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Contents

Preface

This document describes the Dynamic Reconfiguration (DR) feature, which enables you to service system boards without the need to reboot the system. With DR you can power down an individual board slot rather than the entire system. The commands and descriptions in this document apply to Sun™ Enterprise™ 3*x*00, 4*x*00, 5*x*00, and 6*x*00 systems.

Sun Documentation on the Web

For the late-breaking information about Dynamic Reconfiguration, refer to the DR web site. You can find information about supported hardware, firmware updates, known bugs, and documentation errata at:

`http://sunsolve2.Sun.COM/sunsolve/Enterprise-dr/`

The `docs.sun.com` web site enables you to access Sun technical documentation on the World Wide Web. You can browse the `docs.sun.com` archive or search for a specific book title or subject at:

`http://docs.sun.com`

Using UNIX Commands

This document may not contain information on basic UNIX® commands and procedures such as shutting down the system, booting the system, and configuring devices.

See one or more of the following for this information:

- *Solaris 2.7 Handbook for Sun Peripherals*
- AnswerBook^{TM} online documentation for the Solaris^{TM} 2.7 software environment
- Other software documentation that you received with your system

Typographic Conventions

TABLE P–1   Typographic Conventions

Typeface or Symbol	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. Command-line variable; replace with a real name or value.	Read Chapter 6 in the *User's Guide.* These are called *class* options. You *must* be root to do this. To delete a file, type rm *filename.*

Shell Prompts

TABLE P–2 Shell Prompts

Shell	Prompt
C shell	*machine_name*%
C shell superuser	*machine_name*#
Bourne shell and Korn shell	$
Bourne shell and Korn shell superuser	#

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Overview

The Dynamic Reconfiguration (DR) features described in this user's guide are specific to Sun™ Enterprise™ 3000, 3500, 4000, 4500, 5000, 5500, 6000, and 6500 systems. These features may not apply to other types of server systems.

Directory of Service Procedures

Use this list to find information and service procedures in this book.

- Checking the status of a board, see: "How to Monitor Board Status" on page 6
- Finding the system name of a board or device, see: "How to Monitor Board Status" on page 6
- Determining what types of boards are supported by DR: "Hardware Support" on page 8
- Determining what software patches are needed: "Software Patches" on page 9
- Installing a new board, see: "Installing a New Board" on page 27
- Installing a board for use as a spare unit, see: "Installing a New Board" on page 27
- Removing or replacing a board, see: "Removing a Board" on page 22
- Removing a device driver that does not support DR, see: "Removing Boards that Use Detach-Unsafe Drivers" on page 25
- Connecting storage devices to an I/O board, see: "Adding Storage Devices" on page 29
- Adding modules or I/O cards to a board, see: "Adding Storage Devices" on page 29

What Is DR?

The DR software package enables a service provider to safely add, remove, or modify some types of system hardware while the system is still running.

You can use DR commands to:

- Shorten the interruption of system applications while installing or removing a board

- Disable a failing device by removing it from the logical configuration, before the failure can crash the operating system

- Display the operational status of boards in a system

- Initiate system tests of a board while the system continues to run

- Reconfigure a system while the system continues to run

- Invoke hardware-specific functions of a board or a related attachment

This release of DR uses a command-line user interface. The primary command for Dynamic Reconfiguration is the configuration administration program `cfgadm`. Refer to the `cfgadm(1M)` man page for further details.

Description and Functions

This chapter describes how Dynamic Reconfiguration (DR) works and explains the terms used in DR.

Using this Guide

1. **Determine the name and status of the board or card cage slot. You will find it listed in the online DR status report. See "How to Monitor Board Status" on page 6.**

2. **In the following table, find the entry corresponding to the condition of the board or device, then go to the procedure or reference listed in the Service Reference column.**

TABLE 2–1 DR Conditions

Condition	Explanation	Service Reference
empty	No board is present in the slot. All LEDs are off.	To install a board, see "Installing a New Board" on page 27
disconnected	A board is present but is electrically disconnected. The system is able to identify the board type. The board LEDs show that the board is in low power mode and can be unplugged at any time. LEDs: green, yellow , green (Off, On, Off) Use `cfgadm -c disconnect` to enable this state.	To remove a disconnected board, refer to the service manual for the system. To power up a disconnected board, see "Installing a New Board" on page 27
connected	The board is electrically connected and powered up. The system is actively monitoring the board for temperature and cooling. LEDs: green, yellow, green (On, Off, Off) Use `cfgadm -c connect` to enable this state.	To remove a connected board, see "Removing a Board" on page 22. To use a connected board, see "Installing a New Board" on page 27.
configured	Devices on the board are fully initialized and may be mounted or configured for use. The LEDs show the normal running pattern. LEDs: On, Off, Flash Use `cfgadm -c configure` to enable this state.	To remove a configured board, see "Removing a Board" on page 22.
unconfigured	The unconfigured state covers all other device states, including receptacles in the empty state. The LED pattern is the same as for the connected receptacle state. LEDs: green, yellow, green (On, Off, Off) Use `cfgadm -c unconfigure` to enable this state.	To remove an unconfigured board, see "Removing a Board" on page 22. To use an unconfigured board, see "Installing a New Board" on page 27.

TABLE 2–1   DR Conditions   *(continued)*

Condition	Explanation	Service Reference
unknown	The current condition cannot be determined. This situation results either when a new board is inserted in a running system, or a board is placed on the disabled board list prior to a reboot. A transition to a connected receptacle state will change an attachment point condition from unknown to either OK or Failed.	To use an unknown board, see "Installing a New Board" on page 27
ok	No problems have been detected. This condition can only occur after a board has been connected. This condition will persist either until the board is physically removed, or a problem is detected. An ok condition requires correct hardware compatibility, correct firmware revision, adequate power, adequate cooling, and adequate precharge.	To remove an ok board, see "Removing a Board" on page 22
failing	A failing condition can only occur when a board that was in the OK condition develops a problem. For example, the board has begun to overheat. This condition will be displayed until the problem is corrected or the attachment point is disconnected.	To remove a failing board, see "Removing a Board" on page 22. To correct an overheating condition, see the system service manual.

TABLE 2–1   DR Conditions   *(continued)*

Condition	Explanation	Service Reference
failed	The board has failed POST/OBP. A failed condition may occur either during bootup or after a failed connect attempt. This condition is considered uncorrectable and will persist until the board is physically removed. For a failed attachment point condition, the receptacle state should never transition beyond disconnected.	To remove a failed board, see "Removing a Board" on page 22.
unusable	Either an attachment point has incompatible hardware, or an empty attachment point lacks power, cooling, or precharge current. An unusable condition is correctable. This condition is caused by one of the following events: (1) inadequate cooling in a slot, (2) power is detected in an empty slot, (3) a disconnected board has inadequate cooling, inadequate power, or unsupported hardware, or (4) firmware has detected a problem either during bootup or when a board is inserted.	To remove a board from an unusable slot, see "Removing a Board" on page 22. To correct overheating conditions in the slot, refer to the system service manual.

How to Monitor Board Status

The cfgadm program can display the status of DR boards and slots.

When used without options, the cfgadm command displays a simple list of all known DR attachment points in the system. Here is a typical output:

Figure 2–1   Typical Display for the `cfgadm` Command

When used with the -v option, the `cfgadm` command displays a more detailed list:

Figure 2–2   Typical Display for the `cfgadm` Command with the -v Option

Here are some useful details of the display:
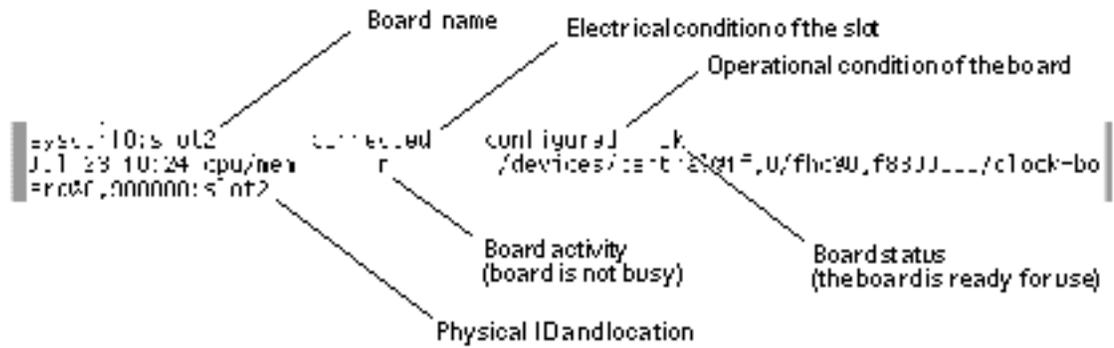
Figure 2–3   Details of the Display for `cfgadm -v`

Hardware Support

The following table lists currently supported and unsupported boards.

TABLE 2–2   Supported and Unsupported Boards

Name	Supported?	Board Identification
CPU/memory	No	
CPU/memory+	No	
I/O type 1 (SBus)	Yes	3 SBus slots, 2 FC/OM fiber channel slots
I/O type 2	Yes	Graphics slot, 2 SBus slots, 2 FC/OM fiber channel slots
I/O type 3	No	2 PCI slots, 2 FC/OM fiber channel slots
I/O type 4	Yes	3 SBus slots, 2 GBIC (FC/AL) fiber channel slots
I/O type 5	Yes	Graphics slot, 2 SBus slots, 2 GBIC (FC/AL) fiber channel slots

> **Note -** Support for additional types of boards is being developed. Refer to the DR web site (see below) or the release notes supplement for Solaris™ 7 for any changes to this list.

```
http://sunsolve2.Sun.COM/sunsolve/Enterprise-dr/
```

Software Patches

For software patch requirements, refer to the release notes supplement for Solaris™ 7, or the DR web site at:

```
http://sunsolve2.Sun.COM/sunsolve/Enterprise-dr/
```

Definitions

Attachment Point

Attachment point: a collective term for a board and its card cage slot.

DR can display the status of the slot, the board, and the attachment point. For DR purposes, a board also includes the devices connected to it, so the DR term *occupant* is used to refer to the combination of board and attached devices.

- A slot (also called a *receptacle*) may have the ability to electrically isolate the occupant from the host machine. That is, DR software can put a single slot into low-power mode.
- Receptacles can be named according to slot numbers or can be anonymous (for example, a SCSI chain). To obtain a list of all available logical attachment points, use the `-l` option with the `cfgadm` command.
- An occupant I/O board includes any external storage devices connected by interface cables.

There are two types of system names for attachment points:

- A *physical* attachment point describes the software driver and location of the card cage slot. An example of a physical attachment point name is:

```
/devices/central@1f,0/fhc@0,f8800000/clock-board@0,900000:sysctrl,slot0
```

- A *logical* attachment point is an abbreviated name created by the system to refer to the physical attachment point:

```
sysctrl0:slot0
```

Detachability

A board is not detachable if it has a critical resource (such as a boot drive) connected to it. Similarly, if a system has only one CPU board, the CPU board cannot be detached.

For a device to be detachable:

- The device driver must support DDI_DETACH

- Critical resources must be accessible through an alternate pathway

If there is no alternate pathway for an I/O board, you can:

- Put the second disk chain on a separate I/O board. The secondary I/O board can be detached (with a loss of access to the secondary disk chain).

- Add a second path to the device through a second I/O board. The I/O board can be detached (using Alternate Pathing software to switch access through the alternate board) without losing access to the secondary disk chain.

Conditions and States

State: the operational status of either a receptacle (slot) or an occupant (board).

Condition: the operational status of an attachment point.

The cfgadm program can display 10 types of states and conditions. See Table 2–1.

Note - For a receptacle procedure to be valid, the receptacle must transition in sequence through all three states (empty, disconnected, connected) or in the reverse sequence (connected, disconnected, empty).

Connection and Configuration

There are four main types of DR operations:

Connection: in this operation, the slot provides power to the board and begins monitoring the board temperature.

Configuration: the operating system assigns functional roles to a board and loads device drivers for the board and for devices attached to the board.

Unconfiguration: the system detaches a board logically from the operating system and takes the associated device drivers offline. Environmental monitoring continues, but any devices on the board are not available for system use.

Disconnection: the system stops monitoring the board and power to the slot is turned off.

If a system board is in use, before powering it off and removing it, stop its use and unconfigure it. After a new or upgraded system board is inserted and powered on, connect its attachment point and configure it for use by the operating system.

`cfgadm` can connect and configure (or unconfigure and disconnect) in a single command, but if necessary, each operation (connection, configuration, unconfiguration, or disconnection) can be performed separately.

Hot-plug Hardware

Hot-plug: hot-plug boards and modules have special connectors which supply electrical power to the board or module before the data pins make contact. Boards and devices which do not have hot-plug connectors cannot be inserted or removed while the system is running.

I/O boards and CPU/memory boards used in Enterprise x000 and x500 systems are hot-plug devices. Some devices, such as the clock board and peripheral power supply (PPS), are not hot-plug modules and cannot be removed while the system is running.

Quiescence

Quiescence: during a DR unconfigure/disconnect operation on a system board with non-pageable Open Boot PROM (OBP) or kernel memory, the operating system is briefly paused, which is known as operating system quiescence. All operating system and device activity on the backplane must cease for a few seconds during a critical phase of the operation.

Before it can achieve quiescence, the operating system must temporarily suspend all processes, processors, and device activities. If the operating system cannot achieve quiescence, it displays the reasons, which may include the following:

- A user thread did not suspend
- Real-time processes are running
- A device exists that cannot be paused by the operating system

The conditions that cause processes to fail to suspend are generally temporary. Examine the reasons for the failure. If the operating system encountered a transient condition—a failure to suspend a process—you can try the operation again.

Suspend-Safe and Suspend-Unsafe Devices

suspend-safe: a suspend-safe device is one that does not access memory or interrupt the system while the operating system is in quiescence. A driver is suspend-safe if it supports operating system quiescence (suspend/resume). It also guarantees that when a suspend request is successfully completed, the device that the driver manages will not attempt to access memory, even if the device is open when the suspend request is made.

suspend-unsafe: a suspend-unsafe device is one that allows a memory access or a system interruption while the operating system is in quiescence.

Suspend-safe drivers provide the ability to:

- Stop user threads
- Execute the `DDI_SUSPEND` call in each device driver
- Stop the clock
- Stop the CPUs

The operating system refuses a quiescence request if a suspend-unsafe device is open. To manually suspend the device, you may have to close the device by killing the processes that have it open, asking users not to use the device, or disconnecting the cables. For example, if a device that allows asynchronous unsolicited input is open, you can disconnect its cables prior to activating operating system quiescence and reconnect them after the operating system resumes. This action prevents traffic from arriving at the device and, thus, the device has no reason to access the backplane.

Testing for Suspend-Safe Drivers

The `quiesce-test` option tests for suspendable drivers.

```
# cfgadm -x quiesce-test sysctrl#:slot#
```

Tape Devices

The sequential nature of tape devices prevents them from being reliably suspended in the middle of an operation, and then resumed. Therefore, all tape drivers are suspend-unsafe. Before executing a DR operation that activates operating system quiescence, make sure all tape devices are closed or not in use.

Installation of a Board or Device

The installation of a new board involves the DR connection and configuration operations described below. If the board is intended to be a spare board, it must additionally be disabled now, then enabled when you later wish to use it.

For the board installation procedure, see "Installing a New Board" on page 27.

To add a storage device to an existing board, see "Adding Storage Devices" on page 29.

Board Connection

After physically inserting a board in the card cage, logically connect the board:

```
# cfgadm -c connect sysctrl#:slot#
```

sysctrl#:slot# is the logical attachment point identification (the system name for the board), which can be found in the `cfgadm` status display.

The states and conditions for the attachment point before a board is inserted are:

- Receptacle state—Empty
- Occupant state—Unconfigured
- Condition—Unknown

After a board is physically inserted, the states and conditions are:

- Receptacle state—Disconnected
- Occupant state—Unconfigured
- Condition—Unknown

After the attachment point is logically connected, the states and conditions are:

- Receptacle state—Connected
- Occupant state—Unconfigured
- Condition—OK

Now the system is aware of the board, but not the usable devices which reside on the board. Temperature is monitored and power and cooling affect the attachment point condition.

Board Configuration

To logically configure a board (add the board to the system configuration), enter:

```
# cfgadm -c configure sysctrl#:slot#
```

The states and conditions for a configured attachment point are:

- Receptacle state—Connected
- Occupant state—Configured
- Condition—OK

Now the system is also aware of the usable devices which reside on the board and all devices may be mounted or configured to be used.

If the configure operation fails for any reason, the states and conditions will still transition to configured. This creates a special situation where the board is partially configured. In this situation, only an *unconfigure* operation is allowed. A further attempt to configure the partial configuration is not permitted.

Disabling a Board

If a board is to be kept in the system for use as a spare board, enter this board in the disabled board list. This prevents the board from being used when the system is turned on or rebooted.

To disable a board, use the EEPROM command:

```
# eeprom disabled-board-list=sysctrl#:slot#
```

Alternatively, you can use the DR command:

```
# cfgadm -c disconnect -o disable-at-boot sysctrl#:slot#
```

Note that disabled boards remain in the cfgadm status display even if a different board is subsequently placed in the same slot.

Enabling an Unconfigured Board

A running system may contain one or more unconfigured boards. That is, the boards are not being used by the system. These unconfigured boards may have been:

- Hot-swapped into the system after the system was booted

- Disabled by the EEPROM setting `disable-board-list`
- Previously unconfigured

To enable a board, use the configure option described above.

Addition of Storage Devices

To add a storage device, see "Adding Storage Devices" on page 29.

Removal of a Board

The removal of a board requires the devices attached to the board be prepared, followed by the unconfiguration and disconnection of the board, as described below.

For the removal procedure, see "Removing a Board" on page 22.

Preparing I/O and Network Devices

A board with vital system resources cannot be detached unless alternate resources are available on another board. A boot disk is an example of a vital system resource.

A board hosting non-vital system resources can be unconfigured whether or not there are alternate paths to the resources. All of its file systems must be unmounted and its swap partitions must be deleted. You may have to kill processes that have open files or devices, or place a hard lock on the file systems (using *lockfs(1M)*) before unmounting them. All I/O device drivers must be detachable.

The system swap space should be configured as multiple partitions on disks attached to controllers hosted by different boards. With this kind of configuration, a particular swap partition is not a vital resource because swap partitions can be added and deleted dynamically. See *swap(1M)* for more information.

Note - When memory or disk swap space is detached, there must be enough memory or swap disk space remaining in the machine to accommodate currently running programs.

I/O Board Unconfiguration

Note - The screen, mouse, and keyboard will not be operational while the system is suspended, but you will regain control of these devices after the suspension.

Preparation of an I/O Board for Removal

Before the Unconfigure operation can be completed, you must manually terminate usage of all I/O devices on the board, including network interfaces.

Note - To identify the components that are on the board to be unconfigured, use the `ifconfig`, `mount`, `pf`, or `swap` commands. The `prtdiag(1M)` command provides some information, but is less informative.

Termination of Network Devices

DR does not automatically terminate use of all network interfaces on the board that is being disconnected. You must manually terminate the use of each interface.

DR does not allow an Unconfigure operation on any interface that fits the following conditions. In these cases, the Unconfigure operation fails and DR displays an error message.

- The network interface is the primary network interface for the machine. That is, the IP address of the interface corresponds to the network interface name contained in the file `/etc/nodename`. Halting the primary network interface for the machine prevents network information name services from operating, which results in the inability to make network connections to remote hosts using applications such as `ftp(1)`, `rsh(1)`, `rcp(1)`, `rlogin(1)`. NFS client and server operations are also affected.

- The active alternate for an Alternate Pathing (AP) meta device when the AP meta device is plumbed. Interfaces used by the AP system should not be the active path when the board is being unconfigured. Manually switch the active path to one that is not on the board being unconfigured. If no such path exists, manually execute the `ifconfig down` and `ifconfig unplumb` commands on the AP interface. (To manually switch an active path, use the `apconfig(1M)` command.)

Replacement or Modification of a Board or Device

For the procedure to replace a board, see "Installing a Replacement Board" on page 26

For the procedure to add an interface to a board, see "Adding Storage Devices" on page 29

Replacement Sequence

When replacing other types of hardware at the same time that you add or replace a board in Enterprise x000 and x500 servers, replace the hardware in this order, as applicable, before adding or replacing a board:

1. Clock board or clock+ board
2. Peripheral power supply (PPS)—the PPS supplies hot-plug current
3. Power and cooling module (PCM)—the PCM supplies cooling air

System Reconfiguration

This section describes how to reconfigure your system after you have configured or unconfigured a system board.

When to Reconfigure

You might need to reconfigure the system under several conditions, including:

- *Board addition*: When adding a board, you must execute the reconfiguration sequence to configure the I/O devices associated with the board.

- *Board removal*: If you remove a board that is not to be replaced, you may (but do not have to) execute the reconfiguration sequence to clean up the `/dev` links for disk devices.

- *Board replacement*: If you remove a board and then insert it into a different slot, or replace a board with another board that has different I/O devices, you must execute the reconfiguration sequence to configure the I/O devices associated with the board. However, if you replace a board with another board that hosts the *same*

set of I/O devices, inserting the replacement into the *same* slot, you do not need to execute the reconfiguration sequence. But be sure to insert a replacement into the same slot that was vacated to retain the original /dev link names.

I/O Device Reconfiguration

The DR reconfiguration sequence is the same as the Solaris reconfiguration boot sequence (boot -r):

```
drvconfig; devlinks; disks; ports; tapes;
```

When the reconfiguration sequence is executed after a board is configured, device path names not previously seen by the system are entered into the /etc/path_to_inst file. The same path names are also added to the /devices hierarchy and links to them are created in the /dev directory.

Disk Controller Renumbering during a Reconfiguration

Caution - The disk controller number is part of the /dev link name used to access the disk. If that number changes during the reconfiguration sequence, the /dev link name also changes. This change may affect file system tables and software, such as Solstice™ DiskSuite™, which uses the /dev link names. Update /etc/vfstab files and execute other administrative actions necessary due to the changes in the /dev link names.

When the reconfiguration sequence is executed after a board is unconfigured or disconnected, the /dev links for all the disk partitions on that board are deleted. The remaining boards retain their current numbering. Disk controllers on a newly inserted board are assigned the next available lowest number by disks(1M).

The disks(1m) utility creates symbolic links in the /dev/dsk and /dev/rdsk directories pointing to the actual special disk device files under the /devices directory tree. These entries take the form /dev/dsk/c*X*t*X*d*X*s*X* where:

- c*X* is the disk controller number
- t*X* corresponds to the disk target number, in most cases
- d*X* refers to the logical unit number
- s*X* is the partition number

Removing boards that contain one or more disk controllers prompts the disks(1m) utility to examine entries in /dev/dsk and /dev/rdsk. These entries list the disks

attached to the removed controller(s). The `disks(1m)` utility discovers references to disconnected devices have been removed from `/dev/dsk` and `/dev/rdsk`. This removal action makes the logical controller numbers available for re-use. This re-use of controller numbers can lead to confusion when unexpected controller numbers are assigned to disk controllers that are added to the system.

Procedures

Click one of the following links to go to the procedure:

- "General Preparations" on page 21
- "Removing a Board" on page 22
- "Removing Boards that Use Detach-Unsafe Drivers" on page 25
- "Installing a Replacement Board" on page 26
- "Installing a New Board" on page 27
- "Adding Storage Devices" on page 29

Note - The screen, mouse, and keyboard will not be operational at times when DR momentarily suspends the system, but you will regain control of these devices after the suspension.

General Preparations

1. **Look for the latest service information on the web at**
   `http://sunsolve2.Sun.COM/Enterprise-dr`

   The web site is updated periodically. If you do not have direct access to this web site, ask your Sun service provider for assistance.

2. **Determine that the board is compatible with DR.**
   Some drivers do not yet support DR operations. A driver must be suspendable. The `quiesce-test` option tests for suspendable drivers:

   ```
   # cfgadm -x quiesce-test sysctrl#:slot#
   ```

3. **Be sure that the board to be replaced is inactive.**

   DR does not automatically stop activity on system boards.

   For example, before replacing an I/O board that controls a tape drive, wait for any read/write operations to finish.

Removing a Board

If you have not already done so, read "General Preparations" on page 21.

Terminating I/O Devices

Terminate the use of all devices in the board. All I/O devices must be closed before they are unconfigured.

1. **Terminate all usage of devices on the board.**

   a. **To identify the components that are on the board to be unconfigured, use the** `ifconfig`, `mount`, `pf`, **or** `swap` **commands.**

   b. **To see which processes have these devices open, use the** `fuser(1M)` **command.**

   c. **Ensure that any networking interfaces on the board are not in use. All storage devices attached to the board should be unmounted and closed. See "I/O Board Unconfiguration" on page 16.**

   > **Note -** DR does not automatically terminate network use or close devices. There currently is no way to ensure that the use of the network remains terminated or that all devices remain closed. Other clients may remount them between the time of the unmount and the unconfigure operations, so be careful.

   d. **If AP (alternate pathing) is in use on the system, switch all board functions to the alternate board. Wait until all of the alternate paths are functioning before proceeding to Step 2.**

   e. **If AP is not available, warn all users to stop using the functions that the board provides.**

2. **If the redundancy features of Alternate Pathing or Solstice DiskSuite mirroring are used to access a device connected to the board, reconfigure these subsystems so that the device or network is accessible by way of controllers on other system boards.**

3. **Unmount file systems, including Solstice DiskSuite meta-devices that have a board resident partition. (Example:** `umount`**/partit)**

4. **Remove Solstice DiskSuite or Alternate Pathing databases from board-resident partitions. The location of Solstice DiskSuite or Alternate Pathing databases is chosen by the user and can be changed.**

5. **Remove any private regions used by Sun**™ **Enterprise Volume Manager**™**. Volume Manager by default uses a private region on each device that it controls, so such devices must be removed from Volume Manager control before they can be detached.**

6. **Any Sun**™ **RSM Array**™ **2000 controllers on the board that is being detached should be taken offline, using the** `rm6` **or** `rdacutil` **commands.**

7. **Remove disk partitions from the swap configuration.**

8. **Either kill any process that directly opens a device or raw partition, or direct it to close the open device on the board.**

9. **If a detach-unsafe device is present on the board, close all instances of the device and use** `modunload(1M)` **to unload the driver. If a detach-unsafe device is present on the board, close all instances of the device and use** `modunload(1M)` **to unload the driver.**

Caution - Unmounting file systems may affect NFS™ client systems.

Removal Procedure

1. **Terminate all usage of devices on the board.**
   See "Terminating I/O Devices" on page 22.

2. **Check the status of the board:**
   - For a simple list containing board names, states, and conditions, enter:

```
# cfgadm
```

■ For a more detailed list, enter:

```
# cfgadm -v
```

For a board removal or replacement, the states and conditions must be one of the following sets:

■ The board is ok:
  ■ Receptacle state—Connected
  ■ Occupant state—Configured
  ■ Condition—OK
■ The board is failing:
  ■ Receptacle state—Connected
  ■ Occupant state—Configured
  ■ Condition—Failing

3. **Unconfigure the board:**

```
# cfgadm -c unconfigure sysctrl#:slot#
```

For *sysctrl#:slot#* (the attachment point ID) use the board name that was listed in the status report of the previous step.

4. **Use the** cfgadm **command to see if the board is unconfigured.**

   If the unconfigure operation failed:

   a. **See "Removing Boards that Use Detach-Unsafe Drivers" on page 25.**

   b. **See "Quiescence" on page 11.**

   c. **Resolve the problem.**

   d. **Unconfigure the board again (Step 3 on page 24).**

Note - A failure of the unconfigure step results in a partially unconfigured condition. If this happens, attempt to unconfigure again. A configuration operation is not permitted at this point.

---

5. **When the board is successfully unconfigured, you can do one of the following:**
   ■ Leave the board in the system unconfigured
   ■ Configure the board
   ■ Logically disconnect the board, in preparation for removal:

```
# cfgadm -v -c disconnect sysctrl#:slot#
```

6. **The disconnection takes a few moments, so if you wish to remove the board from the card cage at this time, first verify the board status.**

   a. **Use** `cfgadm` **to verify that the board is logically disconnected.**

   b. **Check the LEDs on the board to verify that the board is electrically disconnected.**

      The two outer LEDs must be off and the middle LED may be either lighted or off.

7. **After you have verified that the board is disconnected, you may physically remove or replace the board (see "Installing a Replacement Board" on page 26).**

If you wish, you can leave the board in place until a later time.

Caution - If no replacement is available, leave the board in the slot, or fill the empty slot with a dummy board or a load board to maintain the proper flow of cooling air in the cardcage. For Enterprise 3000, 3500, 4000, 4500, 5000, and 5500 systems, use a dummy board. For Enterprise 6000 or 6500 systems, use a load board.

Removing Boards that Use Detach-Unsafe Drivers

Some drivers do not yet support DR on Sun Enterprise 3*x*00, 4*x*00, 5*x*00, and 6*x*00 systems.

DR cannot detach these drivers, but you can remove some undetachable drivers manually.

1. **Halt all use of the device controller.**

2. **Halt the use of all other controllers of the same type on all boards in the machine.**

   The remaining controllers can be used again after the DR unconfigure operation is complete.

3. **Use Unix commands to manually close all such drivers on the board and use the** `modunload` **command to unload them.**

4. **Disconnect the board with this command:**

cfgadm -c disconnect *sysctrl#:slot#*

The disconnected board can be physically removed now or at a later time.

Caution - If no replacement is available, leave the board in the slot, or fill the empty slot with a dummy board or a load board to maintain the proper flow of cooling air in the cardcage. Use a dummy board for Enterprise 3000, 3500, 4000, 4500, 5000, and 5500 systems. Use a load board for Enterprise 6000 or 6500 systems.

Note - If you cannot execute the above steps, recover the system configuration by adding the board to the disabled board list using the NVRAM setting `disabled-board-list` (see Platform Notes), then reboot the system. Remove the board at a later time.

Tip - Many third-party drivers (those purchased from vendors other than Sun Microsystems) do not yet properly support the standard Solaris software `modunload` interface. Test these driver functions during the qualification and installation phases of any third-party device.

Installing a Replacement Board

If you have not already done so, read "General Preparations" on page 21.

1. **If you are not continuing from "Removing a Board" on page 22 above, otherwise go to Step 2.**

   a. **Use the** `cfgadm` **command to display the current system configuration.**

   b. **Select a card cage slot to use, but do not insert the board yet.**

2. **View the configuration list and verify that the slot is unconfigured:**

cfgadm

3. **Insert the board in the slot and look for an acknowledgment on the console, such as, "*name* `board inserted into slot3`."**

4. **Use the `cfgadm` command again to look for the system name assigned to the new board.**

5. **Configure the board using the system name for the board:**

`cfgadm -c configure` *sysctrl#:slotx*

6. **Configure any I/O devices on the board using commands such as `drvconfig` and `devlinks`, as appropriate.**

7. **Activate the devices on the board using commands such as `mount` and `ifconfig`, as appropriate.**

Installing a New Board

If you have not already done so, read "General Preparations" on page 21.

The process of adding and configuring a board involves (1) connecting the attachment point and (2) configuring its occupant. In most cases the `cfgadm(1M)` command can perform both steps at once.

1. **Verify that the selected slot is ready for a board.**

`cfgadm`

The states and conditions should be:
- Receptacle state—Empty
- Occupant state—Unconfigured
- Condition—Unknown
or
- Receptacle state—Disconnected
- Occupant state—Unconfigured
- Condition—Unknown

2. **If the status of the slot is not "empty" or "disconnected", enter:**

`cfgadm -c disconnect` *sysctrl#:slot#*

3. **Physically insert the board into the slot and look for an acknowledgment on the console, such as, "*name* `board inserted into slot3`."**

   After an I/O board is inserted, the states and conditions should become:

   - Receptacle state—Disconnected
   - Occupant state—Unconfigured
   - Condition—Unknown

   Any other states or conditions should be considered an error.

4. **Connect any peripheral cables and interface modules to the board.**

5. **Configure the board with the command:**

   `# cfgadm -v -c configure` *sysctrl#:slot#*

   This command should both connect and configure the receptacle. Verify with the `cfgadm` command.

   The states and conditions for a connected and configured attachment point should be:

   - Receptacle state—Connected
   - Occupant state—Configured
   - Condition—OK

   Now the system is also aware of the usable devices which reside on the board and all devices may be mounted or configured to be used.

   If the command fails to connect and configure the board and slot (the status should be shown as "configured" and "ok"), do the connection and configuration as separate steps:

6. **Connect the board and slot by entering:**

   `# cfgadm -v -c connect` *sysctrl#:slot#*

   The states and conditions for a connected attachment point should be:

   - Receptacle state—Connected
   - Occupant state—Unconfigured
   - Condition—OK

   Now the system is aware of the board, but not the usable devices which reside on the board. Temperature is monitored and power and cooling affect the attachment point condition.

7. **Configure the board and slot by entering:**

   `# cfgadm -v -c configure` *sysctrl#:slot#*

The states and conditions for a configured attachment point should be:

- Receptacle state—Connected
- Occupant state—Configured
- Condition—OK

Now the system is also aware of the usable devices which reside on the board and all devices may be mounted or configured to be used.

8. **Reconfigure the devices on the board by entering:**

```
# drvconfig; devlinks; disks; ports; tapes;
```

The console should display a list of devices and their addresses.

9. **Activate the devices on the board using commands such as** `mount` **and** `ifconfig`**, as appropriate.**

Adding Storage Devices

To add storage devices to an existing I/O board:

1. **Terminate all active use of the devices on the I/O board.**
   See "Terminating I/O Devices" on page 22.

2. **Unconfigure the board.**

```
# cfgadm -c unconfigure sysctrl#:slot#
```

3. **Add the storage device controller:**
   - For an optical controller, attach the I/O module and interface cable.
   - For an SBus or PCI controller card, use the Disconnect command before removing the board. Add the controller card and place the I/O board back in the card cage.

4. **Reconfigure the board.**

```
# cfgadm -c configure sysctr#:slot#
```

Only the Occupant state should change. The Receptacle state and condition should remain the same.

5. If you installed the board in a different slot, reconfigure the devices on the board by entering:

```
# drvconfig; devlinks; disks; ports; tapes;
```

The console should display a list of devices and their addresses.

6. Activate the devices on the board using commands such as `mount` **and** `ifconfig`**, as appropriate.**

Troubleshooting

Diagnostic Messages

The following table lists examples of `cfgadm` diagnostic messages. (Syntax messages are not included in this list.)

```
cfgadm: Configuration administration not supported on this machine
cfgadm: hardware component is busy, try again
cfgadm: operation: configuration operation not supported on this machine
cfgadm: operation: Data error: error_text
cfgadm: operation: Hardware specific failure: error_text
cfgadm: operation: Insufficient privileges
cfgadm: operation: Operation requires a service interruption
cfgadm: System is busy, try again
```

See `config_admin(3X)` for additional error message detail.

Troubleshooting Specific Failures

There are several common types of failure:

- "Driver Does Not Support DR" on page 32
- "Unable to Unconfigure " on page 32
- "Unable to Configure " on page 33
- "Problems with Network Devices" on page 33

- "Problems with I/O Devices" on page 33
- "RPC Time-out or Loss of Connection" on page 34

Driver Does Not Support DR

1. Some drivers do not yet support DR operations. A DR-compatible driver must be suspendable. Use this command to test for suspendable drivers.

```
# cfgadm -x quiesce-test sysctrl#:slot#
```

2. DR may not yet support some types of I/O and CPU/memory boards in Enterprise 3x00, 4x00, 5x00, and 6x00 systems. Use the quiesce test (above) or refer to the latest release notes.

Unable to Unconfigure

Before you attempt a DR unconfigure operation:

- Devices must not be in use by the operating system

- Drivers must be detachable or suspendable
A device cannot be unconfigured or disconnected while it is in use. Disks attached to an I/O board must unmounted before any attempt is made to unconfigure or disconnect that board. Any attempt to unconfigure/disconnect a board whose devices are still in use will generate an error.

If an unconfiguration operation fails because an I/O board has a busy or open device, the board is left only partially unconfigured. The operation sequence stopped at the busy device.

To regain access to the devices which were not unconfigured, the board must be completely unconfigured and then reconfigured.

In such a case, the system will log messages similar to the following:

```
NOTICE: unconfiguring dual-pci board in slot 7
NOTICE: dual-pci board in slot 7 partially unconfigured
reason:sysc iohelp unconfigure: Device busy
output from sysctrl unconfigure is:detach failed: /pci@f,4000/SUNW,isptwo@3/sd@2,0
is busy
```

To continue the unconfigure operation, unmount the device and retry the unconfigure operation. The board must be in the unconfigured state before you try to configure this board.

Unable to Configure

A configure operation may fail because an I/O board with a device does not currently support hot-plugging. In such a situation, the board is now only partially configured. The operation has stopped at the unsupported hot-plug device. In this situation, the board must be brought back to the unconfigured state before another configure attempt. In such a case the system will log messages similar to the following:

```
NOTICE: configuring dual-sbus-soc+ board in slot 4
NOTICE: dual-sbus-soc+ board in slot 4 partially configured
reason:sysc iohelp configure: Bad address
output from sysctrl configure is:attach failed: /sbus@8,0/SUNW,foo@d,10000/bar
```

To continue the configure operation, either remove the unsupported device's driver or replace it with a new version of the driver that will support hot-plugging.

Problems with Network Devices

DR does not automatically terminate use of all network interfaces on the board that is being disconnected. You must manually terminate the use of each interface.

DR does not allow an unconfigure operation on any interface that fits any of the following conditions. In these cases, the unconfigure operation fails and DR displays an error message. The operation fails if:

- The interface is the primary network interface for the machine; that is, the interface whose IP address corresponds to the network interface name contained in the file /etc/nodename. Note that bringing down the primary network interface for the machine prevents network information name services from operating, which results in the inability to make network connections to remote hosts using applications such as ftp(1), rsh(1), rcp(1), and rlogin(1). NFS client and server operations are also affected.

- The interface is the active alternate for an Alternate Pathing (AP) meta device when the AP meta device is plumbed. Interfaces used by the AP system should not be the active path when the board is being unconfigured. Manually switch the active path to one that is not on the board being unconfigured. If no such path exists, manually execute the ifconfig down and ifconfig unplumb commands on the AP interface. (To manually switch an active path, use the apconfig(1M) command.)

Problems with I/O Devices

All I/O devices must be closed before they are unconfigured. To see which processes have these devices open, use the fuser(1M) command.

Perform the following tasks for I/O devices.

- If the redundancy features of Alternate Pathing or Solstice DiskSuite mirroring are used to access a device connected to the board, reconfigure these subsystems so that the device or network is accessible by way of controllers on other system boards.

- Unmount file systems, including Solstice DiskSuite meta-devices that have a board resident partition. (Example: `umount`/partit)

- Remove Solstice DiskSuite or Alternate Pathing databases from board-resident partitions. The location of Solstice DiskSuite or Alternate Pathing databases is explicitly chosen by the user and can be changed.

- Remove any private regions used by Sun Volume Manager or Veritas Volume Manager. Volume Manager by default uses a private region on each device that it controls, so such devices must be removed from Volume Manager control before they can be detached.

- Any RSM 2000 controllers on the board that is being detached should be taken offline, using the `rm6` or `rdacutil` commands.

- Remove disk partitions from the swap configuration.

- Either kill any process that directly opens a device or raw partition, or direct it to close the open device on the board.

- If a detach-unsafe device is present on the board, close all instances of the device and use `modunload(1M)` to unload the driver.If a detach-unsafe device is present on the board, close all instances of the device and use `modunload(1M)` to unload the driver.

Caution - Unmounting file systems may affect NFS client systems.

RPC Time-out or Loss of Connection

RPC time-outs occur by default after two minutes. Administrators may need to increase this time-out value to avoid time-outs during a DR-induced operating system quiescence, which may take longer than two minutes. These changes affect both the client and server machines.

Glossary

AP	See Alternate Pathing.
ap_id	Attachment point identifier; an ap_id specifies the type and location of the attachment point in the system and is unambiguous. There are two types of identifiers: physical and logical. A physical identifier contains a fully specified pathname, while a logical identifier contains a shorthand notation.
Alternate Pathing	Alternate Pathing (AP) is software package which allows the use of multiple paths (connections) between a server and a disk array) or a network. If one path fails, AP can ensure that the disk array or network is still available through the alternate path. For example, the alternate path can be a second port on an interface board, or an entirely separate interface board. See also Dynamic Reconfiguration.
Attachment point	A collective term for a board and its card cage slot. A *physical* attachment point describes the software driver and location of the card cage slot. A *logical* attachment point is an abbreviated name created by the system to refer to the physical attachment point.
`cfgadm` **command**	The configuration administration command has these options: `-l` —display (or list) status `-t` —initiate testing `-c` —invoke changes to configuration `-x` —invoke hardware-specific functions that do not change states `-v` —verbose
Commands for DR	The common commands include: `cfgadm`. Refer to the man pages for information about the use of this command. Refer to the release notes for any late-breaking news of other commands.
Condition	The operational status of an attachment point.

Configuration (system)	The collection of attached devices known to the system. The system cannot use a physical device until the configuration is updated. For a DR board, the operating system assigns functional roles to a board and loads device drivers for the board and for devices attached to the board.
Configuration (board)	The operating system assigns functional roles to a board and loads device drivers for the board and for devices attached to the board.
Connection	A board is present in a slot and is electrically connected. The temperature of the slot is monitored by the system.
Detachability	The device Driver supports DDI_DETACH and the device (such as an I/O board or a SCSI chain) is physically arranged so that it can be detached.
Disconnection	The system stops monitoring the board and power to the slot is turned off. A board can be unplugged at any time.
DR	See Dynamic Reconfiguration
Dynamic Reconfiguration	Dynamic Reconfiguration (DR) is software which allows the administrator to (1) view a system configuration, (2) suspend or restart operations involving a port, storage device, or board, and (3) reconfigure the system (detach or attach hot-swappable devices such as disk drives or interface boards) without the need to power down the system. When DR is used with Alternate Pathing or Solstice DiskSuite software (and redundant hardware), the server can continue to communicate with disk drives and networks without interruption while a service provider replaces an existing device or installs a new device. DR supports replacement of a CPU/Memory, provided the memory on the board is not interleaved with memory on other boards in the system.
Hot-plug	Hot-plug boards and modules have special connectors which supply electrical power to the board or module before the data pins make contact. Boards and devices which do not have hot-plug connectors cannot be inserted or removed while the system is running.
Hot Swap	A hot swap device has special DC power connectors and logic circuitry that allow the device to be inserted without the necessity of turning off the system.
Logical DR	A DR operation in which hardware is not physically added or removed. An example is the deactivation of a failed board which is

then left in the slot (to avoid changing the flow of cooling air) until a replacement is available.

Physical DR   A DR operation that involves the physical addition or removal of a board. See also "Logical DR" above.

Quiescence   During a DR unconfigure/disconnect operation on a system board with non-pageable Open Boot PROM (OBP) or kernel memory, the operating system is briefly paused, which is known as operating system quiescence. All operating system and device activity on the backplane must cease for a few seconds during a critical phase of the operation.

Receptacle   A receiver such as a board slot or SCSI chain.

State   The operational status of either a receptacle (slot) or an occupant (board).

Suspendability   To be suitable for DR, a device driver must have the ability to stop user threads, execute the DDI_SUSPEND call, stop the clock, and stop the CPUs.

Suspend-safe   A suspend-safe device is one that does not access memory or interrupt the system while the operating system is in quiescence. A driver is considered suspend-safe if it supports operating system quiescence (suspend/resume). It also guarantees that when a suspend request is successfully completed, the device that the driver manages will not attempt to access memory, even if the device is open when the suspend request is made.

Suspend-unsafe   A suspend-unsafe device is one that allows a memory access or a system interruption while the operating system is in quiescence.

Occupant   Hardware resource such as a system board or a disk drive that occupies a DR receptacle or slot.

Unconfiguration   The system detaches a board logically from the operating system and takes the associated device drivers off-line. Environmental monitoring continues, but any devices on the board are not available for system use.