a different adapter, the output will be similar. For user input, replace `ce` with `qfe` for the Quad FastEthernet adapter or `ge` for the Gigabit Ethernet adapter. The Dual FastEthernet and Dual SCSI adapter uses the `ce` driver.

Using the `grep` command, search the `path_to_inst` file for all of the devices on your system:

```
# grep ce /etc/path_to_inst
"/pci@1f,4000/network@2" 0 "ce"
"/pci@1f,4000/network@4" 1 "ce"
```

In the previous example, instances `0` and `1` are GigaSwift Ethernet adapters. Your information will be similar if you are using a different adapter. TABLE 3-1 lists the network interface number, physical name, and instance number for each GigaSwift Ethernet instance on this example system.

TABLE 3-1 Example GigaSwift Ethernet Instance Numbers

Network Interface Number	Device Name	Instance Number
0	/pci@1f,4000/network@2	0
1	/pci@1f,4000/network@4	1

You will need to know the instance numbers of the GigaSwift Ethernet network interfaces in order to configure the Sun Trunking software.

Note – You cannot trunk an interface that is already plumbed. To display a list of all plumbed interfaces, execute `ifconfig -a` command.

▼ To Resolve the Problem of Plumbed Interfaces

1. Before trunking ensure that the links are available:

```
#  ifconfig -a
lo0: flags=1000849<UP,LOOPBACK,RUNNING,MULTICAST,IPv4> mtu 8232
index 1
          inet 127.0.0.1 netmask ff000000
ce0: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500
index 942
        inet 199.99.10.10 netmask ffffff00 broadcast 199.99.10.255
          ether 8:0:20:bc:d6:fa
```

The output from the `ifconfig -a` command in the previous example shows that `ce0` is already plumbed, and therefore, cannot be aggregated.

2. Unplumb the interface as follows:

```
# ifconfig ce0 unplumb
# ifconfig -a
lo0: flags=1000849<UP,LOOPBACK,RUNNING,MULTICAST,IPv4> mtu 8232
index 1
          inet 127.0.0.1 netmask ff000000
```

3. **Setup the trunk and plumb the interface:**

```
# nettr -setup 10 device=ce members=0,1,2,3 policy=2
Aggregation (key) : 10
        ce0
        ce1
        ce2
        ce3
# ifconfig ce0 plumb 199.99.10.10 up
```

Note – The *key* represents the aggregation identifier on `ce` devices. On `ce` devices the key can be any number from 0 to 4096. On `qfe` and `ge` devices the *trunk head* represents the aggregation identifier. Therefore on `qfe` and `ge` devices the key *must* be the trunk head.

Accessing Trunk Members for `qfe` and `ge` Devices

Trunk members can be accessed *only* through the trunk head. Since trunking appears to the system as a single "fat pipe," the trunk head is the single access point. Other links in an aggregation are not plumbed beneath TCP/IP and are not visible. Networking commands such as `ifconfig(1M)` and `netstat(1M)` work only on the head instance.

You cannot do a DLPI attach on a non-head member. The following error message was returned for a `snoop` command for a non-head member:

```
# snoop -d ge1
dlattachreq:  DL_ERROR_ACK:  dl_errno 8 unix_errno 0
```

In this example, `ge1` is a member of a trunk. The trunk head for that trunk is `ge0`. To use the `snoop` command, for example, in such a case, the following would be the correct usage:

```
# snoop -d ge0
Using device /dev/ge (promiscuous mode)
         ? -> (multicast)  ETHER Type=0C34 (Unknown), size = 52 bytes
         ? -> (multicast)  ETHER Type=0C34 (Unknown), size = 52 bytes
         ? -> (multicast)  ETHER Type=0C34 (Unknown), size = 52 bytes
         ? -> (multicast)  ETHER Type=0C34 (Unknown), size = 52 bytes
```

Note – If you are using the `ce` driver, you can run the `snoop` command on all trunk member instances. But if you run the snoop command on a trunk member instance you will see duplicated packets. For best results, look at the aggregation traffic using the trunk head instance (virtual link) and `nettr -stat key`. Networking commands such as `ifconfig(1M)` and `netstat(1M)` work on any member instance.

Maximum Number of Links for Each Adapter

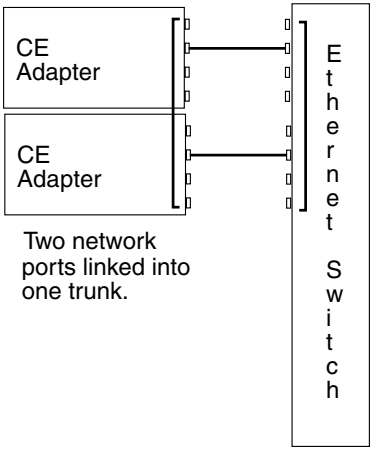
TABLE 3-2 shows a matrix of supported drivers and the maximum number of supported links for each:

TABLE 3-2 Matrix of Supported Drivers and Number of Links

Driver	Supported Links
`qfe`	16 links
`ge`	4 links
`ce`	4 links

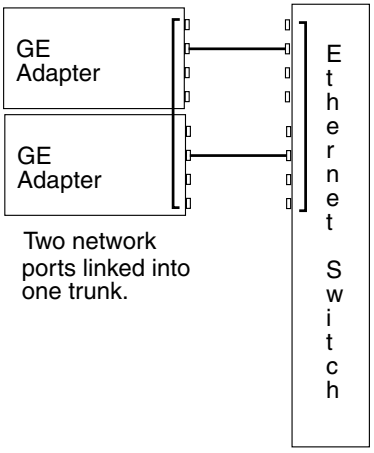
The two network interfaces of the GigaSwift Ethernet (`ce`) adapter can be linked as follows.

FIGURE 3-1 GigaSwift Ethernet Trunking Network Configuration Example



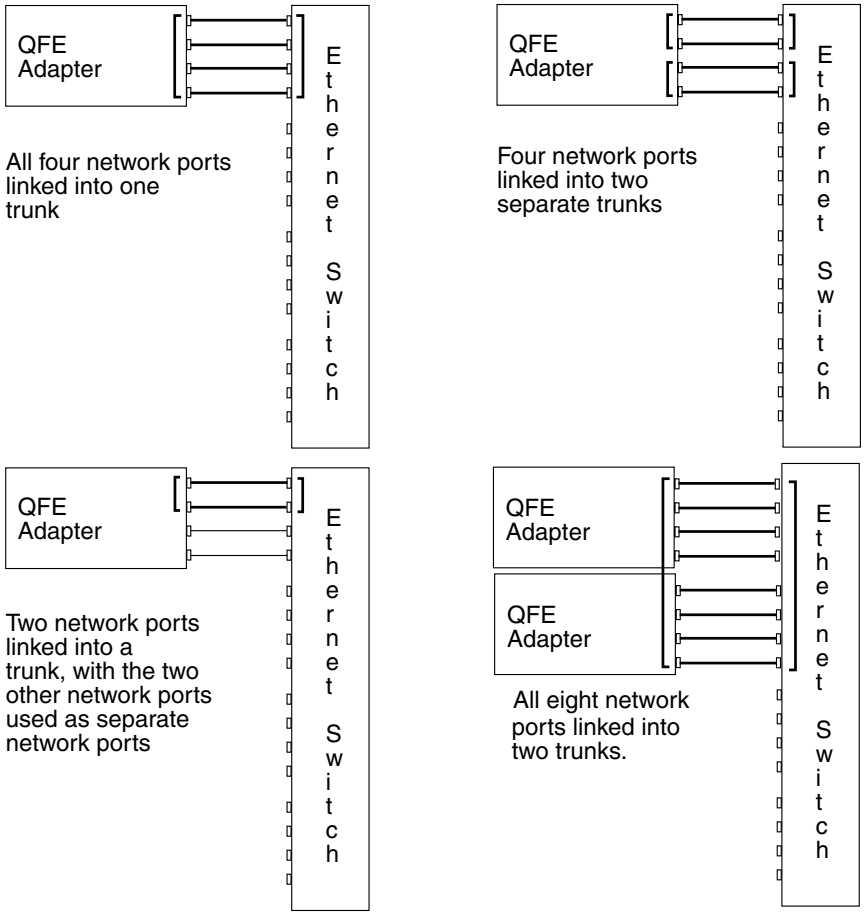
The two network ports of the GigabitEthernet (`ge`) adapter can be linked as follows.

FIGURE 3-2 GigabitEthernet Trunking Network Configuration Example



The four network ports of the Quad FastEthernet (`qfe`) adapter can be linked in a number of ways, depending on the needs of your network. All four of the network ports can be linked into one trunk, or two network ports can be linked into one trunk. FIGURE 3-3 shows four different common linking possibilities.

FIGURE 3-3 Quad FastEthernet Trunking Network Configuration Examples



The configuration of the Sun Trunking 1.3 software files depends on how you want to organize the Ethernet network. You must also configure the Ethernet switch software to be symmetrical with the way you configured the Sun Trunking 1.3 software. Refer to your Ethernet switch documentation for the switch configuration instructions.

`local-mac-address?` Property

Each Ethernet adapter has been assigned a unique Media Access Control (MAC) address, which represents the 48-bit Ethernet address for that network interface. Each host system also provides a single global MAC address. For historical reasons,

the default MAC address for each interface is that of the single global host MAC address rather than the MAC address of each individual Ethernet adapter. This must be modified for trunking. You can set the OpenBoot firmware `local-mac-address` property.

The `mac-address` property of the network device specifies the network address (system-wide or `local-mac-address?`) used for booting the system. To start using the MAC addresses assigned to the network interface of the Ethernet adapter, set the NVRAM configuration variable `local-mac-address?` to `true`.

```
ok setenv local-mac-address? true
```

Client machines with multiple interfaces that communicate with the trunked machine should also set `local-mac-address?` to `true`.

Using Trunking Auto-configuration Setup at Boot Time

After locating the instance numbers of the Ethernet network interfaces, and deciding how you want to organize your network, you can begin to configure the Sun Trunking 1.3 software.

▼ To Edit the `nettr.sh` File

This section describes the minimum set of instructions to configure trunking. For more details, see "Configuring Trunking with the `nettr` Utility" on page 26.

The main configuration file of the Sun Trunking 1.3 software is the `/etc/opt/SUNWconn/bin/nettr.sh` file. You will define each trunk by adding information to this file. Before you edit the `nettr.sh` file, you must know how many Ethernet network interfaces you want to link into a trunk, the trunking policy and the `lacp` mode of operation. You can also add new members to an existing trunk or delete an existing member from the trunk.

- **Using a text editor, add commands to the `nettr.sh` file to define your trunking network.**

In the `nettr.sh` file, add the following `nettr` command to configure a `ce` trunk. Use the following format to set up a trunk:

```
./nettr -setup <key> device=<dev1> members=<instance,...>
                [ { device=<dev2> members=<instnace,...> }... ]
                [ policy=<policy-no> ]
                [ mac=<a:b:c:d:e:f> ]
                [ lacp=<A|a|P|p|O|o> [ ptimer=<0|1> ] ]
```

In the `nettr.sh` file, add the following `nettr` command to configure a `ge` or `qfe` trunk. Use the following format to set up a trunk:

```
./nettr -setup <head-inst> device=<qfe | ge> members=<instance,...>
                [ policy=<policy-no> ]
```

In the previous command, the *key* is the aggregation identifier for (`ce` devices) *head-inst* is the aggregation identifier for `qfe` or `ge` devices. The *device* represents the adapter type (`qfe` for a Quad FastEthernet adapter or `ce` for GigaSwift Ethernet adapter, or `ge` for Gigabit Ethernet). The member option is used to select members of a trunk. The `policy` option can either be the default value of 1 for MAC or 2 for round robin, 3 for IP Destination, or 4 for IP Source/IP Destination. For the `lacp` option, specify `lacp` mode of operation. It can be Active (A|a), Passive (P| p), or Off (O| o). For the `ptimer` option, specify a short(0) or long(1) `lacp` timeout value.

Note – The following examples use the instance numbers found in TABLE 3-1. *The instance numbers on your system will be different*. See "Determining Instance Numbers" on page 12 for more information.

- If you want to use the MAC trunking policy and two links for a trunk, add the following line to the `nettr.sh` file:

```
nettr -setup 10 device=ce members=0,1 policy=1 lacp=p ptimer=1
```

- Check the output that results from executing the `nettr -conf lacp` command after executing the `-setup` commands.

  It will be similar to the following:

```
# nettr -conf lacp
Key: 10; Policy: 1;
Aggr MAC address: 0:3:ba:34:a2:43
Name    Original-Mac-Addr   Speed   Duplex   Link Status
----    -----------------   -----   ------   ---- ------
ce0     0:3:ba:34:a2:43     1000    full     up    enb
ce1     8:0:20:e3:61:74     1000    full     up    enb

Name   Pri     Prt/Pri  sync  mode  timeout  coll/dist  cfg  state  delay(us)
----   ---     -------  ----  ----  -------  ---------  ---  -----  ---------
ce0    4096     0/4096   no   pas    long       enb      adm   act     100
ce1    4096     1/4096   no   pas    long       enb      adm   act     100
```

- For two trunks, containing two network interfaces each using the MAC policy, you would add these two lines:

```
nettr -setup 10 device=ce members=0,1 policy=1 lacp=p ptimer=1
nettr -setup 20 device=ce members=2,3 policy=1 lacp=p ptimer=1
```

Note – The command syntax of Sun Trunking 1.3 is fully compatible with Trunking 1.2.1. Existing `nettr.sh` files do not need any modifications.

- To verify whether you have set up the trunking configuration file correctly, run the `nettr -run` command. You should see information similar to the following:

```
# nettr -run

Configuring Sun Trunking devices

Aggregation (key) : 10
  ce0
  ce1

Aggregation (key) : 20
  ce2
  ce3
```

- Execute the `nettr -conf` command to check the configuration.

```
# nettr -conf
Key: 10; Policy: 1;
Aggr MAC address: 0:3:ba:34:a2:43
Name    Original-Mac-Addr   Speed   Duplex   Link Status
----    -----------------   -----   ------   ---- ------
ce0     0:3:ba:34:a2:43     1000    full     up    enb
ce1     8:0:20:e3:61:74     1000    full     up    enb


Key: 20; Policy: 1;
Aggr MAC address: 8:0:20:e3:61:75
Name    Original-Mac-Addr   Speed   Duplex   Link Status
----    -----------------   -----   ------   ---- ------
ce2     8:0:20:e3:61:75     1000    full     up    enb
ce3     8:0:20:e3:61:76     1000    full     up    enb
```

▼ To Configure the Host Files

Before you can use these trunked Ethernet network interfaces, you must create an `/etc/hostname.`*driver*# file.

Where *driver* = `ce` for GigaSwift Ethernet, `ge` for Gigabit Ethernet, or `qfe` for Quad FastEthernet

= instance number

Then add an entry in the `/etc/hosts` file for each trunk.

1. **For each trunk, create a `/etc/hostname.ce`# file, where # corresponds to the instance number used as the trunk head.**

   For example, if you had two trunks using two network interfaces each, you would have to create two files containing the host name of the trunk as seen by network. The extensions of these files would have to correspond with the trunk head interface numbers of the trunks.

TABLE 3-3 Example `hostname.ce`# Files

Filename	GigaSwift Ethernet Adapter Network Interfaces Used in the Trunk[1]
`/etc/hostname.ce0`	0, 1
`/etc/hostname.ce2`	2, 3

[1] See FIGURE 3-1 for more information.

- The `/etc/hostname.ce#` file must contain an appropriate host name for the trunk.
- The host name should be different from any other host name of any other interface, for example: `/etc/hostname.ce0` and `/etc/hostname.ce2` cannot share the same host name.
- The host name should have an IP address that is entered in the `/etc/hosts` file (see Step 2).

  Using the example in TABLE 3-3, the following example shows the three `/etc/hostname.`*device*`#` files required for a system called `proboscis`, which has an onboard `bge` device (`proboscis`), and two trunks (`proboscis-11`, `proboscis-12`).

```
# cat /etc/hostname.bge0
proboscis
# cat /etc/hostname.ce0
proboscis-11
# cat /etc/hostname.ce2
proboscis-11
```

2. **Create an appropriate entry in the `/etc/hosts` file for each trunk.**

   Using the example from Step 1, you would have:

```
# cat /etc/hosts
#
# Internet host table
#
127.0.0.1     localhost
129.144.10.57 proboscisloghost
129.144.11.83 proboscis-11
129.144.12.41 proboscis-12
```

Note – Make sure you configure the switch software to be symmetrical with the Sun Trunking 1.3 software. Refer to your Ethernet switch documentation for instructions.

▼ To Activate the Networks Without Rebooting

- **Setup the `ce` adapter using the `ifconfig` command, where *ip_address* corresponds to the system IP address.**

```
# ifconfig ce0 plumb
# ifconfig ce0 ip_address up
```

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

The following example shows the `/etc/hosts` file.

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

Note – Make sure you configure the switch software to be symmetrical with the Sun Trunking 1.3 software. Refer to your Ethernet switch documentation for instructions.

▼ To Reboot and Activate the Trunked Networks

If you do not use `ifconfig`, you will need to reboot your system to make these trunked networks active. If you did use the previous `ifconfig` instructions, you can ignore this section.

1. **Shut down your system.**

```
# sync
# init 0
Shutdown messages.
```

2. **Set `local-mac-address?` to `true`.**

```
ok setenv local-mac-address? true
```

3. **Perform a reconfiguration boot.**

```
ok boot -r
```

Verifying the Auto-configuration Setup

You can verify trunking networks using the `ifconfig` and the `nettr` commands.

Use the `ifconfig -a` command to print out the addressing information for each interface on the system.

```
# /usr/sbin/ifconfig -a
lo0: flags=849<UP,LOOPBACK,RUNNING,MULTICAST> mtu 8232
        inet 127.0.0.1 netmask ff000000
hme0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST> mtu
1500
        inet 129.144.131.27 netmask ffffff00 broadcast
129.144.131.255
        ether 8:0:20:8f:bf:79
ce0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST> mtu
1500
       inet 199.100.2.10 netmask ffffff00 broadcast 199.100.2.255
        ether 8:0:20:8d:2f:ff
```

Even though a trunk may be composed of two linked GigaSwift Ethernet network interfaces, the `ifconfig -a` command will only print out the addressing information for the plumbed interface (`ce0` in the example above).

For a more complete listing of the `ce` devices, use the `nettr -conf` command. This command prints out a list of the trunked `ce` instances on the system.

```
# /etc/opt/SUNWconn/bin/nettr -conf
Key: 10; Policy: 1;
Aggr MAC address: 0:3:ba:34:a2:43
Name    Original-Mac-Addr   Speed   Duplex   Link Status
----    -----------------   -----   ------   ---- ------
ce0     0:3:ba:34:a2:43     1000    full     up    enb
ce1     8:0:20:e3:61:74     1000    full     up    enb
```

The `nettr -conf` command will also show the policy of each trunk on the system, as well as listing the original MAC address of each interface.

For `qfe` or `ge`, use the `nettr -stat` *trunkhead* `device=`*device* command to monitor the network statistics of each interface on the system.

Where:

trunkhead is the trunk head interface number of the trunk you want to monitor

device is `qfe` or `ge`

```
# /etc/opt/SUNWconn/bin/nettr -stats 0 device=ge
Mar 30 15:26:58 2003

Name    Ipkts     Ierrs   Opkts   Oerrs   Collis   Crc    %Ipkts %Opkts

ge0   66518099    0      67498218     0      0       0     50.00   50.00
ge1   66527490    0      67498218     0      0       0     50.00   50.00
```

This command will list each interface and the network performance statistics, of the specified trunk. See "Configuring Trunking with the `nettr` Utility" on page 26 for more information.

You can also monitor the network statistics of a trunk at regular intervals. The full usage of the command is `nettr -stats` key *interval=sec*, with *sec* being the number of seconds between monitoring the trunk's interfaces. In the example below, the trunk is monitored once every second.

```
# /etc/opt/SUNWconn/bin/nettr -stats 0 interval=1
Mar 30 15:26:58 2003

Name    Ipkts     Ierrs   Opkts   Oerrs   Collis   Crc    %Ipkts %Opkts

ce0   66518099    0      67498218     0      0       0     50.00   50.00
ce1   66527490    0      67498218     0      0       0     50.00   50.00
```

You can also use the `netstat(1M)` or `kstat(1M)` command to monitor the network statistics. Refer to the `netstat(1M)` and `kstat(1M)` `man` pages for more information.

Disabling the Sun Trunking Interface

To permanently disable the trunking interface, comment out the `nettr` command in the `/etc/opt/SUNWconn/bin/nettr.sh` file. You will need to reconfigure the `/etc/hostname.ce#` and `/etc/hosts` files if you want to use the Ethernet network interfaces separately. Refer to the product documentation for more information.

Configuring Trunking with the `nettr` Utility

You can use the `nettr(1M)` utility to configure trunking. Use `nettr(1M)` to:

- set up a trunk
- release a trunk
- add a new trunk member
- remove an existing member of the trunk
- modify the trunking parameters
- display a trunk configuration
- display statistics of trunked interfaces

Command Syntax

Following is the command syntax for `nettr`.

CODE EXAMPLE 3-1 Command Syntax for `nettr`

```
nettr -setup <key> device=<dev1> members=<instance,...>
              [ { device=<dev2> members=<instnace,...> }... ]
              [ policy=<policy-no> ]
              [ mac=<a:b:c:d:e:f> ]
              [ lacp=<A|a|P|p|O|o> [ ptimer=<0|1> ] ]
      nettr -setup <head-inst> device=<qfe | ge> members=<instance,...>
              [ policy=<policy-no> ]

      nettr -stats <key>
              [ type=<1|2> ] [ interval=<number> ]
      nettr -stats <head-inst> device=<qfe | ge>
              [ type=<1|2> ] [ interval=<number> ]

      nettr -release <key>
      nettr -release <head-inst> device=<qfe | ge>

      nettr -add <key>
              device=<dev1> members=<instance,...>
              [ { device=dev2> members=<instnace,...> }... ]

      nettr -rem <key>
              device=<dev1> members=<instance,...>
```

CODE EXAMPLE 3-1 Command Syntax for `nettr` *(Continued)*

```
nettr -setup <key> device=<dev1> members=<instance,...>
              [ { device=dev2> members=<instnace,...> }... ]

       nettr -mod <key>
              [ policy=<policy-no> ]
              [ lacp=<A|a|P|p|O|o> ] [ ptimer=<0|1> ]

       nettr -conf [ <lacp> ]
       nettr -conf

       nettr -run [ <file> ]
       nettr -run

       nettr -policy

       nettr -hash <key>
              { [ mac=dest-mac-address> ] |
              [ ip=dest-ip-address ] |
              [ ip=src-ip-addr/dest-ip-addr ] }
       nettr -hash <head-inst> device=<ge | qfe>
              { [ mac=dest-mac-address> ] |
              [ ip=dest-ip-address ] |
              [ ip=src-ip-addr/dest-ip-addr ] }
```

Enabling the Sun Trunking Interface

Use the following format to enable the trunking interface for ce devices:

```
nettr -setup <key> device=<dev1> members=<instance,...>
              [ { device=<dev2> members=<instnace,...> }... ]
              [ policy=<policy-no> ]
              [ mac=<a:b:c:d:e:f> ]
              [ lacp=<A|a|P|p|O|o> [ ptimer=<0|1> ] ]
```

The key is the aggregation identifier and can be any number you choose. It does not have to be tied to a member instance. The *device* represents the adapter type (`ce`). The member option is used to select members of a trunk. The `policy` option can either be the default value of 1 for MAC or 2 for round robin, 3 for IP Destination, or 4 for IP Source/IP Destination. For the `lacp` option specify `lacp` mode of operation. It can be Active(A|a), Passive(P| p), or Off(O| o). For the `ptimer` option, specify a short(0) or long(1) `lacp` timeout value.

For ge and qfe devices the format of this command is:

```
nettr -setup <head-inst> device=<qfe | ge> members=<instance,...>
                [ policy=<policy-no> ]
```

In the previous command, the head instance is the instance number of the first linked network interface of the trunk. The *device* represents the adapter type (qfe for a Quad FastEthernet adapter or ge for GigabitEthernet adapter). The member option is used to select members of a trunk. The policy option can either be the default value of 1 for MAC or 2 for round robin, 3 for IP Destination, or 4 for IP Source/IP Destination. If you want to use the MAC trunking policy and two links for a trunk, execute the following line:

```
nettr -setup 0 device=ge members=0,1 policy=1
```

Verifying the Sun Trunking Interfaces

You can verify trunking networks using the ifconfig and the nettr commands.

Use the ifconfig -a command to print out the addressing information for each interface on the system.

```
# /usr/sbin/ifconfig -a
lo0: flags=849<UP,LOOPBACK,RUNNING,MULTICAST> mtu 8232
        inet 127.0.0.1 netmask ff000000
hme0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST> mtu
1500
        inet 129.144.131.27 netmask ffffff00 broadcast
129.144.131.255
        ether 8:0:20:8f:bf:79
ce0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST> mtu
1500
       inet 199.100.2.10 netmask ffffff00 broadcast 199.100.2.255
        ether 8:0:20:8d:2f:ff
```

Even though a trunk can be composed of two linked GigaSwift Ethernet network interfaces, the ifconfig -a command will only print out the addressing information for the key head interfaces (ce0 in the previous example).

Use the `nettr -conf` command to print out a list of trunked `ce` instances on the system.

```
# nettr -conf
Key: 10; Policy: 1;
Aggr MAC address: 0:3:ba:34:a2:43
Name    Original-Mac-Addr   Speed   Duplex   Link Status
----    -----------------   -----   ------   ---- ------
ce0     0:3:ba:34:a2:43     1000    full     up    enb
ce1     8:0:20:e3:61:74     1000    full     up    enb
```

In the previous example, the `ce0` interface is the key for a two-network interface trunk, composed of the `ce0`, and `ce1` interfaces. The `nettr -conf` command also shows the policy of each trunk on the system and lists the original MAC address of each interface.

Use the `nettr -stat` *key* `device=`*device* command to monitor the network statistics of each interface on the system.

Where:

key is the trunk head interface number of the trunk you want to monitor

device is `qfe` or `ge`

```
# /etc/opt/SUNWconn/bin/nettr -stats 0
Mar 30 15:26:58 2003

Name   Ipkts    Ierrs  Opkts  Oerrs  Collis  Crc   %Ipkts %Opkts

ge0   66518099   0     67498218    0     0      0     50.00   50.00
ge1   66527490   0     67498218    0     0      0     50.00   50.00
```

The `nettr -stats` command will list each interface and the network performance statistics, summarized in TABLE 3-4, of the specified trunk.

TABLE 3-4 Output of the `nettr -stats` Command

Network Statistic	Definition
`Ipkts`	The number of Ethernet packets inputted into the interface.
`Ierrs`	The number of errors that occurred while inputting these Ethernet packages.
`Opkts`	The number of Ethernet packets outputted through the interface.
`Oerrs`	The number of errors that occurred while outputting these Ethernet packages.
`Collis`	The number of collisions detected on the interface.

TABLE 3-4 Output of the `nettr -stats` Command

Network Statistic	Definition
`Crc`	The number of cyclic redundancy check (CRC) errors detected on the interface.
`%Ipkts`	The percent of Ethernet packets input to the interface.
`%Opkts`	The percent of Ethernet packets output through the interface.

You can also monitor the network statistics of a trunk at regular intervals. For a Sun GigaSwift Ethernet driver, the full usage of the command is `nettr -stats` *key device=[ce] interval=sec*, with *sec* being the number of seconds between monitoring the trunk's interfaces. In the example below, the trunk is monitored once every second.

```
# /etc/opt/SUNWconn/bin/nettr -stats 0 interval=1
Mar 30 15:26:58 2003

Name   Ipkts    Ierrs  Opkts  Oerrs  Collis  Crc   %Ipkts %Opkts

ce0   66518099   0     67498218    0     0      0    50.00   50.00
ce1   66527490   0     67498218    0     0      0    50.00   50.00
```

To monitor the network statistics of a trunk for a Sun Gigabit Ethernet driver or a Sun Quad FastEthernet driver, the full usage of the command is `nettr -stats` *trunkhead device=[ge|qfe] interval=sec*, with *sec* being the number of seconds between monitoring the trunk's interfaces. In the example below, the trunk is monitored once every second.

```
# /etc/opt/SUNWconn/bin/nettr -stats 0 interval=1
Mar 30 15:26:58 2003

Name   Ipkts    Ierrs  Opkts  Oerrs  Collis  Crc   %Ipkts %Opkts

ge0   66518099   0     67498218    0     0      0    50.00   50.00
ge1   66527490   0     67498218    0     0      0    50.00   50.00
```

You can also use the `netstat(1M)` or `kstat(1M)` command to monitor the network statistics. Refer to the `netstat(1M)` and `kstat(1M)` `man` pages for more information.

Adding a Trunk Member

If you need to add a new member to the trunk, use `-add` command.

```
# nettr -add 10 device=ce members=3
```

With the new member added to the trunk, the output from the `-conf` command would look similar to the following:

```
# nettr -conf
Key: 10; Policy: 1;
Aggr MAC address: 0:3:ba:34:a2:43
Name    Original-Mac-Addr   Speed   Duplex   Link Status
----    -----------------   -----   ------   ---- ------
ce0     0:3:ba:34:a2:43     1000    full     up    enb
ce1     8:0:20:e3:61:74     1000    full     up    enb
ce3     8:0:20:e3:61:76     1000    full     up    enb
```

Removing a Trunk Member

If you need to remove a member from the trunk, use `-rem` command.

```
# nettr -rem 10 device=ce members=1
```

The previous command removes `ce1` from the trunk. The output from the `-conf` command would look similar to the following:

```
# nettr -conf
Key: 10; Policy: 1;
Aggr MAC address: 0:3:ba:34:a2:43
Name    Original-Mac-Addr   Speed   Duplex   Link Status
----    -----------------   -----   ------   ---- ------
ce0     0:3:ba:34:a2:43     1000    full     up    enb
ce3     8:0:20:e3:61:76     1000    full     up    enb
```

Disabling the Sun Trunking Interface

If you need to disable a trunk, use the `nettr -release` *key* command, with *key* being the trunk identifier.

```
# /etc/opt/SUNWconn/bin/nettr -release 0 device=ce
```

`nettr` automatically unplumbs IPv4 and IPv6 stacks. If any other application (such as VLAN) are plumbed, remember to manually unplumb the application.

Load Balancing Methods

Trunking Policies

The four supported trunking policies used in the Sun Trunking 1.3 software are MAC, Round Robin, IP Destination, and IP Source+Destination. With these policies, if a link fails, the traffic failsover to the next available link. The policies are defined below.

MAC

- Is the default policy used by the Sun Trunking 1.3 software. MAC is the preferred policy to use with switches. Most trunking-capable switches require using the MAC-hashing policy, but check your switch documentation.
- Uses the last three bits of the MAC address of both the source and destination. For two ports, the MAC address of the source and destination are first XORed: Result = 00, 01, which selects the port.
- Favors a large population of clients. For example, this ensures that 50 percent of the client connections will go through one of two ports in a two-port trunk.
- Is required by most trunking-capable switches.

Note – Do not use MAC-hashing for connecting two servers back to back.

Round Robin

- Is the preferred policy with a Back to Back connection, used between the output of a transmitting device, and the input of an associated receiving device.
- Uses each network interface of the trunk in turn, as a method of distributing packets over the assigned number of trunking interfaces.
- May have an impact on performance since the temporal ordering of packets is not observed.

IP Destination Address

- Uses the four bytes of the IP Destination address to determine the transmission path.
- Is the preferred policy to use if a trunking interface host has one IP source address, and it is necessary to communicate to multiple IP clients connected to the same router.

IP Source Address/IP Destination Address

- Connects the source server to the destination, based on where the connection originated or terminated.
- Uses the four bytes of the source and destination IP addresses to determine the transmission path.

  The primary use of the IP Source/IP Destination Address policy occurs where you use the IP virtual address feature to give multiple IP addresses to a single physical interface. For example, you might have a cluster of servers providing network services, in which each service is associated with a virtual IP address over a given interface. If a service associated with an interface fails, the virtual IP address migrates to a physical interface on a different machine in the cluster. In such an arrangement, the IP Source Address/IP Destination Address policy gives you a greater chance of using more, different links within the trunk than would the IP Destination Address policy.

  The `-hash` option to the `nettr` (`1M`) command enables you to determine over which link a given packet will travel. The following section describes hashing in greater detail.

Note – Sun Trunking 1.3, like any server trunking software, load balances the outgoing traffic, not the incoming packets. Trunking 1.3 software relies on the link partner (switch or server) to load balance the incoming packets.

▼ To Use the Hashing Feature

Note – Trunking interfaces must be set up prior to using hashing features. If, for example, on one trunk, the link to transmit is 0, with the following hash command input, the policy IP Source and Destination Address would read as follows:

```
# /etc/opt/SUNWconn/bin/nettr -hash 0 device=ce ip=
199.100.1.29/199.100.1.3

Name  Key  Policy  Source Address   Dest Address   Link to Transmit
ce0   ce0   4     199.100.1.29       199.100.1.3      0
```

The `-hash` option to the `nettr` (`1M`) command enables you to determine over which link a given packet will travel. For example, if you use the Destination IP Address policy, you can supply an IP address to a `nettr -hash` command to determine over which link a packet with the specified IP address will travel.

Interoperability

Sun Trunking 1.3 operates as a virtual network adapter that is visible to the system through the head or key instance. Applications will work transparently as though they are on a single link, yet experience the benefits of increased bandwidth and automatic failover. On applications that deal with a physical NIC, such as DR, you must simply unaggregate the trunk prior to performing those functions, then reaggregate the trunk when you are finished.

IEEE 802.3ad Link Aggregation

Sun Trunking 1.3 works in the static mode with 802.3ad switches. For a link to be part of an aggregation it must be running at full-duplex and at the same speed. The endpoints of the links must be terminated at the same switch or system.

Sun Trunking 1.3 also supports dynamic mode providing a fully compliant IEEE 802.3ad implementation. This includes the LACP protocol and associated Marker Responder. For more information on the LACP protocol, see Appendix B.

IP Multipathing

IP Multipathing (IPMP) works transparently with Sun Trunking 1.3. Configure two aggregations (two trunk-heads) and group these two aggregations into one IPMP group.

Note – IPMP failover may not happen if one of the links in an aggregation fails because Sun Trunking 1.3 software will failover to the next available link in the aggregation.

▼ To Perform Dynamic Reconfiguration

Dynamic Reconfiguration (DR) works transparently with Sun Trunking 1.3. Here is how it works:

1. **Unconfigure the aggregation:**

```
# nettr -release
```

2. **Unconfigure the Ethernet adapter:**

```
# cfgadm
```

3. **Change the Ethernet adapter.**

4. **Configure the Ethernet adapter:**

```
# cfgadm
```

5. **Reconfigure the aggregation:**

```
# nettr -setup
```

VLAN

Sun Trunking 1.3 works transparently with 802.1q, but it is available only on Sun GigaSwift Ethernet adapters. For more information on configuring VLANs, refer to "Configuring VLANs," in the *Sun GigaSwift Ethernet Adapter Installation and User's Guide*, part number 816-1702-11.

When configuring VLANs on an aggregation (trunk), make sure that the link partner (or switch) has VLAN enabled on all the ports belonging this aggregation.

SunVTS Diagnostic Software

The SunVTS software executes multiple diagnostic hardware tests and is used to verify the configuration and functionality of most hardware controllers and devices.

Since trunking aggregates many network adapters behind a single head instance, these tests may not provide the information intended. Unaggregate all trunking interfaces to be tested before running SunVTS.

If you still want to use the SunVTS `nettest` option on an aggregated link, use the Round Robin policy option and then use the `nettr -stats` option to ensure that test traffic is flowing over all interfaces in the aggregation.

Note – To use the `nettest` diagnostic, you must have the SunVTS software installed on your system. Refer to the *Solaris Sun Hardware Platform Guide*, which was shipped with the *Solaris Supplement* CD, for instructions on how to install the SunVTS software.

Caution – Do not run the SunVTS `netlbtest` when links are aggregated. This test will not make sense on aggregated links because the packets are distributed to multiple links based on the load balancing policy.

Performance Tuning

Refer to the Solaris operating environment user documentation for more information.

- For maximum performance, network traffic should be evenly distributed across the aggregation. Use `nettr -stats` command to ensure that packets are being evenly distributed. See "Load Balancing Methods" on page 32 for a full description of load balancing policies.
- To get better performance from `ge` or `ce` running at 1000Mbps, install each adapter in different PCI or Sbus slot. Note that some slots utilize the same PCI bus. Refer to your system documentation for more information.

- For optimum performance, use 2 MHz of CPU speed for every 1 Mbps of NIC bandwidth capability. Any number of aggregations is supported within this guideline.
- For better performance from a GigaSwift Ethernet card (`ce`) add the following to the driver configuration file `ce.conf` under `/platform/sun4u/kernel/drv`:

```
interrupts=1;
```

- To get better throughput over the TCP/IP stack, execute the following at the command line:

```
# ndd -set /dev/tcp tcp_xmit_hiwat 65536
# ndd -set /dev/tcp tcp_recv_hiwat 65536
# ndd -set /dev/tcp tcp_maxpsz_multiplier 10
```

Plumbing Multiple Streams on Trunk Members

The default behavior for Sun Trunking 1.3 does not expose trunk members to upper layers like IP. However, for performance sake, you may want to plumb multiple IP streams on member instances with different subnets on the trunk members to derive multiple connections to IP. You can achieve this by setting the `laggr_multistream` tuning variable in ce driver using `ndd` or `ce.conf` file.

▼ To Configure Using `ndd`

1. **Release all trunks to the `ce` device.**

```
# ./nettr -conf

# ndd -set /dev/ce instance 0
# ndd -set /dev/ce laggr_multistream 1
# ndd -set /dev/ce instance 1
# ndd -set /dev/ce laggr_multistream 1
```

2. **Repeat for all member instances within the trunk**

You can configure the trunk now and plumb on one or all member instances.

```
# nettr -setup ....
# ifconfig ce0 plumb ...
# ifconfig ce1 plumb ....
```

▼ To Configure Using `driver.conf`

1. **Edit the `/platform/sun4u/kernel/drv/ce.conf` file and add the following line:**

```
laggr_multistream=1;
```

Note – This feature is available only on Sun GigaSwift Ethernet (`ce` device drivers). When enabling this feature, be aware that certain Layer 3 protocols (like IPMP or Routing) may not work properly. It is best used in local LAN setup. This feature is disabled for VLAN streams. So, VLAN streams can only be plumbed on the key instance.

For example:

```
# ./nettr -setup 2 device=ce members=2,3

Aggregation (key) : 2
        ce2
        ce3

trunk5-127# ifconfig ce123003 plumb 199.99.23.102 up
Sep  1 15:14:36 trunk5-127 ce: NOTICE: Vlan Capability available
only on trunkhead
ifconfig: SIOCSLIFNAME for ip: ce123003: no such interface
# ifconfig ce123002 plumb 199.99.23.102 up
#
```

Troubleshooting

If you have problems with Sun Trunking 1.3, use the following commands to gather information that may help resolve the problems.

Using the `stats` Option

Use the `nettr -stats` command to check whether network packets are showing in each trunk instance. In the following example, 1 represents the trunk head instance being monitored.

```
# /etc/opt/SUNWconn/bin/nettr -stats 0
Mar 30 15:26:58 2003

Name   Ipkts   Ierrs    Opkts  Oerrs  Collis  Crc   %Ipkts  %Opkts

ce0   66518099    0   67498218    0      0      0      50.00  50.00
ce1   66527490    0   67498218    0      0      0      50.00  50.00
```

If you use MAC policy, you may not see packets on certain interfaces, as shown in the example. This occurs because two or more clients may have MAC addresses with the last two bits identical. See "Trunking Policies" on page 32 for more information.

Using the `snoop` Command

Use the `snoop -d` command to capture and inspect network packets. This command enables you to troubleshoot network problems at the packet level, allowing examination of the contents of a packet. The following shows example output for ce0.

```
# snoop -d ce0
Using device /dev/ce (promiscuous mode)
199.100.1.10 -> 199.100.1.11 TCP D=5100 S=59412  Ack=2577009842
Seq=391268307  Len=1460 Win=8760
199.100.1.10 -> 199.100.1.11 TCP D=5100 S=59412  Ack=2577009842
Seq=391269767 Len=1460 Win=8760
199.100.1.10 -> 199.100.1.11 TCP D=5100 S=59412  Ack=2577009842
Seq=391271227  Len=1460 Win=8760
```

In this example, if there were packets meant for hostname `hs4-net11`, but none showed in the output from the `snoop` command, you would know a problem existed. In that case, you would check your host file, network connection, or your ethernet switch setup. Refer to the `snoop(1M)` man page for more information.

Because of the trunk head concept (as virtual link) in Sun Trunking 1.3, you might expect the `snoop` command on the trunk head instance to monitor the aggregation traffic. While Sun provides a feature in `ce` drivers that allows you to snoop the trunk member instance to monitor the running traffic on that instance, using the `snoop` command on trunk member instance can present confusing results.

The best way to look at the aggregation traffic is by using the trunk head instance (virtual link) and the `nettr -stat` key instead of using the `snoop` command on the trunk member instance. For example, if `ce0` and `ce1` are aggregated and ce0 is the trunk head and you run `snoop` on both `ce0` and `ce1`, you will see some duplicated packets appear on the `snoop` output for both instances. That is because all the packets to this aggregation link will be seen by the `snoop` command to the trunk head instance (`ce0`), which appears as a "fat pipe" presenting this aggregation link, and at the same time, the packets physical using the trunk member port will also be seen by the `snoop` command to this trunk member instance (`ce1`).

Networking commands such as `ifconfig` (1M) and `netstat` (1M) work on any member instance.

Using the `conf` Option

Use the `nettr -conf` command to verify your trunking configuration.

```
# nettr -conf
Name    Key      Policy DEV Type   Original-Mac-Addr   Speed   Duplex    Link

 ce0   ce0          2         pci    8:0:20:8f:be:24      1000    Full      Up
 ce1   ce0                    pci    8:0:20:8f:be:24      1000    Full      Up
```

Make sure the Ethernet switch software and the Sun Trunking 1.3 software are configured symmetrically. For example, both Sun Trunking and the switch should be configured with the same number of links per trunk.

Once you have configured Sun Trunking 1.3 software, be sure to re-configure your switch to match the trunking configuration.

Error Messages

See your console for error messages when configuring a Sun GigaSwift Ethernet adapter or a Sun Dual FastEthernet and Dual SCSI/P adapter for trunking. It is best to aggregate and unaggregate links on the console because error messages from the console and `nettr` are displayed inline.

Note – If you are configuring a Sun Gigabit Ethernet adapter or a Sun Quad FastEthernet adapter, error messages are returned by `nettr`, but may not appear in the console.

- If you try to configure a trunk that has already been configured, you will see the following error message from `nettr`:

```
# ./nettr -setup 0 device=ce members=0,1,2
./nettr: ioctl failed: Invalid argument
```

A message similar to the following appears in the console stating that the aggregation already exists:

```
Jul  8 15:36:55 proboscis trslm: NOTICE: trunk(0): Aggregation
exists.
```

- If you try to configure a trunk member that is part of another aggregation, you will see the following message from `nettr`:

```
# ./nettr -setup 4 device=ce members=0,4
./nettr: ioctl failed: Invalid argument
```

A message similar to the following appears in the console stating that the aggregation already exists:

```
Jul  8 15:38:18 proboscis trslm: NOTICE: trunk link (ce0): device
instance in use on aggregation 0
```

- If you try to configure a non-existent member as part of an aggregation, `nettr` will fail as follows:

```
# ./nettr -setup 7 device=ce members=7,8
./nettr: ioctl failed: I/O error
```

A message similar to the following appears in the console stating that the aggregation already exists:

```
trslm: NOTICE: trunk link (ce7): DL_ERROR_ACK for DL_ATTACH_REQ(11),
errno 8, unix 0
```

- If the policy is set out of range, you will see an error message and trunk will be setup with default policy=1(MACSD).

```
proboscis#  nettr -setup 1 device=ce members=0,1,2,3 policy=7
Jul 10 17:40:04 trunk5-127 laggr: trunk(1) laggr_ioc: Policy 7 not
within supported range(1 - 4), Using default Policy 1
```

- If you plumb trunk member, you will see following message. The following example shows, an attempt to plumb ce2, which is already aggregated and is a trunk member. Plumbing is allowed only on the trunk-head.

```
proboscis#  ifconfig ce2 plumb
ifconfig: Jul 10 17:57:59 trunk5-127 ce: NOTICE: Illegal BIND to
trunk mbr
SIOCSLIFNAME for ip: ce2: no such interface
```

User Hints

- Aggregate and unaggregate from the console because error messages from the console and `nettr` are displayed inline.
- After aggregating the links, be sure that the head instance is plumbed using `ifconfig`.
- Remember that *only* IPv4 and IPv6 are unplumbed during `nettr -release` operation. You must unplumb all other VLANs and applications running on the head instance manually.
- `netlbtest` in SunVTS fails when the links are aggregated. If you want to run `netlbtest` on an interface, unconfigure trunking on that interface.

Getting Help

If you cannot resolve the problems and you have a SunService contract, send the information gathered from these commands to your SunService representative. You must have the following information ready:

- Product name and release number (Sun Trunking 1.3)
- Model number of your machine
- Solaris release number

Use the `showrev` command to display your operating system release:

```
% showrev
Hostname: proboscis-11
Hostid: 8081d6ca
Release: 5.9
Kernel architecture: sun4u
Application architecture: sparc
Hardware provider: Sun_Microsystems
```

APPENDIX **A**

Installing the Software Packages Manually

This appendix describes how to install the Sun Trunking 1.3 software and the driver software manually. This appendix includes the following sections:

Verifying Required Driver Software

You cannot activate the Sun Trunking 1.3 software until the driver software is installed.

▼ To Verify that the Software is Installed

1. Verify the presence of the driver software:

- If your system is booted using the 32-bit kernel:

```
# pkginfo -l package
```

  Where *package* = `SUNWqfed`, `SUNWged`, or `SUNWced`

- If system is booted using the 64-bit kernel:

```
# pkginfo -l package
```

Where *package* = `SUNWqfedx`, `SUNWgedx`, or `SUNWcedx`

SUNWqfed, SUNWqfedx (for QuadFast Ethernet)

SUNWged, SUNWgedx (for Gigabit Ethernet)

SUNWced, SUNWcedx (for GigaSwift Ethernet and Dual FastEthernet and Dual SCSI/P)

If the command responds with packaging information, the packages are installed. If the packages are not installed, refer to your product documentation.

Installing the Driver Software

You can install the packages from the Solaris release media for the installed version of the Solaris operating environment. However, if you are using the Solaris 7 or Solaris 8 operating environment with Gigabit Ethernet, GiagaSwift Ethernet, or Dual FastEthernet and Dual SCSI/P adapters, install the packages from the Trunking 1.3 CD-ROM. The packages on the Trunking 1.3 CD-ROM contain a pre-applied patch, so you will not need to install the required Solaris 7 or Solaris 8 patch for the driver after you install the driver packages from the Trunking 1.3 CD-ROM.

▼ To Install the Gigabit Ethernet Software for Solaris 7

1. As superuser (root), change to the following directory:

```
# cd media_path/Solaris_7/GigabitEthernet/Packages
```

Where:

media_path = `/cdrom/cdrom0`, if you are installing from the Trunking 1.3 CD-ROM

or

unzipped Trunking_1_3_path`/Trunking_1_3`, if you are installing from a download file.

2. Install the packages as follows:

```
# pkgadd -d . SUNWged SUNWgedm SUNWgedu
```

Answer `y` for package installation questions.

▼ To Install the GigaSwift Ethernet Software or Dual Fast Ethernet Software for Solaris 7 or 8 OS

1. As super-user (root), change directories as follows:

```
# cd media_path/Solaris_x/GigaSwiftEthernet/Packages
```

Where *x* = 7 for Solaris 7, 8 for Solaris 8

Where:

media_path = `/cdrom/cdrom0`, if you are installing from the Trunking 1.3 CD-ROM

or

unzipped Trunking_1_3_path`/Trunking_1_3`, if you are installing from a download file.

2. Install the packages:

- For Solaris 7:

```
# pkgadd -d . SUNWced.u SUNWcedu SUNWcedx
```

- For Solaris 8:

```
# pkgadd -d . SUNWced.u SUNWcedu SUNWcedx SUNWvld SUNWvldu SUNWvldx
```

Answer `y` for package installation questions.

Verifying and Installing Driver Patches

Ensure that the latest patches are installed on your system.

- **Use the** `showrev` **command to see if the latest patches are currently installed.**

```
# showrev -p | grep patch-id
```

If the following patches (or more recent versions) are present, proceed with the Sun Trunking 1.3 software installation. If the patch version is less than indicated below, install the patches as described in the next section.

The patches are installed in the various product directories. The following patch versions (or higher) are required to support Trunking 1.3:

- GigaSwift Ethernet Driver
  - Solaris 7 112327-12
  - Solaris 8111883-18 or 112119-02 if VLAN utility is installed.
  - Solaris 9112817-10 or 114600-02 if VLAN utility is installed
  - Solaris 10 SPARC118777-08 and 119648-03 if VLAN utility is installed
  - Solaris 10 x86118778-07 and 119649-03 if VLAN utility is installed
- Gigabit Ethernet Driver
  - Solaris 7 106765-11
  - Solaris 8108813-15
  - Solaris 9113361-06
  - Solaris 10 118945-01
- Quad FastEthernet Driver
  - Solaris 7 107743-14
  - Solaris 8108806-15
  - Solaris 9 112764-06
  - Solaris 10118981-03

▼ To Install the Patches for Solaris 7, 8, or 9 OS

1. **Change to the directory of the desired patch area:**

```
# cd media_path/Solaris_x/network_product/Patches
```

Where:

media_path = `/cdrom/cdrom0`, if you are installing from the Trunking 1.3 CD-ROM

or

unzipped Trunking_1_3_path`/Trunking_1_3`, if you are installing from a download file.

x = Solaris Version: 7, 8, or 9

network_product = GigaSwiftEthernet, GigabitEthernet, or QuadFast Ethernet

Install the required patch:

```
# patchadd patch_id
```

Where *patch_id* = See "Verifying and Installing Driver Patches" on page 47 for the patch list.

▼ To Install the Patches for Solaris 10 OS

1. **Change to the directory of the desired patch area:**

```
# cd unzipped Trunking_1_3_path/Trunking_1_3/Solaris_10/Patches/arch
```

Where:

unzipped Trunking_1_3_path = the directory path where the downloaded unzipped trunking directory is located

arch = sparc or i386

2. **Install the required patch:**

```
# patchadd patch_id
```

Where *patch_id* = See "Verifying and Installing Driver Patches" on page 47 for the patch list.

Installing the Trunking Software

Once the desired network Ethernet drivers are installed and updated, the Trunking packages can be installed.

▼ To Install Trunking Packages for Solaris 7, 8, or 9 OS

1. **Change to the directory of the Trunking packages:**

```
# cd media_path/Solaris_x/Trunking/Packages
```

Where:

media_path = `/cdrom/cdrom0`, if you are installing from the Trunking 1.3 CD-ROM

or

unzipped Trunking_1_3_path`/Trunking_1_3`, if you are installing from a download file.

x = Solaris Version: 7, 8, or 9

2. **Install the packages:**

```
# pkgadd -d . SUNWtrku SUNWtrkm
```

Answer `y` for package installation questions.

▼ To Install Trunking Packages for Solaris 10 OS

1. **Change to the directory of the Trunking packages:**

```
# cd unzipped Trunking_1_3_path/Trunking_1_3/Solaris_10/Trunking/Packages/arch
```

Where:

unzipped_Trunking_1_3_path = the directory path where the downloaded unzipped trunking directory is located

arch = sparc or i386

2. **Install the packages:**

```
# pkgadd -d . SUNWtrku SUNWtrkm
```

Answer y for package installation questions.

APPENDIX **B**

Link Aggregation Control Protocol

This appendix describes the Link Aggregation Control Protocol (LACP), which has been added to this release. This appendix includes the following sections:

Overview

Sun provides a fully compliant IEEE 802.3ad implementation including the LACP protocol and associated Marker Responder.

Link Aggregation Control Protocol

The following quotation is taken directly from the 802.3ad specification,

> The Link Aggregation Control Protocol (LACP) provides a standardized means for exchanging information between Partner Systems on a link to allow their Link Aggregation Control instances to reach agreement on the identity of the Link Aggregation Group to which the link belongs, move the link to that Link Aggregation Group, and enable its transmission and reception functions in an orderly manner.

Information from received LACP messages is used to determine which physical ports to bind to which Aggregators and to control the operation of the Distributors and Collectors within each Aggregator.

Each device refers to itself as an Actor (that is, the device taking action) and to the device at the other end of the link as its Partner: LACP compares Actor information with that of the Partner to determine what action to take.

LACP ensures that aggregations are created only among links that interconnect the same pair of devices. An Actor will only consider aggregating links when received LACP information indicates that the same system is the Partner for all links in the potential aggregation.

LACP Benefits

The Sun implementation of LACP provides two basic benefits:

At the time that a user is requesting a link to aggregate, LACP will communicate with the Partner system to determine that the port is suitable for aggregation. If not, the port will remain associated with the aggregation yet there will be no traffic on this link until such time that the partner system information becomes suitable for aggregation or the link is unaggregated. The nettr(1M) command will return success in either case.

After a link has been successfully aggregated, LACP will detect if a Partner link is moved or cannot be unaggregated in some other way. If the link cannot be unaggregated, LACP will disable the port's Collector_Distributor and the link status will be continually monitored. Data traffic will not flow on the port until such time that the link can be aggregated. The user will be notified of such events. A few examples follow:

An example where LACP is beneficial is when a user decides to dynamically add a NIC to a system and request that it join an aggregation. LACP will dynamically determine if the NIC is plugged into the appropriate switch and add it to the aggregation if everything is correct.

Another example is where network interfaces on a Sun system are connected across layer 2 switches. When a user requests to aggregate, LACP will prevent links with a different System ID (MAC) from transmitting data. Without LACP, links that are statically aggregated would cause spanning tree to break a link Additionally, the illegal configuration would succeed.

Preventing traffic from flowing on illegal configurations in the first place is helpful. Subsequently, when encountering illegal configurations due to modifications, disconnecting the transmit/receive functions of the offending links and issuing user warnings also provides benefit.

Marker Protocol

The Marker Protocol includes the Marker Responder as well as the Marker Generator and Receiver for functionally correct load distribution schemes. Trunking 1.3 implements the Marker Responder as specified in 802.3ad. The 802.3ad standard also provides two methods to ensure that packets are not disordered when moving conversations. They are time-outs and the Marker Generator. Either a time-out can be used or the Distributor can send an explicit Marker PDU after the last frame in a conversation. Sun uses the timeout method with an initial default value of 2500Us prior to moving a conversation to another link.

Note – LACP will never aggregate a link that has not been previously configured through the `nettr`(1M) utility.

Dynamic link aggregation is disabled by default. This is called LACP_OFF. If enabled, the values can be either LACP_PASSIVE or LACP_ACTIVE. This can be controlled by a `nettr`(1M) option to turn on LACP. This option can also be modified after links have been aggregated through the -mod option.

System priorities are configured on all systems and switches that are running 802.3ad. A lower numerical value, such as 0, has a higher system priority than a higher numerical value. A system with a higher System Aggregation Priority can dynamically modify it's operational Key values.

Sun Trunking 1.3 has a default System Priority value of 0x1000. This is a very low system priority. Switches must retain the ability to dynamically alter their Actor Operational parameters such as key values. The link aggregation configuration on the Sun system on the other hand, is statically determined at the time the aggregation is specified through `nettr`(1M).

Index

T