SCO

SCO OpenServer™ Handbook

How to install, configure, and start using an SCO OpenServer system

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Introduction

About this book

This book provides the information you need to get your SCO OpenServer™ system up and running. It includes installation and configuration instructions, as well as introductions to the Desktop, online documentation, system administration, and troubleshooting.

You will find the information you need more quickly if you are familiar with:

- "How this book is organized" (this page)
- "Related documentation" (page 4)
- "Typographical conventions" (page 8)

Although we try to present information in the most useful way, you are the ultimate judge of how well we succeed. Please let us know how we can improve this book (page 9).

How this book is organized

After introducing the SCO OpenServer product line, this book describes how to:

- install an SCO OpenServer system (page 19)
- install software (page 69)
- use the system, including:
  - the Desktop (page 122)
  - help and online documentation (page 127)
  - e-mail (page 129)

- administer the system (page 137), including:
  - starting and stopping the system (page 169)
  - customizing startup of the Desktop (page 199)
  - adapting the system to your language or country (page 221)
  - troubleshooting (page 247)
- add memory, disks, terminals, and other hardware (page 271)
- configure network hardware and protocols (page 481)

Appendixes provide additional configuration information.

Related documentation

SCO OpenServer systems include comprehensive documentation. Depending on which SCO OpenServer system you have, the following books are available in online and/or printed form. Access online books on your system by double-clicking on the Desktop **Help** icon. Access online books at the SCO web site at http://www.sco.com/documentation. Additional printed versions of the books are also available.

The Desktop and most SCO OpenServer programs and utilities are linked to extensive context-sensitive help (page 127), which in turn is linked to relevant sections in the online versions of the following books.

> **NOTE** When you upgrade or supplement your SCO OpenServer software, you might also install online documentation that is more current than the printed books that came with the original system. For the most up-to-date information, check the online documentation.

Late News
: Contains information that was obtained too late for inclusion in the documentation shipped with SCO OpenServer Release 5. You can view this document at the SCO web site by following the SCO OpenServer Release 5 link from http://www.sco.com/documentation.

Release Notes
: Contain important late-breaking information about installation, hardware requirements, and known limitations.

SCO OpenServer Features and Limitations
: summarizes the enhancements and new features of the current release, describes additional limitations and workarounds, and lists supported hardware.

Graphical Environment Guide
Describes how to customize and administer the Graphical Environment, including the X Window System™ server, the SCO® Panner™ window manager, the Desktop, and other X clients.

Graphical Environment help
Provides online context-sensitive help for Calendar, Edit, the Desktop, Help, Mail, Paint, the SCO Panner window manager, and the UNIX® command-line window.

Graphical Environment Reference
Contains the manual pages for the X server (section X), the Desktop, and X clients from SCO and MIT (section XC).

Guide to Gateways for LAN Servers
Describes how to set up SCO® Gateway for NetWare® and LAN Manager Client software on an SCO OpenServer system to access printers, filesystems, and other services provided by servers running Novell® NetWare® and by servers running LAN Manager over DOS, OS/2®, or UNIX systems. This book contains the manual pages for LAN Manager Client commands (section LMC).

Internet services documentation
Includes these books:

- *SCO PPP from Morning Star User's Guide*
- *Netscape FastTrack Administrator's Guide*
- *Netscape FastTrack Programmer's Guide*
- *Netscape JavaScript Guide*

Mail and Messaging Guide
Describes how to configure and administer your mail system. Topics include **sendmail**, MMDF, **SCO Shell Mail**, **mailx**, and the Post Office Protocol (POP) server.

Networking Guide
Provides information on configuring and administering TCP/IP, NFS®, and IPX/SPX™ software to provide networked and distributed functionality, including system and network management, applications support, and file, name, and time services.

Networking Reference
Contains the command, file, protocol, and utility manual pages for the IPX/SPX (section PADM), NFS (sections NADM, NC, and NF), and TCP/IP (sections ADMN, ADMP, SFF, and TC) networking software.

Operating System Administrator's Reference
: Contains the manual pages for system administration commands and utilities (section ADM), system file formats (section F), hardware-specific information (section HW), miscellaneous commands (section M), and SCO Visual Tcl™ commands (section TCL).

Operating System Tutorial
: Provides a basic introduction to the SCO OpenServer operating system. This book can also be used as a refresher course or a quick-reference guide. Each chapter is a self-contained lesson designed to give hands-on experience using the SCO OpenServer operating system.

Operating System User's Guide
: Provides an introduction to SCO OpenServer command-line utilities, the SCO Shell utilities, working with files and directories, editing files with the **vi** editor, transferring files to disks and tape, using DOS disks and files in the SCO OpenServer environment, managing processes, shell programming, regular expressions, **awk**, and **sed**.

Operating System User's Reference
: Contains the manual pages for user-accessible operating system commands and utilities (section C).

Performance Guide
: Describes performance tuning for uniprocessor, multiprocessor, and networked systems, including those with TCP/IP, NFS, and X clients. This book discusses how the various subsystems function, possible performance constraints due to hardware limitations, and optimizing system configuration for various uses. Concepts and strategies are illustrated with case studies.

System Administration Guide
: Describes configuration and maintenance of the base operating system, including account, filesystem, printer, backup, security, UUCP, and virtual disk management.

Many other useful publications about SCO systems by independent authors are available from technical bookstores.

Development documentation

The SCO OpenServer Development System includes extensive documentation of application development issues and tools. Additional resources for developers are available at the SCO Developer's Home Page (http://www.sco.com/developer).

Driver development

The Consolidated Hardware and Driver Development Kit contains documentation, sample drivers, and test suites for developing drivers on SCO OpenServer and UnixWare 7. You can download all packages from the SCO HDK Homepage (http://www.sco.com/hdk) or can order the CD through the standard channels. The documentation can also be viewed online at http://uw7doc.sco.com using Netscape or another frames-aware browser; Select "Hardware and Driver Development" from the left frame.

The documentation for the Consolidated Hardware and Driver Development Kit is built using the UnixWare 7 tools. The manual pages can be installed and accessed on SCO OpenServer systems using the **hdkman** command, which is provided with the HDK software. The graphical ScoHelp documentation cannot be installed on SCO OpenServer systems but can be read from the web site and is provided as a flatfile that can be downloaded from the web or read directly from the CD using the file:/ syntax of any frames-aware browser.

Typographical conventions

This publication presents commands, filenames, keystrokes, and other special elements as shown here:

Example:	Used for:
lp or **lp**(C)	commands, device drivers, programs, and utilities (names, icons, or windows); the letter in parentheses indicates the reference manual section in which the command, driver, program, or utility is documented
/new/client.list	files, directories, and desktops (names, icons, or windows)
root	system, network, or user names
filename	placeholders (replace with appropriate name or value)
⟨Esc⟩	keyboard keys
`Exit program?`	system output (prompts, messages)
yes or **`yes`**	user input
"Description"	field names or column headings (on screen or in database)
Cancel	button names
Edit	menu names
Copy	menu items
File ➪ Find ➪ Text	sequences of menus and menu items
open or **open**(S)	library routines, system calls, kernel functions, C keywords; the letter in parentheses indicates the reference manual section in which the file is documented
$HOME	environment or shell variables
SIGHUP	named constants or signals
"adm3a"	data values
employees	database names
orders	database tables
`buf`	C program structures
`b_b.errno`	structure members

How can we improve this book?

What did you find particularly helpful in this book? Are there mistakes in this book? Could it be organized more usefully? Did we leave out information you need or include unnecessary material? If so, please tell us.

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NOTE For answers to technical questions, please contact your software vendor or your support representative. Technical Publications is not qualified to give technical support.

To contact us, use the card at the back of this *SCO OpenServer Handbook* or write to us at:

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Thank you.

Chapter 1

About SCO OpenServer systems

The SCO OpenServer product line is a family of software products, licenses, and additional products which are designed to work together.

System configurations

SCO offers several software products (this page), media packages (page 12), and additional documentation in printed format (page 12) which you can combine in the way that most effectively addresses your needs.

SCO OpenServer systems

The SCO OpenServer family includes three operating systems, a general-purpose Internet server, and a single, combined development system. For more information on the latter, see the documentation provided with the SCO OpenServer Development System.

Host System
: This product is designed for low-cost, turnkey solutions and mission-critical applications that require a central application host and do not require networking. In addition to many features that deliver improved performance and reliability, it contains full graphical support, including SCOadmin, an OSF/Motif® system administration tool that also runs on character terminals. The Host System also contains the SCO Advanced File and Print Server, which provides NetBEUI networking for native Microsoft Windows file and print connections.

Enterprise System

This product includes all the features of the Host System and complete networking tools, including installation over a network, TCP/IP (with SCO Advanced File and Print Server running over TCP/IP), NFS, IPX/SPX, SCO Gateway for NetWare, LAN Manager Client, Netscape Communicator™, and the Netscape FastTrack server. As such, it is the most powerful and versatile server in the product line.

Desktop System

This product is designed as a single-user workstation and contains full graphical support as well as full networking connectivity. The Desktop System also includes Netscape Communicator.

SCO Internet FastStart

This product is an easily configured, general-purpose Internet server. Including Netscape Communicator, Netscape FastTrack server, the Internet Manager, enhanced PPP from Morning Star Technologies, and SendMail, this Internet server is robust and powerful.

Media

All SCO OpenServer products are provided on a single CD-ROM. The Boot Disk is a 3.5-inch floppy disk. If your system supports it, you can now boot directly from the installation CD-ROM (page 28).

Printed documentation

The *Release Notes* and *SCO OpenServer Handbook* are provided in printed format with every SCO OpenServer system package. The *SCO OpenServer Handbook* is also available online, along with many other books. Most of the online books are available in printed format from your vendor, in two sets. **Set 1** includes all the user's and administrator's guides. **Set 2** includes all the reference manual pages (several volumes).

See "Related documentation" (page 4) for detailed information about the SCO OpenServer documentation set.

Additional licenses and products

Many additional licenses and products are available for purchase with SCO OpenServer systems. See the *Release Notes* for more information.

NOTE Before you can use any SCO product (including additional user and CPU licenses), you must license as well as install it (page 72). You will be prompted to license all additional products during the **custom**(ADM) installation procedure. Certain commercial versions of SCO software also require registration. You can register a product online at the SCO web site (http://www.sco.com/register), or with the SCO Registration Center.

See also:

- "Licensing and registration terminology" (this page)
- Chapter 6, "Licensing and registering SCO products" (page 87)

Licensing and registration terminology

The SCO Software License is a contract that grants you rights to use SCO-supplied software. Typically, you obtain the license from your SCO software provider. It may accompany the software media, or you may acquire it online on the World Wide Web. The license agreement accompanies all SCO products, either as a printed booklet or on the product media (typically in a directory named */license*).

You can obtain the license for some SCO products interactively at SCO's website. Some SCO products display the license agreement when you install the product, at which time you are prompted to read and accept the terms.

The following items identify the license:

License Number
: A unique number identifying each SCO product.

License Code
: A license code which activates the product.

License Data
: Additional license information needed to activate some products. If this field is not provided with your license, it is not required.

Most of SCO's commercial products require registration after installation. Registration is your confirmation to SCO that you have installed and licensed an SCO product. You can perform registration interactively at http://www.sco.com/register.

Some products (such as the Free* SCO products) do not need to be registered.

See the *SCO Software Registration* booklet provided with your SCO OpenServer system. To register an SCO product, you must have:

SCO System ID
: A unique ID used to identify your SCO OpenServer installation. It is generated at initial system installation, and at any subsequent low-level disk reformat. The SCO System ID is displayed when you run the **License Manager** (page 88).

Registration Key
: A key generated by the Registration Center when you register your SCO product. You will receive one Registration Key for each SCO product (identified by its License Number) that you register. Until you register your SCO product, warning messages will be displayed reminding you to register. Because the Registration Key is tied to the SCO System ID, you must re-register your SCO products if you run a low-level disk reformat.

See Chapter 6, "Licensing and registering SCO products" (page 87) for more information.

Accessing SCO Services information online

If you are connected to the Internet and have a World Wide Web browser (such as Netscape Communicator), the following URL (Uniform Resource Locator) will lead you to the SCO World Wide Web home page:

http://www.sco.com/

To access detailed information about SCO support services, click on "Support".

* "Free" means that there is no charge to license the software for personal and non-commercial use. The media kit has a nominal fee, and any number of users can share it. Each installation requires a unique license.

Finding SCO training

SCO Authorized Education Centers around the world offer training in the use and administration of SCO products. To learn more about available training:

- From anywhere in the world, access the SCO Training home page (http://www.sco.com/Training).
- In the United States or Canada, call 1-800-SCO-UNIX (1-800-726-8649).

Installation and software configuration

Chapter 2

Installing or upgrading an SCO system

This chapter explains how to install or upgrade an SCO OpenServer system on your computer. Specifically, it covers:

- assembling the information you need for installation (page 20).
- installing the software (page 29).
- choosing an upgrade path (page 36).

If you encounter problems during the installation, see Chapter 3, "Troubleshooting the installation" (page 53).

Before you begin:

- Read the first chapter of the *Release Notes*, which describes the hardware and disk space you need. Also read any other sections in the *Release Notes* that specifically discuss your software and hardware.
- Gather the information for the installation checklist (page 20).
- Your SCO software includes drivers for the hardware listed in *SCO OpenServer Features and Limitations*. If you use drivers and peripherals from a dealer other than SCO, contact your dealer to verify that those drivers work with the latest SCO OpenServer software. If the drivers are incompatible with the operating system, your peripherals will not work. For more information about new and updated driver support, see "Accessing the SCO Compatible Hardware Web Pages" (page 273).

- If you have just assembled your computer for the first time or are unsure about the hardware requirements, review the manuals provided with your computer and hard disk. In addition, run the system self-test described in the operator's guide for your computer to detect any hardware problems.
- Read your license agreement.

See also:

- "Installing or upgrading the system from a remote host" in the *Networking Guide*

Installation and upgrade checklist

You will need this information to respond to prompts during the installation. If you do not record this information before starting, you might have to stop the installation and start again from the beginning.

After installation, keep this checklist with your system log (page 139).

1. **Boot-time Loadable Drivers (BTLDs) required?** (page 284) Also consult your BTLD software supplier's documentation.	☐ No ☐ Yes, enter package names: ____________ ____________ ____________ ____________
2. **Installation media** If you use your primary drive, autodetection will probably fill in the correct entry. See SCO's Compatible Hardware Web Pages for device names. See this book for SCSI configuration (page 303).	☐ ATAPI/EIDE CD-ROM (ATAPI-2-compliant) IDE Controller Primary or secondary: Master or slave: ☐ SCSI CD-ROM SCSI Adaptor Type: SCSI Host Adaptor: SCSI ID: SCSI LUN: 0 (always 0 for SCO-provided drivers) SCSI BUS:

(Continued on next page)

(Continued)

3. **Keyboard language** ____________________
   (For example, UK English.)

4. **License number** ____________________
   Copy answers 4, 5, and 6 from the Certificate of License and Authenticity (COLA.) If you are performing an **Upgrade** installation, you must have the license keys for both the original system as well as the upgrade. ____________________

5. **License code** ____________________ ____________________

6. **License data** ____________________
   (This field appears only during certain installations.) ____________________

7. **Installation type** (page 37)
   An **Upgrade** preserves your existing filesystems, but may not provide all the new functionality that a **Fresh** installation offers. (Some systems cannot be upgraded.)
   - ☐ Fresh
   - ☐ Upgrade (if system is suitable)

   If upgrading, stop here and begin the upgrade procedure (page 29).

8. **System name** (page 515) ____________________
   Must be unique, begin with a letter, and contain only lowercase letters and numbers (a maximum of 8 characters).

9. **Domain name** (page 516) ____________________

10. **Security profile** (page 142)
    Use **High** for systems with confidential information and many users, **Improved** for systems with users who share information, **Traditional** to maintain compatibility with existing UNIX systems, or **Low** for systems not widely or publically accessed.
    - ☐ High (above C2)
    - ☐ Improved (C2)
    - ☐ Traditional
    - ☐ Low

(Continued on next page)

Install

(Continued)

11. Time zone	Continent or geographic area: ______________________ Time zone name: ______________________ Daylight savings observed? ☐ Yes ☐ No
12. Language If you will be running a language product other than US English (for example, French or German), specify it here.	______________________
13. Initial system profile **Standard Enterprise** installs all software except Microsoft LAN Manager Client, SCO Gateway, and PC-Interface® Server. **Lightweight character terminal** also leaves out the X11 server and clients, graphical administration tools, and the IPX/SPX run-time. **Database services** adds the **suds** driver for large database products.	☐ Standard system ☐ Lightweight character terminal ☐ Database services (add to either Standard or Lightweight)
14. Hard disk setup, first disk **Preserve** (page 40) maintains current partitions and divisions (some systems cannot be preserved). **Use whole disk for UNIX** (page 42) configures default partitions and divisions. **Customize** (page 42) lets you create and resize partitions and divisions. **Interactive** (page 41) invokes **fdisk**(ADM) and **divvy**(ADM) for more precision.	☐ Preserve (if available) ☐ Use whole disk for UNIX ☐ Customized layout ☐ Interactive fdisk/divvy

(Continued on next page)

(Continued)

Customized or Interactive layout (page 101)
(Also see the *Release Notes* for a description of filesystem types.)

UNIX partition size (MB)	____________
DOS partition size (MB)	____________
Other partition size (MB)	____________
boot filesystem size (MB)	____________
swap space size (MB) (recommend 1.5 to 2 times RAM)	____________
root filesystem size (MB) (new filesystem types no longer require small root filesystems)	____________
Other filesystems size (MB)	____________

15. **Bad track/block, first disk** (page 341)
Thorough/destructive ensures the highest disk integrity, but takes longer. Less thorough choices increase the risk of installation failure due to bad spots on the disk.
   - ☐ None
   - ☐ Thorough/destructive
   - ☐ Thorough/non-destructive
   - ☐ Quick/destructive
   - ☐ Quick/non-destructive

16. **Hard disk setup, second disk** (page 45)
(If applicable)
   - ☐ Preserve (if available)
   - ☐ Use whole disk for UNIX
   - ☐ Customized layout
   - ☐ Defer

Customized layout

UNIX partition size (MB)	____________
DOS partition size (MB)	____________
Other partition size (MB)	____________
boot filesystem size (MB)	____________
swap space size (MB)	____________
Other filesystems size (MB)	____________

17. **Bad track/block, second disk**
(If applicable)
   - ☐ None
   - ☐ Thorough/destructive
   - ☐ Thorough/non-destructive
   - ☐ Quick/destructive
   - ☐ Quick/non-destructive

(Continued on next page)

Install

(Continued)

18. Software components To override the initial system profiles, you can install whole and partial components in any combination. (See the *Release Notes* for disk space requirements.) After initial installation, you can add or remove software (page 69).	☐ Operating system ☐ Graphical environment ☐ Connectivity ☐ Online documentation
19. Network card (page 505) You do not need this information if you autodetect the network card or defer networking configuration. (If the address you want to use for your network card does not appear on the list of valid addresses, defer network configuration until after installation.) See your hardware documentation for more information.	Vendor and model: ____ Interrupt vector (IRQ): ____ Base I/O address (if applicable): ____ ROM address (if applicable): ____ DMA (if applicable): ____ Base RAM address (if applicable): ____ RAM size (if applicable): ____ Local Ring Broadcast (Token-Ring only): ____ Slot number (if applicable): ____ Cable type (if applicable): ____
20. IP address (page 513). Four decimal numbers separated by periods (for example, 132.145.80.9). If you do not already have an IP address, defer network configuration.	____

(Continued on next page)

(Continued)

21. **Network mask** (page 514)
If you are not configuring a subnetwork, accept the default value.
____

22. **Broadcast address** (page 515)
____

23. **Domain name service (DNS) client configuration**
Enter the IP address (page 513) of the **gateway** machine on your network to set the default route. For more information, see Chapter 5, "Configuring Internet Protocol (IP) routing" in the *Networking Guide.*

Gateway address:
____
____

Enter the IP addresses (page 513) of the **primary** and **secondary name servers**. Entering a name server creates a default **resolv.conf**(SFF) file. For more information, see Chapter 6, "Configuring the Domain Name Service" in the *Networking Guide.*

Primary nameserver address:
____
____

Secondary nameserver address:
____
____

These fields are optional. If no values are entered, */etc/tcp* does not add a default route (although **routed** is started) and *resolv.conf* is not created.

24. **IPX/SPX network number** (page 518)
Links DOS Workstation clients and SCO system software over the NetWare network.
____

25. **IPX/SPX internal network number** (page 518)
____

26. **IPX/SPX framing type** (page 519)
____

27. **Video card** (page 357)
Also consult SCO's Compatible Hardware Web Pages.
____

(Continued on next page)

(Continued)

28. Video mode (page 357)	____________
29. Video monitor (page 357)	____________
30. Graphical login If you plan to use the graphical environment, leave the graphical login on. See "Starting a Graphical Environment session" (page 199).	☐ On ☐ Off
31. Mouse (page 387) Also consult your hardware documentation.	Type (vendor): ____________
For a bus mouse, specify the interrupt. For a serial mouse, specify the COM1 port. If your serial mouse is connected to COM2, specify COM1 and then reconfigure your mouse after installation (page 389).	☐ Bus mouse ☐ IRQ2 (INTR2) ☐ IRQ3 (INTR3) ☐ IRQ5 (INTR5) ☐ Serial mouse: COM1 (COM2 not supported) ☐ Keyboard mouse ☐ low resolution ☐ high resolution
32. E-mail system Choose sendmail if you will use advanced features of SCO Internet Services, such as virtual domains, or if your systems currently use sendmail. Otherwise, choose MMDF. For more information on sendmail and the **Internet Manager**, see Chapter 27, "Configuring Internet services" (page 453). For a detailed comparison of sendmail and MMDF, see the *Mail and Messaging Guide*.	☐ MMDF ☐ sendmail

Responding to prompts

Use these keys when responding to prompts for information during the first section of the installation (before software loading begins):

To:	Press:
Get help	⟨F1⟩
Abort the installation	⟨F2⟩
Display other choices	⟨Space⟩
Restore defaults	⟨F5⟩
Return to the previous screen	⟨Esc⟩
Exit help screen	⟨Esc⟩
Move down one line	⟨↓⟩
Move up one line	⟨↑⟩
Scroll up one screen	⟨PgUp⟩
Scroll down one screen	⟨PgDn⟩
Select or deselect multiple items in a list	⟨Space⟩
Accept an item	⟨Enter⟩
Accept the current configuration	⟨Enter⟩

If you make an error while entering information:

- Use the ⟨Bksp⟩ key or ⟨Ctrl⟩**H** to erase a character.
- Press ⟨Esc⟩ to restart the entire line.

To stop the installation, press ⟨F2⟩ in any window, or select **q** at a prompt to quit. Once you quit the installation, any information you have already entered is lost. You must start the installation again from the beginning.

To restart the installation, verify that the Boot Disk is in the drive and press ⟨Enter⟩. At the `Boot:` prompt, press ⟨Enter⟩ again. If you are using the BTLD utility and you need to restart the installation, insert the Boot Disk and enter **restart link=*pkg1*** at the `Boot:` prompt (where ***pkg1*** is the name of the package from which to extract the required BTLD drivers).

To stop the installation process after the software loading begins, verify that the Boot Disk is in the drive, then press the computer "reset" button or turn the power off and on. At the `Boot:` prompt, press ⟨Enter⟩ to start the installation again from the beginning.

If you stop the installation after the software starts loading, **the previous system cannot reliably be restored**. If the previous system is not restored, the **Upgrade** installation type and the **Preserve** disk layout option may not be available in the restarted installation, even though they were available in the first (aborted) installation.

Install

Installing boot-time loadable drivers

If you are installing boot-time loadable drivers (BTLDs):

- At the beginning of the installation, follow the instructions in "Adding BTLDs at boot time" (page 285) to link the drivers at the first `Boot:` prompt.
- At the end of the installation, after the software is loaded and the kernel is rebuilt, you see a table of the packages installed on the disk. Enter the name of the BTLD package to install, or press ⟨Enter⟩ to install the default package.

Booting from CD-ROM

The SCO OpenServer installation CD-ROM is now bootable. This allows for a faster installation and allows you to skip the steps which require you to insert and load the installation boot floppy.

You can use this feature if your system BIOS supports CD-ROM as a boot option. You cannot use this feature if your system BIOS recognizes only a proprietary bootable CD-ROM format.

To use this feature:

1. Complete steps 1-3 of the standard installation procedure (page 29).
2. Enter your system's BIOS configuration program. This program might be accessed from a configuration floppy or by pressing keys immediately after you power-cycle the system.
3. Specify CD-ROM as the primary boot device (before *C:* or *A:*).
4. Save this change to the system BIOS and exit the configuration program.
5. Shut down your system.
6. Insert the SCO OpenServer CD-ROM and remove any other media from other boot devices on your system.

7. Resume the standard installation procedure at step 5 (page 30).

   For step 6, press ⟨Enter⟩ without inserting any additional media, unless you have a Boot Time Loadable Driver to install.
   For step 7, you do not need to insert the CD-ROM as it is already present.

NOTE Because not all installation utilities are aware that the CD-ROM drive is emulating the floppy drive, you might see an error message or prompt that mistakenly refers to the floppy drive.

If you are using the bootable CD-ROM feature, assume that messages you receive that refer to installation media pertain to the CD-ROM drive.

Install

The installation and upgrade procedure

Follow these steps, remembering to press ⟨Enter⟩ after responding to each prompt:

1. Complete the "Installation and upgrade checklist" (page 20).

   This is very important. If you do not gather this information first, you might have to stop the installation and start again from the beginning.

2. If your hard disk already contains more than one partition, make sure that the UNIX partition is active. The installation copies the SCO OpenServer system to the active partition.

3. Before beginning any installation or upgrade, make sure you have up-to-date backups of all the data currently on your system (see the *System Administrator's Guide*). Some of the options available during installation overwrite all the data on the hard disk, including user data and DOS partitions.

4. With the power off, or at the `Press any key to reboot` prompt, insert the Boot Disk into the drive.

If you have more than one floppy disk drive, make sure the 3.5-inch drive is the primary drive (sometimes called the boot drive). Check your computer hardware manual if you are unsure which is the primary drive.

> **NOTE** You might be able to use the new bootable CD-ROM feature of SCO OpenServer. See "Booting from CD-ROM" (page 28) for more information.

5. Turn on your computer (or press any key to continue from **haltsys**), and wait for the `Boot:` prompt.

> **NOTE** If you need to restart the installation completely at any time, insert the Boot Disk, and press ⟨Enter⟩ at the `Boot:` prompt. The installation starts again from the beginning.
>
> If you are using the BTLD utility and you need to restart the installation, insert the Boot Disk and enter **restart link=*pkg1*** at the `Boot:` prompt (where ***pkg1*** is the name of the package from which to extract the required BTLD drivers).

6. At the `Boot:` prompt:

   - If you are **not** installing boot-time loadable drivers, press ⟨Enter⟩ to boot from the floppy disk drive.
   - If you **are** installing BTLDs, follow the instructions in "Adding BTLDs at boot time" (page 285) before continuing.

   The system checks to see what hardware is present and if there are any hardware problems. Each stage of checking generates a letter ranging from D through M. See Appendix G, "Kernel initialization check letters" (page 539) for an explanation of these letters.

   A `RESTRICTED RIGHTS LEGEND` appears after the kernel initialization letters.

7. When prompted, supply the information about your CD-ROM drive, insert the CD-ROM, and press ⟨Enter⟩. **Do not** remove the Boot Disk from the drive.

> **NOTE** If you select the incorrect address for the CD-ROM, and another device is actually present at that address, you cannot successfully change to the correct address. Press ⟨F2⟩ to quit the installation, then start again from the beginning.

8. Follow the instructions on each screen, and complete the information fields using the answers that you recorded in the "Installation and upgrade checklist" (page 20). Two lines at the bottom of the screen give brief instructions for completing each field. For more detailed help, press ⟨F1⟩. Press ⟨Space⟩ to see a list of options from which you can select, or to bring up a secondary set of prompts.

   NOTE If the "Installation Type" field reads **Fresh** and you cannot highlight any other choice, your system cannot be upgraded. Complete the "Installation and upgrade checklist" (page 20) to make sure you have all the necessary information, then continue with a fresh installation. See "Choosing an upgrade path" (page 36).

9. When prompted, assign the *root* (superuser or administration) password.

   Do not forget the *root* password. To restore a forgotten *root* password, you must contact your support provider for assistance.

10. If you selected the **Interactive fdisk/divvy** disk setup option, the installation prompts you to initialize your hard disk. Follow the instructions in "Partitioning a hard disk using fdisk" (page 330) and "Dividing a disk partition into divisions using divvy" (page 333) to complete this step.

    CAUTION Do not allocate all of the available space to the optional */u* filesystem. This will leave insufficient space for the root filesystem. If the root filesystem has insufficient space, the installation will fail.

    If you encounter an error at this point, reboot the system and start the installation again from the beginning. Do not attempt to move backwards through the installation screens.

11. The **badtrk**(ADM) utility runs next, if you selected it. If you encounter an error during **badtrk**, reboot the system and start the installation again from the beginning.

12. The software load begins after any disk setup or badtracking. Software load is the longest stage of the installation, but it can proceed unattended.

    As the installation loads each software component onto the hard disk, you see messages such as:

    ```
    Installing: SCO UNIX System V Operating system (Ver 5.0.5E)
    Installing Phase: Copying files from the media
    Installation Status: Copying file
    ```

Install

These messages are logged in the **custom** log file, */var/opt/K/SCO/SoftMgr/*/custom/custom.log*, for future reference.

After the software is loaded, the kernel (*/stand/unix*) is rebuilt. This takes several minutes. The */stand* directory also contains two other bootable kernels, to use in case *unix* will not boot. *unix.safe* is the same as *unix*, but with all third-party drivers removed. *unix.install* is the kernel used during installation. It contains most drivers. See "Booting an old kernel" (page 184) and **kernel**(ADM) for more information.

13. If you linked BTLDs in at boot time, you see a table of the packages installed on the disk. Enter the name of the BTLD package to install, or press ⟨Enter⟩ to install the default package.
14. The system shuts down, then you see `Press any key to reboot.` **Remove the floppy disk or bootable CD-ROM from the drive**, then press any key.
15. At the `Boot:` prompt, press ⟨Enter⟩.
16. To do any of the following, enter the *root* password when you see:

    INIT: SINGLE USER MODE

- Set up a serial mouse.

  If you have a serial mouse that is not installed on COM1, configure it now. See Chapter 21, "Adding serial and parallel ports" (page 367) and Chapter 23, "Adding mice and bitpads" (page 387).

- Install additional software or remove software.

  To install or remove software, see Chapter 4, "Installing and managing software components" (page 69).

  NOTE When installing language products with the **Software Manager**, make sure you select the language product that matches your initial product configuration. For example, if you installed the SCO OpenServer Enterprise System and want to add the German product, select "Enterprise German Language Support".

- Configure the network.

  If you installed the "Connectivity" components and deferred network configuration during initial installation, you can configure the network now. See Chapter 29, "Configuring network connections" (page 481).

- Install Internet Services components.

  If you selected a full installation on your Enterprise or Desktop system, Netscape FastTrack server and Netscape Communicator were automatically installed. If you did not select a full installation, follow the instructions in Chapter 4, "Installing and managing software components" (page 69) to install Netscape components. See the *Release Notes* for notes about configuring and using Netscape FastTrack and Netscape Communicator.

  If you chose sendmail during installation, you can use the **Internet Manager** to configure your mail system and can make use of advanced features such as creating virtual domains. If you chose MMDF, you cannot use the **Internet Manager** to configure mail. You can switch mail systems by removing the SCO MMDF (MMDF) package and adding the SCO **sendmail** (SendMail) component. See Chapter 4, "Installing and managing software components" (page 69). Also see "Mail" (page 470) for information on configuring sendmail.

  PPP from Morning Star allows you to use the **Internet Manager** to configure your dial-up connections. By default, PPP from Morning Star is not installed when you install your SCO OpenServer system. To install and use PPP from Morning Star, remove the SCO PPP (tcp:PPP) package and add the SCO PPP from Morning Star (mstppp) package, then configure connections with the **Internet Manager**. See Chapter 4, "Installing and managing software components" (page 69), "Accessing the network" (page 455), and Chapter 27, "Configuring Internet services" (page 453).

17. Bring the system up in multiuser mode from the `INIT: SINGLE USER MODE` prompt by pressing ⟨Ctrl⟩**D**. (Or, from single-user mode, press ⟨Ctrl⟩**D** at the # prompt. Then, when you see `INIT: SINGLE USER MODE`, press ⟨Ctrl⟩**D** again.)

18. If the displayed time is correct, press ⟨Enter⟩. If the time is incorrect, enter the current time.

    As the system starts up, you see copyright credits, followed by software component start-up messages. When you see the graphical **scologin** screen on tty02, or the `login:` prompt on tty01, the system is ready.

19. **To start the Desktop**, log in as *root* at the graphical **scologin** screen on tty02 (press ⟨Ctrl⟩⟨Alt⟩⟨F2⟩ if it is not displayed).

    To log in on a character screen, switch from the graphical login screen on tty02 by pressing ⟨Ctrl⟩⟨Alt⟩⟨F*n*⟩ (where *n* is the function key associated with another tty, such as ⟨F1⟩). Then, log in as *root*.

For more information about **scologin**, see "Starting a Graphical Environment session" (page 199) and "Using multiscreens" in the *System Administration Guide*.

20. At this time you can:

    - Add user accounts. The installation automatically creates the *root* account; this account should be used for system administration tasks only. To maintain system security, you **must** create separate accounts for each user on your system. (An **Upgrade** installation retains all user accounts and data.) See Chapter 1, "Administering user accounts" in the *System Administration Guide*.
    - Add local printers (printers that are directly attached to your system). See Chapter 24, "Adding printers" (page 397).
    - Add hard disks to your system. See Chapter 18, "Adding hard disks" (page 323) or "Upgrading a non-primary hard disk" (page 45).
    - Configure ISA Plug and Play hardware present on your system. See Chapter 17, "Installing Plug and Play devices" (page 311).
    - Configure the mail system. See the *Mail and Messaging Guide*.
    - Create additional partitions on your hard disk (if you left space for them). See "Partitioning a hard disk using fdisk" (page 330).
    - Create additional filesystems on your hard disk (if you left space for them). See "Dividing a disk partition into divisions using divvy" (page 333).

21. Make a complete backup of your system. See "Running unscheduled filesystem backups" in the *System Administration Guide*.

    If your system should become corrupted, you can use this backup, along with the emergency boot floppy disk set that you create in the next step, to restore it without having to reinstall the software completely. See Chapter 3, "Backing up filesystems" in the *System Administration Guide* for a complete discussion of backups.

    CAUTION Make regular backups of your filesystems so that, if corruption occurs, you have a recent backup of your system to restore.

22. Create an emergency boot floppy disk set for your system.

    These disks allow you to recover your root filesystem quickly if it becomes so corrupted that you cannot start the system from your hard disk. See Chapter 5, "Creating an emergency boot floppy disk set" (page 81) for instructions. Then, test the emergency floppy disk set, and verify that you can read the backup you made in the previous step according to the directions in "Examining the contents of a backup" in the *System Administration Guide*.

23. Register your software. See Chapter 6, "Licensing and registering SCO products" (page 87). (You already licensed your system during the installation.) The system software displays frequent reminders until you register the software you installed.

    NOTE Your software generates a new SCO System ID each time you do a low-level reformat of the root hard disk. If you do a low-level reformat, you must contact an SCO Registration Center to obtain a new Registration Key and repeat the registration process (page 90).

Install

After installation

The SCO OpenServer system is now installed and registered. Review Chapter 2 of the *Release Notes* for tasks you need to complete immediately following installation. For further information on administering the system, see the remaining chapters in the *SCO OpenServer Handbook* (especially Chapter 3, "Troubleshooting the installation" (page 53), Chapter 9, "Administering SCO systems" (page 137), and Chapter 13, "Troubleshooting system-level problems" (page 247)). Also see the *System Administration Guide*.

To help system administration, troubleshooting, and future upgrades go more smoothly, keep a copy of the completed installation checklist (page 20) with the system log (page 139).

To configure Internet services, including the Netscape FastTrack Server, **sendmail**, and **ppp**, refer to Chapter 27, "Configuring Internet services" (page 453)

Choosing an upgrade path

Read this and the following sections on upgrading your system thoroughly *before* beginning an upgrade installation. They describe:

- the different types of installation you can choose if you are already running an SCO operating system
- steps you must take before or after installing the new system so that certain components from your previous system continue to work as you expect

Also read the chapters in the *Release Notes* that discuss the installation.

> **CAUTION** Before beginning any installation or upgrade, make sure you have up-to-date backups of all the data currently on your system (see the *System Administrator's Guide*). Some of the options available during installation overwrite all the data on the hard disk, including user data and DOS partitions.
>
> We recommend that you use **cpio**(C) format for the backups (the **Backup Manager** uses **cpio**), and that you back up one filesystem per tape.

If you currently run an earlier version of an SCO UNIX operating system, one or more of the following methods are available for you to upgrade to an SCO OpenServer system. Read the referenced sections and the *Release Notes* to decide which method works best for your system.

- Choose an **Upgrade** installation (page 37).
- Choose a **Fresh** installation, then choose the **Preserve** option (page 40) for setting up your hard disk.
- Choose a **Fresh** installation, then run **Interactive fdisk/divvy** (page 41) to recreate your current hard disk setup.
- Choose a **Fresh** installation, choose the **Use whole disk for UNIX** or **Customize** option (page 42) for setting up your hard disk, then restore the data from backups.

NOTE If your system is currently running SCO Internet FastStart release 1.0 or 1.1, you must select the **Fresh** installation type. You may select either the **Interactive fdisk/divvy** (page 41) or **Preserve** (page 40) option for setting up your hard disk. You cannot select the **Upgrade** installation type for SCO Internet FastStart release 1.0 or 1.1.

Before reinstalling your system, read the *Release Notes* for instructions on how to migrate your current Internet FastStart data. This information will help you save **sendmail**, **ppp**, and server configuration information so that you do not need to completely reconfigure these services.

Install

See also:

- "Issues with any upgrade" (page 43)
- "Upgrading from release 5.0" (page 48)
- "Upgrading from release 3.0" (page 52)
- "Upgrading from release 2.0" (page 52)

About the Upgrade installation type

The **Upgrade** option is available if your previous installation is SCO OpenServer Release 5.0.0, 5.0.2, 5.0.4, or 5.0.5 and your hard disk has sufficient space available for SCO OpenServer Release 5.0.6. (See the *Release Notes* for disk space requirements, and for other information about the **Upgrade** option.) This option leaves all non-root filesystems and partitions as they are. On the root filesystem, it removes the old system and installs new versions of all the previously installed packages. The **Upgrade** option appears near the beginning of the installation prompts, under **Installation type**.

If an upgrade fails, the installation program attempts to restore the previous system. The program displays a message about the expected state of the system, depending on the phase in which the upgrade failed, and may direct you to check whether you need to restore the system from backups.

Here are the paths available for **Upgrade** installations:

If you are upgrading from:	You can upgrade to:
SCO OpenServer 5.0.0 Host	SCO OpenServer 5.0.6 Host
SCO OpenServer 5.0.0 Desktop	SCO OpenServer 5.0.6 Desktop
SCO OpenServer 5.0.0 Enterprise	SCO OpenServer 5.0.6 Enterprise
SCO OpenServer 5.0.2 Host	SCO OpenServer 5.0.6 Host
SCO OpenServer 5.0.2 Desktop	SCO OpenServer 5.0.6 Desktop
SCO OpenServer 5.0.2 Enterprise	SCO OpenServer 5.0.6 Enterprise
SCO OpenServer 5.0.4 Host	SCO OpenServer 5.0.6 Host
SCO OpenServer 5.0.4 Desktop	SCO OpenServer 5.0.6 Desktop
SCO OpenServer 5.0.4 Enterprise	SCO OpenServer 5.0.6 Enterprise
SCO OpenServer 5.0.5 Host	SCO OpenServer 5.0.6 Host
SCO OpenServer 5.0.5 Desktop	SCO OpenServer 5.0.6 Desktop
SCO OpenServer 5.0.5 Enterprise	SCO OpenServer 5.0.6 Enterprise

See also "Upgrading to the Enterprise configuration from Host or Desktop" (page 49).

NOTE The **Upgrade** installation type is not necessarily tied to purchasing the SCO OpenServer system as an upgrade. It simply describes one path that the installation software can follow, and depends entirely on the configuration of the system before the upgrade. For example, if you currently run SCO OpenServer Release 5.0.0, you can select the **Upgrade** installation type even if you purchased a standard installation. On the other hand, if you purchased an upgrade from SCO Open Desktop Release 3.0, you must select the **Fresh** installation type, then choose the option under **Hard disk setup** that is most appropriate for your upgrade — probably **Preserve** (page 40).

NOTE If you are performing an upgrade installation, you must provide licenses for both the original system and the new system you are upgrading to. Please have this information ready before proceeding with the upgrade.

Because the default configuration for SCO OpenServer Release 5.0.6 is larger than the default configuration for SCO OpenServer Release 5.0.0, 5.0.2, 5.0.4, 5.0.5, the root filesystem on your primary hard disk might not be large enough to hold the upgraded system. Check the *Release Notes* for space requirements. If you want to choose the **Upgrade** option, but your root filesystem will not hold the new release, you have three options:

- Increase the size of your root filesystem by reconfiguring your hard disk.
- Install a larger primary disk.

- Install components of the new system on non-root filesystems. If your total disk space is sufficient and you have available partitions, the installation prompts you to relocate components to other filesystems (including filesystems on non-primary disks).

CAUTION The filesystems offered during the installation for relocated components may contain data that you do not want to disturb, such as user accounts or DOS files installed by SCO Merge. If you choose to relocate components to such filesystems, that data is lost.

Do not rely on being able to put additional data (such as user accounts) on the filesystems you choose for relocation. The relocation program uses nearly all the space in the chosen filesystems, in an attempt to create free space in the root filesystem.

Only filesystems in */etc/default/filesys* are offered for relocated components. If you want to relocate components to filesystems that are not displayed at this stage of the installation, abort the installation, reboot your previous system, and run **mkdev fs** to place the filesystems in */etc/default/filesys*.

See the *Release Notes* for more information on relocated filesystems.

Data retained with the Upgrade installation type

User data retained on the root filesystem includes:

- home directories
- user-created files and directories
- user IDs
- group IDs
- passwords
- file permissions
- mailboxes

System data retained on the root filesystem includes:

- system configuration files
- job scheduling files
- filesystems
- filesystem nodes
- mount points
- terminal control database
- auditing parameters
- file control database
- system defaults
- mail aliases
- configuration files for incoming and outgoing PPP lines
- UUCP dialer files

Non-root filesystems and non-root disks are not changed, unless you select them to receive relocated components.

About the Preserve hard disk option

The **Preserve** option is available if your system has an active UNIX partition with a clean root filesystem and a valid */etc/default/filesys* (see **filesys**(F)). This option retains the filesystem layouts from the previous installation, except for the root filesystem. It removes everything from the root filesystem and installs the new system, leaving all other data intact. To access the **Preserve** option, press ⟨Space⟩ at **Hard disk setup** in the **Preparing your disk and choosing software** window, then press ⟨Space⟩ again at **Partitions & filesystems**.

If the list of hard disk setup options does not include **Preserve**, the installation could not find an active UNIX partition with a valid root filesystem and */etc/default/filesys*. To preserve your existing partitions and filesystems, see "About the Interactive disk setup option" (this page). When using the **Interactive fdisk/divvy** option to retain your previous hard disk layout, you must assemble the hard disk layout information from your previous system *before* beginning the new installation.

The **Preserve** option is also available for the second hard disk. See "Upgrading a non-primary hard disk" (page 45).

About the Interactive disk setup option

CAUTION To retain your previous partitions and divisions using the **Interactive fdisk/divvy** option, you must assemble the hard disk layout information from your previous system *before* beginning the new installation.

The disk setup option for **Interactive fdisk/divvy** is available for any installation that starts as a **Fresh** (rather than **Upgrade**) installation type. **Interactive fdisk/divvy** defers disk setup until the end of the installation prompts. The installation then runs the utilities **fdisk**(ADM) and **divvy**(ADM) interactively. To retain your previous partitions and divisions on the new system, assemble the hard disk layout information from your previous system (including any preexisting DOS partitions) *before* beginning the new installation, as follows:

1. Run **fdisk** and select option **1**. Record the numbers of the partitions that hold your filesystems, then exit **fdisk**.
2. Run **divvy**(ADM) for each partition.

   CAUTION Do not select **c** within **divvy**. Doing so destroys the contents of the selected filesystem. Only select **c** *if* you have a complete backup of the filesystem, *and* you want to remake the filesystem into a different format. You must then restore all the data to that filesystem after installation.

3. Copy the information from your screen into the following table:

Table 2-1 Primary Hard Disk Filesystems

Name	Type	New FS	#	First Block	Last Block

4. Exit **divvy**.
5. Enter this information during the installation's **fdisk** and **divvy** sessions to recreate your previous hard disk layout for the new installation.

To access the **Interactive fdisk/divvy** option, press ⟨Space⟩ at **Hard disk setup** in the **Preparing your disk and choosing software** window, then press ⟨Space⟩ again at **Partitions & filesystems**.

The **Interactive fdisk/divvy** option is not available for the second hard disk. See "Upgrading a non-primary hard disk" (page 45).

About other hard disk setup options

Other hard disk setup options available from **Partitions & filesystems** (under **Hard disk setup**) are **Use whole disk for UNIX** and **Customize**. The **Use whole disk for UNIX** option clears any existing partitions and divisions from your hard disk and creates a default UNIX partition and division, which you cannot modify. The **Customize** option clears any existing partitions and divisions and creates the same default layout, then allows you to modify it with new partitions and divisions. (The **Interactive fdisk/divvy** option gives you more precise control over the size and location of partitions and divisions, but the **Customize** option is simpler.) Neither of these options preserves previous data or disk setups. If you select the **Use whole disk for UNIX** or **Customize** option, you must restore any previous data from backups after the installation is complete.

The **Use whole disk for UNIX** and **Customize** options are also available for the second hard disk. See "Upgrading a non-primary hard disk" (page 45).

Issues with any upgrade

This section covers issues that could potentially apply to any upgrade, no matter what SCO system you are upgrading from or what SCO OpenServer system configuration you are installing.

Restoring user accounts

If the upgrade path you choose (page 36) does not retain the user account profiles on your system, use **ap**(ADM) to preserve the account profiles.

Before beginning the installation, run:

ap -dg > ***filename***

This copies the account profiles, including group membership information, of every user listed in the password file into the file ***filename***. Back up this output file.

After completing the installation, copy the file ***filename*** to the new system, and run:

ap -ro -f*filename*

This restores the account profiles for every user, overwriting any existing account profiles of the same name (including *root*).

User-configured files and directories

This is a list of files and directories that are often configured, and *may* have changes that you need to restore after installing a new SCO system. (The **Upgrade** installation type attempts to preserve configurable files.) This list is not exhaustive, nor will every file on this list have changes that you want to save. The list is simply a starting-point for deciding which files have important user-specific or system-specific information.

CAUTION Before beginning any installation or upgrade, make sure you have up-to-date backups of all the data currently on your system (see the *System Administrator's Guide*).

> **NOTE** Please be aware that some of the listed files might be links. In order to properly back up all required data, you must traverse each of these links to the target file. Set the option on your backup utility to traverse symbolic links. For example, use the -L option with **cpio**(C) , which will traverse and back up all symbolic links.

Files likely to be configured:

/etc/checklist
/etc/default/*
/etc/conf/init.d/*
/etc/cshrc
/etc/ddate
/etc/dialups
/etc/d_passwd
/etc/motd
/etc/gettydefs
/etc/group
/etc/inittab
/etc/mscreencap
/etc/passwd
/etc/profile
/etc/rc
/etc/systemid
/etc/termcap
/etc/ttys
/etc/ttytype
/etc/wtmp

users' home directories under /usr

/usr/adm/hwconfig
/usr/adm/messages
/usr/adm/pacct
/usr/lib/mail/aliases
/usr/lib/mail/aliases.hash
/usr/lib/mail/faliases
/usr/lib/mail/maliases
/usr/lib/mail/mailrc
/usr/lib/mkuser/*
/usr/lib/uucp/*
/usr/lib/X11/app-defaults/*
/usr/lib/X11/Mosaic/*
/usr/lib/X11/scologin/Xservers
/usr/lib/X11/system.mwmrc
/usr/lib/X11/sys.startrc
/usr/man/cat.LOCAL (local man pages)
/usr/man/man.LOCAL (local man pages)
/usr/mmdf/mmdftailor
/usr/mmdf/table/*.dom (mmdf configuration)
/usr/mmdf/table/*.chn (mmdf configuration)

(Continued on next page)

(Continued)

/usr/mmdf/table/alias* (mmdf configuration)
/usr/spool/cron/crontabs (cron jobs)
/usr/spool/lp/admins/lp/interfaces/* (printer scripts)
/usr/spool/lp/pstatus
/usr/spool/lp/qstatus
/usr/spool/mail/*

/var/opt/httpd/htdocs/*

/.profile

Upgrading a non-primary hard disk

CAUTION **mkdev hd** now runs **badtrk** for SCSI as well as non-SCSI disks. During **mkdev hd**, **badtrk** displays the size of the current **badtrk** table as the default. Accept this default size, as changing the size of the **badtrk** table destroys the contents of the partitions.

You can protect any filesystems on a non-primary hard disk by selecting the **Upgrade** installation type or the **Preserve** option for setting up the secondary hard disk. If neither of these options is available, or if you do not select either one, select the **Defer** disk setup option during the installation, or remove the additional hard disks before beginning the installation.

If you select **Preserve** for the second hard disk, you must run **divvy** for that disk after the installation is complete. Within **divvy**, select **n** and name the preserved partitions, then exit. Then, run **mkdev fs**, as described in step 4.

CAUTION Do not select **c** within **divvy**. Doing so destroys the contents of the selected filesystem. Only select **c** *if* you have a complete backup of the filesystem, *and* you want to remake the filesystem into a different format. You must then restore all the data to that filesystem from backups.

Follow the numbered procedure in this section for any non-primary disk that you plan to remove before the installation, or for which you plan to select the **Defer** disk setup option.

1. Before the installation, run **fdisk**(ADM) for each affected hard disk. For example, for the second hard disk, enter:

   fdisk -f /dev/rhd10

   Enter **1** at the main **fdisk** menu. Record the numbers of the **fdisk** partitions that hold your UNIX filesystems, then exit **fdisk**.

2. Also before the installation, run **divvy**(ADM) for each affected partition and record the information. For example, for the active partition on the second hard disk, enter:

   /etc/divvy /dev/hd1a

   Copy the information from your screen into the following table:

   Table 2-2 Secondary Hard Disk Filesystems

Name	Type	New FS	#	First Block	Last Block

   Exit **divvy** by selecting **quit**, then **exit**.

3. After you install the SCO OpenServer system, follow the instructions for using **mkdev hd** in Chapter 18, "Adding hard disks" (page 323). (**mkdev hd** runs **fdisk** and **divvy**.) During **mkdev hd**, make sure that:

   - you accept the default size for the **badtrk** table.
   - the partition numbers in the **fdisk** partition table match those you recorded before the installation.
   - the information you recorded in the "Secondary Hard Disk Filesystems" table is in the new **divvy** table.
   - you select **n** and name each filesystem. (The **divvy** utility now creates device nodes for the divisions if they do not already exist, so you must change the **divvy**-generated names to match the original names.)

CAUTION Do not select **c** within **divvy**. Doing so destroys the contents of the selected filesystem. Only select **c** *if* you have a complete backup of the filesystem, *and* you want to remake the filesystem into a different format. You must then restore all the data to that filesystem.

4. For each affected filesystem, enter:

   mkdev fs

   Select option **1** to add a new filesystem. When prompted, enter the full pathname of the device from */dev*. For example, to add a filesystem called *u*, enter **/dev/u**.

   When prompted, enter the name of the directory on which the filesystem is mounted. For example, a filesystem called *u* is usually mounted on the directory */u*.

   Specify how you want the filesystem mounted when the system enters multiuser mode:

   - mount automatically at system startup (select **1**)
   - mount only at the request of the system administrator (select **2**)
   - prompt for mount choice at system startup (select **3**)

   When asked whether or not users will be allowed to mount the filesystem, it is usual to respond **n** for security reasons. (In any case, users running backups must have both **sysadmin** and **backup** authorizations. See "Assigning subsystem authorizations" in the *System Administration Guide*.)

   Exit **mkdev fs**.

5. If you want to mount the filesystem now, enter the following command (*/u* is used in this example):

   mount /dev/u /u

Upgrading third-party drivers

We recommend that you remove any third-party drivers from your system before upgrading to SCO OpenServer Release 5.0.6, then restore the drivers after you have rebooted successfully following the upgrade. If a third-party driver from your previous SCO system is not compatible with SCO OpenServer Release 5.0.6, the kernel (*/stand/unix*) may not link at the end of installation.

Install

If the kernel does not link at the end of installation, try to boot from the kernel called */stand/unix.safe* (which does not contain the third-party drivers), into single-user mode.

If the driver for the root hard disk controller is one of the third-party drivers missing, the *unix.safe* kernel will not boot. If this happens, boot the system using a boot-time loadable driver (BTLD) for this SCO OpenServer system. Then, remove the old driver from the link kit, and install the BTLD using **installpkg**(ADM).

Upgrading SCO OpenServer Development System

When you upgrade to SCO OpenServer Release 5.0.6, we recommend that you upgrade to the corresponding SCO OpenServer Development System release (5.1.1) as well. Earlier versions of the SCO Development System are not supported, and may behave unpredictably.

The Development System is not automatically upgraded when you upgrade the SCO OpenServer system. After you complete the operating system upgrade, use the **Software Manager** (page 69) to install the new version of the SCO OpenServer Development System. Supply the license information from the Development System's own Certificate of License and Authenticity, which is included in the SCO OpenServer box.

If you do choose to run an earlier version of the SCO Development System, you must reactivate it after upgrading to SCO OpenServer Release 5.0.6. The instructions for reactivating the Development System are displayed when you invoke the **/bin/cc**, **/bin/rcc**, or **/usr/bin/CC** command.

Upgrading from release 5.0

This section covers issues that may arise when upgrading from SCO OpenServer Release 5.0.0, 5.0.2, 5.0.4, or 5.0.5 to SCO OpenServer Release 5.0.6.

See also:

- "Choosing an upgrade path" (page 36)
- "Issues with any upgrade" (page 43)

- the *Release Notes* for information on migrating previous SCO Internet FastStart data configurations

Missing user-created files

An **Upgrade** installation may move aside certain user-created files or directories when it creates directory-level symbolic links.

When a directory ***directory_name*** is moved, it is renamed ***directory_name#***. (If a directory called ***directory_name#*** already exists, sufficient number signs are appended to the directory's original name to create a unique name, such as ***directory_name##***.) For example, if */tcb/files/audit* contained user-created files before an upgrade that you cannot find there after the upgrade, check whether a directory exists called */tcb/files/audit#*. If so, you can return your files to the upgraded */tcb/files/audit* directory.

CAUTION Move only the user-created files from a displaced directory to an upgraded directory. Do not overwrite other files in the upgraded directory.

Third-party products and system serial numbers

Some third-party applications that are run after a system has been upgraded may find that the serial number of the installation is not the same as the one under which the application was originally installed.

The installation tries to rebrand the new kernel with the old serial number during an upgrade. If this does not work, rebrand the kernel with the serial number of a previous release using the command:

brand -n ***old_serial_number old_activation_key*** **/etc/conf/pack.d/kernel/os.a**

Then, relink the kernel and reboot the system.

Upgrading to the Enterprise configuration from Host or Desktop

If you purchased an upgrade for one of the following scenarios, the upgrade requires a two-step procedure:

- SCO OpenServer 5.0.0, 5.0.2, or 5.0.4 Host System to SCO OpenServer 5.0.5 Enterprise System
- SCO OpenServer 5.0.0, 5.0.2, or 5.0.4 Desktop System to SCO OpenServer 5.0.5 Enterprise System

The first step upgrades the system to SCO OpenServer Release 5.0.6 in the same configuration, and the second step upgrades the system to SCO OpenServer Enterprise System.

The first step happens automatically when you choose the **Upgrade** installation option. Use the license information from the previous (5.0.0, 5.0.2, 5.0.4, or 5.0.5) Certificate of License and Authenticity (COLA) for this step.

To complete the second step, follow the instructions in Chapter 4, "Installing and managing software components" (page 69) to invoke the **Software Manager** and install the SCO OpenServer Enterprise System. When prompted, supply the license information from the 5.0.6 COLA.

After you install the SCO OpenServer Enterprise System, exit the **Software Manager** and reboot the system.

Upgrading anonymous ftp from Desktop to Enterprise

When you upgrade an SCO OpenServer Release 5.0.6 Desktop System to an Enterprise System, anonymous **ftp** will no longer work if it was configured before. This is because the Enterprise System functionality that enables "virtual domains" prevents the **ftp** server from recognizing existing anonymous **ftp** user information.

To re-enable anonymous **ftp** in this environment:

1. Back up the */etc/passwd* file in a safe location.
2. Edit the */etc/passwd* file, changing the home directory entry of the *ftp* user to */usr/internet/ip/0.0.0.0/sco_ftp*:

   ```
   ftp:x:20:50:anonymous ftp account:/usr/internet/ip/0.0.0.0/sco_ftp:/bin/sh
   ```

   The *ftp* account entry must be on one line.
3. Create a virtual domains stub directory:

   mkdir -p /usr/internet/ip/0.0.0.0
4. Create a symbolic link from the stub directory to the original *ftp* home directory:

   ln -s /u/ftp /usr/internet/ip/0.0.0.0/sco_ftp

NOTE Virtual domains are only available with a Fresh installation of the Enterprise system; see Chapter 28, "Managing virtual domains" (page 473) for more information.

Upgrading the language product

If you upgrade the system within the SCO OpenServer family (for example, from Host to Enterprise), you must also install the appropriate language support product in the usual way, after the upgrade.

Ideally, do not install language products until after an upgrade.

IPX/SPX upgrades overwrite *_tune.h files

An **Upgrade** installation to an SCO OpenServer Desktop System or Enterprise System does not automatically upgrade the files *ipx_tune.h*, *nvt_tune.h*, and *spx_tune.h*. Instead, during the installation, the files get saved to */usr/lib/ipxrt/saved_config*. If you have made changes to these files that you want to preserve, compare them with the newly-installed versions after the upgrade, and make any necessary changes to the new files.

Upgrading SCO Merge

SCO Merge is not automatically upgraded when you install SCO OpenServer Release 5.0.6. If you have been running SCO Merge under SCO OpenServer Release 5.0.0, 5.0.2, 5.0.4, or 5.0.5 and you select the **Upgrade** installation type for Release 5.0.6, SCO Merge will not be disturbed. If you select a **Fresh** installation for Release 5.0.6, use the **Software Manager** (page 69) to install the latest release of SCO Merge from the SCO Optional Services CD-ROM. Supply the license information provided in a file on the same CD-ROM.

Additional product documentation unavailable after upgrades

If you perform an **Upgrade** installation on a system that has additional products installed (such as SCO Merge, SCO Advanced File and Print Server, or SCO OpenServer Development System), the documentation for these products is unavailable unless the additional products are upgraded as well. (This does not apply to manual pages.) To retain the documentation for the older versions, you must remove the documentation package for each product and reinstall it on the upgraded system from the original media.

Upgrading from release 3.0

There are no specific issues to consider when upgrading from SCO Open Desktop Release 2.0 to SCO OpenServer Release 5.0.6. Make sure you read "Issues with any upgrade" (page 43) and the *Release Notes* before beginning the installation. The material in "Upgrading from release 5.0" (page 48) may also apply to systems running Release 3.0.

NOTE To upgrade from Release 3.0, you must select the **Fresh** installation type, then preserve or restore your data using one of the methods introduced in "Choosing an upgrade path" (page 36).

Upgrading from release 2.0

There are no specific issues to consider when upgrading from SCO Open Desktop Release 2.0 to SCO OpenServer Release 5.0.6. Make sure you read "Issues with any upgrade" (page 43) and the *Release Notes* before beginning the installation. The material in "Upgrading from release 5.0" (page 48) may also apply to systems running release 2.0.

NOTE To upgrade from Release 2.0, you must select the **Fresh** installation type, then preserve or restore your data using one of the methods introduced in "Choosing an upgrade path" (page 36).

Chapter 3

Troubleshooting the installation

This chapter describes troubleshooting procedures for some of the more common problems that might occur during (page 54) or immediately following (page 58) installation of your SCO OpenServer system and additional SCO products.

Sometimes errors occur during the installation procedure that cause problems as you install the software or when you boot immediately after installation. The problem is usually not with the software or the procedure itself. Occasionally, there is a hardware problem, but typically such problems are minor, such as an improperly connected cable.

If your problem is not described here, use "Solving undocumented installation problems" (page 62) to help you identify your problem. For example, if your system hangs mysteriously, use the information in that section to eliminate some of the more common causes of this problem.

If you cannot solve your problem and you must contact your support provider for help, be sure to record your system information as described in "Before calling for help" (page 64).

During the installation procedure, do not assume that you know what is about to happen, even if you have installed the system before. There have been changes to the installation process, so you should read the installation documentation closely.

See also:

- Chapter 13, "Troubleshooting system-level problems" (page 247)

Solving problems during installation

This section covers solutions for some common problems that might occur while installing the software.

- "System does not boot during installation" (this page)
- "Error reading a floppy disk" (page 55)
- "Errors when using SCSI installation devices" (page 56)
- "System reboots from Boot Disk or screen blanks after Boot: prompt" (page 56)
- "System hangs at hardware configuration screen" (page 57)
- "Hardware self-check stops" (page 57)
- "System does not boot from the hard disk" (page 58)

System does not boot during installation

If the system does not display prompts for starting the installation the first time you boot from the Boot Disk:

1. Verify that the Boot Disk is in the drive. If another floppy disk is in the drive, the system does not display the `Boot:` prompt. Replace the floppy disk with the Boot Disk and reboot the machine.
2. If the Boot Disk is in the drive and the machine still does not boot, make sure that the floppy disk is inserted correctly and that the floppy disk drive door is closed. Then, reboot the machine.
3. If the Boot Disk still does not boot, verify that your floppy disk drive works by booting a DOS disk.
4. If the floppy disk drive works, your problem may be a damaged Boot Disk. Verify the media by booting on another similar machine if possible. If the Boot Disk is damaged and you do not have a backup copy, request a new Boot Disk from your software provider.

If the system still does not boot, you most likely have a problem with your hardware:

1. Check that your system has enough RAM (Random Access Memory)—see your computer's documentation. Your computer must have the minimum recognized memory listed in your *Release Notes* to install the operating system.

   At the `Boot:` prompt, entering the command **mem=/p** displays all the RAM the system will use. On most systems, you can override this default using the **mem=** command. See the **boot**(HW) manual page.

2. If your system has enough RAM, check that the boards (bus cards) are seated properly.
3. If the system still does not boot, you may have a badly configured floppy disk drive. Make sure that the values in the CMOS match the drives actually attached to the system and that the positions of multiple drives on the drive cable match the BIOS configuration. If the CMOS setup has a `Swap drives` setting, make sure this is turned off.
4. Check that all cards are supported (see the *SCO Hardware Compatibility Handbook* or SCO's Compatible Hardware Web Pages) and correctly configured (as described in Chapter 14, "Basic hardware configuration" (page 271)).
5. Disable cache (to enable diagnostics) and shadow RAM.
6. If, after performing all the above tests, the system still does not boot, you may have a hardware failure. Check the documentation that came with your computer for hardware tests.

Error reading a floppy disk

If an error occurs while reading a floppy disk:

- Verify that the correct disk is in the floppy disk drive.
- Make sure that the floppy disk is inserted correctly.
- Verify that the door to the floppy disk drive is completely closed after you insert the floppy disk.

- Verify that the CMOS is configured correctly. Check to make sure that the values in the CMOS match the drives actually attached to the system and that the positions of multiple drives on the drive cable match the BIOS configuration. If the CMOS setup has a `Swap drives` setting, make sure this is turned off.
- If the error message persists, call your software provider to arrange for a new floppy disk.

Errors when using SCSI installation devices

If you make a mistake selecting the configuration of the SCSI installation device when the system includes more than one SCSI device, and another SCSI device is actually at the configuration you selected, you may need to restart the installation. This is because the kernel configures the SCSI device and "locks" it into place. Once the device is locked into place, it cannot be removed. The only solution is to restart the installation, making sure you select the correct configuration the first time.

You can restart the installation completely at any time by inserting the Boot Disk, then pressing ⟨Enter⟩ at the `Boot:` prompt. If you are using the BTLD utility and need to restart, insert the Boot Disk and enter **restart link=*pkg1*** at the `Boot:` prompt (where ***pkg1*** is the name of the package from which to extract the required BTLD drivers). For more information, see "Adding BTLDs at boot time" (page 285).

System reboots from Boot Disk or screen blanks after Boot: prompt

If you cannot install because the system keeps rebooting from the Boot Disk or the screen blanks after pressing ⟨Enter⟩ at the `Boot:` prompt, one of two known situations may be causing this problem:

- an improperly configured EGA or VGA adapter
- an incompatible EGA or VGA adapter

If you have an EGA or a VGA adapter, check the following:

- Verify that the adapter is supported by your SCO OpenServer system. Check the *SCO Hardware Compatibility Handbook* or SCO's Compatible Hardware Web Pages.
- Make sure that the switches on the adapter are set correctly. Many cards have emulation modes; make sure that you are using the card in its native mode. You can also experiment with the VGA, EGA, CGA, MONOCHROME switches.

If the card has an AUTOSWITCH feature, the system may hang during the startup hardware check. See "Hardware self-check stops" (page 57).

System hangs at hardware configuration screen

When you start the installation from the Boot Disk, the system displays information about your hardware configuration, followed by a series of diagnostic messages. These messages display quickly and overwrite each other, so they are not generally visible, although the process normally pauses for a while at certain points if lengthy checks or initialization are involved. If the process stops and does not continue, this usually indicates a problem with the initialization of the corresponding device driver. The startup messages are described in Appendix G, "Kernel initialization check letters" (page 539).

If your system hangs at this point, the problem might be an improperly installed adapter as described in "Hardware self-check stops" (this page), or it might be an I/O address conflict.

- Check the hardware configuration screen; each line in the "address" column must be unique.
- If there are no I/O address conflicts, run hardware diagnostics as explained in your computer manual and correct any identified problems.

Start the installation procedure again from the beginning. You can restart the installation completely at any time by inserting the Boot Disk, then pressing ⟨Enter⟩ at the `Boot:` prompt. If you are using the BTLD utility and need to restart, insert the Boot Disk and enter **restart link=*pkg1*** at the `Boot:` prompt (where ***pkg1*** is the name of the package from which to extract the required BTLD drivers). For more information, see "Adding BTLDs at boot time" (page 285).

If the system hangs at the hardware configuration screen again, contact your software supplier for more information and be prepared to report the last message displayed.

Hardware self-check stops

One possible cause for stopping for more than several seconds during the hardware self-check is an improperly installed EGA or VGA adapter. If you have an EGA or VGA adapter, shut the computer off and check your card documentation. Errors at this point may also mean an incompatible network card. Check the SCO *Hardware Compatibility Handbook* or SCO's Compatible Hardware Web Pages to verify that the card is supported by your SCO OpenServer system.

If your graphics card has the AUTOSWITCH feature, it must be disabled to install the product. Check the documentation included with your graphics card for information on how to disable AUTOSWITCH. This is typically controlled by setting a small switch on the card to the off position.

You can then restart the installation from the beginning by inserting the Boot Disk, then pressing ⟨Enter⟩ at the `Boot:` prompt. If you are using the BTLD utility and need to restart, insert the Boot Disk and enter **restart link=*pkg1*** at the `Boot:` prompt (where ***pkg1*** is the name of the package from which to extract the required BTLD drivers). For more information, see "Adding BTLDs at boot time" (page 285).

If the problem persists, contact your support provider for help.

Another symptom of this problem appears if you are using an AUTOSWITCH EGA or VGA card that normally displays in high-resolution EGA or VGA mode, and the `Boot:` prompt appears in low-resolution CGA mode. (Standard CGA text is low-resolution: dark lines are visible through the characters. EGA and VGA text is high resolution: no dark lines are visible.) In this case, reset the video adapter until the high-resolution display appears.

System does not boot from the hard disk

If the system does not boot from the hard disk as described near the end of the installation procedure, you may see an error message, possibly like this one:

```
PANIC: iinit
```

This generally happens if the boot block was written on a bad track. Whatever the reason for this problem, you must reinstall your SCO OpenServer system software.

Scan for bad blocks during the installation by pressing ⟨Space⟩ at **Hard disk setup** on the **Preparing your disk and choosing software** window, pressing ⟨Space⟩ again at **Disk 0 bad block type** or **Disk 0 bad track type** (which option is displayed depends on the disk type), then selecting an option.

If, after reinstalling, the operating system still does not boot, run the hardware diagnostics that came with your computer and hard disk (if any).

Solving problems after installation

This section describes some common problems that you could encounter when you boot the system immediately after installing the software.

- "Console screen looks strange" (page 59)
- "Graphical scologin screen on tty02 looks strange" (page 59)
- "Hardware does not work" (page 59)
- "DOS does not work" (page 60)

- "System not licensed or unregistered software" (page 60)
- "Error message: Can't fork" (page 60)
- "Error message: X TOOLKIT ERROR" (page 60)
- "Common system resource error messages" (page 61)

Console screen looks strange

When booting, if the console screen blanks, the cursor is gone, or the display is garbled, you may have an incompatible video card. If the card does not work, check the card hardware documentation. See if there are ways to configure the switch settings so the card is in an IBM-compatible emulation mode, and that it is addressing the kind of monitor attached. In particular, disable AUTOSWITCH modes. If changing the switch settings fails, then your video card is incompatible and must be replaced with a compatible card.

Install

Graphical scologin screen on tty02 looks strange

If the graphical **scologin**(XC) screen that appears on tty02 on the console looks strange (for example, the **Login** window does not fit in the display), you may have incorrectly configured your video hardware during the installation.

To solve this problem, reconfigure your video selections:

1. Check the *SCO Hardware Compatibility Handbook* or SCO's Compatible Hardware Web Pages to verify that your video hardware (adapter and monitor) is compatible with the SCO OpenServer system.
2. Check the hardware documentation to verify that you configured the switch settings correctly.
3. Follow the instructions for using the **Video Configuration Manager** to reconfigure your video hardware in Chapter 20, "Configuring video adapters" (page 355).

Hardware does not work

If some hardware (for example, a tape drive) does not work with the software installed, but it works under another operating system, the hardware may not be supported by the product or might not be configured correctly.

Refer to the *SCO Hardware Compatibility Handbook* or SCO's Compatible Hardware Web Pages for information on the hardware that you can use with this product.

DOS does not work

If neither the SCO OpenServer system nor DOS works after installing the system, you need to reinstall both systems. Make certain that you followed the guidelines in Chapter 7, "Using other operating systems with an SCO system" (page 101) and "Physical and virtual DOS drives" in the *SCO Merge User's Guide*.

System not licensed or unregistered software

If you get the error `System not licensed` when logging in, or see messages about unregistered SCO software:

1. Switch to tty01 by pressing ⟨Ctrl⟩⟨Alt⟩⟨F1⟩.
2. Log in as *root*.
3. Use the command **scoadmin license manager** (or **scoadmin license**) to run the **License Manager** as described in "The License Manager interface" (page 88). Confirm that you have a valid license for each installed product by looking for the word `Yes` in the *Licensed* column.
4. To stop the periodic messages about unregistered software, register your products as described in "Registering products" (page 90). Confirm that a product is registered by looking for the word `Yes` in the *Registered* column.
5. Check that your system date accurately reflects today's date by running the **date**(C) command with no arguments. If the date displayed is not today's date, reset the date with the **date** command, and reboot the system.

Error message: Can't fork

If your system swap space is insufficient, you may see error messages such as:

```
Can't fork
```

In general, the default amount of swap space assigned at installation time is sufficient, but if your machine is heavily loaded with graphical or other processes, you should increase the amount of swap space using **swap -a**. See the **swap**(ADM) manual page.

Error message: X TOOLKIT ERROR

If some of your system's resource allocations are insufficient, you may see this error message:

```
X TOOLKIT ERROR:
```

One of the more commonly under-allocated resources is inode buffers; increasing the number of inode buffers may correct the condition that caused this error message.

NOTE If you are running X, this message may not appear on your console.

Refer to "Common system resource error messages" (this page) for more information about system kernel parameters.

Common system resource error messages

When system limits are exceeded, the operating system advises you by displaying messages on the console. Some of the messages are advisory only. Others precede a system panic: the system displays some additional diagnostic messages and then "hangs," requiring you to reboot.

If you are running X, these messages may not appear on your console. If your system hangs, switch to the console multiscreen by pressing ⟨Ctrl⟩⟨Alt⟩⟨F1⟩, if possible, and read the diagnostic messages. If you cannot switch multiscreens, reboot the system and read the messages in the */usr/adm/messages* and */usr/adm/syslog* files.

If you use multiple servers (X terminals or console multiscreens) with an SCO OpenServer system, you may need to reset some system parameters. See "Kernel parameters that you can change using configure" in the *Performance Guide*.

Kernel error messages that appear while running this product are similar to this:

```
CONFIG: routine - Out of streams (NSTREAM = n exceeded)
```

routine is the kernel routine that requested a stream or queue, but did not allocate one and ***n*** is a decimal number indicating the current value of the parameter setting. For information on modifying **NSTREAM** and other kernel parameters, and on relinking the kernel, see Appendix B, "Configuring kernel parameters" in the *Performance Guide* and the **configure**(ADM) manual page.

For detailed information on modifying kernel tuning parameters, see Appendix B, "Configuring kernel parameters" in the *Performance Guide*. To invoke the **Hardware/Kernel Manager** enter this command as *root*:

scoadmin hardware

Select **Tune Parameters**.

Solving undocumented installation problems

Even if your problem is not described here, this section can help you to isolate, identify, and solve the problem.

First, you must determine whether you have a software or hardware problem. In general, hardware problems are intermittent, while software problems are consistent.

Hardware and operating systems

The fact that a given piece of hardware works under DOS is no guarantee that it works with the SCO OpenServer system.

A critical difference between SCO OpenServer systems and some DOS applications is the way they access hardware. For example, older DOS systems and some DOS applications read or write information to a device controller (disk, tape, or serial/parallel) by making a device-independent call to the BIOS (Basic Input Output System). The BIOS translates the device-independent call into a device-dependent set of instructions to transfer data to or from a particular device.

Except for very short periods of time during installation and during the boot process, SCO OpenServer systems never use the BIOS; device drivers handle many of the functions for which DOS can use the BIOS.

Some PC manufacturers depend on something called BIOS compatibility. DOS functions can be, in a sense, device-independent, because some of the device-dependent functions of DOS have been separated into the BIOS. This means that manufacturers can make their non-standard devices work under DOS by modifying the ROM BIOS that acts as the interface between the hardware and DOS.

By writing code that reads and writes directly to the device, DOS can also use devices without going through the BIOS. This is similar to writing a device driver for an SCO OpenServer system. The ability to write directly to a device is one reason some hardware works with DOS, but not with SCO OpenServer systems. The hardware vendor can make DOS work with hardware that uses a non-standard BIOS by writing a DOS device driver that translates between DOS and the non-standard BIOS. This makes it BIOS-compatible for DOS, even though the BIOS is non-standard. DOS polls the system bus and the custom device driver to access the device. Because an SCO OpenServer system does not make use of the BIOS, it expects a piece of hardware to be at a specific interrupt vector, DMA channel, and base address, and does not recognize the hardware if it is incorrectly configured.

Identifying the problem

If the system hangs mysteriously, either at boot time, during installation, or shortly thereafter, use these steps to isolate and identify the problem:

1. Confirm that your hardware is listed as supported in the *SCO Hardware Compatibility Handbook* or SCO's Compatible Hardware Web Pages. If it is not, SCO recommends that you use supported hardware.
2. If possible, check a suspected component on another machine with the same configuration (under an SCO OpenServer system, not MS-DOS).
3. If any third-party drivers are installed, such as those supplied with multiport cards, remove both the driver and the hardware that it controls, relink the kernel, and see if the problem persists.
4. Make certain that your devices are recognized at boot time. Watch the boot display, use **cat**(C) or **vi**(C) to look at the */usr/adm/messages* and */usr/adm/syslog* files, or use the **hwconfig**(C) utility.
5. Check for hardware conflicts between components, including DMA, interrupt vectors, and memory addresses. Check for documented incompatibilities or limitations in the *SCO Hardware Compatibility Handbook* or SCO's Compatible Hardware Web Pages.
6. If your machine has features such as shadow RAM or memory caching, disable them.
7. If you have a DOS partition installed, verify that it follows the guidelines in "Physical and virtual DOS drives" in the *SCO Merge User's Guide*.
8. If your hard disk has more than 1024 cylinders, you must follow the restrictions described in "BIOS support for disks larger than 1024 cylinders" (page 337).
9. If your video card is incorrectly installed, the system can also fail. Check the following:
   - Read "System reboots from Boot Disk or screen blanks after Boot: prompt" (page 56).
   - Known conflicts exist between video cards and network cards. Sometimes, attempts to send or receive data from the network card are blocked. To solve this problem, avoid using IRQ 2 (interrupt vector 2) for your network card. Some graphics cards use the additional interrupt, causing the conflict to occur. Check the *SCO Hardware Compatibility Handbook* or SCO's Compatible Hardware Web Pages for warnings that apply to specific cards and card combinations. Most video cards that use IRQ 2 have a jumper to disable this behavior.

Install

- Known conflicts exist between the default RAM buffer base address for the **wdn** driver for the Western Digital WD8003 and WD8013 networking cards, and certain motherboards and VGA video adapters. The **wdn** driver uses the RAM buffer base address, D0000, as a ROM address. This conflicts with motherboards that store CMOS information at this address and with VGA adapters that use D0000 as a ROM address.

  To solve this problem, reconfigure your Western Digital WD8003 or WD8013 networking hardware to use CC000 or C0000 as the RAM buffer base address. Then, reconfigure the **wdn** driver using the instructions in "Driver configuration" (page 487).

- Known conflicts exist between some brands of 16-bit VGA boards and floppy or tape data transfer. If you experience data corruption during floppy or tape data transfers, try configuring the card to 8-bit mode or put it in an 8-bit slot. Consult your hardware documentation for more information.

10. If you did a low-level format of your hard disk, you may have a format program that does not work. Format programs that are known to work are **DOS Debug** and **Speedstor**.
11. If you installed DOS on your hard disk, you may have a partition table that SCO OpenServer system software does not recognize. You must use DOS version 6.0 or earlier. The DOS partition must *not* have been created with **Disk Manager**.

Before calling for help

If your problem is not discussed in Chapter 3, "Troubleshooting the installation" (page 53), and you cannot isolate the problem using "Solving undocumented installation problems" (page 62), call your support provider for help. Before calling, however, make a copy of the following trouble report forms and your installation checklist from "Installation and upgrade checklist" (page 20). Then, write down the critical information about your system, including a description of your problem and system configuration, so that the support personnel can analyze your problem quickly.

A description of the problem

Write down a complete description of your problem, including the precise series of commands or steps that you took that led to the problem. Include the exact text of any error messages displayed.

Problem description
(Include steps that led to the problem and error messages, if applicable.)

System configuration

Knowing the hardware and software configuration of your system is vital to a correct diagnosis of your problem. If this information is readily available when you speak to your support provider, the diagnostic process is much easier and less time-consuming. Make sure that you list *all* the hardware components, including brand names and model numbers, when you fill out the hardware configuration trouble report worksheet. On the software configuration worksheet, check the SCO OpenServer product that is installed, the installed components (if a subset of the SCO OpenServer system is installed), any additional SCO products, and list all applications and non-SCO device drivers that you installed.

Install

Hardware configuration		
Component	Brand name	Model
Computer		
Monitor		
Processor type		
Processor speed		
Coprocessor		
Memory size		
Bus interface (PCI, ISA, MCA, EISA)		
Floppy drive(s)		
Video card		
Video mode		
Hard disk(s)		
Disk Controller or Host adapter		
Tape drive/Controller		
Network adapter		
Mouse		
Serial card		
Printer		
Modem		
Other device(s)		

Software configuration: System	Release Number
☐ SCO OpenServer Enterprise System	
☐ SCO OpenServer Desktop System	
☐ SCO OpenServer Host System	
☐ SCO OpenServer Development System	

Software configuration: Components	Release Number
☐ Operating System	
☐ Graphical Environment	
☐ Connectivity	
☐ Online Documentation	

Software configuration: Additional SCO Products	Release Number
☐ SCO Merge	
☐ SCO Advanced File and Print Server	
☐ SCO® Virtual Disk Manager	
☐ SCO® SMP® License	
☐ SCO User Licenses	
☐ 10, ☐ 25, ☐ 100, ☐ 500, ☐ unlimited users	

Software configuration: Additional Applications	
Product name	Release number

Install

Install

Chapter 4

Installing and managing software components

From the **Software Manager**, you can:

- install software products and patches (page 72)
- remove software products and patches (page 74)
- examine a product's components, packages, files, patches, dependencies, PRD value, version number, and installation state (page 75)
- verify that each product's files are present and arranged correctly (page 77)

To perform these and related tasks from the command line, see the **custom**(ADM) manual page.

To perform these tasks across the network, see Chapter 21, "Installing and managing software over the network" in the *Networking Guide.*

The Software Manager interface

> **NOTE** If you start the **Software Manager** and the **License Manager** one right after the other, the **Software Manager** menus may not respond. To work around this problem, re-invoke the **Software Manager**.

You can start the **Software Manager** in any of these ways:

- Double-click on the **Software Manager** icon in the *System Administration* window on the Desktop.
- Start the SCOadmin launcher by entering **scoadmin** on the command line, then select **Software Manager**.
- Enter **scoadmin software manager** on the command line. (You can abbreviate this to **scoadmin so**.)

To run the **Software Manager**, you must have *root* or *sysadmin* authorization.

For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

Figure 4-1, "The Software Manager" (page 71) shows the main window for the **Software Manager** and defines the symbols that mark the available software. (Most of the symbols are based on a picture of a CD-ROM.) The figure is missing one symbol: a broken disk, indicating that the software became corrupted during or after installation.

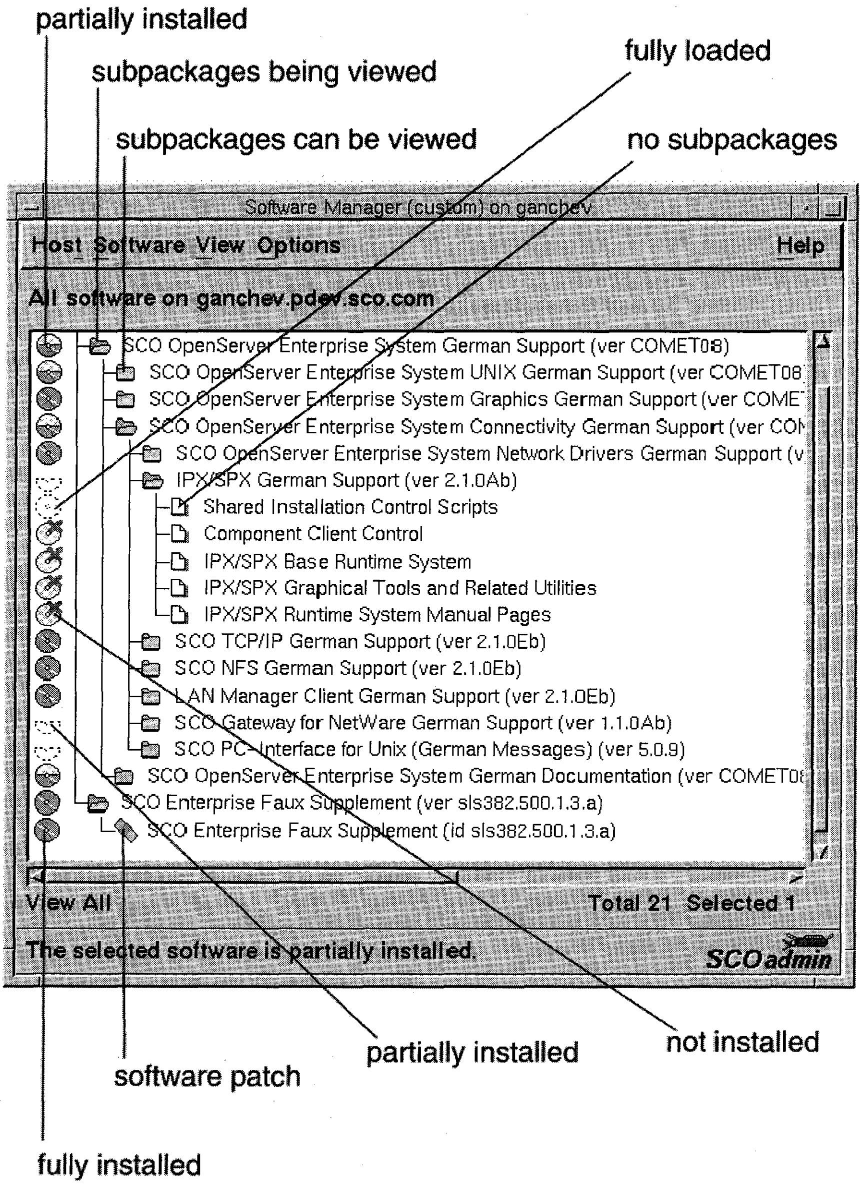


Figure 4-1 The Software Manager

Installing software

In the **Software Manager**:

> **NOTE** The procedure for installing a patch (page 80) is now the same as the procedure for installing any other software. Also, there is no longer an option to "apply" a patch (activate it on its target software) without loading it.

1. From the **Software** menu, select **Install New**.
2. Select the current host, then:
   - To install from a CD, tape, or floppy disk, identify the media device and insert your installation media.
   - To install from media images on the local host, select **Media Images** as the media device and identify the image directory. Media images must follow the naming convention: *VOL.000.000, VOL.001.000,* etc.
   - To complete the installation of software that is loaded on the local host (page 73), select **Loaded Software** as the media device.

   To install from another host, see the instructions in "Installing from remote source machines" in the *Networking Guide*.

   > **NOTE** The CD-ROM from which you install the SCO OpenServer system also contains many other SCO products. You must purchase, install, license, and register these additional products separately. See "Additional licenses and products" (page 13).

3. Select the software items that you want from the list of available software, and click on **Install**.

   The list of available software does not include individual files. To restore a damaged or missing file, see **customextract**(ADM).
4. To license the product during installation, enter the license number and code from the Certificate of License and Authenticity when prompted. If you defer licensing at this time, see "Licensing products" (page 89) for instructions on licensing the product.

To install software on a machine across the network, from the **Host** menu, select **Open Host**. Then, type in the host name, or click on **Select** to choose from a list of hosts. (Sort the list by host name or IP address by toggling the **Sort by** buttons, or type one or more characters into the "Filter" field to search for a host name.) Then, install the software as you would locally.

See also:

- "Examining software packages" (page 75)
- Chapter 21, "Installing and managing software over the network" in the *Networking Guide*

Loading software

To load software products or patches, follow the same procedure as for installing software (page 72), *except*:

> In the **Install Selection** window, select the software items that you want from the list of available software, and click on **More Options**. Then, specify **Load Only** as the installation option, and click on **Install**.

Other machines can use loaded software as installation source for installing across the network, but the software is not configured to run locally. A loaded patch is not configured to affect its target component; that is, it is not applied.

To configure loaded software to run locally (or to apply a patch), run the installation procedure, selecting **Loaded Software** as the media device.

About products, components, and packages

Each SCO product is arranged in the following units:

product
: The unit of software that you buy. For example, SCO OpenServer Enterprise System and SCO Doctor™ are products. Each product has its own version number. A product is composed of one or more "components", "packages", or "parcels".

  A "patch-product" (page 80) is one or more patches distributed as a product.

component
: The smallest unit of software that can stand alone. A component can constitute an entire product, or it can be one of many components in a product, but it cannot be split into smaller units for distribution. Each component has its own version number. A component is organized into a hierarchical tree of "packages".

  A patch (page 80) is applied to a component (rather than to a product or package).

package
: The most basic unit of software that can be installed or removed. Each package consists either of files or of other packages. A package does not have its own version number; it inherits the version number of its parent component.

In addition to these units, a product might be subdivided into "parcels". In a parcel, related software is grouped for convenience. For example, a parcel might contain the documentation packages from several components, making it easier to install or remove all the documentation in a product. A parcel can contain one or more components, packages, or parcels from the product.

See also:

- "About the new product structure" in the *Networking Guide*

Removing software

In the **Software Manager**, select the unneeded products, components, packages, and patches from the list of installed software. Then, from the **Software** menu, select **Remove Software.**

To leave the software loaded (page 73), click on **More Options** in the **Confirm Selected Software** window. Then, specify **Leave Loaded**, and click on **Remove**. (Removing a patch and leaving it loaded corresponds to the **Rollback Patch** operation in earlier versions of the **Software Manager**.)

When you start to remove a piece of software, the **Software Manager** checks to see whether it has any dependent components or packages and notifies you of any dependencies. If dependencies are found, you can either continue the removal procedure or cancel.

To remove software from a machine across the network, from the **Host** menu, select **Open Host**. Then, type in the host name, or click on **Select** to choose from a list of hosts. (Sort the list by host name or IP address by toggling the **Sort by** buttons, or type one or more characters into the "Filter" field to search for a host name.) Then, remove the software as you would locally.

See also:

- "Examining software packages" (page 75)
- "About products, components, and packages" (page 73)
- "About dependencies" (page 75)
- "About software patches" (page 80)
- Chapter 21, "Installing and managing software over the network" in the *Networking Guide*

About dependencies

If software B must be installed for software A to run, software A is "dependent" on software B, and software B is a "dependency" of software A. Dependencies and their dependent software may be products, components, or packages.

When you start to remove a piece of software, the **Software Manager** notifies you of dependent components or packages if they exist. You can then choose whether to continue or to cancel the removal procedure.

See also:

- "Examining software packages" (this page)

Install

Examining software packages

In the **Software Manager**, you can examine two different sets of software:

- The first window of the **Software Manager** lists the software **currently installed** (page 76).
- The **Install Selection** window of the **Software Manager**, which appears after you specify a source (media, image directory, loaded software, or remote machine) for the software you are installing, lists the software available on that **installation source** (page 77).

You can list software by product (the default), component, or package.

NOTE Patches (page 80) are now listed in the same displays as other software.

To examine software on a machine across the network, from the **Host** menu, select **Open Host**. Then, type in the host name, or click on **Select** to choose from a list of hosts. (Sort the list by host name or IP address by toggling the **Sort by** buttons, or type one or more characters into the "Filter" field to search for a host name.) Then, examine the software as you would locally.

See also:

- "About products, components, and packages" (page 73)
- Chapter 21, "Installing and managing software over the network" in the *Networking Guide*

Examining installed software

You can change the way software is listed in the **Software Manager** window in these ways:

- To view a product's (or patch-product's) components, double-click on the product name. To view a component's packages, double-click on the component name.

  (Selecting **Expand** from the **View** menu gives the same result as double-clicking.)
- To view all of the packages in a product or component at once, select the product or component name, then from the **View** menu, select **Expand Fully**.
- To view just the software that is installed on your system (including patches), without the software that is only loaded, select **View Installed** from the **View** menu.
- To view just the software available from your system for networked installation, select **View Available For Network Install** from the **View** menu.
- To view just the software that is loaded but not installed, select **View Loaded-Only** from the **View** menu.
- To view just the patches on your system, select **View Patches** from the **View** menu.
- To view all the software installed or loaded on your system (including patches), select **View All** from the **View** menu.

You can see additional information about specific software in these ways:

- To see all the files contained in a listed product, component, or package, select the list item, then from the **Software** menu, select **Examine**, then **Files**. Click on **Details** to display a file's owner, group, and size.
- To see additional information about a listed product, component, or package, select the list item, then from the **Software** menu, select **Examine**, then **Attributes**. The available information includes the dependencies, full name, size, version number, and installation state of the software.
- To see the patches applied to a listed software item, or to see the component affected by a listed patch, select the list item, then from the **Software** menu, select **Examine**, then **Patch Status**.

  To see additional information on a list item in the **Patch Status** window, double-click on that item, or select the item and click on **Details**.

See also:

- "Loading software" (page 73)
- "About dependencies" (page 75)

Examining software to be installed

In the **Install Selection** window of the Software Manager:

- To view a product's (or patch-product's) components, double-click on the product name. To view a component's packages, double-click on the component name.

  (Selecting the **Expand** button, under **More Options**, gives the same result as double-clicking.)
- To see all the files contained in a listed product, component, or package, select the list item, click on **More Options**, then click on **Files**. Click on **Details** to display a file's owner, group, and size.
- To see additional information about a listed product, component, or package, select the list item, click on **More Options**, then click on **Attributes**. The available information includes the dependencies, full name, size, version number, and installation state of the software.

See also:

- "Loading software" (page 73)
- "About dependencies" (page 75)

Verifying software

The **Verify** options in the **Software Manager** let you check the software files on your machine against the product and component databases (which define how each product and component should be arranged). Depending on which **Verify** option you choose, you can check for (and automatically fix) broken or missing symbolic links, and incorrect file permissions, owner, group, major and minor numbers, and number of hard links. The verification can also check for missing files and for incorrect file type, checksum, and size. To resolve these discrepancies (with the exception of certain missing files), you must fix them manually after exiting the **Software Manager**. (See **customextract**(ADM) for information on restoring files.)

NOTE The **Software Manager Verify** function only checks software under the */opt/K* and */var/opt/K* directories. If ownership or permissions of system directories (such as those under */etc* or */bin*) become corrupted on a running system, you can use **fixperm**(ADM) to correct them. (For **fixperm** to work, the directories must be listed in the perms list in */etc/perms*; for example, */etc/perms/rts* or */etc/perms/ext*.)

1. **To verify (and optionally fix) certain products, components, and packages**, select them from the list of installed software, then from the **Software** menu, select **Verify Software**.

   To verify (and optionally fix) all the products on the machine, select **Verify System** from the **Software** menu.

2. Indicate whether you want to check for:

   "Normal system state (Quick)"
   : Verifies that the status of the system is consistent with normal operation. It does not report on size or checksum changes for configuration (non-shared) files, because these often change as part of normal operation. It also does not verify checksums for shared files, and it does not remove a "corrupt" setting from a verified package.

   "Normal system state (Thorough)"
   : Verifies the checksums for shared files in the selected packages, in addition to the checks made during the "Quick" option. When the "Thorough" option has verified and fixed a package marked "corrupt", it replaces the package's "corrupt" icon on the main **Software Manager** window.

   "Modified configuration files"
   : Reports checksum changes for configuration (non-shared) files, showing which configuration files have changed since installation. Also verifies permissions, owner, group, major and minor numbers, number of hard links, symbolic link target, export location, file type, and size for each configuration file in the selected packages.

"Broken/missing symbolic links"

Reports symbolic links that should link a file from */opt* or */var/opt* to an external directory, but are broken or missing.

A weekly **cron** job runs this option on the entire system and mails the report to *root*.

"Strict database compliance"

Compares files in the selected packages to the product and components databases, and reports *all* discrepancies, including expected discrepancies, such as changed configuration files and missing optional files. This option can take a long time.

3. When the verification report is finished, indicate whether you want to send it to a printer or save it to a file, or both. If you do not want to fix the discrepancies, select **Done** at this point, then retrieve the printed or saved report.

   CAUTION If you try to print the report, but have no printer set up to receive it, you see a completion message even though the report was not printed.

4. To fix the discrepancies, select **Fix Discrepancies**. The verification report lists which types of discrepancies can be fixed automatically and which must be fixed manually.

NOTE To update the product database, see the **custom**(ADM) manual page.

To verify software on a machine across the network, from the **Host** menu, select **Open Host**. Then, type in the host name, or click on **Select** to choose from a list of hosts. (Sort the list by host name or IP address by toggling the **Sort by** buttons, or type one or more characters into the "Filter" field to search for a host name.) Then, verify the software as you would locally.

See also:

- "About products, components, and packages" (page 73)
- "Examining software packages" (page 75)
- Chapter 21, "Installing and managing software over the network" in the *Networking Guide*
- **hierarchy**(M) manual page

Install

About software patches

A "patch" updates features or fixes bugs in existing software. A "patch-product" is one or more software patches distributed as a product.

A patch affects its target software at the component level, not at the product level or package level. Each patch in a patch-product can affect a different component.

From the **Software Manager**, you can:

Install a patch — Load (copy) the patch onto the system and activate (apply) the patch on the target software. You can also load the patch without applying it. (It is no longer possible to apply the patch without loading it.) See "Installing software" (page 72).

Remove a patch — Remove the patch from the system and remove its effect on the target software. You can also remove the patch's effect on the target software, but leave a copy of the patch loaded on the system. (This operation was formerly called **Rollback**.) See "Removing software" (page 74).

Examine patches and the components they affect — See "Examining software packages" (page 75).

Chapter 5

Creating an emergency boot floppy disk set

Install

The emergency boot floppy disk set allows you to recover your system in the event of a catastrophic system failure (when the computer does not respond to your attempts to start it). Use these floppy disks to restore a corrupted *root* filesystem without reinstalling the system.

If you have more than one system, you must make one emergency boot floppy disk set for each machine. Label each set with the machine name and store the floppy disks in a safe and secure place near the computer.

WARNING If you use the wrong floppy disk set on a machine, it could cause further corruption.

These tasks are associated with creating an emergency boot floppy disk set:

- "Configuring the floppy disks" (page 82)
- "Adding files to the root floppy disk" (page 84)
- "Testing your emergency boot floppy disk set" (page 84)
- "Reading backups" (page 84)
- "Booting from the hard disk" (page 86)

Configuring the floppy disks

You can create your emergency boot floppy disk set on a pair of 5.25-inch 1.2MB (96tpi, 15 sectors per track), 3.5-inch 1.44MB (135tpi, 18 sectors per track), or a single 3.5-inch 2.88MB (135tpi, 36 sectors per track) floppy diskette.

NOTE If you have less than 16MB of RAM installed, you may need shut down the system (page 179) and bring it up in single-user mode (page 172) before creating your emergency boot floppy disk set. This is because the root floppy disk creates a RAM disk that requires 2MB of *contiguous* memory (a single block of memory instead of multiple segments that add up to 2MB). When there is insufficient contiguous memory to create the RAM disk, you see the message: `/dev/ramfs: cannot open`.

1. Log in as *root*.
2. Use the **Floppy Manager** located in the *Filesystems* directory of the SCOadmin hierarchy, or enter this command:

   mkdev fd

3. At the main menu, enter **2** to create the emergency boot floppy disk set.
4. When prompted, indicate the type of disk drive you are using; unless you have a 2.88MB drive, enter **2**.
5. If you have more than one floppy disk drive, you are prompted for the drive that you are using to create the floppy disk. Enter either **0** (for the primary drive) or **1** (for the secondary drive).
6. When prompted for the type of filesystem, select **1** to create the root floppy disk. If you are creating a single boot/root floppy disk, select **3**.
7. When prompted, insert a blank floppy disk and press ⟨Enter⟩.
8. When prompted to format the floppy disk:
   - If the floppy disk is already formatted, enter **n**. The filesystem is then created immediately.
   - If the floppy disk is not formatted, enter **y**. You see the track and head numbers count up as the floppy disk is formatted. (If the */etc/default/format* file contains the string `VERIFY=Y`, the format is also verified.)

9. A filesystem is created on the floppy disk and system files are copied over to a RAM disk for compression, including copying */dev/cmos* to */etc/cmos.root*. You can use this file to restore the CMOS settings later as described in **cmos**(ADM).

10. When you see the message:

    `Do you want a shell escape to place extra files on the root filesystem? (y/n)`

    If you want to place additional files on the disk, enter **y** and follow the instructions in "Adding files to the root floppy disk" (page 84). Otherwise enter **n**. If you are creating a single boot/root floppy disk, skip to step 13.

    > **NOTE** Disk space on the emergency boot floppy disks is limited and only critical utilities are loaded. Where possible, additional utilities such as **tar**(C) are copied when space permits.

11. The filesystem is checked using **fsck**(ADM) and displays messages similar to the filesystem check displayed at boot time. You are notified when the the floppy disk is ready. Remove the floppy disk from the drive, and label it "root" and include the machine name. Put a write-protect tab on it so that you do not accidentally erase the information on the floppy disk.

12. Press ⟨Enter⟩ to continue and you are returned to the filesystem type menu. Enter **2** to create the boot floppy disk.

13. You have two options for the boot floppy disk: a system-specific disk that contains the same kernel that is currently on your system, or a smaller "generic" kernel that has fewer drivers linked in. If your current kernel is too large to fit on the disk, you will be warned and you will have to select the generic disk.

14. Insert the floppy disk and respond to the prompts as you did for inserting and formatting the root floppy disk.

15. The boot floppy disk is created and you see messages as files are copied to the disk. Then, the filesystem is checked using **fsck**(ADM). When complete, be sure and label it as you did with the root disk.

16. Follow the procedure in the "Testing your emergency boot floppy disk set" (page 84) section to verify that you can boot your system and access backups using your boot and root floppy disks.

Store your emergency boot floppy disk set (or single boot/root floppy disk) in a safe and secure place. Make sure they are easily accessible; you will need them if your system becomes corrupted and is no longer bootable.

Install

Adding files to the root floppy disk

If you respond y to the prompt for a shell escape during root floppy disk creation, you see:

```
You can copy files into /mnt to customize your root filesystem floppy.
After you finish, type "exit 0" to continue.
You have  n free blocks (512 bytes each) available on the floppy.
```

The command prompt is `<bootroot>`.

If you have enough free space available, you can copy additional files to the root floppy disk. For example, to copy the file */usr/pest* to the disk, you would enter:

cp /usr/pest /mnt/usr

When your additions are complete, enter **exit 0** at the `bootroot>` prompt.

Testing your emergency boot floppy disk set

After you create your emergency boot floppy disk set, verify that you can boot from it and read from backups:

1. Log in as *root*.
2. Shut down the system by entering **/etc/shutdown**.
3. At the prompt to reboot, insert your boot floppy disk in the floppy disk drive and press ⟨Enter⟩.
4. At the `Boot:` prompt, press ⟨Enter⟩ to boot from the floppy disk.
5. When prompted, insert the root floppy disk and press ⟨Enter⟩.
6. When you see the system prompt, verify that you can access your floppy disk or tape drive; follow the steps in "Reading backups" (this page).

Reading backups

At the end of the installation procedure, you made a complete backup of your system. If you have not already backed up your system, do it now using the instructions in "Running unscheduled filesystem backups" in the *System Administration Guide.*

Verify that you can read from this backup after booting from the emergency boot floppy disk set.

NOTE Unless you have a second floppy disk drive, you can only read from tape backups when you boot from the floppy disk drive with your boot and root floppy disks.

1. Make sure that the root floppy disk is in the drive.
2. List the contents of the backup:

   cpio -itvcB -I /dev/rct0

   NOTE You *must* be able to access your backup tape volumes when you boot from the emergency boot floppy disk set. If you cannot, follow the steps in the next section, "Booting from the hard disk".

3. Once you are satisfied that you can read backups after booting from your emergency boot floppy disk set, reboot the system from the hard disk by entering **/etc/haltsys** at the prompt.
4. When you see the message to reboot, remove the floppy disk from the drive and press ⟨Enter⟩.
5. At the `Boot:` prompt, press ⟨Enter⟩ to boot from the hard drive.

For information on using your emergency boot floppy disk set to access and restore a corrupted *root* filesystem, see "Restoring a corrupted root filesystem" (page 250).

Emergency boot floppy set and mirrored root disks

If you have a mirrored root configuration, there are several important considerations when creating and using an emergency boot floppy set:

- If you create a mirrored root filesystem, create a new emergency boot floppy set immediately. If possible, create a system-specific Boot disk rather than a generic one.
- If you must create a generic Boot disk (when the system-specific kernel does not fit on a floppy disk), then only the original piece of the mirror will open when the system is booted. You cannot use this Boot disk on another system with a mirrored root.
- When using the emergency boot floppy set to boot the system, use this bootstring instead of just pressing ⟨Enter⟩ at the Boot prompt:

  fd(60)unix.Z root=vdisk(1) swap=none dump=none

  WARNING If root is not directed to `vdisk(1)`, then the two halves of the mirror will become out-of-date, which could corrupt the filesystem when the machine is next booted from the hard disk.

Booting from the hard disk

If you experience problems booting your system with the emergency boot floppy disk set or you cannot access your backup volumes when you boot with these floppy disks, reboot the system from the hard drive:

1. Press the computer "reset" button, or turn the power off, then on.
2. At the `Boot:` prompt, press ⟨Enter⟩ to reboot from the hard drive.
3. If you have trouble with your floppy disks, try "Configuring the floppy disks" (page 82) again.

Chapter 6

Licensing and registering SCO products

You must both license and (for some products) then register each SCO product. You license the base operating system when you install it. Most additional SCO products prompt you for the license information during their installation procedures.

NOTE If you defer licensing during installation, your software product is not licensed and will not work.

To license and register a product with the **License Manager** (page 88), log in as *root* and follow these steps:

1. Install the product (page 72).
2. License the product (page 89).
3. Obtain your Registration Key (page 91).
4. Register the product (page 90).

See also:

- "Licensing and registration terminology" (page 13)
- "Licensing additional users and CPUs" (page 90)
- "Removing product licenses" (page 90)
- "Troubleshooting license and registration problems" (page 93)

The License Manager interface

Use the **License Manager** to:

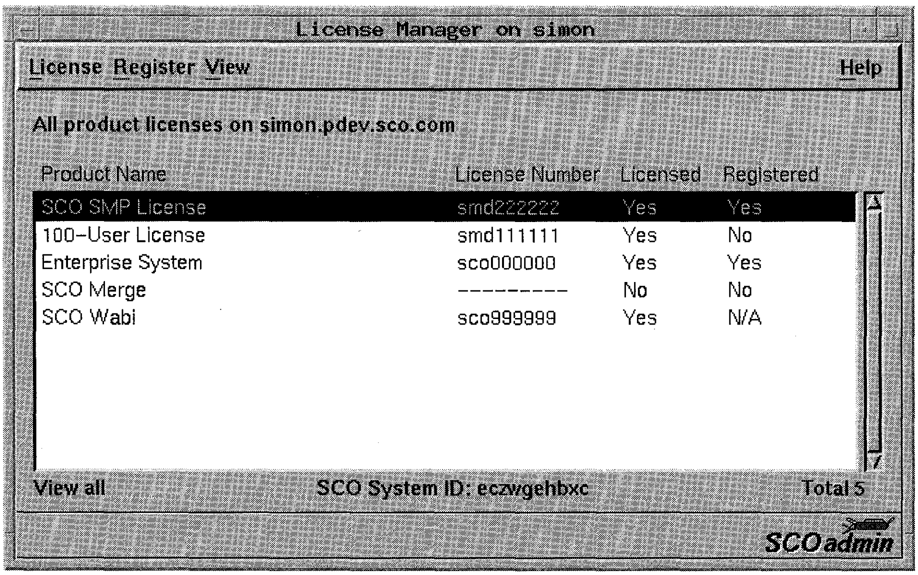
- license products (page 89).
- remove licenses (page 90).
- register products (page 90).

After the software product is installed, log in as *root* and start the **License Manager** in one of these ways:

- Double-click on the **License Manager** icon in the *System Administration* window on the Desktop.
- Start the SCOadmin launcher by entering **scoadmin** on the command line, then select **License Manager**.
- Enter **scoadmin license manager** on the command line (or abbreviate to **scoadmin l**).

> **NOTE** The **scoadmin** command only recognizes the spelling "license", not "licence".

When you start the **License Manager**, this window displays the software products currently installed on the system:



The SCO System ID, used to register the product (page 90), is shown at the bottom of the window.

For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

Licensing products

In the **License Manager**:

1. Select the product you wish to license from the list of installed products.

   NOTE Do not select "OpenServer Software"; it is not a valid product to license.

2. Select **License Product** from the **License** menu.
3. If a Certificate of License and Authenticity (COLA) accompanied your software, verify that it is an original (not a photocopy), with the SCO Security Hologram on the left side. From your COLA or online-acquired license, enter:
   - License Number
   - License Code
   - License Data (if included on the Certificate)
4. Click on **License**.

   (You can ignore the message `wrong number of licenseData`, if it appears. It may appear if non-licensed products are also installed on your system.)

NOTE Remember to register all products (page 90); your system software displays frequent reminders until they have been registered.

To determine which products have been licensed or registered, use the **View** menu in the **License Manager**.

Licensing additional users and CPUs

NOTE You cannot license additional users and CPUs for the Free* SCO products.

In the **License Manager**:

1. Select **License Additional Users** or **License Additional CPU** from the **License** menu.
2. Verify that the Certificate of License and Authenticity provided with your software is an original (not a photocopy), with the SCO Security Hologram on the left side. From it, enter:
   - License Number
   - License Code
   - License Data
3. Click on **License**.

NOTE Remember to register all products (page 90); your system software displays frequent reminders until they have been registered.

Removing product licenses

To make a license available to another system, or if you need to remove a license for any other reason, select the licensed product from the **License Manager** list (page 88), then select **Remove License** from the **License** menu.

If you remove a product license, that functionality will no longer work on that system.

Registering products

Most of SCO's commercial products require registration after installation. Registration is your confirmation to SCO that you have installed and licensed an SCO product. You can perform registration interactively at http://www.sco.com/register.

* "Free" means that there is no charge to license the software for personal and non-commercial use. The media kit has a nominal fee, and any number of users can share it. Each installation requires a unique license.

Some products (such as the Free* SCO products) do not need to be registered.

Once you have installed and licensed your SCO products, register them as soon as possible to deactivate the frequent reminder messages your system software generates. To do so:

1. Complete the SCO Product Registration Form in the *SCO Software Registration* booklet provided with your software. You can register up to six SCO products with each form. We encourage you to register all your products at one time.

   Remember to:

   a. Copy the unique SCO System ID assigned to your system from the bottom of the **License Manager** window (page 88) onto the SCO Product Registration Form.

   b. Transfer the License Number label from the Certificate of License and Authenticity (also known as a "COLA") to the SCO Product Registration Form for each product that you are registering. If you do not have the label, write the License Number printed on the Certificate in one of the six numbered boxes on the SCO Product Registration Form.

   c. Complete the information about your organization and your software supplier.

2. Obtain your Registration Key in one of the following ways:

   - Fax the completed SCO Product Registration Form to an SCO Registration Center. You may send the fax at any time of the day. The SCO Registration Center will send you a Registration Key by fax within 24 hours. If SCO cannot fax the Registration Key, it will be sent by post.
   - Register by telephone. Telephone registrations will be confirmed by fax or post.
   - Mail the SCO Product Registration Form to an SCO Registration Center. The SCO Registration Center will send you a Registration Key by post.
   - Access the Web Registration system from SCO's Home Page at http://www3.sco.com/Products. The Web Registration form is currently offered only in English.

* "Free" means that there is no charge to license the software for personal and non-commercial use. The media kit has a nominal fee, and any number of users can share it. Each installation requires a unique license.

Use the following numbers to contact an SCO Registration Center.

From the Americas, Caribbean, and Pacific Rim:
Fax: (317) 364-0649
Telephone: (317) 364-0804 (between 8:00am and 8:00pm EST)

From Europe, the Middle East, and Africa:
Fax: +44 (0) 1506 460605
Telephone: +44 (0) 1506 401555 (between 8:30am and 5:30pm GMT)

See the Directory of Registration Centers in the *SCO Software Registration* booklet provided with your software for a detailed list of fax and phone numbers. Toll-free numbers are available from most countries.

NOTE Not all SCO products require a Registration Key. However, we still recommend that you register them to receive important information about your SCO products. (There is no procedure for registering Free* SCO products. Your registration information was collected when you obtained your license at the SCO website.)

3. In the **License Manager**:
   a. Select the product you wish to register from the list of installed products.
   b. Select **Register Product** from the **Register** menu.
   c. Enter the Registration Key at the prompt, then click on **Register**.

Once all the SCO products on a system have been registered, registration reminder messages will no longer appear.

NOTE Your software generates a new SCO System ID each time you do a low-level format of the disk. If you do a low-level reformat, you must contact an SCO Registration Center to obtain a new Registration Key and repeat the registration process (page 90).

See also:

• "Troubleshooting license and registration problems" (page 93)

* "Free" means that there is no charge to license the software for personal and non-commercial use. The media kit has a nominal fee, and any number of users can share it. Each installation requires a unique license.

Displaying login licenses in use

You can display the number of login licenses in use with the **brand**(ADM) utility by entering:

brand -u

The total number of licenses is also displayed by the **brand -t** option.

NOTE The **brand** command only reports usage for login licenses, not for other product licenses.

Install

Troubleshooting license and registration problems

The following represent the most common difficulties with licensing and registration:

- "License Manager will not accept registration key" (this page)
- "License Manager will not accept license information" (this page)
- "OpenServer license has expired" (page 94)
- "No user licenses were found on this machine" (page 95)
- "LOGIN: ERROR- Failed to initialize policy manager" (page 96)

License Manager will not accept registration key

If the Registration Key is invalid or was entered incorrectly, an error message appears. Verify that you entered the Registration Key correctly and that you did not type the SCO System ID by mistake. If you still receive the error message, contact an SCO Registration Center to verify that your Registration Key is accurate.

If you lose your Registration Key before you enter it, contact an SCO Registration Center. Tell the registration operator that you have lost your Registration Key. After verifying your registration information, the operator will reissue your original Registration Key.

License Manager will not accept license information

Make sure that you read the license correctly. Occasionally, characters on the license are difficult to read.

Licensing Policy Manager Daemon (ifor_pmd) has terminated

If you see this message:

```
The Licensing Policy Manager Daemon (ifor_pmd) has terminated
and been restarted. This is a normal occurrence only when a
license is removed with the License Manager utility.  If this
is not the case, your system may have a problem which could
lead to undesirable behavior. Contact your SCO service provider
if you suspect that there is a problem.

No user licenses were found on this machine. Please boot
single-user and correct this situation. Licensed software
will not operate until user licenses are installed.

The License Policy Manager Daemon (ifor_pmd) was unable to start.
This is usually due to a read-only root filesystem, lack of
user licenses or a damaged program image file (/etc/ifor_pmd).
If this is not the case, please contact your SCO service provider.
```

The policy manager daemon is a background process that monitors licensing on the system. If you are using an Evaluation License on your system that has has expired, then your system will display this message. Contact the supplier of the software to obtain a valid license for your software. If you do not have an Evaluation License, see "LOGIN: ERROR- Failed to initialize policy manager" (page 96).

OpenServer license has expired

If the **License Manager** indicates your operating system license is expired, check the system clock and the CMOS clock (the battery-powered hardware clock inside your computer) to ensure they are synchronized with the correct time and year. If the CMOS clock is set to the wrong year, it could cause the license to expire. Check the system time with the **date**(C) command, and the CMOS time with **setclock**(ADM). If they are out of sync, you can log in as *root* and synchronize them with this command:

date *MMDDhhmmYY*

where **MMDDhhmmYY** is the correct time in month-day-hour-minute-year format. For example, here is the correct entry for 9:31 AM on August 31, 1997:

```
0831093197
```

Once you have changed the clock time to reflect the current time, reboot your system, start the **License Manager** and check to see if the license has changed from "Expired" to "Yes." Your operating system license should be fully operational within the options specified by the license.

Checking for OpenServer product license expiration

Use this procedure to check the expiration date:

1. Determine the OS license using the **brand**(ADM) command:

   brand -L

   The command generates two lines of data *per product,* the second line indented relative to the first. The product is identified in the second line. The output is similar to this example for the SCO OpenServer:

   ```
   {
   {{132} {5.0} {bif654321} {bdhxyz10z;g0;k255/bif654321;s950502;u5} {799372800} {3955219199}
      {SCO:odtes} {5.0.4b} {SCO OpenServer Enterprise System} {bdhyff00z;g0;k;u5}}
   }
   ```

   The start and end dates for the license are the last two numbers respectively on the first line of data for each product. The number you are interested in is the end date, shown in bold in the example.

2. Use the **fmtclock**(TCL) command to convert the expiration time to the more usual date format, as in this example where the user input is in bold:

   ```
   # tcl
   tcl>fmtclock 3955219199
   Mon Jan 18 19:14:07 PST 2038
   tcl>
   ```


No user licenses were found on this machine

If you see this message at boot time:

```
No user licenses were found on this machine. Please boot
single user and correct this situation. Licensed software
will not operate until user licenses are installed.

The License Policy Manager Daemon (ifor_pmd) was unable to start.
This is usually due to a read-only root filesystem, lack of
user licenses or a damaged program image file (/etc/ifor_pmd).
If this is not the case, please contact your SCO service provider.
```

This error message is usually caused by a system clock that is grossly out of date (page 94). It may also may result from a lack of user licenses or a corrupted policy manager daemon (*/etc/ifor_pmd*). See "LOGIN: ERROR- Failed to initialize policy manager" (page 96) for more information.

LOGIN: ERROR- Failed to initialize policy manager

If you see this message after logging in:

```
LOGIN: ERROR- Failed to initialize policy manager.(IFOR_PM_FATAL)
Login session denied.
```

Either the policy manager daemon, */etc/ifor_pmd,* has stopped and not restarted, or some crucial file required by the policy manager to satisfy the login request is missing or corrupted.

> **NOTE** You may be logged out and be unable to log in to troubleshoot the problem. Additional error messages may also appear. If so, simply turn the system off and reboot. If the error messages persist when the system is brought up, follow the procedures described here.

Here are possible specific sources of corruption or malfunction:

- The /etc/ifor_pmd binary is corrupted or missing (this page)
- Key files or directories are missing (page 97)
- The root filesystem is mounted read-only (page 98)
- No user licenses exist, or there are no more licenses (page 98)
- The system has run out of STREAMS resources (page 99)

The /etc/ifor_pmd binary is corrupted or missing

The policy manager (*/etc/ifor_pmd*) must be present and running for your system to function. In the **Software Manager**, choose **Software ⇨ Verify Software** and select **Broken/missing symbolic links**. This will check and possibly repair the link from */etc/ifor_pmd* to the */opt/K/SCO* hierarchy. You can also perform this operation on the policy manager package alone by making the following successive selections *first*:

SCO OpenServer Enterprise System
SCO OpenServer Enterprise System UNIX
SCO OpenServer Enterprise System Core OS
Base Operating System
Policy Manager

If the *ifor_pmd* binary is actually missing from the */opt/K/SCO* directory tree, you can use the **customextract**(ADM) command to install a single file from the installation media. In the case of cdrom media and the cdrom device */dev/cd0,* the command would be:

customextract -m /dev/cd0 /opt/K/SCO/Unix/*/pmd/ifor_pmd

After the restore is complete, you should use the **Software Manager** to verify the link in */etc.*

Key files or directories are missing

The directory */pmd* and/or its contents, the named streams pipes *IPCCT_pipe, PMDCT_pipe, LST_pipe,* and the file *ifor_pmd.**pid**,* are corrupted or missing.

If */pmd* exists, but any of its file contents do not, they may be restored by stopping and restarting */etc/ifor_pmd.* In order to do this, perform these steps:

1. Enter the command:

   ps -ef | grep ifor_pmd | grep -v grep

   which should return two lines similar to this:

   ```
   root 41     1  0   Aug-29      ?    00:00:00 /etc/ifor_pmd
   root 42    41  0   Aug-29      ?    00:00:04 /etc/ifor_pmd
   ```

   Any of the numbers shown may vary on your system, with the exception that one of the entries should have "1" in the third field (parent process ID). This is the "parent" copy of *ifor_pmd,* and the other entry is the "child", whose parent process ID should match the second field (process ID) of the parent entry.

2. Kill the child *ifor_pmd.* In the example, the command would be:

   kill 42

3. In a few moments, run the **ps** command again. You should observe that a new child *ifor_pmd* is running.

4. Check the contents of */pmd.* You should see four files:

   IPCCT_pipe
   PMDCT_pipe
   LST_pipe
   ifor_pmd.pid

The root filesystem is mounted read-only

This has been identified as a common reason for policy manager-related failures. Of course, in this case, the policy manager errors would accompany many write failures to */dev/root*, with corresponding error messages.

It is usually sufficient to check this by examining the file */etc/default/filesys* for nondefault root filesystem settings, such as **mountflags=-r**, or **mntopts="-o ro"** If such settings are found, remove them.

No user licenses exist, or there are no more licenses

First, determine how many users are already logged in to the system with the **brand**(ADM) command; see "Displaying login licenses in use" (page 93). A user is defined as a distinct physical keyboard or a login over the network. If the system has run out of licenses to check out, the only way to avoid the error message is to add user licenses by purchasing an additional-user license product.

If the login user count has not been exceeded, it is possible that the license database itself has been corrupted. Follow the steps below to re-apply the user licenses on the system. This procedure assumes that user licenses are supplied only through the SCO OpenServer Enterprise System Certificate of License and Authenticity. If you have already licensed additional users with a separate user-license product, apply the procedure to that product *first*.

1. Tell all users to log off the system.
2. When all users are logged off, invoke the **License Manager**, select **SCO OpenServer Enterprise System**, and choose **License ⇨ Remove License** to remove the SCO OpenServer Enterprise System license.
3. Re-license and register the SCO OpenServer Enterprise System, choosing the appropriate options in the **License Manager**.
4. Run the **grep** command discussed in "Key files or directories are missing" (page 97) to check whether the policy manager daemon is running. If two instances of the */etc/ifor_pmd* process are not running, issue this command to restart the policy manager:

   /etc/ifor_pmd

   Repeat the **grep** command to verify that two instances of *ifor_pmd* are running.
5. Tell users to log back in to the system.

The system has run out of STREAMS resources

Issue the command:

netstat -m

Note the first line of the output (`streams`):

```
streams allocation:
                     config   alloc    free   total      max    fail
streams                 292     110     182  337172      126       0
.
.
.
```

If the `streams` line shows a `fail` greater than zero, then run the **Hardware/Kernel Manager** (page 286) or the **configure**(ADM) command and increase the **NSTREAM** kernel parameter. See "Tuning STREAMS usage" in the *Performance Guide* for more information.

Install

Chapter 7

Using other operating systems with an SCO system

If you plan to share your root disk with other operating systems, you should read this chapter before installing the SCO system.

Configuring your system to accommodate multiple operating systems can include:

- Installing OS/2 or Windows NT™ partitions (page 102)
- Creating and formatting a physical DOS partition (page 102)
- Partitioning the hard disk using fdisk (Interactive installation) (page 105)
- Switching operating systems (page 106)
- Installing a UNIX partition on a DOS system (page 109)
- Using an SCO system and DOS with two hard disks (page 110)
- Removing an operating system from the hard disk (page 111)
- Managing DOS files with doscmd(C) (page 111)
- Mounting DOS filesystems or partitions (page 113)

NOTE You must have SCO Merge installed to run DOS programs from the UNIX partition.

Installing OS/2 or Windows NT™ partitions

Use Windows NT or OS/2 tools or DOS **fdisk** to install Windows NT or OS/2 partitions. These partitions should be installed prior to installing the SCO distribution or you will need to back up and reinstall the SCO system. Windows NT and OS/2 rewrite the disk partition table differently than do UNIX, DOS, or Windows 95 systems. This means that partition labels change. Device nodes that refer to specific partitions point to different partitions after Windows NT or OS/2 has rewritten the partition table. This occurs when Windows NT or OS/2 is installed, but not subsequently.

In addition:

- SCO systems do not include tools to exchange files from OS/2 or Windows NT partitions.
- You must use **fdisk**(ADM) to switch to or from OS/2 or Windows NT.
- **fdisk**(ADM) displays OS/2 and Windows NT partitions as OS/2.

Creating and formatting a physical DOS partition

NOTE If a second disk is installed you get a primary partition on the second disk and, optionally, an extended partition. You cannot boot DOS from the second extended partition.

If you want a physical DOS partition on an SCO system, you can create it before, during, or after you install your SCO system, as long as you follow the restrictions listed below.

NOTE If you create a physical DOS partition before installing the product, you must select the **Preserve installation** option to preserve the existing DOS partition during hard disk initialization.

Use the utilities and documentation packaged with your computer hardware and your DOS installation documentation. "Partitioning the hard disk using fdisk (Interactive installation)" (page 105) explains how the UNIX partition and DOS partitions share the hard disk.

DOS partition restrictions

The following restrictions apply when creating a DOS partition:

- The DOS partition should have a minimum size of 3 MB; some DOS copy-protection schemes do not install on a partition smaller than this size.
- If you plan to install DOS version 6.0 or greater (including Windows 95), the DOS partition can be any size greater than 7 MB.
- If you plan to install a version of DOS earlier than 5.0, the DOS partition size must not exceed 32 MB.
- The DOS partition should be the first partition on the first disk. This applies to all versions prior to and including DOS 3.3 must adhere (except DOS 4.01.)
- You must specify the correct drive and label when formatting the DOS partition. Use the following syntax:

  format ***drive*** **/s /v**

  This command formats the disk in the specified ***drive*** to accept DOS files. The **/s** option copies the operating system files listed in the DOS file *formats.tbl* from the disk to the specified ***drive***.

  NOTE The DOS **format** command is not the same as a low-level format.

- When using the **Interactive** installation option, verify that the size of your UNIX partition is a multiple of the number of heads on the hard disk. (If you remapped the drive during a low-level format of the disk, use the mapped number of heads.) Otherwise **fdisk**(ADM) warns that the UNIX partition is not on a cylinder boundary.

  In addition, do not begin the UNIX partition on the track immediately following the last track of the DOS partition. A safe rule is to set the first track of the UNIX partition to the ending block of DOS plus the number of heads on the hard disk (if you remapped the drive during a low-level format of the disk, use the mapped number of heads). As DOS does not expect another operating system after its last track, it sometimes uses that space to store programs temporarily. If you install the UNIX partition directly after the DOS partition, you may lose the boot block.
- Do not use a disk partitioning product from another supplier, such as Disk Manager, to partition the hard disk before installing DOS and the SCO system. Use DOS **fdisk** to partition DOS, and UNIX **fdisk** to partition the SCO system.

NOTE If you do not follow these restrictions, you may have problems. If so, you will have to begin again with a low-level format of your hard disk.

Using low-level format programs

If necessary, use a program such as **DOS-Debug** or **Speedstor** to perform a low-level format of the disk. Many computers also have a format utility included in the BIOS setup; check the hardware manual for your computer.

WARNING A low-level format destroys all information currently stored on a hard disk.

Many ESDI and SCSI disk controllers have on-board BIOS routines. You can use these routines to perform a low-level format of your disk:

1. Boot DOS.
2. At the DOS prompt, enter:

   debug

3. Depending on your disk controller, enter one of the following commands at the "-" prompt:
   - for Adaptec SCSI controllers:

     g=dc00:6

   - for ESDI controllers:

     g=c800:5

   See your computer and/or controller documentation for more details.

Converting fdisk numbers

DOS 3.3 **fdisk** uses cylinders (both DOS 5.0 and 6.0 use MB) and UNIX **fdisk**(ADM) uses tracks. If you know the number of tracks per cylinder, you can use consistent numbers when using the two different versions of **fdisk** .

To determine the number of tracks per cylinder, you must know the number of platters in your hard disk. Usually there are two tracks per hard disk platter. For example, a hard disk with two physical platters has four tracks per cylinder.

To determine disk size, you should multiply the number of heads by the number of cylinders, times the number of sectors per track, times 512 (the number of bytes per sector).

Partitioning the hard disk using fdisk (Interactive installation)

During installation, you have the option of controlling the layout of partitions manually. This option is called **Interactive** disk setup.

NOTE Each version of **fdisk** is documented in the respective operating system's manual. Unless otherwise noted, SCO documentation refers to the UNIX system version of **fdisk**(ADM).

fdisk is interactive, and uses a menu to display your options:

```
1. Display Partition Table
2. Use Entire Disk For UNIX
3. Use Rest of Disk for UNIX
4. Create UNIX Partition
5. Activate Partition
6. Delete Partition
7. Create Partition

Enter your choice or 'q' to quit:
```

You can do the following using **fdisk**:

- Reserve separate areas (partitions) on your hard disk for different operating systems. The hard disk is divided into *tracks*. The number of tracks depends upon the size of the hard disk. A *partition* consists of a group of tracks. Each hard disk can accommodate four partitions.
- Specify one disk partition as "active". This means that when you turn on (boot) your computer, the operating system installed in the active partition will start running. The UNIX partition must be active when you intend to use the SCO system.
- Specify the number of tracks assigned to each partition. The number of available tracks will vary according to the size of your hard disk. Consult the *Release Notes* for the recommended UNIX partition size. The size of the UNIX partition also depends on the number of software packages you want to install. You can install the SCO system in this space, and have the rest of the space for user files and other software packages. Refer to the **custom**(ADM) manual page for information on how to install and remove software.
- Specify precisely where the partition begins and ends. **fdisk** will not allow you to construct overlapping partitions. You do not need to install the SCO system in the first partition.

  You should start your DOS partition at the beginning of the disk, starting at cylinder 0 or cylinder 1.

If you install a UNIX partition on the same disk after the DOS (or extended DOS) partition, start the UNIX partition at the beginning of the next cylinder on the disk. To find the beginning of the next cylinder, note the ending track number of your DOS partition and start the UNIX partition on the next track number that is a multiple of the number of heads on your hard disk. For example, if you have five heads on your hard disk and your DOS partition ends at track 103, start your UNIX partition at track 105.

When you are running the SCO system, the device name of the active UNIX partition is */dev/hd0a*. For more information about hard disk device names, see the **hd**(HW) manual page.

Displaying current partition table

Use **Display Partition Table** to report the current state of the partitions. For each partition, you can see whether the partition is active, the first track, the last track, the number of tracks used, and the associated operating system. If you use **Display Partition Table** and press ⟨Enter⟩ to see the partition table, the result will be similar to Example 7-1 (this page).

Example 7-1 Sample fdisk table

```
Current Hard Disk Drive: /dev/rhd00

        +------------+----------+-----------+---------+---------+---------+
        | Partition  | Status   | Type      |  Start  |     End |    Size |
        +------------+----------+-----------+---------+---------+---------+
        | 1          | Inactive | DOS       |       5 |     398 |     393 |
        | 2          | Inactive | DOS (ext) |     400 |    1219 |     819 |
        | 3          | Active   | UNIX      |    1220 |    2220 |    1000 |
        +------------+----------+-----------+---------+---------+---------+

Total disk size: 2229 tracks (17 reserved for masterboot and diagnostics)
```

Switching operating systems

There are three ways to switch to another operating system partition:

- Enter **dos** at the boot prompt (to boot the first DOS partition) or boot an arbitrary partition using the **bootos**(HW) command at the boot prompt.
- Use a floppy disk that contains the files necessary to boot the DOS operating system.
- Use **fdisk** to change the current active partition.

When you use the boot prompt or a floppy disk to boot another operating system, the UNIX partition remains active even though you have switched operating systems. When you use **fdisk**, the UNIX partition is inactive until you switch back to it.

Booting a DOS partition

To boot a DOS partition, enter **dos** at the boot prompt:

```
Boot
: dos
```

NOTE The system boots from the first DOS partition found. The **dos** boot string applies to any DOS partition, including those containing Windows 95.

Booting an arbitrary partition

You can boot different operating systems or partitions using the **bootos**(HW) command. You can either specify a partition by number (obtained by entering **bootos ?**) or by type:

ccpm concurrent CP/M filesystem

dos matches any DOS filesystem

dos_12 DOS 12-bit FAT (file access table)

dos_16 DOS 16-bit FAT

dos_32 DOS 32-bit FAT

dos_ext DOS extended partition

nt, os2, os2_hpfs
Windows NT, OS/2, or OS/2 HPFS filesystem; **bootos** cannot distinguish between these

unix UNIX system filesystem

xenix XENIX filesystem

For example, the following command loads an OS/2 partition:

```
Boot
: bootos os2
```

See **bootos**(HW) for more information.

Install

Booting DOS from a floppy disk

To use a floppy disk to boot DOS:

1. Make sure all users are logged off the system.
2. Use the **Shutdown Manager** (page 178) or the **shutdown**(ADM) command to shut down the SCO system. These ensure all users know the system is being shut down, terminate all processes, then halt the system.
3. Once the system has shut down, insert the bootable DOS disk into the primary (boot) drive.
4. Boot DOS.
5. To get back to the UNIX partition, remove any disks from the floppy drive(s) and press ⟨Ctrl⟩⟨Alt⟩⟨Del⟩ or the reset key, or turn the computer off, then on. Because the UNIX partition is still active, your UNIX system boots.

Remember that if you have an active UNIX partition and boot DOS from a floppy disk you can transfer to *C:* to work with the DOS files.

The other way to change operating systems is to run **fdisk** and change the active partition from the UNIX partition to DOS. Then, after you shut down the system (see the previous steps) DOS boots from the hard disk. From here you can switch operating systems from the DOS partitions. You do not need a bootable DOS floppy disk as long as DOS is loaded on the DOS partition of the hard disk.

To switch back to the UNIX partition, run **fdisk** under DOS and make the UNIX partition active. To reboot the UNIX partition, press ⟨Ctrl⟩⟨Alt⟩⟨Del⟩ or the reset key, or turn the computer off, then on.

Because the UNIX partition must be active for it to operate, you cannot use a bootable floppy disk to boot the operating system. Using **fdisk** is appropriate for an occasional change of the active operating system.

Table 7-1 DOS hard disk devices

XENIX device convention	UNIX device convention
/dev/hd0d	/dev/dsk/0sd (linked with 0sC)
/dev/rhd0d	/dev/rdsk/0sd (linked with 0sC)
/dev/hd1d	/dev/dsk/1sd
/dev/rhd1d	/dev/rdsk/1sd

The hard disk device names in Table 7-1 (page 108) are similar to */dev/hd0a* (the active disk partition) in that the disk driver determines which partition is the DOS partition and uses that as *hd0d* and *hd1d*. (You can use the XENIX or UNIX system device name conventions; they are equivalent.) This means that software that is running from the UNIX partition and using the DOS partition does not need to know which partition is DOS (the disk driver determines that).

Installing a UNIX partition on a DOS system

If you wish to set up an SCO system on a hard disk which previously contained only DOS, follow these steps:

1. Copy (back up) all the DOS files and directories on the hard disk onto floppies, or whatever backup media you wish to use.
2. Run **fdisk**, under DOS. If there is enough free space for a UNIX partition on your hard disk (check the *Release Notes*), skip to step 4. Otherwise, delete the DOS partition, then recreate it, leaving enough room on the disk for your SCO system and any other software that you intend to install.
3. Return the DOS files from the backup media to the newly created DOS partition on the hard disk. Keep the backups in case there is an error of some kind, so you will not lose any data.
4. Turn off your computer.
5. Follow the installation procedure outlined in Chapter 2, "Installing or upgrading an SCO system" (page 19) to install the SCO system. Be sure and select the **Preserve** option to retain the DOS partition.

   You will see a message warning that the contents of the hard disk will be destroyed. There is no cause for concern, because you have already backed up the DOS files and transferred them to the new DOS partition. The new partition being created will contain the SCO system, and the installation process will only write information on the UNIX partition.
6. During the installation procedure, **fdisk** is invoked to partition the hard disk. Use **fdisk** to assign a sufficiently large UNIX partition.

7. Designate UNIX as the active operating system using the **Activate Partition** option of **fdisk**.
8. Finish installing the SCO system distribution.

> **NOTE** UNIX **fdisk** displays DOS partitions as "DOS" while DOS **fdisk** displays UNIX partitions as "Other". You can only create DOS partitions using DOS **fdisk**, and UNIX partitions using UNIX **fdisk**.
>
> Be aware that DOS **fdisk** reports sizes in terms of cylinders, while UNIX **fdisk** reports sizes in terms of tracks. Check your hard disk manual for the number and size of cylinders on your hard disk.

Using an SCO system and DOS with two hard disks

Your computer always boots the operating system in the active partition on the first hard disk. SCO systems must boot from the first hard disk. There are several ways to configure your system if you have two hard disks and want to boot DOS. Two ways are discussed here.

One configuration consists of designating the entire first disk as a UNIX partition. You then use a DOS boot floppy disk to start DOS and specify:

```
A> D:
```

to switch to the DOS area on the second hard disk, where **D:** is the designation for the second hard disk. This strategy works for some versions of DOS. Early versions recognize only the first hard disk on the system.

> **NOTE** If you devote a hard disk for use with DOS, the disk must already be configured under DOS.

Another method is to maintain a small DOS partition on the first hard disk. The DOS partition is designated the active partition. In this configuration, the computer always boots DOS. This requires changing the active partition to boot the SCO system from the hard disk.

If you use the entire second disk for DOS, you need only create the additional special device files in */dev* so that you can access the DOS partition. See "Accessing DOS partitions on a second disk" (page 114) for more information.

> **NOTE** Be sure to make a backup copy of your boot floppies if you use them to boot your secondary operating system.

Removing an operating system from the hard disk

You may find that you no longer need one of the operating systems installed on your hard disk. If you want to delete an operating system, use the appropriate version of **fdisk**. To delete a UNIX partition, you must use the UNIX system version of **fdisk**. To delete a DOS partition, use **fdisk** under DOS. To delete an Extended DOS partition, you must delete all logical drives on that partition using **fdisk**. Deleting the partition removes the contents of that partition and leaves unallocated space.

You can then reallocate that space by either adding another UNIX or DOS partition, or enlarging an existing partition. Enlarging a partition requires reinstalling the operating system and (for a UNIX partition) remaking the filesystem on the partition using **divvy**(ADM).

Managing DOS files with doscmd(C)

SCO systems include special tools to manipulate DOS files that are described in Chapter 6, "Working with DOS" in the *Operating System User's Guide* and the **doscmd**(C) manual page. Note that you must have a bootable, although not active, DOS partition on the hard disk or a DOS floppy disk to use these SCO system commands. For example, you can only transfer a file from a UNIX partition on the hard disk to a DOS floppy disk if either the DOS floppy disk is bootable or there is also a DOS partition on the hard disk.

NOTE Mounting DOS filesystems and accessing the files directly with UNIX commands is faster and more efficient than using the **doscmd**(C) utilities. See "Mounting DOS filesystems or partitions" (page 113) for more information.

You may also be able to use the UNIX system **dd**(C) and **diskcp**(C) commands to copy and compare DOS floppies. The UNIX system **dtype**(C) command tells you what type of floppies you have (various DOS and UNIX system types).

Also, the file */etc/default/msdos* describes which DOS filesystems (for example, *A:*, *B:*, *C:*, ...) correspond to which UNIX system devices.

NOTE You cannot execute (run) DOS programs or applications from an SCO system unless SCO Merge is installed.

SCO systems do not record bad tracks in the DOS area of the hard disk. If a bad track develops in the DOS area, an operation such as **doscp** that attempts to access the affected area may fail (resulting in the `Error on fixed disk` message).

NOTE When trying to use the DOS utilities to access files on your DOS partition, you may see the error message `bad media byte`. This message indicates that the DOS partition on the hard disk is not bootable. You can make your DOS partition bootable by first backing up the files on the DOS partition, booting DOS from the floppy, and formatting the DOS partition using the command:

format c: /s

You should now reinstall your DOS files.

doscmd(C) default file

For convenience, the user-configurable default file */etc/default/msdos* can define DOS drive names that you can use in place of UNIX system special device file pathnames. For example, you can include the following entries in that file:

```
A=/dev/fd096ds15
B=/dev/fd048ds9
C=/dev/dsk/0sC
D=/dev/dsk/0sD
```

Once you have defined the variables, you can use the drive letter **A:** in place of the special device file */dev/fd0* (96ds15 by default) when referencing DOS files or directories. For example:

```
/dev/fd0:/john/memos
```

can be replaced with:

```
A:/john/memos
```

The drive letter **B:** refers to a low density (48ds9) primary floppy drive. Drive letter **C:** refers to the primary DOS partition on the primary hard drive. **D:** refers to a logical drive in the extended DOS partition.

NOTE If you get the message `cannot open /dev/dsk/0sC` (or similar message), check the user permissions on the special device file involved. As *root*, change the permissions with the **chmod** command. For example:

chmod 666 /dev/dsk/0sC

gives full read and write permissions to all users for the special device file */dev/dsk/0sC*, which is the DOS partition on the primary hard disk.

Mounting DOS filesystems or partitions

You can mount DOS filesystems, including those on floppy disks, and access their files while still operating from the UNIX partition.

NOTE You must add support for DOS filesystems to the kernel before you can mount DOS filesystems. See "Adding support for different filesystem types" in the *System Administration Guide* for more information.

You can mount DOS filesystems from the **Filesystem Manager** after adding them to the mount configuration as described in "Adding and removing mount configuration" in the *System Administration Guide.* You must use the device names shown in Table 7-2, "DOS device names" (page 114) or create the nodes described in "Accessing DOS partitions on a second disk" (page 114) For information on the behavior of DOS filesystems, see "About mounting DOS filesystems" in the *System Administration Guide.*

Install

You can also mount these partitions manually using the **mount**(ADM) command. The form for a DOS filesystem mount command is:

mount -r -f DOS /dev/dsk/*xsy* /*mountpoint*

where:

x	is the hard disk number
y	is the drive letter (for example, *C:*, *D:*)
mountpoint	is the name of the directory in the *root* filesystem where the DOS filesystem is to be mounted.

The **-r** flag mounts the filesystem read-only, an optional precaution that will prevent damage to the DOS filesystem (which is not as robust as other filesystems.

DOS automatically calls the primary DOS drive, on the first disk, *C:*. If you have a primary DOS partition on the second disk this becomes *D:*, automatically, and logical drives on extended partitions are named in order (for example disk0 Primary *C: EXT E: F: G: H:*, disk1 Primary *D: EXT I: J:*). Table 7-2 (page 114) lists these device names under DOS and SCO systems.

Table 7-2 DOS device names

DOS	C:	D:	E:	F:	G:	H:	I:	J:
UNIX	0sC	1sC	0sD	0sE	0sF	0sG	1sD	1sE

NOTE When using **mount**, you must give the specific hard disk and partition numbers (wildcards are not allowed).

Accessing DOS partitions on a second disk

To access DOS partitions on a second disk you may have to create the correct special device files in the */dev* directory. Special devices are created with the **mknod**(C) command. To create the DOS devices for the second disk, log in as root and run the following commands:

```
cd /dev/dsk
mknod 1sC b 1 112
mknod 1sD b 1 113
mknod 1sE b 1 114
mknod 1sF b 1 115
mknod 1sG b 1 116
mknod 1sH b 1 117
mknod 1sI b 1 118
mknod 1sJ b 1 119
mknod 1sd b 1 112
```

To change the permissions and ownerships of the files, make sure you are still logged in as *root* and run the following script (you must be using the Bourne shell, the default shell for *root*):

```
cd /
for letter in C D E F G H I J d
do
    chmod 640 1s$letter
    chgrp sysinfo 1s$letter
    chown dos 1s$letter
done
```

You will then be able to access the multiple DOS partitions on the second hard disk.

If you are not mounting the DOS filesystem and plan to use **doscmd**(C) commands to access the files, you should add appropriate entries to the */etc/default/msdos* file (page 112). For example, if the third multiple DOS partition on the second hard disk were called *H:* you could include the line:

```
H=/dev/dsk/1sE
```

in the */etc/default/msdos* file. From then on any access to *H:* would refer to */dev/dsk/1sE*, the third multiple DOS partition on the second hard disk.

Using the system

Chapter 8

Using the system

There are several ways to interact with your SCO OpenServer system, including:

- clicking on or dragging icons, selecting actions from menus, and making choices or answering questions in dialog boxes. Instructions for working on the Desktop are in this chapter and in the online help linked to the Desktop and programs running on it.
- typing commands, either outside the graphical environment or in a UNIX window on the Desktop. Instructions for working on the command line are in the *Operating System User's Guide*.
- selecting commands and managing files with the SCO Shell interface. Instructions for working with the SCO Shell are provided in the *Operating System User's Guide*.
- working inside an application (such as an order-processing system) without directly interacting with either the graphical environment or the underlying operating system. Instructions for working in such an environment are provided by the supplier of the application software.
- automating routine processes with command-line scripts. This enables you to run a complex series of commands by typing a simple one, by clicking on an icon, or by setting a timer to run the script automatically. Instructions for writing scripts are in the *Operating System User's Guide*.

What do I need to know?

For UNIX systems, a system administrator (page 138) takes care of the system: maintaining it, backing up files, installing software, and handling any problems that might come up. System administrators also sometimes assist users. This chapter focuses on using the system; for more information on system administration, see Chapter 9, "Administering SCO systems" (page 137).

On the most basic level, you can bring information into your system (through the keyboard, disks, tapes, modems, or network connections), store the information in files, organize and manipulate those files, and send information out from your system (through the screen, printers, disks, tapes, modems, or network connections). By combining these operations, especially by using programs that combine them, you can accomplish complex tasks ranging from accounting to word processing to database research to developing other programs.

To use the system most effectively, you should understand how to:

- **Log in.**

  One of the security features of UNIX systems is the requirement that users identify themselves at the beginning of a session with their login names and passwords. For Desktop instructions, see "Starting the Desktop" (page 121). For command-line instructions, see the *Operating System User's Guide.*

- **Run programs and enter commands.**

  For Desktop instructions, see "Using Desktop features" (page 122). On the command line, type the command (with any options or arguments) and press ⟨Enter⟩. For additional instructions on running programs on the command line, see the *Operating System User's Guide.* For DOS command-line and Windows instructions, see the *SCO Merge User's Guide.*

- **Work with files and directories.**

  Files are containers used for storing information; directories (also known as "folders") are containers used for organizing files. For information on how to use files and directories (including creating, controlling access to, and saving them) on the Desktop, see the online help books, *Using the Desktop* and *Using Edit*; for UNIX command-line instructions, see the *Operating System User's Guide* or *Operating System Tutorial*; for DOS command-line and Windows instructions, see the *SCO Merge User's Guide*.

- **Read and send e-mail.**

  For Desktop instructions, see "Sending and receiving mail" (page 129) and the online help book, *Using Mail*; for command-line and SCO shell instructions, see the *Mail and Messaging Guide*.

- **Communicate with other systems.**

  If your system is connected to others through a network, you can remotely log in to other systems, run programs and view files there, and share software and devices (such as printers and hard disks) between systems. For instructions, see Chapter 2, "Using the network" in the *Networking Guide*.

- **Customize your work environment.**

  You can configure many features of the Desktop environment, including colors, fonts, icons, cursors, menus, messages, and mouse buttons. For instructions, see the *Graphical Environment Guide*. From the command line, you can specify your terminal type, default editor and printer, machine name, directory search path, and other environmental variables. For command-line instructions, see the *Operating System User's Guide* .

- **Find more information.**

  SCO OpenServer documentation includes context-sensitive help, reference manual pages, and both printed and online books. Instructions for getting online help are provided in "Getting help" (page 127) and in the online book, *Using Help*.

Command lines, operating systems, and networks

A "command line" is a line on the screen on which you type commands (instructions) to your computer. It is usually identified by a symbol such as " % " or " $ ", called a "prompt":

$ **type command here**

An "operating system" is a group of programs that provide basic functionality on a computer. These programs operate your computer hardware in response to commands such as **copy**, **sort**, and **print**. An operating system can be seen as a set of functional building blocks upon which other programs depend. It also manages computer resources and resolves resource conflicts, as when two programs want to use a disk drive at the same time.

The Desktop graphical environment is constructed on top of the UNIX operating system. The UNIX system is used on a variety of hardware, ranging from personal computers to supercomputers. It is characterized by its assortment of basic tools (or "utilities") and by its ability to support multiple users running multiple programs at the same time.

Another commonly used operating system is DOS, which was designed to support a single user running one program at a time on a single personal computer. Microsoft Windows is a graphical environment built on top of DOS. SCO systems can run most DOS and Windows programs by translating the DOS commands into equivalent UNIX commands. You can use either UNIX or DOS commands from the UNIX command lines, and you can read files from either DOS or UNIX disks.

A "network" is a group of interconnected computers. Each computer on the network acts independently, but can transfer information to and from other computers on the network.

A local-area network (LAN) connects computers at one site directly by a high-speed cable, usually an Ethernet cable. A wide-area network (WAN), which can be worldwide, connects computers at different sites by transmitting data over telephone lines.

Starting the Desktop

To start the Desktop, type your login name in the field, press the ⟨Enter⟩ key, type your password, then press ⟨Enter⟩ again. To keep your password confidential, it is not shown on the screen as you type it.

NOTE Users should log in with a non-*root* account to do their daily tasks. It is recommended that only system administrators log in as *root* on the Desktop.

If you do not have an account (login) name and password, see your system administrator or the *System Administration Guide.* If you have problems, make sure that the "login" field is highlighted (selected) before entering your name. To select the field, use the mouse to move the pointer into that field, then briefly press and release (click) the left mouse button (mouse button 1).

If your screen is blank, try pressing any key. If your screen is still blank, make sure your terminal is turned on.

If your screen is not blank, the absence of the login box means that the Desktop has been set up to start differently at your site. The most common alternative setup requires you to:

1. Enter your login name at a command-line prompt.
2. Enter your password.
3. At the prompt, enter: **startx**.

See your system administrator for instructions if the Desktop still fails to start.

Exiting the Desktop

When you are ready to exit from the Desktop, open the **File** menu at the upper left corner of the Desktop by moving the mouse pointer onto the word **File** and clicking mouse button 1. Then move the mouse pointer to the word **Exit** and click mouse button 1.

When you are asked, click mouse button 1 on the **OK** button to confirm that you want to log out.

Using Desktop features

As you work on the Desktop, you can communicate with your computer by pointing to graphic images (objects) on the screen. The objects that you'll be using the most frequently are icons, windows, menus, and the mouse pointer:

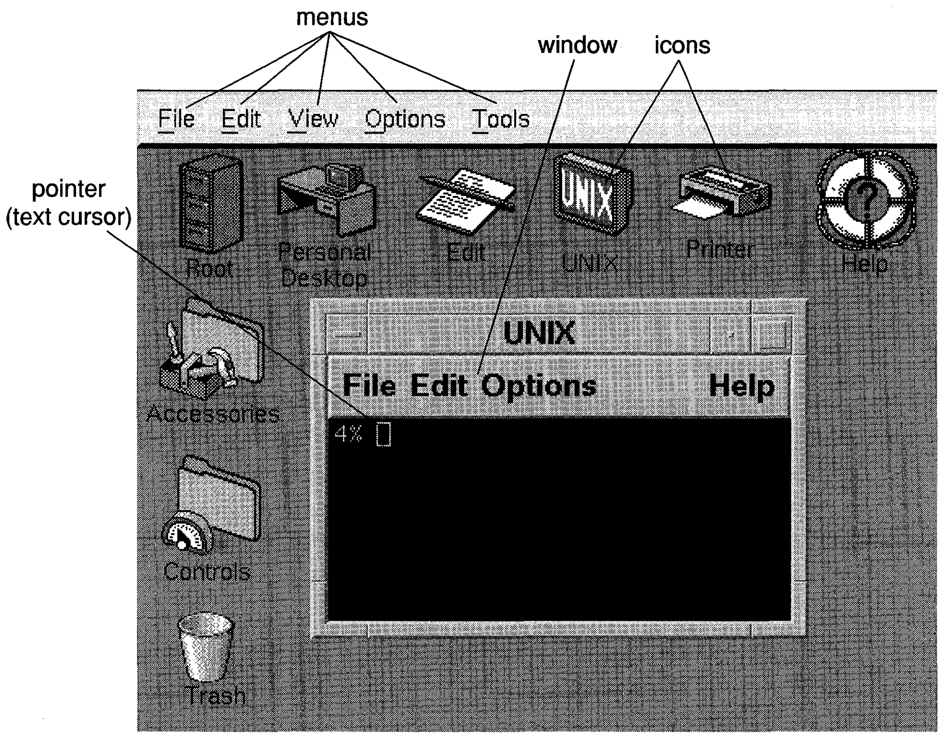


Figure 8-1 Desktop Overview

Icons are small pictures that represent programs, documents, data, or the containers (directories) in which those items are kept.

Windows are work areas that open up on the Desktop. You look at and work with information in these windows.

Menus are lists of tasks you can perform.

Pointer shows you where you are on the screen. It changes shape to let you know what you can do there. An hourglass, for example, indicates that you need to wait while the computer performs your instructions.

Using the mouse

Use the mouse to point to objects on the screen. When you move the mouse, the pointer moves. When the pointer touches an object, you are pointing to it.

Use the buttons on the mouse to tell your computer what you want to do with the object. There are three ways to use the mouse buttons:

Click a button by briefly pressing and releasing it

Double-click a button by clicking twice in rapid succession

Drag (move) an object by pointing to it, then holding down a button while moving the mouse. Releasing the button "drops" the object in the new location.

When you see instructions to click on an object, point to the object, then click the mouse button.

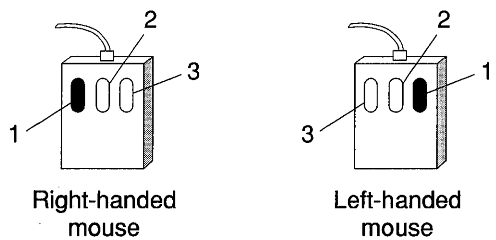


Figure 8-2 Mouse buttons

Always use mouse button 1 unless instructed otherwise. Mouse button 1 is usually the left button. Left-handed people may prefer that the right button function as button 1 and can change the configuration accordingly. For information on how to do so, see the *Graphical Environment Guide.*

Pressing onscreen buttons

When using the various Desktop programs, you will see a variety of dialog boxes that contain onscreen "buttons". To press an onscreen button, click on it.

These buttons always initiate the same actions:

OK accepts any changes you made, closes the window, and initiates the appropriate action. In a message window, press **OK** to indicate you understand the message.

Cancel undoes your changes and closes the window.

Help displays information about the active program.

Using windows

Windows play an important role in your work on the Desktop. For example, you can have several windows open at the same time, such as one for reading your mail and one for writing contracts. You can then move easily back and forth between these two workspaces, and you can transfer a document or tool from one window (workspace) to another, just as you would on your desk.

Select a window to work in by clicking on it. That window's frame changes color to identify it as the active window. Although you can have many windows open at the same time, you can only enter text, draw, or use controls in one window (the active window) at a time. Programs may be running in other windows, but your computer needs to know to which window it should direct your input.

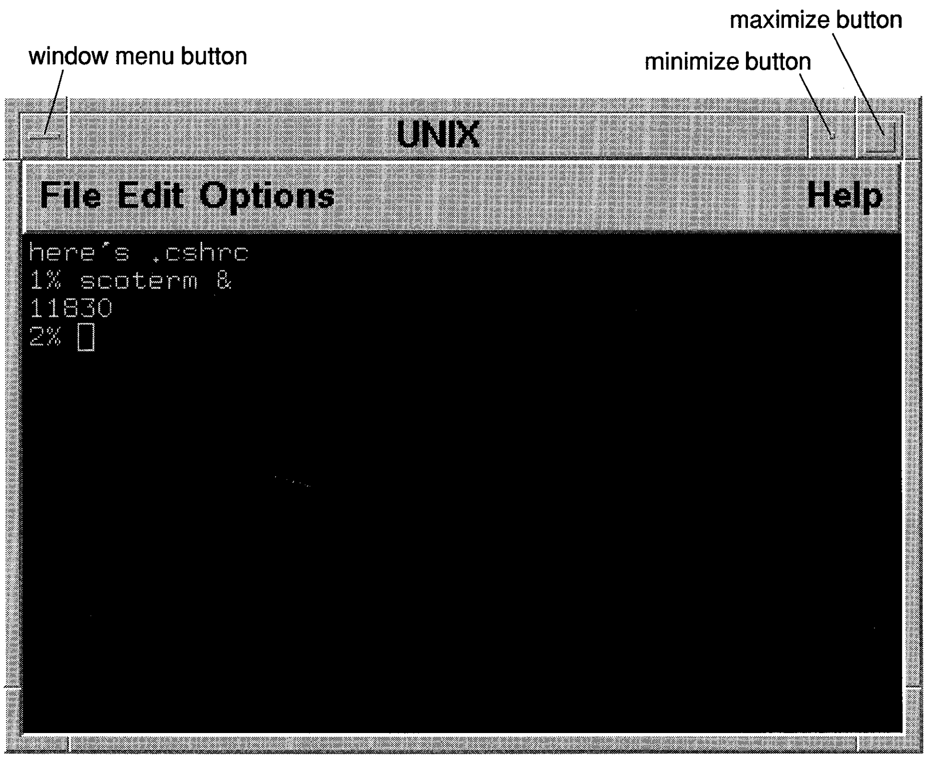


Figure 8-3 Window Components

Every window has a **Window** menu you can use to move, resize, or close the window. Open this menu by clicking on the **Window menu** button in the upper left corner of the window's frame.

To close a window, select **Exit** from the *File* menu or double-click on the **Window menu** button or select **Close** from the **Window** menu.

Scrolling

When there is more information to display than can fit in a window, use the scroll bars to see more:

- To scroll smoothly through the window's contents, drag the scroll bar slider.
- To move in short jumps toward the top or bottom (or right or left edge) of the window's contents, click on the arrow at either end of the scroll bar.
- To jump by one full window, click on the scroll bar between the slider and one of the arrows.

The position of the slider in the scroll bar indicates how much of the window's contents lies to either side of the portion displayed in the window.

Using menus

Each window has a menu bar that lists the names of the menus available in that window. To open a menu, click on its name. To select an item from the open menu, click on that item. To close the menu without selecting an item, move the pointer off the menu and click (or release) the mouse button.

If the menu item you select requires that you make additional choices, a submenu appears. Use the same methods for selecting from submenus.

Using icons

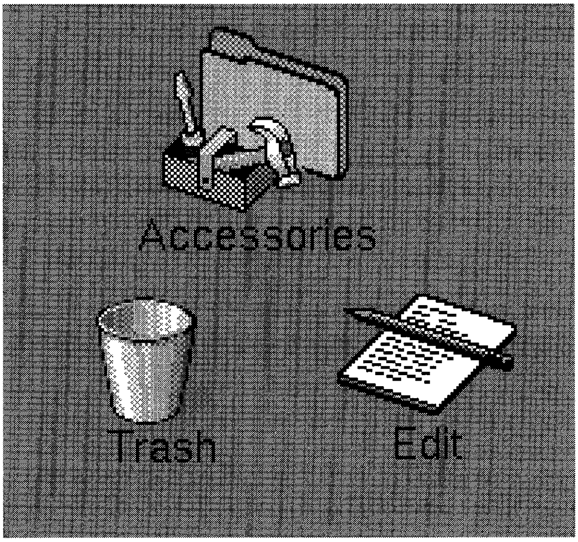


Figure 8-4 Icon Types

Files and directories on the Desktop are represented as pictures, known as icons. These graphics are designed to give you information about the object that the icon represents.

Some icons represent unique functions and are illustrated accordingly. The **Trash** icon, for example, represents the *Trash* desktop, which contains your discarded files and directories.

To activate an icon, double-click on it. For example, if you double-click on the **Help** icon, you can select from the online help books available in the Documentation Library. For more information on using icons, windows, menus, programs, and other Desktop features, click on *Using the Desktop* in this library.

An overview of the SCO Panner window manager

The SCO® Panner™ window manager allows you to use your screen to view different aspects of a much larger workspace than can be displayed at one time. You can organize that workspace to suit your needs. In addition, because you have more space available, your screen becomes less cluttered.

For example, you can control the SCO Panner window manager by using a feature known as the "panner", which contains a map of your entire workspace, divided by a grid into a number of rectangular regions. These regions serve as work areas. Also provided is a "viewfinder", which allows you to navigate around the workspace and change your view area.

For more information, see the online help book, *Using SCO Panner*.

Getting help

You can access online help in a variety of ways:

- From the Desktop, either double-click on the **Help** icon or select **On Help** from the Desktop **Help** menu.
- To get help on a specific Desktop icon, either click on that icon and select **On Object** from the **Help** menu or drop the icon on the **Help** icon.
- From the Desktop, open a UNIX window and type **scohelp** at the command line.
- When available in a window or dialog box, use the **Help** menu or click on the **Help** button.
- Point to the object on which you want help and press ⟨F1⟩ (not supported on the Desktop itself). Some Desktop icons do not have context-sensitive help. For more information about using Desktop icons, see *Using the Desktop* in the *Documentation Library*.
- In a character environment, use the ⟨Tab⟩ and arrow keys to select the **Help** item, then press ⟨Enter⟩.

See also:

- "Getting character-based help" (page 128)
- "Finding information" in *Using Help*

Using

Getting character-based help

Context-sensitive help is available if you are using the character version of any SCOadmin configuration manager tool:

- Press ⟨F1⟩ to get help on the current screen.
- Press ⟨F2⟩ to find out how to move around in the SCOadmin character and help environment.
- Use the ⟨Tab⟩ and arrow keys to select **Help** from your **Help** menu, then press ⟨Enter⟩.

If the information you need is not on the current screen when the *Help* window opens, use the ⟨PgDn⟩ or ⟨PgUp⟩ key to scroll through the document.

To view topics related to the current one, use the ⟨Tab⟩ and arrow keys to select **Related Topics** at the bottom of your screen. Press ⟨Enter⟩. Each item in the **Related Topics** window is a hyperlink to another topic.

To open a related topic, use the ⟨Tab⟩ key to move the cursor to the **View Topics** window. Use your arrow keys to move the cursor over the desired topic, then press ⟨Enter⟩.

To close the help window, use your ⟨Tab⟩ key to move your cursor to **Close Window**, then press ⟨Enter⟩. Your cursor returns to the current SCOadmin or configuration manager tool.

Troubleshooting character-based help

You should note the following in the character environment:

- If you do not install the X clients package, most of the help on **scohelp** is not available. If you need information about how to use character-based **scohelp**, press ⟨F2⟩ in any character-based SCOadmin manager.
- ⟨Esc⟩ does not close character-based **scohelp** screens. You must use **Cancel** to cancel.
- Warning messages can overwrite or garble your help screen. If your character-based screen is garbled or has random characters, press ⟨Ctrl⟩**R**.
- Some special symbols characters do not display correctly in character environments. For example, if a file contains the symbol for the Greek letter Π, will be spelled out as "Pi".

Sending and receiving mail

Use the Desktop **Mail** accessory to send electronic mail (e-mail) messages to other users. In addition, you can use this program to reply to, save, and remove messages.

To start the **Mail** program, double-click on the **Mail** icon on the Desktop.

The **Mailbox** window displays a list of mail messages that are in your mailbox (called the "message" list). The easiest way to select a message to read is to click on it in the message list.

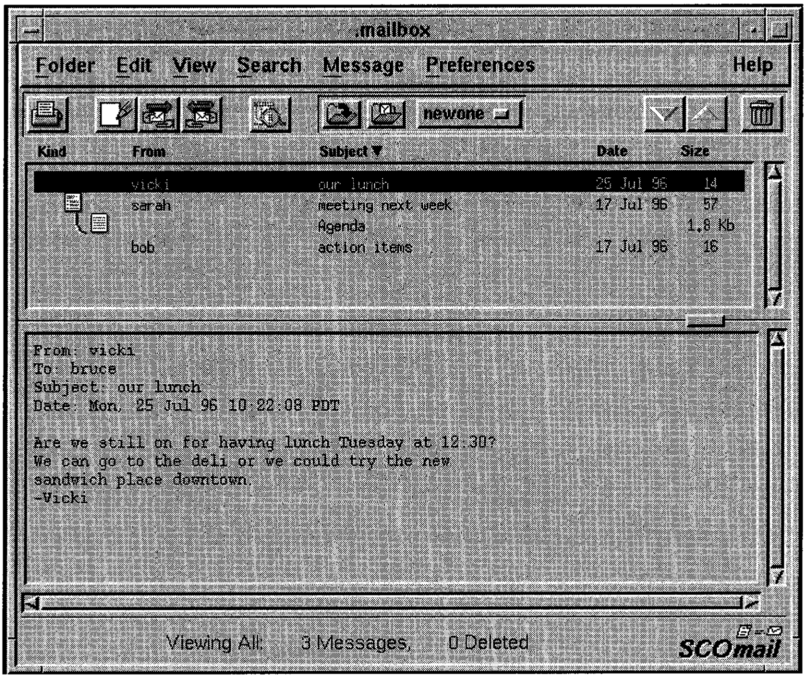


Figure 8-5 Mailbox Window

Each line in the message list describes a message: who sent it, what it is about (the subject), when it was sent, and how big it is. Some messages have additional graphical information under the "Kind" heading. For example, you might see that you have not yet read a message, or that you have already replied to or saved it.

The bottom half of the **Mailbox** window contains the contents of the currently selected (highlighted) message. If a message is longer than the window, use the scroll bar to view the rest of the text.

Using

The icons below the **Mailbox** menu bar are called *toolbar icons*. When you point to one of these icons, a brief description of that icon's function is displayed at the bottom of the window.

Sending e-mail

1. Select **Create** from the **Mailbox** window **Message** menu. You see this window:

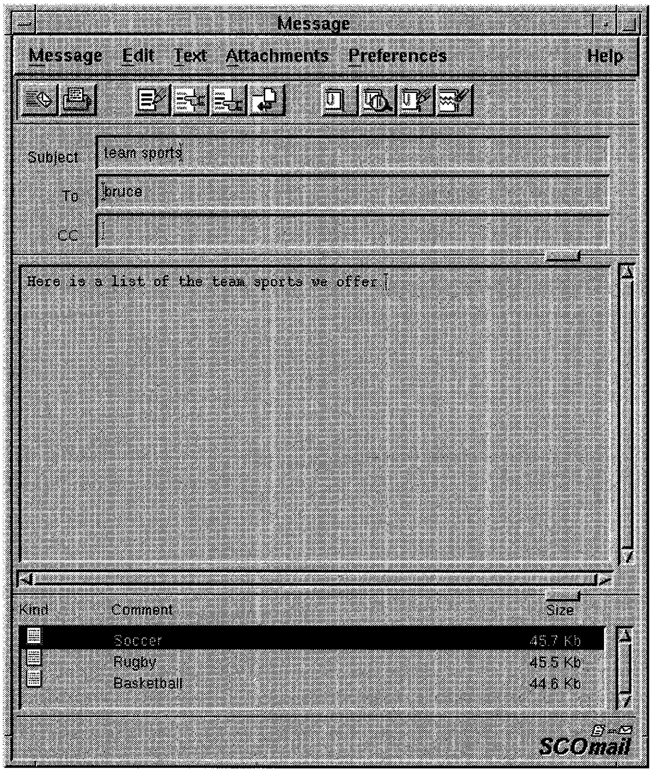


Figure 8-6 Message Window

2. Type the desired text in the "Subject" field, then press ⟨Enter⟩. For example:

   Remember to feed the cats!

3. Type your account name in the "To" field, then press ⟨Enter⟩. When you send and receive mail, your account name is sometimes called your *mail address*.

4. Press ⟨Enter⟩ to leave the "CC" ("carbon copy") field blank.
5. Type your message in the bottom half of the **Message** window. For example:

   This message is to remind myself to
   feed the cats before I go to the
   meeting tonight.

   To add, delete, or change text in the **Message** window, see the online *Using Edit* book.
6. Select **Deliver** from the **Message** window **Message** menu.

   This sends the message and closes the **Message** window.

Replying to e-mail

1. Click on a new message in the top half of the **Mailbox** window.
2. Select **Reply To** from the **Mailbox** window **Message** menu.

   This opens the Reply dialog box, where you specify your preferences for the reply. You may want to change the defaults. For example, if you don't want to reply to everyone on the original list, click in the **Reply only to the originator** checkbox.
3. Click on the **Edit** button.
4. Type your message in the bottom half of the **Message** window. For example:

   In case you didn't read the previous reminder mail:

   To move, delete, and change text in the **Message** window, see the online *Using Edit* book.
5. Select **Deliver** from the **Message** window **Message** menu.

Saving messages

If you want to keep mail messages, you can save them in files or in *mailfolders* (special files that contain mail messages). To keep your mailbox tidy, you should remove messages regularly from your personal mailbox.

1. Click on the first message in the top half of the **Mailbox** window. The selected message is highlighted.
2. Select **Save To Folder** from the **Mailbox** window **Message** menu.

   This opens the *Mail* window containing a list of mailfolders. (When you first start working with **Mail**, your *mailfolders* directory might only contain the *Outgoing* mailfolder.)
3. Click on the blank area in the "Selection" field, type **ReminderMail**, and press ⟨Enter⟩. This specifies *ReminderMail* as the mailfolder where you want to save the message.

   You are prompted to create the folder.
4. Click on **Yes**. The message is saved to a mailfolder called *ReminderMail* in the *mailfolders* subdirectory of your home directory and you return to the **Message** window.

Deleting and restoring messages

Once you have read a message and finished any actions on it (such as replying to or saving it), it is a good idea to delete the message from your personal mailbox to save space and to avoid clutter.

1. Point to the first message and drag the pointer to the last message. This selects the messages to delete.
2. Select **Delete** from the **Mailbox** window **Edit** menu. The selected messages disappear from the top half of the window and the message listing at the bottom of the window shows the number of deleted messages.
3. Select **Deleted** from the **Mailbox** window **View** menu. The window changes to show only the messages you deleted.
4. Click on the first message in the list.

5. Select **Undelete** from the **Mailbox** window **Edit** menu. The first message disappears from the list of deleted messages.
6. Select **All** from the **Mailbox** window **View** menu. This returns you to viewing the remaining contents of your mailbox (all the messages you haven't deleted and the message you just restored).

NOTE Deleted messages are no longer available to be restored (undeleted) after you have exited **Mail**.

Getting more information about Mail

Double-click on the Desktop **Help** icon, then select *Using Mail*. Or press ⟨F1⟩ when using **Mail**.

System administration

Chapter 9

Administering SCO systems

"System administration" refers to the tasks that must be performed to maintain a system. This chapter how to administer your SCO system, including:

- Understanding the basics (this page)
- Administering your system with SCOadmin (page 143)
- Educating users (page 159)
- Planning your site (page 162)
- Summary of system administration tasks (page 164)

Understanding the basics

If you are new to system administration, you should understand:

- What is system administration? (page 138)
- What to read if you are new (page 139)
- Keeping a system log (page 139)
- The superuser account (page 140)
- The keyboard (page 140)
- Running programs simultaneously with multiscreen displays (page 141)

What is system administration?

Every SCO system should have at least one person in charge of system maintenance and operation. Such a person is called a "system administrator". It is the responsibility of system administrators to ensure the smooth operation of the system and to perform a wide variety of tasks that require special privileges.

Among other things, a system administrator is responsible for:

- Bringing the system up and down for maintenance.
- Making certain that adequate backups (regular copies of files on the system) are made and stored for future use.
- Handling problems related to use of limited computer resources (disk space, number of processes, and so on).
- Alleviating system communication (network) stoppages due to failed connections.
- Applying operating system updates and maintenance fixes.
- Providing general support to users.

NOTE This is only a representative set of tasks; refer to "Summary of system administration tasks" (page 164) for a complete list that includes cross-references to the appropriate documentation.

Depending on the size of the system and the number of users on it, system administration can be anything from a once-a-day task to a full-time job. Even if the system is small, the system administrator should consistently perform each required maintenance task, because sloppy maintenance can adversely affect system performance.

You can choose to have a single system administrator or divide the tasks among several persons, each charged with a different area of operation. You can even assign roles that are strictly limited to one aspect of the system. See "Assigning subsystem authorizations" in the *System Administration Guide* for more information.

What to read if you are new

If you are completely unfamiliar with SCO systems (or UNIX systems), you should refer to these manuals:

- *Operating System Tutorial* — covers the basics of the UNIX command line interface. Although many administration tools have sophisticated interfaces, you will often need to use the command line as well.
- *Operating System User's Guide* — includes more advanced uses of the operating system. Pay particular attention to Chapter 3, "Working with files and directories" and Chapter 5, "Controlling processes". You will also benefit from an understanding of the material in Appendix A, "An overview of the system".
- *Networking User's Guide* — explains the networking components, including TCP/IP, NFS, and so on.
- This *SCO OpenServer Handbook* — contains key information you need in the day-to-day operation of your system: Chapter 10, "Starting and stopping the system" (page 169) and Chapter 13, "Troubleshooting system-level problems" (page 247).

See "Educating users" (page 159) for additional references.

Keeping a system log

We recommend you keep a hardcopy log of the initial system configuration, all system modifications, and system events. Each event, message, backup, or modification should be logged along with the date, time, name of the person logging, and the circumstances surrounding the event. For example, if a new application is added to the system software, an entry should be placed in the log. This entry should include the time, date, and name of the person installing the application, and any notes about the software or installation that may be helpful. An accurate log helps in diagnosing system problems and charting the growth and use of a system.

NOTE Keep a copy of your installation checklist in the log book. See "Installation and upgrade checklist" (page 20).

All tasks are presented from a system administrator's point of view, but many can also be accomplished by ordinary users. Because some of the tasks dramatically change the system's operation, we recommend that, whenever possible, the system administrator perform these tasks. However, no matter who performs an operation, it should be entered in the system log. Following these rules can prevent unwanted or unnecessary changes to the system.

The superuser account

The superuser login (also known as *root*) is a special account for performing system maintenance tasks. It gives the system administrator unusual privileges that ordinary users do not have, such as accessing all files in the system, and executing privileged commands. Many tasks presented in the administrative guides require that the system administrator be logged in as the superuser. To do this, the system administrator must know the superuser password created during the installation of your system.

Log in as the superuser only to perform system maintenance tasks. Even if the system administrator is the only user of the system, that person should create a user account for day-to-day work, reserving the superuser account for system maintenance tasks only.

WARNING Few users should know the superuser password. Misuse of the superuser powers by naive users can result in a loss of data, programs, and even the operating system itself.

The keyboard

Many keys and key combinations perform special actions on SCO systems. These actions have names that may not correspond to the keytop labels on your keyboard. Table 9-1 (this page) shows which keys on a typical keyboard correspond to special actions on SCO systems. A list for your particular login device is in the **keyboard**(HW) manual page. Many of these keys can be modified by the user — see the **stty**(C) manual page.

Table 9-1 special keys

Name	Action
⟨Enter⟩	terminates a command line and initiates an action. This key is also called the ⟨Return⟩ key; the keytop may indicate a down-left arrow.
⟨Esc⟩	exits the current mode; for example, exits insert mode when in the editor **vi**. This is also known as the ESCAPE key.
⟨Del⟩	stops the current program, returning to the shell prompt. This key is also known as the INTERRUPT key.
⟨Bksp⟩	deletes the character to the left of the cursor. The keytop may show a left arrow (do not confuse it with the keypad arrow keys).

(Continued on next page)

Table 9-1 special keys
(Continued)

Name	Action
⟨Ctrl⟩**D**	signals the end of input from the keyboard; exits the current shell, or logs you out if the current shell is the login shell.
⟨Ctrl⟩**H**	deletes the character to the left of the cursor. This is also called the ERASE key.
⟨Ctrl⟩**Q**	restarts printing (or displaying) after it is stopped with ⟨Ctrl⟩**S**.
⟨Ctrl⟩**S**	stops printing (or displaying) at the standard output device, such as a terminal. This keystroke does not stop the program.
⟨Ctrl⟩**U**	deletes all characters on the current line. This is also called the KILL key.
⟨Ctrl⟩\	quits current command, creates a *core* file — see the **core**(FP) manual page. This is also called the QUIT key. Recommended for debugging only, but can be used as a last resort when the ⟨Del⟩ key does not stop the current command.

Running programs simultaneously with multiscreen displays

With the multiscreens, you can run several programs on your console at the same time. Pressing a simple key combination switches you from one screen to another, and each screen acts independently from the others.

To open a second screen, press and hold the ⟨Ctrl⟩ and ⟨Alt⟩ keys, then press ⟨F2⟩ or another function key on your keyboard. Function keys are generally located across the top or down the far left side of your keyboard.

After you press the key combination, the screen clears and a login prompt appears. Log in again and you can begin work on the second "screen." Press ⟨Ctrl⟩⟨Alt⟩⟨F1⟩ to switch instantly back to the first screen. Switching between screens in this way can speed up procedures that require working in two different programs. You can run both programs simultaneously, and work on either one at any time.

For example, you can start a session on your first screen, then press ⟨Ctrl⟩⟨Alt⟩⟨F2⟩ to create a second screen. Log in again and begin another session. Use ⟨Ctrl⟩⟨Alt⟩⟨F1⟩ and ⟨Ctrl⟩⟨Alt⟩⟨F2⟩ to switch back and forth between screens.

NOTE Opening more than one graphical session or desktop on the console will consume additional system resources.

Admin

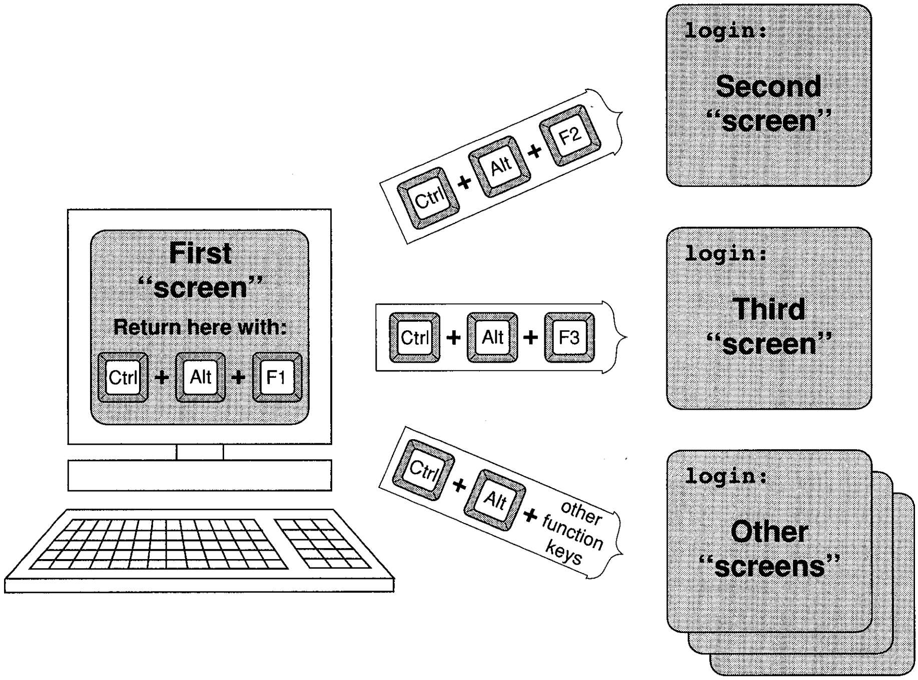


Figure 9-1 multiscreen example

You can open more than two screens at once. However, when you log out you must remember to log out on all screens; unattended screens where you remain logged in allow unauthorized access to the system.

If you have several screens open at once, you can rotate through them by pressing ⟨Ctrl⟩⟨PrtSc⟩. This is helpful if you cannot remember which process is running on a particular screen.

For more information, refer to **multiscreen**(M).

System security

An important consideration is protecting the system and its data from unauthorized access. Your SCO system includes security mechanisms designed to meet the C2 class of "trust" as defined by the *Trusted Computer System Evaluation Criteria* (also known as the *Orange Book*). As the system administrator, you can configure the protection mechanisms to the requirements of your site. Chapter 1, "Administering user accounts" in the *System Administration Guide* explains how to add users to the system and how to configure the default security scheme. For additional information on protecting your system, consult Chapter 5, "Maintaining system security" in the *System Administration Guide*.

Administering your system with SCOadmin

SCOadmin is a series of management applications (or "managers") that help you configure and maintain your system. The managers can be run in graphical or character mode.

You can access SCOadmin managers in three ways:

- *Desktop mode.* Use the icons in the *System Administration* window located on the root desktop.
- *Graphical mode.* Use the **scoadmin**(ADM) command to invoke the SCOadmin launcher (page 145) or run an individual manager in a **scoterm**(XC) window.
- *Character mode.* Use the **scoadmin** command to run the SCOadmin launcher or an individual manager on a character display. See "Starting SCOadmin from the command line" (page 144) and "Using SCOadmin in character mode" (page 146).

NOTE Unless your system is configured with the Low security profile, ordinary users are not authorized to run SCOadmin managers. See "Assigning subsystem authorizations" in the *System Administration Guide* for more information.

Most SCOadmin managers are grouped under folders (directories) that correspond to an administrative area.

Some SCOadmin managers permit you to administer different systems across the network as described in "Administering other systems with SCOadmin" (page 149).

See also:

- "About Sysadmsh Legacy" (page 145)
- "Troubleshooting SCOadmin" (page 156)

Starting SCOadmin from the command line

Enter the command:

scoadmin

This brings up the SCOadmin launcher shown in Figure 9-2 (page 145). Note that most applications are nested in subdirectories (folders in the graphical version), such as **Security Profile** under *System/Security*. In graphical mode, SCOadmin managers are marked with a tool icon, while subdirectories are marked with folders. In character mode only subdirectories are marked, with a greater-than symbol (>).

To run in character mode from a **scoterm** window, set the **CHARM** environment variable to TRUE. To run in the graphical environment again, unset **CHARM** or set it to FALSE.

To ascend the directory tree, click on the parent directory button in the lower left hand corner of the SCOadmin window, or select **Parent** from the **View** menu.

You can also start individual SCOadmin managers from the command line using the syntax:

scoadmin ***application_name***

where ***application_name*** is the name of the SCOadmin manager, such as **account manager**. (You do not need to quote the name or use capitalization.) This command works both graphically and in character mode.

In addition, the **scoadmin** command will accept "minimum matches" consisting of the first few characters of the manager name. For example, you could enter **scoadmin a** to start the **Account Manager**, or **scoadmin au** for the **Audit Manager**. Keep in mind that the names of some managers may have the first few characters in common.

To display a list of available SCOadmin managers, enter:

scoadmin -t

NOTE SCOadmin managers are scripts written in SCO Visual Tcl. Modifying these scripts is not recommended, but if you do alter them, be sure and make a backup copy first. See the **scoadmin**(ADM) and **scoadmin**(F) manual pages and the *SCO Visual Tcl Programmer's Guide and Reference* (page 000) for more information.

See also:

- "Administering other systems with SCOadmin" (page 149)

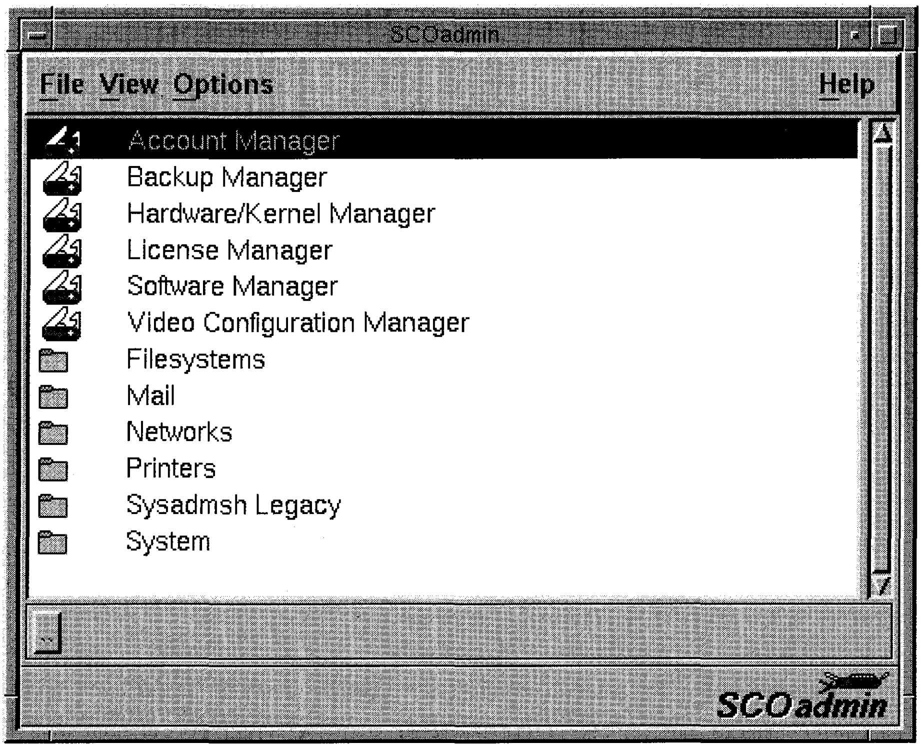


Figure 9-2 SCOadmin Launcher

About Sysadmsh Legacy

Programs located in the *Sysadmsh Legacy* directory of the SCOadmin hierarchy are non-SCO applications originally written for the **sysadmsh** system administration interface used in previous releases of SCO systems. When an update is performed on an SCO system 3.0 or earlier, non-SCO **sysadmsh** applications are automatically moved to this location.

Refreshing data in the display

Many SCOadmin managers display information in their main windows that is updated at regular intervals.

To force an update, select **Refresh Now** from the **View** menu.

To set the rate at which the display is automatically updated, select **Set Auto Refresh** from the **View** menu.

Using point help

SCOadmin managers have a text area at the bottom of the screen where status messages and helpful descriptions called *point help* are displayed.

You can get point help on a text field or other screen element simply by moving the cursor to it. In character mode, highlight the screen element.

To disable the point help feature, deselect the **Point Help** button from the **Options** menu.

Using the toolbar

Many SCOadmin managers include a toolbar with icons you can select just like desktop icons. The icons represent the most common menu selections. To hide the icons, deselect the **Toolbar** button from the **Options** menu.

NOTE The toolbar is only available in graphical mode.

Using SCOadmin in character mode

By its nature, the SCOadmin character interface differs from the graphical version. Character SCOadmin is similar to the previous SCO administrative interface (**sysadmsh**).

Navigating the character screen

In character SCOadmin, the screen is divided into "tab groups", which make it possible to move between the menu bar, the display area, and the control buttons (**OK**, **Cancel**, **Help**) at the bottom of the window. Once you have moved to the desired tab group, you can use the arrow keys to select the desired button, list, or field.

Use the arrow keys to move between items on a menu bar or items in a menu. Use the ⟨Enter⟩ key to open a menu or make a selection.

NOTE If you are having trouble reaching a button or field, try pressing the ⟨Tab⟩ key.

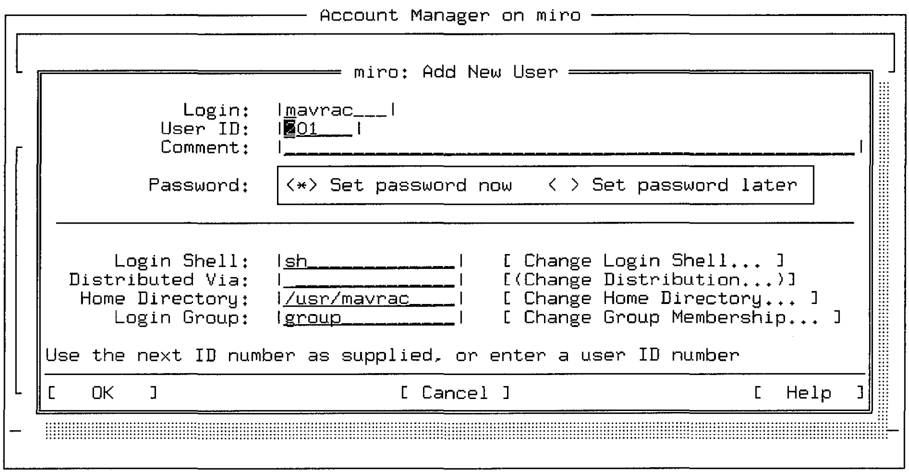


Figure 9-3 Sample character SCOadmin screen

Figure 9-3 (this page) is a character-mode screen from the **Account Manager**. To navigate this screen from top to bottom, press the ⟨Tab⟩ key. There are two rows of buttons: the "Password" selection box and the **OK**, **Cancel**, and **Help** pushbuttons. Use the arrow keys to move between the buttons.

Table 9-2 Character SCOadmin keys

Key	Action
⟨Tab⟩, ⟨Ctrl⟩i	moves to next tab group
⟨Ctrl⟩^, ⟨Shift⟩⟨Tab⟩	moves to the previous tab group
⟨Left, Right Arrow⟩	traverses menu bar, moves between items in a tab group, opens or closes submenu, scrolls list
⟨Up, Down Arrow⟩	opens a menu in menu bar, moves between items in a menu, moves between items in a tab group or a displayed list
⟨Ctrl⟩A	replicates ⟨Alt⟩ in graphical environment
⟨F10⟩	shifts focus to menu bar
⟨Enter⟩	accepts input in text field, opens menu
⟨Esc⟩	cancels action (if applicable), closes menu
⟨Ctrl⟩r	redraws the screen
⟨PgUp⟩, ⟨PgDn⟩	pages through displayed list
⟨Home⟩, ⟨End⟩	shifts between top and bottom of list
⟨Space⟩	selects the highlighted item

Using character buttons

There are three types of buttons, all of which are operated by highlighting them, then pressing ⟨Space⟩ or ⟨Enter⟩:

pushbuttons
: have text names enclosed in square brackets ([ ]). Buttons that bring up other windows have ellipses (...) appended to the text. Some bring up an option menu from which you must make a selection. Highlight the text label associated with the button rather than the button itself.

radio buttons
: are marked with angle brackets (< >) and are used to select exactly one of a group of options. When a radio button is selected, an asterisk (*) appears within the brackets. Selecting a second button deselects the previous button.

checkboxes
: are similar to radio buttons and consist of square brackets ([ ]) and a text label. When a checkbox is selected, an asterisk (*) appears within the brackets. Checkboxes are used to select one, more than one, or none of a group of options. Toggle to deselect.

Administering other systems with SCOadmin

Several SCOadmin applications enable you to manage other SCO systems on your network. Two types of administration are supported: remote and distributed. See "Administering other systems with SCOadmin managers" in the *Networking Guide*.

Remote administration includes:

- configuring and managing remote printers
- configuring remote filesystems
- managing remote accounts
- performing remote backups
- managing remote SNMP agents

Problems with multiple invocations

If you accidentally double-click on a SCOadmin manager icon four or more times, multiple overlapping copies of the manager will be started. If this occurs, close the lower windows, leaving the last copy open for use. If the remaining window fails to accept input, close it using the window menu (as opposed to the SCOadmin menu) and restart the manager.

Making selections in character mode

In graphical mode, selections that cannot be used are dimmed (stippled). In character mode, invalid selections are enclosed in parentheses "( )".

If you encounter difficulties navigating through the selection fields in character mode, press ⟨F2⟩ for quick-reference help.

Using the System Defaults Manager

You can use the **System Defaults Manager** located in the *System* directory of the SCOadmin hierarchy to change a variety of defaults associated with system utilities. The **System Defaults Manager** displays a list that describes the function and the associated utility or application. Use the manual page reference in the description to obtain information about the defaults stored in the file.

To edit a default file, select the file from the list. When used in character mode, the **vi**(C) editor is used by default. For graphical sessions, another editor can be selected; see "Changing the default editor" (this page).

NOTE The defaults are stored in the */etc/default* directory.

See also:

- *default*(F) manual page
- Appendix H, "vi command summary" (page 543)
- "Using the vi editor" in the *Operating System Tutorial*

Changing the default editor

The file editor used by applications such as the **System Defaults Manager** can be defined in the **EDITOR** environment variable. Set the variable on the command line as in these examples:

Bourne or Korn shell:

EDITOR=/usr/bin/X11/scoedit; export EDITOR

C shell:

setenv EDITOR /usr/bin/X11/scoedit

You can also add **EDITOR** to your shell initialization file. For the C shell, simply add the above line to your *.login* or *.cshrc* file. For the Bourne or Korn shells, you need to add the bold elements to your *.profile* file:

```
SHELL=/bin/sh
HOME=/
PATH=/bin:/etc:/usr/bin:/tcb/bin
EDITOR=/usr/bin/X11/scoedit

# set terminal type
eval 'tset -m ansi:ansi -m :\?ansi -e -s -Q'

export TERM PATH SHELL HOME EDITOR
```

Controlling processes with the Process Manager

Processes are programs currently running on the system. You can use the SCOadmin **Process Manager** to perform operations on system processes (locally and on remote systems):

- view processes on the system (this page)
- change the priority of a process (page 154)
- send a signal to a process (page 154)

You can start the **Process Manager** by running the **scoadmin**(ADM) launcher or entering **scoadmin process** on the command line.

Viewing processes

You have several options for viewing processes with the **Process Manager**:

- view all processes (this page)
- by one or more attributes (this page)
- by attribute value (page 152)
- sorted by PID, user, tty, or command (page 153)
- customize the attributes displayed (page 153)
- include/exclude attributes in status labels (page 153)

Viewing all processes

In the **Process Manager** (this page), select **All** from the **View** menu. The default view shows all processes.

Viewing processes by attributes

In the **Process Manager** (this page), select **By User**, **By Tty**, or **By Pid** from the **View** menu.

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To view processes by a set of extended attributes, select **Attributes...** from the **View** menu. The extended attributes are shown in Table 9-3, "Process attributes" (this page) You also have the option of clicking on buttons that select a set of attributes (a **Default** is automatically selected), including **Ownership...**

Select an attribute in the "Available" column and click on the **Add** button. You can remove an attribute from your view by selecting it from the "Selected" column and clicking on the **Remove** button. You can search for a specific attribute by entering it in the "Search for:" field.

Table 9-3 Process attributes

Attribute	Definition
Ruser	real user ID
Tty	controlling port number
Group	group name
Pid	process ID number
Ppid	parent process ID number
Nice	nice(1) value
Time	cumulative execution time for the process
Pcpu	percentage of CPU time used
Vsize	virtual memory size in kilobytes
Pgid	parent group ID number
Etime	time elapsed since the process started
Args	command name with its arguments
User	user name
Command	command being run (no arguments)

Viewing/finding processes by attribute values

In the **Process Manager** (page 151), select **Attribute_Filter**, from the **View** menu, or, to find a specific process, select **Find Attribute** from the **Process** menu.

1. Select the desired attribute from the displayed list.
2. Click on the desired relation (**Equal to** can be selected with either of the **Less than** or **Greater than** buttons.
3. Enter the desired value.
4. When using the **Find Attribute** selection, use the **Find Next** or **Find All** buttons.

Sorting processes

In the **Process Manager** (page 151), select **Sort**, from the **View** menu.

Select the desired sort attribute from the list, then click on a button to select **Increasing** or **Decreasing** order. The **None** button disables ordering.

Customizing the display

You can easily customize the information displayed by the **Process Manager** (page 151). The default display includes the process ID, user name, tty, and command name. You can add or delete fields as desired.

Select **Customize Attributes...** from the **Options** menu.

You can change the following:

- list of attributes (page 152)
- attribute labels
- field width
- data type (alphabetic, octal, integer, hexidecimal)

You can type in the values for "Label" and "Width" fields; use the pull-down list for "Attribute" and "Type".

To change the set of available attributes, see "Viewing processes by attributes" (page 151).

You can reset to the default field widths with the **Default** button.

Click on **Apply** to update the display.

Including or excluding attributes in status labels

The **Process Manager** (page 151) display includes a status labels below the main list to indicate the selected view (page 151) and sort criterion (this page) used. You can configure these labels to include or exclude the actual values for these attributes.

Select **Short View/Sort/Filter Labels** from the **Options** menu. For example, the "long" labels would appear as follows:

```
View by User (root)    Sort(Pid)
```

The "short" labels exclude the values in parentheses.

Searching for a process

In the **Process Manager** (page 151), select **Find** from the **Process** menu. Enter a pattern and use the **Find Next** or **Find All** buttons. The pattern can include standard wildcards.

Changing the priority of a process

All processes are assigned a priority, known as a **nice**(C) value. This value determines how much computing time is allocated to a process, affecting the length of time the process will take to complete.

In the **Process Manager** (page 151), select the process you wish to reprioritize from the list and select **Priority** from the **Process** menu.

Click on the **Raise** or **Lower Priority** buttons and enter an increment, if desired.

Signalling a process

In the **Process Manager** (page 151), select the desired process from the list and select **Signal** from the **Process** menu. The most commonly used signal is **KILL**, used to terminate a process.

The remaining functions are intended for more sophisticated users. See *signal*(S) for more information.

Table 9-4 Signal types

Signal	Purpose
HUP	hangup
INT	interrupt
QUIT	quit
ILL	illegal instruction (not reset when caught)
TRAP	trace trap (not reset when caught)
ABRT	IOT instruction
EMT	EMT instruction
FPE	floating point exception
KILL	kill (cannot be caught or ignored)
BUS	bus error
SEGV	segmentation violation
SYS	bad argument to system call
PIPE	write on a pipe with no one to read it
ALRM	alarm clock
TERM	software termination signal
USR1	user-defined signal 1
USR2	user-defined signal 2
CHLD	death of a child
PWR	power fail
WINCH	window change
POLL	selectable event pending
STOP	sendable stop signal not from tty
TSTP	stop signal from tty
CONT	continue a stopped process
TTIN	background tty read attempt
TTOU	background tty write attempt
VTALRM	virtual timer alarm
PROF	profile alarm
XCPU	exceeded cpu limit
XFSZ	exceeded file size limit
WAITING	all lightweight processes blocked interruptibly notification
LWP	signal reserved for thread library implementation
AIO	asynchronous I/O signal

Troubleshooting SCOadmin

This section addresses problems with running SCOadmin:

- "SCOadmin will not start" (this page)
- "Recovering from SCOadmin failures in character mode" (this page)
- "Remote administration problems" (this page)
- "SCOadmin error trace" (page 157)
- "The SCOadmin event log" (page 158)

SCOadmin will not start

If the SCOadmin launcher or a SCOadmin manager fails to start after a reasonable length of time, there may be a problem with the SCO Visual Tcl daemon process used to run SCOadmin:

1. Enter this command to determine the process number:

   ps -ae | grep vtcld

   You see output similar to this:

   ```
   571   ttyp0    00:00:00 xm_vtcld
   ```

   In this case, the daemon is process number 571. (In character mode, the process is named *cm_vtcld*.)

2. Kill the daemon process with this command, substituting the actual process number for ***number***:

   kill -9 ***number***

3. If the process does not appear to be running, you should check the */tmp* directory for temporary files left there by SCO Visual Tcl daemons. First, SCOadmin character sessions leave files of the format *ch_**PID.UID*** (PID is the process ID number and UID is the user ID number), for example *ch_8132.0*. Graphical sessions can leave similar files of the format ***PID.UID***. If there are a large number of these files present, you should remove them and try running SCOadmin again.

Recovering from SCOadmin failures in character mode

If a SCOadmin manager fails in character mode and you cannot get a prompt, enter the following command to restore your display to normal (the command will not appear on the screen as you type):

⟨Ctrl⟩j**stty sane**⟨Ctrl⟩j

Remote administration problems

If you have problems performing remote administration:

- Ensure that user equivalence is configured properly. The account on the local system used to perform the remote task must be recognized by the remote system. In addition, the account must have the authorizations necessary to run the SCOadmin manager.

- Verify your network connections are configured and functional (including the */etc/hosts* file or name service).
- Verify that SCOadmin is running on the remote system. This is necessary for all tasks except remote printing. You can set up a printer on a remote system that is not running SCOadmin, but the remote system must support LPD, and the local system must be recognized by the remote system (in */etc/hosts.lpd* or */etc/hosts.equiv* on UNIX systems). If the remote system is running SCOadmin, it is possible to get a list of the printers available on the system.

See also:

- "Enabling remote manager capabilities" in the *Networking Guide*
- "Troubleshooting network configuration" (page 494)
- "Troubleshooting TCP/IP" in the *Networking Guide*

SCOadmin error trace

When a non-recoverable error occurs in SCOadmin, SCO Visual Tcl creates a file containing an error trace. The output is put into a file in the */tmp* directory. While the SCO Visual Tcl output will probably not be useful to you, if the problem persists you should save the output when you call your provider for assistance.

Error filenames use the format:

tclerror.*PID*.log

where ***PID*** is the number of the process that created the file. Here is a sample output:

```
Uncaught error in Tcl program: hostmib:
no SMUX entry for hostmib: goingDown

-----------------------------------------------------------------------
Error code = NONE
-----------------------------------------------------------------------
no SMUX entry for hostmib: goingDown

    while executing
"SMUXInit hostmib /etc/sysadm.d/hostmib.defs"
    ("uplevel" body line 3)
    invoked from within
"uplevel $command"
=======================================================================
```

Admin

The SCOadmin event log

SCOadmin includes a logging facility to record administrative events, including errors, object creation, among others.

SCOadmin events are recorded along with other system events in */usr/adm/syslog*. These events help you keep track of all modifications made to your system configuration.

> **NOTE** Do not confuse messages contained in the SCOadmin event log with the system error messages located in */usr/adm/messages*.

See also:

- "Understanding the SCOadmin event log" (this page)
- "Using the SCOadmin Event Logs Manager" (page 159)

Understanding the SCOadmin event log

All SCOadmin managers generate records of administrative events that occur during the daily operation of your system. By default, SCOadmin errors are the only events recorded. This allows you to monitor any problems that might occur. You can also elect to record all administrative changes made to the system, for example when a user account is added to the system or modified.

Log entries use this format:

date sysname syslog SCOADM: ***sessionID object instance event_type message***

sysname	name of the host system
sessionID	tty for the login session when the event took place
object	type of object
instance	name of object
event_type	event type
message	the system message associated with the event

Here is an example:

```
Jul 12 22:27:38 apathy syslog: SCOADM: localhost {sco_printer}
{toaster1} objectCreation SCO_OFACE_MSG_OBJECT_CREATION {object
creation {(null)}}
```

The event types are:

Object creation The creation of an object, such as a new printer.

Object deletion The deletion of an object, such as a printer.

Attribute change The modification of an object, such as the configuration values for a printer.

Error A failure to complete a requested action, typically called an error message.

Warning An action was completed successfully, but with a problem.

Notice An informative message.

You can modify the list of event types by editing the */usr/adm/events* file.

Using the SCOadmin Event Logs Manager

You can select events to be logged using the **SCOadmin Event Logs Manager** located in the *System/Logs* directory of the SCOadmin hierarchy. The **SCOadmin Event Logs Manager** displays the events currently logged and not logged.

To log an event, highlight it in the "Ignored Events" column and click on the **Log event** button.

To ignore an event, highlight it in the "Logged Events" column and click on the **Ignore event** button.

To save your selections, select **Save** from the **File** menu.

See also:

- "The SCOadmin event log" (page 158)
- "Understanding the SCOadmin event log" (page 158)

Educating users

The following list suggests points the system administrator can explain to users so they can take advantage of the system's resources without overloading the system or causing unnecessary system problems. The more users understand the system and its limits, the less demands are placed on the system administrator.

If a user is completely new to SCO systems, the system administrator should recommend a training course or at least a careful review of the basic user documentation. Augment this training with the points listed here. References to documentation cover both graphical and character environments.

- **How to log in**. Emphasize password secrecy and methods of memorization. Explain the limits on password length and type, the schedule for changing passwords, rules about changing passwords, and the number of unsuccessful tries allowed. Tell users with character terminals how to specify their terminal type.

  Character: Chapter 1, "Getting started" in the *Operating System Tutorial*

  Graphical: "Starting the Desktop" (page 121)

- **How to manage files and directories**. Make sure users are familiar with basic operations, including the use of file permissions.

  Character: Chapter 3, "Directories and files" in the *Operating System Tutorial* and Chapter 7, "Protecting files and directories" in the *Operating System Tutorial*

  Graphical: Chapter 11, "Using files and directories" in *Using the Desktop*

- **How to edit files**. Make sure users know basic editing commands.

  Character: "Using the vi editor" in the *Operating System Tutorial*

  Graphical: Chapter 1, "Creating files with Edit" in *Using Edit*

- **How to use the calendar program**. Show users how to organize their schedules with the calendar.

  Character: "Using the Calendar" in the *Operating System User's Guide*

  Graphical: "Using the Graphical Calendar" in *Using the Graphical Calendar*

- **How to run applications**. Relate the names, locations, and commands necessary to run applications that you have installed at your site.

- **How to print files**. Explain the print commands for most-used programs. Tell the user the location of the default print service printer. Demonstrate how to replenish paper and toner, tape, or ribbon cartridge. Refer the user to the printer documentation, if necessary.

  Character: "Printing files" in the *Operating System User's Guide*

  Graphical: Chapter 13, "Printing files" in *Using the Desktop*

- **How to use the undelete feature to restore files**. Explain the filesystem versioning feature. Show users how to version files and recover them with **undelete**(C).

  Character: "Retrieving deleted files" in the *Operating System User's Guide*

  Graphical: Chapter 12, "Deleting and recovering files and directories" in *Using the Desktop*

- **Good mail etiquette**. Explain how to read and send mail, how to read through mail lists, and how to organize messages into mailboxes or folders. Explain how to clean out unwanted messages by deleting or saving them to floppy or tape. Emphasize the importance of maintaining free disk space.

  Character: Chapter 2, "Using e-mail" in the *Mail and Messaging Guide*

  Graphical: "Using Mail" in *Using Mail*

- **Good filesystem planning**. Explain the limits of directory size. For best performance, login and working directories should have less than 64* entries, including the dot (.) and dot-dot (..) entries, and data storage directories should have less than 638* entries. Warn users that directories do not get smaller, even if files are removed. Discourage users from saving mail messages in separate files rather than appending them to existing mailbox files. Refer to "Maintaining filesystem efficiency" in the *System Administration Guide* for more information.

- **How to store (archive) files**. Show users how to use floppy disk and tape archiving facilities to store unused files or directories.

  Character: Chapter 7, "Working with disks, tapes, and CD-ROMs" in the *Operating System User's Guide*

  Graphical: "Using floppy disks" in *Using the Desktop*

- **How to reset a scrambled serial terminal**. Teach users with serial terminals how to escape from the most-used programs and how to reset a terminal with **tset**(C) and **stty sane**. Tell users how to turn the terminal on and off if necessary. Make sure users try these procedures before asking a system administrator to disable and reenable the scrambled terminal. See "Fixing scrambled terminal display" (page 448).

- **How to kill "hung" processes**. Instruct users how to use **ps -flu** on a neighbor's terminal to find the hung process on their own terminal, and how to kill the process without causing undue system problems. See "Fixing hung terminals" (page 447).

---

* These figures apply to filenames of 14 characters or less. As filename lengths increase, up to a maximum of 255 characters, the number of files that fit on a single disk block decreases, reducing the optimum number of files in a directory.

- **Use of environment variables**. Inform users of critical environment variables (especially **$PATH**) and how they can be changed. See "Understanding variables" in the *Operating System User's Guide*.

- **System security profile** Inform users of the security profile configured on the system and any restrictions applied to usage. For a list of security profiles and parameters affected, see "Security profiles" in the *System Administration Guide*. Refer users to Chapter 9, "Using a secure system" in the *Operating System User's Guide*.

Planning your site

Before installing or expanding your system, review this material with management and create a physical plan of the system that makes the most efficient use of available resources and allows users the most direct and complete access to those resources.

If growth is expected, plan for it. Make sure that the resources and the communications lines that connect them are adequate for expected growth.

User resource considerations

- Allow for sufficient disk space in the filesystem where home directories are located. By default, home directories are located in the root filesystem. If possible, place home directories outside the root filesystem.
- Organize users into workgroups so they can share files. See "Managing groups" in the *System Administration Guide*.
- If you need to create large numbers of user accounts at the outset, use the **useradd**(ADM) command and template files. See "Using account templates" in the *System Administration Guide*.
- Assign advanced authorizations and privileges only to designated administrators or trustworthy users. See "Assigning subsystem authorizations" in the *System Administration Guide*.
- Versioning (which makes it possible to recover deleted files) is disabled by default. Consider whether you want to enable this feature and administer it accordingly. See "Versioning filesystems (undelete)" in the *System Administration Guide* for more information.

Network considerations

- If you plan to perform distributed or remote administration, be sure to set up equivalency and requisite authorizations for administrative users. This will allow you to administer systems from one location instead of having to **rlogin** to each system. See "Administering other systems with SCOadmin managers" in the *Networking Guide*.
- Where possible, set up dedicated servers to manage different resources (files, printers, applications, mail, and so on). See "The distributed computing environment" in the *Networking Guide*.

Hardware considerations

- Set up the computers in a place where they will not be bumped or moved at any time. If possible, they should be in a room by themselves, with little or no foot traffic. If workstations are used for data storage, at least place them on stable furniture and leave no cables exposed to traffic.
- Keep the computer room cool and give each machine excellent ventilation. Keep all machines away from walls and, if possible, provide a separate air conditioner for the computer room, with more-than-adequate cooling capability.
- Install a Halon® fire extinguishing system in the computer room rather than sprinklers.
- Store backup media in a separate room from the computers. This room should be fireproof, or and/or have a Halon fire extinguishing system (rather than a sprinkler system).
- Ensure that there is adequate and uninterrupted power for the computers (or at least surge protection). Installing an uninterruptible power source (UPS) will prevent system crashes caused by small electrical failures and may provide enough power for an orderly shutdown following major electrical failures. This is especially important if your building frequently suffers power glitches or if you live in an area that is subject to frequent major storms. The computers should also be on an isolated, fully grounded (earthed) circuit.
- If you install a local area network, plan the cabling and location of all machines and peripherals carefully. Seek the assistance of a networking expert to make these plans. Good planning and the use of adequate connecting media and compatible hardware are essential for long-term network performance.

- If you need leased lines for off-site connections, arrange for these with your local telephone company.
- If you plan to connect a printer to a parallel port, locate it close to the machine running it. Keep the machine out of the path of traffic to and from the printer.
- If you connect terminals, printers, or other peripherals to serial ports, consider using phone-line cabling and switching hardware, especially if your system is expected to grow in size and complexity. You can readily adapt phone lines for serial hardware, and telephone connecting and switching technology is mature and flexible.

Summary of system administration tasks

A system administrator has numerous tasks to perform. They can be divided into groups according to how often they are carried out. The following list of tasks ranges from those that must be performed more often than once a day to those that need be performed less often than once a month. The administrator may have to do some of the tasks in the following list more or less often, depending upon the size and complexity of the system.

Table 9-5 Task list

As needed tasks	For more information:
□ Create/modify user accounts.	"Adding and modifying user accounts" in the *System Administration Guide*
□ Record all system modifications and events in log.	"Keeping a system log" (page 139)
□ Be on call to restart the system after panics, crashes, power spikes.	"Starting the system" (page 169) and "System crashes" (page 253)
□ Maintain security of hardware, software, data file access.	Chapter 5, "Maintaining system security" in the *System Administration Guide*

Daily tasks	For more information:
☐ Perform scheduled backups (if configured).	"Running scheduled backups" in the *System Administration Guide*
☐ Check usage levels.	"ps — check process activity" in the *Performance Guide*
☐ Check for runaway processes.	"Runaway processes" (page 267)
☐ Check disk space.	"Maintaining free space in filesystems" in the *System Administration Guide*
☐ Check mail functionality, connections.	"Checking for MMDF problems" in the *Mail and Messaging Guide*
☐ Check printer status with **lpstat -t**.	Man page for **lpstat**(C)
☐ Check auditing output, if activated.	"Generating audit reports" in the *System Administration Guide*
☐ Check UUCP communications links, if active.	"Generating log reports on usage: uulog" in the *System Administration Guide*
☐ Check for unattended login sessions.	manual page for **who**(C)

Weekly tasks	For more information:
☐ Verify system software (checks permissions, links, and missing or corrupted files) — best done after work hours.	"Verifying software" (page 77)
☐ Check printer spooler status report.	Check **lp**(C) account mailbox for messages
☐ Check log files such as */etc/wtmp* and those in */usr/adm* and */usr/spool* and clear, trim, or truncate.	"Checking and clearing system log files" in the *System Administration Guide*
☐ Use **sar**(ADM) to generate a report of activity.	"sar — system activity reporter" in the *Performance Guide*
☐ Generate detailed report of user disk utilization.	"Displaying filesystem and directory usage statistics" in the *System Administration Guide* — see description of **quot**(ADM)

(Continued on next page)

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(Continued)

Weekly tasks	For more information:
☐ Remove temporary files including *lost+found* files and **.out* files.	"Finding temporary files" in the *System Administration Guide*

Monthly tasks	For more information:
☐ If you are not doing scheduled backups, perform an unscheduled (level 0) backup.	"Running unscheduled filesystem backups" in the *System Administration Guide*
☐ Re-tune system and re-allocate resources, if necessary.	Chapter 2, "Managing performance" in the *Performance Guide*
☐ Perform tape drive maintenance: clean heads and retension drive using **tape reten** command	**tape**(C) manual page
☐ Change dial-in passwords, if necessary.	"Setting passwords for dial-in lines" in the *System Administration Guide*
☐ Change *root* password, if necessary.	"Setting or changing a user password" in the *System Administration Guide*

Occasional tasks	For more information:
☐ Upgrade system and application software, as needed.	*Release Notes* of the new version
☐ Check for configuration errors, including verification of system software	"Checking system configuration" (page 260)
☐ Re-distribute space in filesystems.	"Adding disk space and restructuring filesystems" or "Maintaining free space in filesystems" in the *System Administration Guide*
☐ Find SUID or SGID files, check owner, size. Locate huge (over 64 Mbyte) files and verify their purpose.	"Locating files" in the *System Administration Guide*
☐ Find "orphan" files (files belonging to deleted users).	"Changing ownership of files with an obsolete UID/GID" in the *System Administration Guide*

Chapter 10
Starting and stopping the system

These tasks are related to powering up your system and bringing it down:

- Starting the system (this page)
- Stopping the system (page 178)
- Logging in as the superuser (page 180)
- Understanding the hardware information displayed at boot time (page 181)
- Changing the startup process (page 182)

Additional information on altering the startup process is found in Appendix A, "Customizing UNIX system startup" in the *System Administration Guide*.

Starting the system

Starting your SCO system requires more than just turning on the power. The system goes through a series of stages to ready the system for use, some of which may require intervention:

- Loading the operating system (page 170)
- Saving/deleting a system memory image (page 170) if the system was improperly stopped
- Cleaning filesystems (page 171)
- Choosing the mode of system operation (page 172)
- Setting the time and date at startup (page 173)
- Checking the security databases (page 175)

NOTE The default system behavior is to restart and proceed with these stages without intervention when the computer is switched on (or power is restored). See "Changing the system restart options" (page 182) for more information.

See also:

- "The UNIX system life cycle" in the *Operating System User's Guide*

Loading the operating system

The first step in starting the system is to load the operating system from the computer's hard disk.

1. Turn on power to the computer and hard disk. The computer loads the UNIX system bootstrap program and displays this message:

   ```
   Boot
   :
   ```

2. Press the ⟨Enter⟩ key. The system loads the operating system using the default bootstring as described in "Changing the startup process" (page 182).

When the system is loaded, it displays information about the system configuration (page 181) and verifies that the root filesystem (that is, all files and directories) is in order and not corrupted. If a filesystem is uncorrupted and in good order, it is called "clean". If the root filesystem is clean, you can choose the mode of operation. If not, the system requires you to clean your filesystems first.

Saving/deleting a system memory image

If the system was improperly halted, you may see the message:

```
There may be a system dump memory image in the swap device.
Do you want to save it? (y/n)
```

This memory image contains technical data about the state of the system when operation was interrupted. Information about preserving and analyzing this data is discussed in "Recovering from a system panic" (page 254). If you respond **n**, you are then asked if you want to delete the image; enter **y** to save the image and continue.

Cleaning filesystems

The root filesystem must be "cleaned" (checked and cleared of any inconsistencies) using **fsck**(ADM) if the following message is displayed:

```
fsstat: root filesystem needs checking
OK to check the root filesystem (/dev/root) (y/n)?
```

This message is displayed only if the system was not shut down properly, as described in "Stopping the system" (page 178). Your additional filesystems may also require cleaning.

To clean the filesystem, enter **y** (for "yes") and press the ⟨Enter⟩ key. **fsck** cleans the filesystem, repairing damaged files or deleting files that cannot be repaired. It reports on its progress as each step is completed. At some point, you may be asked if you wish to salvage a file. Always answer by entering **y** or **n** and pressing the ⟨Enter⟩ key. You can also enter **y!** and yes answers will be assumed for all succeeding prompts. For an explanation of how **fsck** works, refer to "Filesystem check phases (HTFS, EAFS, AFS, S51K)" in the *System Administration Guide.*

There are two cases where cleaning will be skipped (or shortened considerably):

Intent logging — If "intent logging" is enabled on the filesystem, it is unlikely that cleaning will be necessary; **fsck** will not be invoked in this case. If any cleaning is necessary, a "fast fsck" will be performed that replays the transaction log for the filesystem. This process lasts several seconds (instead of minutes). See "Logging filesystem transactions" in the *System Administration Guide* for more information.

DTFS filesystems — DTFS filesystems are extremely stable and normally do not require cleaning. When cleaning is necessary, no intervention is needed. See "Filesystem check phases (DTFS)" in the *System Administration Guide* for more information. In some cases, a DTFS root filesystem will be rebooted after checking if many changes had to be made to repair the filesystem.

When cleaning is complete, the system asks you to choose the mode of operation.

NOTE When restarting automatically, the default system behavior is to fix filesystems without operator intervention; the system boots and runs **fsck** assuming "yes" answers. To change this, use the **System Startup Manager** (page 182) or change **FSCKFIX=YES** to **FSCKFIX=NO** in */etc/default/boot.*

Choosing the mode of system operation

You can choose the mode of operation as soon as you see the message:

```
INIT: SINGLE USER MODE

Type CONTROL-d to continue with normal startup,
(or give the root password for system maintenance):
```

The system has two modes: multiuser mode (this page) (for normal operation) and single-user mode (this page), also known as maintenance mode. Multiuser mode is for ordinary work on the system and allows users to log in and begin work. Single-user mode is reserved for work to be done by the system administrator, and does not allow multiple users.

To choose multiuser mode, press ⟨Ctrl⟩**D**. To choose system maintenance mode, enter the superuser password (also called the *root* password) and press ⟨Enter⟩.

NOTE The superuser (*root*) password is assigned during system installation. If you do not know the *root* password, ask the administrator who installed your system.

Single-user mode

Use system maintenance mode only if you must do system maintenance work that requires all other users to be off the system, including checking filesystems, installing updates or new software, and reinstalling system files or packages. Note that many system services (like printing and networking) will not function because the various daemons and startup programs in */etc/rc* are not executed. Single-user mode effectively halts the startup process until you exit using ⟨Ctrl⟩**D**, when the process continues with setting the system time. While in single-user mode, the superuser prompt " # " is displayed.

NOTE You can also configure the system to skip the single-user mode prompt. See "Changing the startup process" (page 182).

Multiuser mode

When you select multiuser mode, the startup process continues, proceeding with setting the system time. The most important distinction between single-user and multiuser mode is the execution of startup commands found in the */etc/rc* directories discussed in "Changing scripts in /etc/rc2.d" in the *System Administration Guide*. These scripts generate startup messages for the various system services, such as the printer or network services. Next, the system displays the `login:` prompt and users are allowed to log in.

Setting the time and date at startup

Once normal operation starts, the system asks for the correct time and date:

```
INIT: New run level: 2

Current System Time is Tue Nov  9 23:26:54 1999
Enter new time ([[CC]YYMMDD]hhmm[.ss]):
```

Unless your clock battery is drained or removed, there should be no need to change the date. To leave the time and date unchanged, simply press ⟨Enter⟩. If you need to change the time and date, enter the new time and press ⟨Enter⟩. The new values must be entered as two or more consecutive sets of digits, where the digits can be one or more of:

ccyy (optional) represents the year (the current year is the default). It can be entered as a 4-digit value to explicitly specify the century or as a 2-digit value, where the range 69-99 refers to years in the twentieth century (1969 to 1999 inclusive) and values in the range 00-68 refer to years in the twenty-first century (2000 to 2068 inclusive).

mm (optional) represents the current month. It can be any two-digit value, from 01 to 12 for January to December, respectively.

dd (optional) represents the current day. It can be any two-digit value, from 01 to the last day of the month.

hh represents the current hour. It can be any two-digit value, from 00 to 23. Hours are expressed in the 24-hour format, in which morning hours range from 00 to 11 and evening hours from 12 to 23.

mm represents the current minutes. It can be any two-digit value, from 00 to 59.

ss (optional) represents the current seconds. It can be any two-digit value, from 00 to 59.

For example, to change the time and date to 3 February 1995 at noon, enter:

9502031200

After accepting the new value, the system then displays the new time and date:

```
Sun Feb 03 12:00:00 PST 1995
```

If you enter an incorrect value, the system prompts you to try again. If you do not enter an optional value, the current value for that item remains unchanged. If you type a new value for the year, you must also type values for the month and day. Similarly, if you type a new value for the month, you must type a value for the day.

The time and date display is followed by service startup messages and the `login:` message.

Setting the time and date during normal operation

You can change the system time during normal operation with the **System Time Manager**, located in the *System* directory of the SCOadmin hierarchy.

Enter numbers manually (or use the up and down buttons in the graphical version) to set the time and date entries. Note that hours are expressed in 24-hour format, in which morning hours range from 00 to 11 and evening hours from 12 to 23.

> **NOTE** If you need to set the system clock back, reboot the system and enter the new time during startup. Failure to do so may cause unpredictable behavior, especially in event-driven processes.

To save your changes, select **Set** from the **Time** menu.

To change your time zone, see "Changing the system time zone" (this page).

Changing the system time zone

You can change the system time zone using the **System Time Manager**, located in the *System* directory of the SCOadmin hierarchy.

1. Select **Change Timezone** from the **Time** menu.
2. Select the "Geographical area". The screen is updated with selections appropriate for your location.
3. Select the "timezone" for your location. If you cannot find your timezone, click on the **Specify Unlisted Timezone** button and provide the name, whether it is east or west of Greenwich Mean Time, and the hours and minutes from GMT.
4. If applicable, select **Yes** or **No** for "Daylight savings time".

> **NOTE** Any users logged in (including *root*) during the timezone change operation will not see the change until they log out and log in again. This is because the timezone variable (located in */etc/TIMEZONE*) is read at login time.

Checking the security databases

Each time your system is rebooted (and after **fsck** is run if your system was brought down unexpectedly) the system automatically checks critical security database files. The messages are:

```
Checking tcb ...
Checking protected password and protected subsystems databases ...
Checking ttys database ...
```

This checking is done to avoid problems with access to your system. In the rare case where a file is missing, you are alerted to this fact and asked to restore the file from backups (or it may be necessary to repair broken symbolic links).

When the system is halted suddenly by power or hardware failures, some filesystem damage can occur. Damage can cause the removal of security database files, or can leave these files in an interim state if they were being updated at the time of the system crash. Whenever a reboot occurs, the system runs a series of programs to check the status of the database files. When the system terminates abnormally and is rebooted, this check is performed after **fsck**(ADM) is run on the root filesystem, and before entering multiuser mode.

The system follows these steps:

1. The script */etc/smmck* (system maintenance mode checker) runs the **tcbck**(ADM) program to clean up any database files that were left in an interim state while being updated.

   When a security database file is updated, the contents of the old file (***file***) is copied or updated to create the new "-t" file (***file****-t*). Next, the old file (***file***) is moved to a "-o" file (***file****-o*), and the new file (***file****-t*) is moved to the original name (***file***). When this process is interrupted, "-o" and "-t" files are left and must be reconciled before the system will function properly. **tcbck** first resolves any "-t" and "-o" files left in the */etc/auth/system*, */etc/auth/subsystems*, and */tcb/files/auth/** directories and the */etc/passwd* and the */etc/group* files. If there are multiple versions of a file, the extra files must be removed. This is done automatically as follows:

   a. If ***file***, ***file****-o*, and ***file****-t* exist and ***file*** is not zero length (empty), then ***file****-t* and ***file****-o* are removed.

   b. If ***file*** and ***file****-t* exist then ***file****-t* is removed.

   c. If only ***file****-t* exists, then it is moved to ***file***.

   d. If only ***file****-o* exists, then it is moved to ***file***.

   If scenario c. occurs, a message similar to this is displayed:

   `/etc/tcbck: file` ***file*** `missing, saved` ***file***`-t as` ***file***

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This is done because the "-t" file is the modified version of the original file and could have been damaged; it is likely that this file does not contain all the entries of the original. This message is repeated for all files found in that state in the specified directories. (The "-o" files are not suspect because they are the original versions of the files renamed prior to updating.)

2. **tcbck** checks that key system files are present and that they are not empty. If a file is missing (or empty), then a message similar to this is displayed:

   `/etc/tcbck: file` ***file*** `is missing or zero length`

   This process is repeated for each of these files (critical TCB files are marked with a †):

   > */etc/auth/system/default* †
   > */etc/auth/system/files*
   > */etc/auth/system/devassign*
   > */etc/auth/system/authorize* †
   > */tcb/files/auth/r/root* †
   > */etc/group*
   > */etc/passwd* †

   When this process is complete, if any files were missing, or empty "-t" files were substituted for real files, this message is displayed:

   ```
   /etc/smmck: restore missing files from backup or distribution.
   ```

   If either */etc/passwd* or */etc/group* is missing, this message is displayed:

   ```
   /etc/tcbck: either slash (/) is missing from /etc/auth/system/files or there
           are malformed entries in /etc/passwd or /etc/group
   ```

   > **NOTE** You can ignore any warnings that */tcb/files/auth/r/root* is missing. Enter **exit** when the root prompt is displayed and **authck** will later repair this file as described in step 6.
   >
   > Corrupted files are not detected by **tcbck**, but other error messages may be displayed that are described in "Troubleshooting system security" in the *System Administration Guide.*

3. If critical database files are missing or corrupted, then the system enters maintenance mode automatically without asking for the *root* password. These messages are displayed:

   ```
   INIT: SINGLE USER MODE
   Security databases are corrupt.
   Starting root shell on console to allow repairs.
   Entering System Maintenance Mode
   ```

   If no critical database files are missing, you are prompted to choose system maintenance mode or normal operation. If files are reported missing, write them down and follow the instructions in "Restoring critical security database files" (page 186).

4. **tcbck** removes the files */etc/auth/system/pw_id_map* and */etc/auth/system/gr_id_map* because the modification times of these files are compared with those of */etc/passwd* and */etc/group*, and problems can occur when the system clock is reset. **tcbck** then tries to rebuild the map files using **cps**(ADM). If this fails, then either the *File Control* database (*/etc/auth/system/files*) is missing, or the *File Control* database entry for " / " is missing, or there are syntax errors in */etc/passwd* or */etc/group*.

5. After the system enters multiuser mode (`INIT: New run level: 2` is displayed) and you are prompted to set the system clock, */etc/authckrc* is reinvoked. If any missing files are found, warnings similar to the ones shown previously are displayed, followed by the message shown below:

   ```
   /etc/tcbck: file file is missing or zero length
   /etc/authckrc: Log in on the OVERRIDE tty and restore
   the missing files from a backup or the distribution disks.
   ```

   This means that files are still missing. These files will have to be replaced when the system comes up in multiuser mode and you are allowed to log in. Write down the names of the missing files and follow the instructions in "Restoring critical security database files" (page 186).

   If */etc/passwd* or */etc/group* are missing, the following messages is displayed at startup (the first if */etc/passwd* is missing, the second if */etc/group* is missing):

   ```
   su: Unknown id: bin
   su: Cannot setgid to auth, no auth entry
   ```

6. The message is displayed:

   ```
   Checking protected password and protected subsystems databases ...
   ```

   The **authck**(ADM) program is run to make certain that all users listed in */etc/passwd* have *Protected Password* database entries. If any are missing, they are created as needed if you respond **y** to this prompt:

   ```
   There are errors for this user
   Fix them (y/n)?
   ```

   The *Protected Subsystem* database files are then checked to ensure that they correctly reflect the subsystem authorization entries in the *Protected Password* database. Each name listed in each subsystem file is verified against the *Protected Password* entry with the same name to ensure that authorizations are consistent between the files. In addition, each *Protected Password* entry is scanned to verify that all the privileges listed are reflected in the *Protected Subsystem* database. If any inconsistencies are found, you are asked if you want them fixed automatically:

   ```
   There are discrepancies between the databases.
   Fix them (Y or N)?
   ```

You may see that many discrepancies are reported and repaired by this process — this is normal.

> **NOTE** If the system is set to restart automatically when an operator is not present ("AUTOBOOT=YES" appears in */etc/default/boot*), then **authck**(ADM) is called noninteractively. Warnings are displayed about inconsistencies found but **authck** is not given the opportunity to fix them. The transition to the multiuser operation then proceeds as normal.
>
> See "Database consistency checking: authck(ADM) and addxusers(ADM)" in the *System Administration Guide* for information on running **authck** manually.

7. You see this message:

   ```
   Checking ttys database ...
   ```

   ttyupd(ADM) is run to ensure that all ttys in */etc/inittab* have entries in the *Terminal Control* database (*/etc/auth/system/ttys*).

8. The system should be up and ready for logins. If any files were reported missing, you must now log in on the override terminal to restore them, following the same procedure outlined earlier. By default, the override terminal is defined as *tty01,* also known as the first multiscreen. If you removed the default entry in */etc/default/login,* you will have to shut the system off, reboot and enter single-user mode, and restore the files that way. When you log in on the override tty, this message is displayed:

   ```
   The security databases are corrupt.
   However, root login at terminal tty01 is allowed.
   ```

Stopping the system

Stopping your SCO system requires more than just turning off the computer. You must prepare the system by using the **System Shutdown Manager** (located in the *System* directory of the SCOadmin hierarchy) or with the **shutdown**(ADM) command. This not only halts system services properly, but warns users and gives them an opportunity to finish their work.

To shut down the system, select **Begin Shutdown** from the **Shutdown** menu. The default behavior is to send the default broadcast message to all users and shut the system down in 60 seconds.

To change the grace period, enter your changes in the "Delay" field. If you set the "Delay" to 0, the "Message" field cannot be filled in and no message will be sent because the shutdown will be immediate.

To change the broadcast message, enter the text in the "Message" field, or select **Read from file** from the **Message** menu to use a prepared file.

To automatically restart the system, select **Reboot after shutdown**.

To request confirmation before shutting down, select **Confirm prior to shutdown**.

To save your selections, select **Save** from the **Shutdown** menu.

Using the shutdown command line

To stop the system with the **shutdown**(ADM) command:

1. Log in as the superuser (page 180). The system opens the superuser account and displays the message of the day and the superuser prompt.
2. Enter this command:

   shutdown -g*n*

   where ***n*** is the number of minutes before the shutdown is to take place. To go from normal operation to system maintenance mode, use this variation:

   shutdown -g*n* su

   The system displays a warning message at each terminal, asking logged-in users to finish their work and to log out. (The warning message can be customized; see the **shutdown**(ADM) manual page for details.) As soon as all users are logged out or the specified time has elapsed, the system closes all accounts and displays this message:

   ```
     ** Safe to Power Off **
             -or-
   ** Press Any Key to Reboot **
   ```

3. If you specified single-user mode on the command line, the system proceeds directly to the single-user prompt without rebooting as described in "Choosing the mode of system operation" (page 172).
4. If you did not specify single-user mode, turn off the computer or press any key to reboot the system.

Using the haltsys command

The **haltsys**(ADM) command halts the system immediately, without warning users. If there are any users logged into the system when the **haltsys** command is given, they are logged out and their work in progress is lost.

To stop the system with the **haltsys** command, log in as the superuser and enter:

/etc/haltsys

The system displays the message:

```
    ** Safe to Power Off **
            -or-
** Press Any Key to Reboot **
```

Turn off the computer, or press any key to reboot the system.

Logging in as the superuser

Many system maintenance tasks require you to log in as the superuser. For example, you must be logged in as the superuser to stop the system. Do not confuse the superuser login with running in single-user mode. (page 172) The only similarity is that both require the use of the *root* password.

To log in as the superuser, you must know the superuser password. If you do not know the *root* password, ask the administrator who installed your system. You also need to see the `login:` message on the screen. If you are using a character-based display and do not see this message, press ⟨Ctrl⟩**D** until it appears.

> **WARNING** Take special care when you are logged in as the superuser. In particular, you should be careful when deleting or modifying files or directories. This is important because the superuser has unlimited access to all files, and it is possible to remove or modify a file that is vital to the system. Avoid using wildcard designators in filenames and keep track of your current working directory.

To log in as the superuser:

1. When you see the login display, enter the superuser login name:

   `login:` **`root`**

2. Enter the superuser password when prompted. The system does not display the password as you enter it, so enter each keystroke carefully.

The system opens the superuser account. If you are using a graphical display, you see the Desktop of the *root* account. If you have logged in to a character-based display, you see the superuser prompt " # ". You can exit at any time by pressing ⟨Ctrl⟩**D**.

Understanding the hardware information displayed at boot time

At boot time, a table of hardware information is displayed after the copyright information. This table represents your hardware configuration as recognized by the operating system.

Example 10-1 Sample boot display

```
device    address      vector dma comment
------------------------------------------------------------------------
cpu      -              -     -  unit=1 family=5 type=Pentium
cpuid    -              -     -  unit=1 vend=GenuineIntel mod=2 step=B5
fpu      -             13     -  unit=1 type=80387-compatible
floppy   0x03F2-0x03F7  06    2  unit=0 type=96ds15
serial   0x02F8-0x02FF  03    -  unit=1 type=Standard nports=1
parallel 0x0378-0x037A  07    -  unit=0
console  -              -     -  unit=ega type=0 12 screens=68k
disk     0x01F0-0x01F7  36    -  type=W0 unit=0 cyls=791 hds=16 secs=48
adapter  0x8000-0x8CDC  11    -  type=eiad ha=0 id=7 fts=std
```

Key:

`cpu/cpuid` The CPU type(s), stepping, and vendor information.

`device` name of the hardware

`address` address in hexadecimal

`vector` interrupt vector

`dma` direct memory access channel

`comment` other details about the hardware

`fpu` floating-point unit present (Intel 80387 math coprocessor, 80486 CPU and Pentium chips)

`floppy` high density 5.25-inch floppy disk drive (type=96ds15)

`serial` this is COM1 with one port (nports=1, no multiport card is installed)

`parallel` this is parallel port lp0 (unit=0)

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`console`	the console has an EGA video adapter (unit=ega) compatible with type 0 (IBM EGA), with 12 multiscreens that take up 68KB of kernel space
`disk`	Western Digital st506 controller number 0 (W0), hard drive 0 (unit 0), as well as the number of cylinders, heads, and sectors
`adapter`	Adaptec AHA-174x host adapter. See "Boot time messages from host adapter drivers" (page 306) for more information.

Due to the wide variety of hardware devices available, you may see additional device entries not discussed here.

The **hwconfig** utility can display or access this information at any time, using the configuration information stored in the file */usr/adm/hwconfig*. Refer to the **hwconfig**(C) manual page for more information.

In addition, the **eisa**(ADM) utility can be used to list the cards installed in EISA machines, and the **slot**(C) utility used for MCA machines.

Changing the startup process

Each time the computer is started, the system runs the **boot** program. Unless you give different instructions at the prompt, **boot** loads the default kernel program using the configuration values specified in the file */etc/default/boot* on the default root filesystem. You can change the current boot process with your response to the prompt, or you can use the **System Startup Manager** (this page) to change the default configuration values for future boot operations. You can also edit the */etc/default/boot* file to change these options manually.

See also:

- **boot**(F) manual page
- "Changing the default bootstring (DEFBOOTSTR)" (page 183)

Changing the system restart options

To alter the system startup behavior, use the **System Startup Manager** located in the *System* directory of the SCOadmin hierarchy.

The restart options determine whether (and how) the system will restart after a power failure or system panic.

You have these options:

Restart automatically when power is restored
If selected, restart without operator intervention and allow users to log in. If not, wait indefinitely for operator to respond to `Boot:` prompt.

Automatically check and clean filesystems
If selected, automatically clean and mount filesystems. (any inconsistencies are resolved automatically). If not selected, wait for operator to continue manually.

Immediately go to multi-user mode during restart
If selected, skip the prompt for single-user mode. (If booting automatically, the prompt is always skipped.)

Restart automatically after a system panic
If selected, restart without operator intervention (a panic always causes the system to halt). Similar to "Restart automatically when power is restored."

Seconds before auto restart
Specifies how long the system waits at the `Boot:` prompt before restarting automatically.

Default Boot String
Specifies the boot string to be automatically loaded when you press ⟨Enter⟩ at the `Boot:` prompt.

To restore system defaults, select **Reset Defaults** from the **Parameters** menu.

To alter other startup parameters in */etc/default/boot*, select **Advanced** from the **Parameters** menu. These are described in *boot*(F) manual page.

To save your changes, select **Save** from the **Startup** menu.

Changing the default bootstring (DEFBOOTSTR)

To change which program is loaded by default when you just press ⟨Enter⟩ at the boot prompt, modify the default bootstring set with the **System Startup Manager** (page 182) or change the **DEFBOOTSTR** option in */etc/default/boot*. For example, this setting in */etc/default/boot* causes the **boot** program to load the kernel from a hard disk by default:

```
DEFBOOTSTR=hd(40)unix
```

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See "Using bootstrings" (page 276) or **bootstring**(HW) for additional keywords or "bootstrings" that you can add to the **boot** command line to load special drivers at boot time. For example, here is the bootstring for a Wangtek cartridge tape:

```
DEFBOOTSTR=hd(40)unix ct=wangtek(0x338,5,1)
```

Booting an old kernel

If you have recently relinked the kernel and it fails to boot properly or causes other problems, you can enter **unix.old** or **unix.safe** at the boot prompt and load a previous kernel. If you find no suitable kernel, see "unix not found" (page 189).

Troubleshooting system startup

This section discusses reasons why a system that has booted successfully in the past may not boot now. These situations usually occur as a result of a power failure or system panic that corrupts the root filesystem, although configuration changes, hardware failure, and human error can also cause these situations.

If you are performing an installation and your system fails to boot see Chapter 3, "Troubleshooting the installation" (page 53).

If you cannot boot your system:

- Is the system plugged in?
- Are any cables loose, disconnected, or misconnected?
- Are the cable chains terminated properly?
- Does the floppy drive contain a floppy disk that is not a boot floppy disk?
- Has your hard disk developed a bad track? A bad track on the disk can corrupt system files that are required for booting the system. See "Fixing bad tracks and bad blocks on hard disks" (page 341) for information on how to recover from this situation.

Many of the problems discussed here relate to missing system files. "About missing or corrupted system files" (page 185) explains what you need to restore files.

These problems are discussed:

- Restoring critical security database files (page 186)
- System fails to boot or displays "NO OS" message (page 188)
- boot not found (page 188)
- unix not found (page 189)
- Cannot load floating point emulator (page 190)
- Cannot exec /bin/login: No such file or directory (page 191)
- Cannot open /etc/inittab (page 192)
- /etc/initscript: /bin/sulogin: not found (page 193)
- /etc/initscript: /etc/bcheckrc: not found (page 193)
- no utmp entry. You must log in from lowest level -sh (page 194)
- Fork failed... Resource temporarily unavailable (page 194)
- System hangs at boot time (page 195)
- Console keyboard locks up (page 195)
- Cannot log into console (page 197)

About missing or corrupted system files

On rare occasions, one or more of the critical system files may be accidentally modified or removed, preventing the system from booting or operating correctly. In cases where your system does not boot, you must boot from floppy disks in order to access the system so that you can restore the critical files from backups.

To boot and access a system that does not boot from the hard disk, you must have an emergency boot floppy disk set (page 81). This set consists of the boot floppy disk and the root filesystem floppy disk. The boot floppy disk contains three files necessary for booting and loading the UNIX system kernel: */boot*, */etc/default/boot*, and */unix*. The root filesystem floppy disk contains a subset of the UNIX system utilities that you can use to restore your system.

NOTE We recommend that you have a separate emergency boot floppy disk set for each system or further corruption can result. Systems that have *identical* hardware and software configurations can share an emergency boot floppy disk set.

If a catastrophic failure occurs and you do not also have a backup of the *root* filesystem, you must reinstall your SCO system. To do this, follow the instructions for reinitializing the root disk in "Replacing the root hard disk" (page 339).

See also:

- "Checking the security databases" (page 175)
- "Restoring a corrupted root filesystem" (page 250)

Restoring critical security database files

If the system startup process reports that security database files are missing, follow these steps:

1. First attempt to verify the "UNIX Run Time System" component of your SCO system using the **Software Manager** (page 77) or the **custom**(ADM) command line:

   custom -v quick SCO:Unix:RTS -x

   The **custom** verify command will repair any broken symbolic links that may have rendered the files unreachable. **custom** leaves a copy of the verify output in *custom.VerifyReport*.

   > **NOTE** If the files */etc/passwd* or */etc/group* are missing from the system, the **custom** command will fail. (For */etc/group*, the command will take a very long time to complete.) If it does, use one of these commands to restore the symbolic link manually:
   >
   > **ln -s /var/opt/K/SCO/Unix/*/etc/passwd /etc/passwd**
   > **ln -s /var/opt/K/SCO/Unix/*/etc/group /etc/group**

   If the process is successful, enter ⟨Ctrl⟩**D** to continue the startup process. If files are actually missing from the system and not just a consequence of a broken link, the error messages will persist and the files must be restored from backups (step 2) or from the original distribution files (step 3).

2. Attempt to restore the files from your backups. For example, if the system reported that the file */etc/auth/system/files* was missing and you had a backup of the root filesystem, run the **Backup Manager** to restore it as described in "Restoring files from a scheduled filesystem backup" in the *System Administration Guide*. You can also restore the file from the command line by inserting the first volume of your last full backup of the root filesystem into the tape drive and entering:

   cd /
   cpio -idv -I /dev/rct0 etc/auth/system/files

3. If backups are unavailable or you find your backups are unreadable, it is possible to restore the original distribution files. These files are located in the software storage object for the "UNIX Run Time System" component of your SCO system. Enter this command:

   cd /opt/K/SCO/Unix/*/.softmgmt/var

   Now use the appropriate copy commands to restore your lost files:

   cp etc/auth/system/default /etc/auth/system/default
   cp auth/system/files /etc/auth/system/files
   cp auth/system/devassign /etc/auth/system/devassign
   cp auth/system/authorize /etc/auth/system/authorize
   cp etc/group /etc/group
   cp etc/passwd /etc/passwd

   If you are missing */etc/default/accounts*, enter these commands:

   cd /opt/K/SCO/Unix_adm/*/.softmgmt/var/etc/sysadm.d/account
   cp accounts /etc/default/accounts

   NOTE The original distribution files will not contain any changes you have made to your system — you will have to add them again. For example, groups added to */etc/group* or users in */etc/passwd*. For */etc/passwd*, you can use the *Protected Password* database entries to get the information:

   cd /tcb/files/auth
   grep u_id */*

   This lists all the accounts on the system and their UIDs (*u_id*). Ignore the system accounts like *root* and *bin*. The remaining accounts can be added by editing */etc/passwd* manually, or by running the **Account Manager** and adding the users (making sure to enter the correct UID and use the existing home directories instead of creating new ones).

4. Repeat step 1 to make sure all the symbolic links are intact. If the system is still in single-user mode, enter ⟨Ctrl⟩**D** and continue with system startup as described in "Checking the security databases", step 4 (page 177). If you are already in multiuser mode, run this command to repair any remaining inconsistencies:

   authck -a -y

System fails to boot or displays "NO OS" message

If the system fails to boot or you see the `NO OS` message, the blocks containing the partition boot blocks (*/etc/hd0boot* and */etc/hd1boot*) or masterboot block (*/etc/masterboot*) may have been corrupted. To restore them:

1. Insert the boot floppy from your emergency boot floppy set and boot from it. When the `Boot:` prompt appears, enter:

   hd(40)unix

2. Enter single user mode and enter these commands at the root prompt:

   instbb hd /dev/hd0a
   dparam -w

   instbb(ADM) writes the partition boot blocks to the hard disk. **dparam**(ADM) writes the masterboot code to the masterboot block on the hard disk.

For some disks it may also be necessary to stamp the disk geometry as described in **dparam**(ADM).

boot not found

If your system displays this message when you turn on the power to your computer, the */boot* file is missing:

```
boot not found
Cannot open
Stage 1 boot failure: error loading hd(40)/boot
```

This refers to the **boot**(HW) program, which loads and executes the kernel each time you turn on the computer.

If */boot* is missing, use this procedure to boot the system from the emergency boot floppy disk set so that you can then restore the file:

1. Insert the boot floppy disk in the drive and reboot the machine. This executes the initial boot from the boot floppy disk.
2. At the `Boot:` prompt, enter:

   fd(60)unix.Z root=hd(42)

   This command boots the system from the floppy disk, loads the the kernel from the floppy disk, and mounts the root filesystem.
3. Bring up the system in single-user mode by entering the *root* password at the prompt.
4. Unmount the */stand* filesystem (where boot and the kernel are located):

   umount /stand

   The reason for this is that */stand* is normally mounted read-only and you must unmount it and mount it again before you can replace *boot*.

5. Re-mount */stand*:

   mount /stand

6. Now mount the boot floppy disk:

   mount -r /dev/fd0 /mnt

7. While the floppy disk is in the drive, restore the */boot* file by entering this command at the system prompt:

   cp /mnt/boot /stand

   This places a new copy of the */boot* file on the hard disk.

8. Before you remove the floppy disk from the drive, unmount the boot floppy disk (*/dev/fd0*) by entering:

   umount /mnt

9. Remove the floppy disk from the drive and bring down the system using **haltsys**(ADM).

10. Reboot the system from the hard disk by pressing ⟨Enter⟩ at the `Boot:` prompt.

unix not found

If the system displays the `unix not found` message after the system starts to boot, the *unix* file is missing. The *unix* file contains the bootable image of the UNIX system kernel. If *unix* is missing, you can boot from another kernel file, (such as *unix.old* or *unix.safe*) by entering the alternate kernel name at the `Boot:` prompt.

If there are no other kernel files on the system, boot the system from the emergency boot floppy disk set so that you can restore the *unix* file:

1. Insert the boot floppy disk in the drive and reboot the machine.

2. At the `Boot:` prompt, enter:

   fd(60)unix.Z root=hd(42) swap=hd(41)

   This loads the kernel from the boot floppy disk and mounts the root filesystem on the hard disk.

   NOTE If you have changed the location of the swap device, you should substitute it for **hd(41)**.

3. Bring up the system in single-user mode by entering the *root* password at the prompt.

4. Unmount the */stand* filesystem (where boot and the kernel are located):

   umount /stand

   The reason for this is that */stand* is normally mounted read-only and you must unmount it and mount it again before you can replace the kernel.

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5. Re-mount */stand*:

   mount /stand

6. Mount the boot floppy disk:

   mount -r /dev/fd0 /mnt

7. While the floppy disk is in the drive, restore *unix*:

   cp /mnt/unix.Z /stand

   This copies the compressed *unix* kernel file from the boot floppy disk to the hard disk. You do not need to uncompress the kernel.

8. Before you remove the floppy disk from the drive, unmount the floppy disk (*/dev/fd0*):

   umount /mnt

9. Remove the floppy disk from the drive and bring down the system with the **haltsys**(ADM) command.

10. Reboot the system by pressing ⟨Enter⟩ at the `Boot:` prompt.

11. The kernel you loaded from the boot disk does not include any changes you've made since creating your emergency boot floppy disk set. You should immediately relink your kernel as described in "Relinking the kernel" (page 290). Whenever you make changes to your system configuration that add drivers and relink your kernel, you should create a new emergency boot floppy disk set.

Cannot load floating point emulator

If your computer does not have a 387 math coprocessor chip and the */etc/emulator* file is missing or corrupted, the boot fails with these messages:

```
WARNING:  Cannot load floating point emulator (error 2): /etc/emulator
          No floating point is available
```

(If the 387 chip is present, the kernel recognizes it in the hardware recognition boot message.)

If the boot fails with this message, boot the system and restore */etc/emulator*:

1. Insert the boot floppy disk in the drive and reboot the machine.

2. At the `Boot:` prompt, press ⟨Enter⟩ and when instructed, insert the root floppy disk. This boots the system and mounts the root filesystem from the floppies.

3. Clean the root filesystem:

   fsck -ofull /dev/hd0root

4. Working from the floppy disk, use this command to mount the hard disk root filesystem to */mnt*:

    /etc/mount /dev/hd0root /mnt

    If **mount** fails, refer to "Checking and repairing filesystems" in the *System Administration Guide* for information on checking the hard disk with **fsck**(ADM).

5. Copy */etc/emulator* from the *root* filesystem on the floppy disk to the mounted hard disk:

    cp /etc/emulator /mnt/etc/emulator

6. Unmount the hard disk:

    /etc/umount /mnt

7. Make sure that the floppy disk is still in the drive, then reboot the system with the **haltsys**(ADM) command.

8. When you see the `Press any key` prompt, remove the floppy disk from the drive. Press ⟨Enter⟩ at the `Boot:` prompt to boot from the hard disk.

Cannot exec /bin/login: No such file or directory

If the system boots correctly but hangs at the login prompt after you enter multiuser mode, try other multiscreens or serial terminals. If you cannot get a response from any tty, the */bin/login* file may be missing. The */bin/login* file is the **login**(M) program. This command is run at the beginning of each terminal session to allow users access to the system. To restore */bin/login*:

1. Power-cycle the machine and press ⟨Enter⟩ at the `Boot:` prompt.
2. When prompted, enter the *root* password to go into single-user mode.
3. Use the **Backup Manager** as described in "Restoring files from a scheduled filesystem backup" in the *System Administration Guide* to restore the */bin/login* file from your root filesystem backup. You can also restore the file from the command line by inserting the first volume of your last full backup of the root filesystem into the tape drive and entering:

    cd /
    cpio -idv -I /dev/rct0 bin/login

    The default tape device is linked to */dev/rct0*. If you are using a different device (such as */dev/rctmini*), substitute it for */dev/rct0*.

Cannot open /etc/inittab

If the system fails to enter multiuser mode when you press ⟨Ctrl⟩**D**, or this message is displayed at boot time, the */etc/inittab* file is missing:

```
INIT: Cannot open /etc/inittab errno: 2

INIT: SINGLE USER MODE
```

The */etc/inittab* file contains instructions for **init**. When *inittab* is missing, **init** cannot execute the system startup instructions and the system cannot enter multiuser mode. When you press ⟨Ctrl⟩**D**, the system remains in single-user mode and displays the error message above.

To restore *inittab*, you must recreate the kernel environment:

1. Enter the *root* password to go into system maintenance mode.
2. Enter these commands:

   cd /etc/conf/cf.d
   touch /etc/.new_unix
   ../bin/idmkenv

3. When you see these messages:

   ```
   The kernel environment includes device node files and /etc/inittab.
   The new kernel may require changes to /etc/inittab or device nodes.

   Do you want the kernel environment rebuilt? (y/n)
   ```

   Enter " y " and press ⟨Enter⟩. This message is displayed:

   ```
   The kernel has been successfully linked and installed.
           To activate it, reboot your system.

   Setting up kernel environment
   ```

4. Enter the command:

   cat /etc/inittab

   If you see a message that the system cannot open the file, enter this command:

   ln -s /var/opt/K/SCO/Unix/*/etc/inittab /etc/inittab

   This restores the symbolic link to the *inittab* file in the UNIX system software storage object.

5. Enter the command:

   exit

6. You see the message:

   ```
   ENTER RUN LEVEL (0-6,s or S):
   ```

   Enter **2** and the system will continue into multiuser mode.

The new */etc/inittab* file is in place. You do not need to reboot your system.

/etc/initscript: /bin/sulogin: not found

If the system displays this error message and goes directly into multiuser mode (run level 2) at boot time, the */bin/sulogin* file is missing from the hard disk. The **sulogin**(ADM) utility must be present on the system to access single-user mode. If this file is missing, log in as *root* and use the **Backup Manager** in the *System Administration Guide* to restore the */bin/sulogin* file from your root filesystem backup. You can also restore the file from the command line by inserting the first volume of your last full backup of the root filesystem into the tape drive and entering:

cd /
cpio -idv -I /dev/rct0 bin/sulogin

The default tape device is linked to */dev/rct0*. If you are using a different device (such as */dev/rctmini*), substitute it for */dev/rct0*.

/etc/initscript: /etc/bcheckrc: not found

If the system displays the `/etc/initscript: /etc/bcheckrc: not found` error message when you boot up, the */etc/bcheckrc* file is missing. The **init** utility executes **bcheckrc** according to instructions in the */etc/inittab* file whenever the system is booted. This utility checks the *root* filesystem and repairs it, if necessary. The */etc/bcheckrc* file should be on the hard disk when you boot the system.

If */etc/bcheckrc* is missing, use this procedure to recover it:

1. Bring up the system in single-user mode by entering the *root* password at the prompt.
2. Clean the *root* filesystem manually with **fsck** before doing anything on the system:

   /etc/fsck /dev/root

3. When filesystem has been checked and, (if necessary) repaired, use the **Backup Manager** in the *System Administration Guide* to restore the */etc/bcheckrc* file from your root filesystem backup. You can also restore the file from the command line by inserting the first volume of your last full backup of the root filesystem into the tape drive and entering:

   cd /
   cpio -idv -I /dev/rct0 etc/bcheckrc

   The default tape device is linked to */dev/rct0*. If you are using a different device (such as */dev/rctmini*), substitute it for */dev/rct0*.

4. Enter **haltsys** at the prompt and reboot the system.

For more information on **bcheckrc**, see the **bcheckrc**(ADM) manual page.

no utmp entry. You must log in from lowest level -sh

One or more of the system login record files */etc/utmp*, */etc/wtmp*, and */etc/utmpx* have been corrupted. They can be emptied without affecting the system. Perform these steps:

1. Log in as *root* and enter single user mode.
2. Delete the contents of these files by executing the these commands:

   ```
   > /etc/utmp
   > /etc/wtmp
   > /etc/utmpx
   ```
3. Shut down the system and reboot the system.

Fork failed... Resource temporarily unavailable

If you see this message displayed on the console:

```
Fork failed: Command[scoterm]System Error was: Resource temporarily unavailable
```

This message is usually caused by running out of virtual memory and can be easily remedied by adding more swap space. This must be done while in multiuser mode. When executed as *root*, these commands add approximately 30MB of virtual memory:

```
touch /swap
swap -a /swap 0 60000
```

The */swap* file will only grow according to the actual swap requirements and may not actually consume 30MB of disk space. To avoid reissuing this command every time the system is rebooted, simply add the above commands to the */etc/rc.d/8/userdef* file.

Virtual memory is tracked via the kernel variable **availsmem**, which tracks the available virtual memory in 4K pages. This variable is handled conservatively, and normally reserves more swap space than will actually be needed. Programs that use shared libraries will decrement **availsmem**. Programs that use the **mmap**(S) facility and map privately also require a large reserve of virtual memory.

To monitor **availsmem**, use the **crash**(ADM) utility:

```
# crash
dumpfile = /dev/mem, namelist = /unix, outfile = stdout
> od -d availsmem
f0175120:  0000011682
> q
```

In this example, the value "0000011682" translates to 11,682 4K pages, or approximately 45.63 MB.

System hangs at boot time

If the boot process hangs after the `Kernel: i/o bufs` message, the */etc/init* file is missing from the system. The */etc/init* file contains the **init**(M) program. Once started, the **init** process spawns all other processes on the system, so if it is missing, no new processes are started.

To restore */etc/init*:

1. Insert the boot floppy disk from the emergency boot floppy disk set in the floppy drive and reboot the machine.
2. Press ⟨Enter⟩ at the `Boot:` prompt and, when instructed, insert the root floppy disk.
3. Mount the hard disk root filesystem:

   /etc/mount /dev/hd0root /mnt

   If **mount** fails, check the hard disk with the **fsck**(ADM) command as discussed in "Checking and repairing filesystems" in the *System Administration Guide*.
4. Copy the */etc/init* file from the root filesystem on the floppy disk to the mounted hard disk:

   cp /etc/init /mnt/etc/init
5. Unmount the hard disk:

   /etc/umount /mnt
6. With the floppy disk in the drive, reboot the system with the **haltsys**(ADM) command.
7. Remove the floppy disk from the drive when you see the `Press any key to reboot` prompt. Press ⟨Enter⟩ at the `Boot:` prompt to boot from the hard disk.

Console keyboard locks up

When the system does not respond to input from the console keyboard, the situation is known as "keyboard lockup." Console keyboard lockup only affects keyboards that are attached to the computer's console, not standard terminals that are attached to serial lines.

You may be experiencing keyboard lockup if all these statements are true:

- The system console keyboard cannot be used to enter data or perform any tasks.
- You cannot switch multiscreens, and the ⟨CapsLock⟩ key does not turn the CapsLock light on or off.

- Other terminals on the system continue to work.
- Printers or other devices continue to work, and the system is still running.

Before trying to fix a locked keyboard, make sure that:

- you did not accidentally press ⟨Ctrl⟩**S** (which stops the screen from scrolling). To check this, press ⟨Ctrl⟩**Q** and then see if you can enter characters from the keyboard.
- if your computer has a Keyboard Lock key, it is not in the locked position.
- the keyboard is plugged into the correct socket.
- the system itself is still running.

Check a terminal to see if it is still working and that you can perform system tasks, such as logging in and checking the date. If you do not have a terminal, watch the hard disk access light (if your computer has one).

NOTE If you are in single-user mode, you cannot use other terminals and the hard disk access light may not flash.

If it flashes periodically (at least once every 30 seconds), the system is still running and is using the hard disk.

WARNING Unplugging the keyboard and reconnecting it while the system is powered up can damage some computers.

If the console keyboard is still locked after checking these suggestions, try unplugging the console keyboard and plugging it in again.

If this fixes the problem, your situation is definitely keyboard lockup. If this last step does not fix the problem, you may still have keyboard lockup.

Preventing console keyboard lockup

You can prevent keyboard lockup by applying a special "patch" that changes the operating system kernel.

NOTE This patch disables the keyboard lights, so you should use it only if you have tried the other approaches.

To prevent console keyboard lockup:

1. Get the system console working, if it is not. If necessary, reboot the system and bring it up in single-user mode by entering the *root* password at the `Boot:` prompt.

   If you did not reboot, log in as *root* on the system console and shut the system down to single-user mode with the **shutdown**(ADM) command:

   /etc/shutdown su

2. Once the system is in single-user mode, enter these commands:

   umount /stand
   mount /stand

   This unmounts the */stand* filesystem (which is normally mounted read-only) and remounts it so that you can make modifications.

3. Back up the kernel with these commands:

   cd /stand
   cp unix unix.00

4. Patch the kernel with these commands:

   /etc/_fst -w /unix
   ledspresent/w 0
   $q

5. Shut down the system using **/etc/shutdown**.

6. When you see the `Normal System Shutdown` message, press any key to reboot the system. You have now fixed the keyboard lockup problem. Confirm that the keyboard is functioning normally. If you have no problems, you should now apply this fix permanently:

   cd /etc/conf/pack.d/cn
   copy -om Driver.o Driver.o.save
   /etc/_fst -w Driver.o
   ledspresent/w 0
   $q

Wrong console keyboard type

If your console keyboard is an XT or other non-AT keyboard and the operating system is configured for use with an AT keyboard, the system does not recognize input from the keyboard. For information on testing and switching keyboard modes, see "Setting the console keyboard type" in the *System Administration Guide*.

Cannot log into console

If you try to log into the console in multiuser mode, and the system displays this error message:

```
Cannot obtain database information on this terminal
```

Refer to "Cannot obtain database information on this terminal" in the *System Administration Guide* for more information.

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Chapter 11

Customizing startup of the Graphical Environment

This chapter discusses how to customize the startup characteristics of the SCO OpenServer Graphical Environment. Specifically, this chapter covers how to:

- use the display manager (**scologin**) (page 200)
- use the **startx** script (page 202)
- use the session manager (**scosession**) (page 205)
- use environment variables (page 208)
- customize **scologin** to manage multiple servers (page 210)
- use the Graphical Environment on X terminals (page 217)

Starting a Graphical Environment session

By default, the Graphical Environment runs the **scologin** display manager on the second of your console multiscreens (*/dev/tty02*). This display manager starts the X server and keeps it running on your system, even when a user is not engaged in a Graphical Environment session.

However, you can choose to turn the **scologin** client off and start the X server manually, or you can run an additional server session on another multiscreen manually. To run the X server manually, run the **startx** script.

Regardless of the method you use to actually run the X server, a default Graphical Environment session is controlled by the session management client, **scosession**. **scosession** defines the clients that are run when you start the server and controls their appearance and behavior.

See also:

- "Running scologin" (this page)
- "Running the startx script" (page 202)
- "Using the session manager" (page 205).

The above sections assume that you are using clients in their default configuration.

Running scologin

The **scologin** display manager provides graphical login windows to local and remote X servers, as well as services that are similar to those provided by **login** or **getty**. In particular, **scologin**:

- keeps the X server running
- prompts for user login and password
- authenticates users
- requests new passwords when appropriate
- establishes secure Graphical Environment sessions

NOTE See "Customizing scologin" (page 210) for information on modifying **scologin** to manage multiple displays, including X terminals.

The **scologin** client is started as a daemon from the *P86scologin* script in */etc/rc2.d*. By default, **scologin** controls the display on the second multiscreen, */dev/tty02*.

The **scologin** window appears on the screens of all active X servers for which **scologin** is configured to manage. The **scologin** window contains two fields into which you enter your login name and password. The box also contains three buttons: **Login**, **Restart**, and **Help**. To start your session, enter your login and password, then press ⟨Enter⟩ or click on **Login**. To restart the X server and redisplay the **scologin** window, click on **Restart**.

If the login is successful, the following environment variables are set: **$DISPLAY**, **$HOME**, and **$PATH**. If you run the Desktop client, the **$LANG** environment variable is also set. These variables are discussed in "Using environment variables" (page 208).

Once a user is successfully authenticated, several scripts are executed. These scripts are located in */usr/lib/X11/scologin* and are listed in Table 11-1, "scologin session scripts".

Table 11-1 scologin session scripts

Configuration file	Description
Xstartup	a startup script that defines actions **scologin** takes before beginning the user's session
Xsession, Xsession-csh, Xsession-ksh, Xsession-sh	defines the nature of the user's X server session by running the **/usr/bin/startx** script, which starts **scosession**
Xreset	defines the actions that **scologin** takes when the user ends a session

See also:

- "Configuring scologin's startup behavior" (this page)
- "Defining X server sessions" (this page)
- "Logging out of scologin" (page 202)

Configuring scologin's startup behavior

After **scologin** authenticates a user, it executes the startup script, */usr/lib/X11/scologin/Xstartup*.

NOTE This script is run as *root* and as such, should be written with security issues in mind.

This script does not execute any commands by default — it is empty except for a few comment statements. You can place shell commands in the file to perform custom startup tasks, such as mounting users' home directories from file servers, displaying the message of the day, setting custom shell environment variables, and so forth.

Once this script has been executed, **scologin** begins the user's session.

Defining X server sessions

After executing the startup script, **scologin** searches for a script that defines the X server session. First, it looks for a file called *.xsession* in the user's home directory.

If no user-specific file is found, **scologin** looks for */usr/lib/X11/scologin/Xsession-**SHELL***, where ***SHELL*** is the user's current shell. For example, a session that is running **csh** would use the *Xsession-csh* file.

The *Xsession* files are started as login shells, which set any environment variables that are specified in the user's *.profile* or *.login* file. Then the *Xsession* files run the **startx -t** script. Basically, **scologin** passes the responsibility for session management to the **startx** script, which then passes control to the **scosession** client. For more information on these next stages of session startup, see "Running the startx script" (this page).

Logging out of scologin

When you end your Graphical Environment session and log out of the system, **scologin** runs a "reset" script, called */usr/lib/X11/scologin/Xreset*. This script executes as *root* and removes the session manager property from the Root window.

You can also use this script to undo the effects of commands that were executed in the *Xstartup* script. For example, the *Xreset* script could unmount directories from a file server that were mounted when the session was started.

When a Graphical Environment session is terminated, **scologin** resets the X server and redisplays the **scologin** window.

Running the startx script

If you want to start a Graphical Environment session from the command line, you must run the **startx** script:

startx &

If you started a session by logging in through the **scologin** window, **scologin**'s *Xsession-**SHELL*** file also runs the **startx** script, with the **-t** option. See "Defining X server sessions" (page 201) for more information on the *Xsession-**SHELL*** file.

If the **startx** script is run without any options, it:

- modifies the **$PATH** environment variable to include */usr/bin/X11*, if necessary
- checks to see if the **$DISPLAY** environment variable is set or not. If not, it sets the variable to:

  hostname:display_number

  where ***hostname*** is the name of the current host and ***:display_number*** is the next available display. If no other servers are running, the ***:display_number*** is set to zero.

- runs **xinit**, which starts the X server
- reads the **$HOME**/*.startxrc* file, if it exists, and executes any clients specified in the file. If a *.startxrc* file is not located in the user's home directory, the */usr/lib/X11/sys.startxrc* file is read.

If the **startx** script is executed with the **-t** option, as it is from the **scologin** *Xsession-SHELL* file, the script does all of the tasks above, including modifying the **$PATH** environment variable. However, the **-t** option does *not* set the **$DISPLAY** environment variable or run **xinit** to start the X server. In the case of the **scologin** display manager, it is unnecessary to start the server because it is already running. The **-t** option is also useful if you want to run a Graphical Environment session on an X terminal, which uses its own internal server. For more information on using the Graphical Environment with X terminals, see "Using X terminals" (page 217).

NOTE If you run the **startx** script with the **-t** option, you must set the **$DISPLAY** environment variable before you run **startx**. Otherwise, you see the error message:

```
DISPLAY environment variable not set
```

For information on the **$DISPLAY** environment variable, see "Using environment variables" (page 208).

The */usr/lib/X11/sys.startxrc* file specifies the clients and commands that are run by default in X server sessions for all users on the system. Because the default configuration uses the session manager to control Graphical Environment sessions, **scosession** is the only client that is run by the *sys.startxrc* file. This file contains the following line:

```
exec scosession 2> /dev/null
```

If you want your system to use **scosession** to manage Graphical Environment sessions, you should not modify this file.

The **startx** script also looks for a local *.startxrc* file, located in a user's home directory. If a user wants to use the session manager, there is no need to put a *.startxrc* file in **$HOME**. The *sys.startxrc* file is used to run **scosession**.

If, however, a user does not want to run **scosession**, a *.startxrc* file is needed in **$HOME** to start the desired clients, particularly the window manager. The *.startxrc* file is not placed in a user's home directory by default. To create this file, copy */usr/lib/X11/sys.startxrc* to *.startxrc* in your home directory.

NOTE You are strongly urged to use **scosession** to control the clients you want to run automatically in a Graphical Environment session, instead of adding clients to either **$HOME**/*.startxrc* or */usr/lib/X11/sys.startxrc*. If you do not use the session manager, you may accidentally overlook starting an important element of the Graphical Environment, resulting in the loss of some functionality.

See also:

- **startx**(X) manual page
- "Using the session manager" (page 205)

Using grey-scale monochrome monitors with the X server

Running **startx** with some grey-scale monitors (sometimes incorrectly called monochrome) causes the system to crash. If this happens, ensure that the console ports are properly configured. To configure your ports automatically at boot-up:

1. As *root*, use an ASCII editor (such as **vi**) to open */etc/rc.d/8/userdef*.
2. Add the following lines:

```
vidi v80x25 < /dev/tty01
vidi v80x25 < /dev/tty02
vidi v80x25 < /dev/tty03
vidi v80x25 < /dev/tty04
vidi v80x25 < /dev/tty05
vidi v80x25 < /dev/tty06
vidi v80x25 < /dev/tty07
vidi v80x25 < /dev/tty08
vidi v80x25 < /dev/tty09
vidi v80x25 < /dev/tty10
vidi v80x25 < /dev/tty11
vidi v80x25 < /dev/tty12
echo "Screen devices set to color mode ..."
```

3. Save the file.
4. Use **shutdown**(ADM) or **init**(M) to reboot your machine.
5. Restart the X server.

Solving problems exiting the X server

If you use **startx** to start the X server, you may notice problems when exiting your Desktop or X server. Sometimes, the screen remains in graphics mode or the keyboard does not function correctly after exiting.

To prevent this problem, start the X server using this command line:

startx; /etc/clean_screen

If you log in using **scologin**, you should not encounter any problems.

Using the session manager

The session manager client, **scosession**, is responsible for the startup and shutdown of your X server session. Regardless of whether you start your X server through **scologin** or by running **startx** on the command line, the **scosession** client is invoked by the */usr/lib/X11/sys.startxrc* file by default.

scosession uses several files to determine its behavior. These files are located in */usr/lib/X11/sco/ScoSession*, and are listed in Table 11-2, "scosession configuration files".

Table 11-2 scosession configuration files

Configuration file	Description
startup	defines **scosession**'s tasks when a Graphical Environment session is started
static	defines the clients that are run for the default session
shutdown	defines **scosession**'s tasks when a Graphical Environment session is ended
xrdbcomp	compares the system resources loaded by **xrdb** with any resources added to the resource database for the current session and saves the settings so they can be used in future sessions. For information on **xrdb**, see Chapter 5, "Understanding resources" in the *Graphical Environment Guide*.

scosession also stores information on individual users' sessions in files in the **$HOME**/*.odtpref* directory. These files are listed in Table 11-3, "User scosession files".

Table 11-3 User scosession files

Configuration file	Description
$HOME/.odtpref/ScoSession	this directory contains files related to the management of a user's session
$HOME/.odtpref/ScoSession/dynamic	contains the clients that are saved from a previous session. These clients are started if the user resumes the previous session.
$HOME/.odtpref/ScoSession/static	contains the clients that constitute a user's default session. This file only exists if the user selected to save a session configuration from the **Session** control. in the *Graphical Environment Guide* Otherwise, the default session is derived from the *static* file, located in */usr/lib/X11/sco/ScoSession.*
$HOME/.odtpref/ScoSession/xrdb.save	contains the resource settings from the resource database that existed at the end of a user's session. Resources are stored in this file by the **xrdbcomp** utility. These resources are loaded into the resource database the next time the session is resumed.

The **$HOME**/*.odtpref* directory may contain other directories and files, depending on the clients you use and configure.

See also:

- "Starting scosession" (page 207)
- "Stopping scosession" (page 207)
- "Using scosession options" (page 208)
- **scosession**(XC) manual page
- **xrdb**(XC) manual page

Starting scosession

When **scosession** is started, the */usr/lib/X11/sco/ScoSession/startup* script is read. This file sets up your Graphical Environment session. In particular, it:

- loads resources located in files in */usr/lib/X11/sco/startup* into the resource database, using the **xrdb** command. The script also loads resources stored in the file **$HOME**/*.odtpref/ScoSession/xrdb.save*. (For information on resources and the resource database, see Chapter 5, "Understanding resources" in the *Graphical Environment Guide*.) These resources reside in the server and determine the basic appearance and behavior of many of the clients you run.
- restores any state information from your previous session, including mouse acceleration, threshold, mouse double-click interval, and left- or right-handed button mapping preferences. This information is determined by files located in **$HOME**/*.odtpref*.
- reads the file **$HOME**/*.odtpref/ScoSession/dynamic* if you resume a previous session or **$HOME**/*.odtpref/ScoSession/static* if you select the default session, and starts all of the specified clients. If neither of these files are located, **scosession** runs the clients indicated in */usr/lib/X11/sco/ScoSession/static*.

  These files indicate not only the clients to run, but any special command line options used to start the applications, their geometry (size and location on the screen), the host machine from which the client can be accessed, and whether or not the client should be run in an iconified or normal state.
- starts the window manager client that is specified by the **ScoSession*windowManager** resource. By default, the SCO Panner window manager, an enhanced version of the OSF/Motif window manager, is run. See Chapter 5, "Understanding resources" in the *Graphical Environment Guide*, for more information on resource specifications.

Stopping scosession

When you end your Graphical Environment session and either stop the X server or log out of **scologin**, **scosession** runs the */usr/lib/X11/sco/ScoSession/shutdown* file, which in turn calls */usr/lib/X11/sco/ScoSession/xrdbcomp*. These perform the following:

- Remove the resource database from the RESOURCE_MANAGER property of the Root window. Any resources that you merged into the resource database during the session are stored in the file *xrdb.save*, located in **$HOME**/*.odtpref/ScoSession*. These resources are also loaded into the resource database the next time you run a Graphical Environment session. (For more information on resources and the resource database, see Chapter 5, "Understanding resources" in the *Graphical Environment Guide*.)

- Note the state of clients left running when you ended your session and save this information in **$HOME**/*.odtpref/ScoSession/dynamic*. These clients are run in the same state for your next session, if you choose to resume the previous session.
- Save all state information in the appropriate files in **$HOME**/*.odtpref*.
- Shut down all running clients, including the window manager, in a controlled manner.

Using scosession options

You can use the following options with **scosession**:

-stop shuts down the clients comprising the session and saves the state of the session. If you run **scosession -stop** from a **scoterm** window, you are logged out.

-configure configures how **scosession** starts and stops your session. This option brings up a dialog box that allows you to specify if you want subsequent sessions to start in the same state you left your previous session, or if you want to start in the default state. This dialog box also allows users to save the current session's state as a customized default state and to choose the option of an interactive logout prompt.

-help provides a list of the available **scosession** options

See also:

- **scosession**(XC) manual page

Using environment variables

When you start a Graphical Environment session, the **$DISPLAY**, **$HOME**, and **$PATH**. environment variables are set. When you run the Desktop client, the **$LANG** environment variable is also set.

> **NOTE** If the **$LANG** variable is not set to the appropriate locale, you must do so using the **International Settings Manager** (page 221). For more information, see Chapter 12, "Specifying the locale" (page 221).

The **$PATH** and **$HOME** environment variables are actually set when you first log in, whether through a multiscreen running **getty** or through **scologin**. However, the X server modifies the **$PATH** variable to include the */usr/bin/X11* directory.

The **$DISPLAY** and **$LANG** environment variables are described below:

- The **$DISPLAY** environment variable is used to tell a client to which server it should send its output.

  The X display consists of one or more screens, a keyboard, and a mouse. A system may have several displays, and each display may, in turn, have more than one screen. Each display has exactly one server process controlling all its input and output. Therefore, the terms "display" and "server" are used synonymously.

  When a client is run, it must open a connection to a display. You must be able to tell the client the name of the display that you want it to use for output. You can also indicate a specific screen for the display. Because the display can be anywhere on the network, you have to provide the network name of the system to which the display is connected to fully identify the display.

  Use the following format when setting the **$DISPLAY** variable:

  [***hostname***]:***display_number***[.***screen_number***]

  where:

  hostname specifies the name of the machine to which the display is connected, and must be either a machine name or the machine's network address. If the ***hostname*** is not specified, the client assumes it should communicate with the display on the same machine.

  :display_number specifies the number of the display, or X server, that you want the client to use. Each display on a system is assigned a ***:display_number***. If the display is managed by **scologin**, the ***:display_number*** is specified explicitly in the */usr/lib/X11/scologin/Xservers* file. If the X server is started by **startx**, the server is assigned the first available ***:display_number***, starting with ":0".

  Usually, if only one X server is running, its ***:display_number*** is ":0". If more than one server is running on your system, you must determine which display number corresponds to the X server you want to specify.

  screen_number specifies the screen on which the server is running.

  The default display name is stored in the **$DISPLAY** environment variable when the X server is started by either **scologin** or the **startx** script. However, if you want a client to use a different display, you must reset the **$DISPLAY** variable so it specifies the other server.

For example, to run your clients on a remote server on a machine named *scooter*, you would enter:

DISPLAY=scooter:0.0; export DISPLAY *(for sh, ksh)*

or

setenv DISPLAY scooter:0.0 *(for csh)*

NOTE Most clients understand the **-display** command line option. This option temporarily overrides the contents of the **$DISPLAY** variable. For more information on using this command line option, see Chapter 5, "Understanding resources" in the *Graphical Environment Guide.*

- The **$LANG** environment variable specifies the language that is used on your system. By default, the **$LANG** variable is set to "english_us.ascii".

Customizing scologin

The default configuration of **scologin** runs the X server, and the **scologin** client, on the second multiscreen (*/dev/tty02*) of the console. You can change this configuration so that **scologin** does not run at all, or you can specify that **scologin** manage multiple displays, on your system or on remote systems, including X terminals.

There are several files that are used to configure **scologin**'s behavior. These files are all located in */usr/lib/X11/scologin* and are listed in Table 11-4, "scologin configuration files".

Table 11-4 scologin configuration files

Configuration file	Description
Xconfig	a special configuration file that specifies resources that determine the scripts used by **scologin**. The resources in this file configure the following files.
Xerrors	**scologin** error messages that would otherwise go to standard error (`stderr`) are directed to this file
Xhelp	contains the help text that you see if you click on the **Help** button on the **scologin** window
Xresources	contains resources that configure **scologin**'s appearance. These resources are loaded into the resource database by **xrdb**.
Xservers	contains entries for all of the non-XDMCP X servers that **scologin** is to manage

See also:

- "Using the scologin administration script" (this page)
- "Configuring scologin on multiple displays" (this page)
- "Using X terminals" (page 217)

Using the scologin administration script

The Graphical Environment provides a script, */etc/scologin*, that allows system administrators to control the **scologin** process. The script must be run as *root*.

There are six options that you can use with this script:

start starts the **scologin** process, which in turn reads the files *Xconfig*, *Xservers*, and *Xresources*, all located in */usr/lib/X11/scologin*

stop stops the **scologin** process. Run **scologin stop** to halt all current sessions managed by **scologin**. For example, use the **stop** option if you want to reclaim **scologin**-managed *ttys* and restore **getty** processes.

> **NOTE** This option shuts down *all* **scologin** processes on your system, which results in the closure of any sessions running at the time you run the script. You should notify users before you run this script.

query shows the current state of the **scologin** process

disable stops the current **scologin** process and prevents **scologin** from starting when the system re-boots; re-enables **getty** processes on **scologin**-managed *ttys*

enable ensures that **scologin** starts when the system re-boots and starts the **scologin** process if it is not already running

init if **scologin** is enabled, disables **getty** processes on screens that are configured for **scologin**. **scologin init** should only be run by **init** at boot time.

Configuring scologin on multiple displays

The **scologin** display manager can do more than run the simple session that its default configuration provides. In fact, **scologin** can control multiple servers, both on the local machine and on remote machines, or X terminals.

There are two ways to specify the X servers that you want managed by **scologin**:

- If the server supports the X Consortium standard X Display Manager Control Protocol, also known as XDMCP, you can usually specify the name or network address of a remote machine running **scologin** at the server.

  XDMCP is a dynamic mechanism whereby connections are made when requested by a display, such as a workstation or an X terminal, that can communicate through the protocol. The SCO X server (**Xsco**) supports XDMCP.

- If you want to configure **scologin** to run on a set of console ttys (for example, on *tty01* through *tty12*), or if you want **scologin** to manage an X server that does not support XDMCP, you can add an entry for each of the displays in the */usr/lib/X11/scologin/Xservers* file. Each line in this file specifies a display that should constantly be managed by **scologin**.

See also:

- "About XDMCP X server options" (this page) for a list of the X server options for using XDMCP
- "Running scologin with XDMCP" (page 213) for information on running **scologin** on remote systems using XDMCP
- "Running scologin with the Xservers file" (page 214) for information on manually configuring **scologin** sessions
- "Using X terminals" (page 217) for information on managing an X terminal's display with **scologin**

About XDMCP X server options

Any X server that supports the XDMCP protocol can request a **scologin** session. To do this, the server must be started with the appropriate options to request the session.

The SCO X server (**Xsco**) uses the following options to determine how it uses XDMCP:

-broadcast enables XDMCP and broadcasts BroadcastQuery packets to the network. The first responding display manager is chosen for the session.

-class *display_class* sets the value of the additional XDMCP display qualifier, which is used in resource lookup for display-specific options. By default, the value is "MIT-Unspecified".

-cookie *xdm-auth-bits*	sets the value of a private key shared between the X server and the manager, which is used when testing XDM-AUTHENTICATION-1
-displayID *display-id*	allows the display manager to identify each display so that it can locate the shared key
-indirect *host_name*	enables XDMCP and sends IndirectQuery packets to the specified host
-once	exits the X server after the first session is over. Normally, the X server keeps starting sessions, one after the other.
-port *port_num*	specifies an alternate port number for XDMCP packets. It must be specified before any **-query**, **-broadcast** or **-indirect** options.
-query *host-name*	enables XDMCP and sends Query packets to the specified host

See also:

- **Xsco**(X) manual page for a complete list of X server options

Running scologin with XDMCP

To configure the SCO X server to request a **scologin** session using the XDMCP protocol, do one of the following. You must be logged onto the system as *root*.

- Specify the desired **Xsco** options from the command line — see "About XDMCP X server options" (page 212) from the command line. For example:

  /usr/bin/X11/Xsco -broadcast -once

  This broadcasts to all machines on the network for a **scologin** session. The session is provided by the first machine on the network to answer.

  You can also request a session from a specific machine with this command:

  /usr/bin/X11/Xsco -query ***hostname*** **-once**

  This requests a session from the host ***hostname***.

- Alternately, you can create a shell script that runs the **Xsco** server, as in one of the examples above.

Admin

Running scologin with the Xservers file

You can use the */usr/lib/X11/scologin/Xservers* file to configure **scologin** management of displays on your local system or on X servers that do not support XDMCP. You can also use this approach if you do not want to reconfigure the SCO X server, as described in "Running scologin with XDMCP" (page 213).

To configure **scologin** to manage multiple displays using the *Xservers* file, use the following procedure. You must be logged onto the system as *root*. For information on each of the steps in this list, see the sections immediately following the procedure.

1. Use the **scologin** administration script to stop **scologin**, if it is currently running on your system.

   /etc/scologin stop

2. On the host machine where you want to run **scologin**, add the servers you want to manage to the */usr/lib/X11/scologin/Xservers* file. Use the following format when making entries in this file:

   display_name [***display_class***] ***display_type*** [***startup_command***]

   When you are finished, save and exit the file.

3. To manage a remote display, you must provide access to the server. On the system where the display is to be managed, edit the */etc/X**n**.hosts* file, where ***n*** represents the display number you want to use on the remote machine, and add the name of the machine on which **scologin** will be running.

4. When managing a remote display, you must start the X server on that display before **scologin** can gain control. On the actual screen you want managed by **scologin**, run the X server:

   /usr/bin/X11/X ***:display_number***

   On a local system, this step is unnecessary because **scologin** automatically starts the X server.

5. Returning to the **scologin** host machine, use the **scologin** administration script to restart **scologin**, so it reads its configuration files, including *Xservers*:

   /etc/scologin start

The **scologin** display manager should now be running on all of the displays you configured.

Step 1: Stopping existing scologin processes

Before you set up **scologin** to manage multiple displays, you must first stop any **scologin** processes that are currently running. You can do this using the **scologin** administration script:

/etc/scologin stop

NOTE This script shuts down *all* **scologin** processes on your system, which results in the closure of any Graphical Environment sessions running at the time you run the script. You should notify users before you run this script.

Step 2: Editing the Xservers file

For every X server you want **scologin** to manage, you must add an entry to the */usr/lib/X11/scologin/Xservers* file. This file should include entries for additional displays on the local machine and entries for displays on remote machines.

Entries in the *Xservers* file use the following format:

display_name [***display_class***] ***display_type*** [***startup_command***]

The various segments of the format are described below:

display_name
: name of either a local X server or a remote X display using the following syntax:

  [***hostname***]:***display_number***[.***screen_number***]

  hostname specifies the name of the machine to which the display is connected. If you omit ***hostname***, the display on the current machine is assumed. ***:display_number*** specifies the number of the display you want to use. ***screen_number*** specifies the number of the screen on the display that you want to use.

display_class
: defines a display class with which ***display_name*** is associated. Although ***display_class*** is optional, it is useful if you have a large collection of similar displays and want to set **scologin** configuration resources for groups of them. To include several X displays in the same class, use the same ***display_class*** in each *Xservers* entry.

display_type
: indicates either a local or remote X server:

  - if ***display_type*** is "local," **scologin** manages a local display on which an X server should be run
  - if ***display_type*** is "foreign," **scologin** manages a remote display *on which the X server is already running*

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startup_command applies only to local displays, and by default is **/usr/bin/X11/X**. Use ***startup_command*** to specify command line options to the X server, such as the local *tty* you want **scologin** to manage.

For example, to manage a local display on */dev/tty03* that is not yet running and a display on another SCO system named *scooter*, include the following lines in the */usr/lib/X11/scologin/Xservers* file:

```
1  :0 local /usr/bin/X11/X :0 -crt /dev/tty03
2  scooter:1 foreign
```

In this example, `:0` on line 1 and `scooter:1` on line 2 are the ***display_name***. Also, `local` on line 1 and `foreign` on line 2 are ***display_type***. `/usr/bin/X11/X :0 -crt /dev/tty03` is the ***startup_command***. The **-crt** option associates the X server with a particular console multiscreen, in this case */dev/tty03*.

The `scooter:1 foreign` entry indicates that you want **scologin** to manage the second X server running on the remote machine, *scooter*.

Step 3: Enabling access to the remote display

If you only want to manage the local display, you can skip this step.

If you want **scologin** to manage a remote display that is running the X server, you must enable the server to provide access to your host machine. On the system where the display is to be managed, edit the */etc/Xn.hosts* file, where ***n*** represents the display number you want to use. Add the name of the host machine where **scologin** will be running.

For example, to gain access to the *scooter:1* display, include the name of the **scologin** host machine in the */etc/X1.hosts* file on *scooter*.

Step 4: Running the X server on the remote display

If you only want to manage the local display, you can skip this step.

To enable **scologin** to manage a remote display, you must first start the X server on the desired screen of the display where you want the **scologin** window to appear:

/usr/bin/X11/X ***:display_number***

For example, for **scologin** to manage a second X server on the fourth multiscreen on the machine *scooter*, you would log in on *scooter*'s */dev/tty04* and run:

/usr/bin/X11/X :1

Step 5: Starting scologin

Now you are ready to start **scologin** on all of the displays you configured in the *Xservers* file. On the host system, use the **scologin** script to start the client:

/etc/scologin start

This process reads the **scologin** configuration files, including */usr/lib/X11/scologin/Xservers*. A **scologin** process is started for all of the displays specified in the *Xservers* file.

Using X terminals

You can use X terminals to run Graphical Environment sessions. In fact, you can configure your X terminal so the **scologin** display manager automatically manages the X terminal's display. When you log in through the **scologin** window, you start a Graphical Environment session, running on the host machine and displaying on the X terminal.

Many X terminals can use the X Display Manager Control Protocol (XDMCP) to facilitate the connection to remote hosts through **scologin**. From a user's standpoint, the main advantage of XDMCP is that it allows you to turn an X terminal off and instantly re-establish the connection to the **scologin** host machine when you turn the X terminal back on. When you turn on an X terminal, **scologin** automatically displays a login window. The exchange of information between the X terminal and the remote host is invisible to the user. In fact, XDMCP and **scologin** are intended to make X terminals as easy to use as traditional character terminals. With XDMCP, an X terminal basically requests a connection to a remote host, is recognized by the host, and is sent a login prompt by **scologin**.

If you are using X terminals at your site, the way you set up **scologin** depends on whether or not the terminals can communicate through XDMCP. If a terminal cannot communicate using XDMCP, you must include an entry for it in the */usr/lib/X11/scologin/Xservers* file and the terminal must be left powered on at all times to maintain the connection to the host machine.

If an X terminal can communicate through the protocol, the machine that will host the **scologin** process requires no configuration. However, the X terminal must be configured to communicate with the host through the X terminal's setup procedures, which vary from one model to another. Some X terminals let you specify the address of a host machine from which you want to run the display manager. Some X terminals can broadcast a request for a host over the network and then display a list of all available hosts from which the user can choose. Other X terminals can broadcast a request and merely accept the first available host.

See also:

- "Managing an X terminal display with scologin" (this page)
- "Running a session on an X terminal without scologin" (page 220)

Managing an X terminal display with scologin

The following procedures explain how to run the **scologin** display manager so it manages the server on an X terminal.

Once configured, you can log in directly to the machine running **scologin** using the **scologin** window. The **scosession** manager is started, the Desktop appears, and you can begin your session. If an *.Xdefaults-**hostname*** file exists in your home directory on the host machine, clients you run use the resources defined in this file.

These procedures assume that the X terminal has already been correctly connected to the network and that the X terminal's name and IP address are known to the machine that will host the **scologin** process. For information on how to do this, refer to "Configuring TCP/IP" in the *Networking Guide* and to the documentation supplied with your X terminal.

See also:

- "X terminals that do not support XDMCP" (this page)
- "X terminals that support XDMCP" (page 219)

X terminals that do not support XDMCP

If the X terminal **does not** support XDMCP, use this procedure to set up a **scologin** session:

1. Log into the host machine as *root*. If **scologin** is currently running on the host machine, use the **scologin** administration script to stop it:

   /etc/scologin stop

2. On the host machine, edit the */usr/lib/X11/scologin/Xservers* file so that it contains an entry for the X terminal.

   For example, to configure a terminal named *vortex* so it runs **scologin** from a host machine named *scooter*, add the following line to the *Xservers* file on *scooter*:

   vortex:0 foreign

3. Start **scologin** on the host machine by running **/etc/scologin start**.
4. On the X terminal, restart the X server. When the server is running again, the **scologin** window appears on the X terminal screen.

See also:

- "Running scologin with the Xservers file" (page 214)
- "Using the scologin administration script" (page 211)

X terminals that support XDMCP

If the X terminal **does support** XDMCP, use the following procedure. Note that you do not need to configure the *Xservers* file in this situation.

1. Configure the X terminal to use XDMCP. While there are three ways you can do this, the most common method is mentioned first:
   - Set the display manager access parameter to "Direct" and specify the IP address of the machine on which **scologin** will be running. This method transmits a Query packet directly to the specified host machine.
   - Set the terminal's display manager access parameter to "Broadcast." This method broadcasts a query packet, to which one or more hosts may respond. Depending on how your X terminal functions, the display can request management from the host that responds first or it can provide a list of available hosts and allow you to pick one.
   - Set the display manager access parameter to "Indirect." This method transmits a query packet to an intermediate host, which relays it to another host.
2. Verify that **scologin** is running on the host machine with the **/etc/scologin query** command. Enter **/etc/scologin start** to start the display manager if it is not already running.
3. Restart the server session on the X terminal. The **scologin** window displays on the X terminal's screen.

See also:

- The documentation supplied with your X terminal for more information on setting display manager access

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Running a session on an X terminal without scologin

You can run a Graphical Environment session on your X terminal without going through the process of configuring **scologin** to manage your X terminal's server. To do so:

1. Start a telnet session on the X terminal. Connect to the host machine on which you want to run your Graphical Environment session.
2. Once you are logged into the host machine, set the **$DISPLAY** environment variable to the X terminal's display. For example, if your X terminal is named *vortex*, you would specify:

   DISPLAY=vortex:0; export DISPLAY

3. Run the **startx** script, using the **-t** option, to start the session:

   startx -t &

4. The **scosession** client is started, the Desktop appears, and you can begin your session.

If an *.Xdefaults-**hostname*** file exists in your home directory on the host machine, clients you run automatically use the resources defined in this file.

Chapter 12

Specifying the locale

The **International Settings Manager** (this page) controls the locale settings for your system and for each user. This affects the format in which information such as dates and currency values are displayed, the language in which some system messages are displayed, the system (graphical console) keyboard configuration, and the characters recognized by the system (the "codeset").

Each user can set the locale for their own environment. If you are the system administrator, you can configure the locale for everybody on the system — see "Setting the system locale" (page 223).

See also:

- "Setting locales" (page 222)
- "Selecting codesets" (page 227)
- "Setting device character mapping" (page 230)
- "Creating a character mapping table" (page 232)
- "Enabling Euro currency symbol support" (page 244)

- the **vidi**(C) manual page

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The International Settings Manager interface

Use the **International Settings Manager** to:

- set user locales (page 224).
- set the system locale (page 223).
- configure the system keyboard (page 226).
- specify codesets (page 227).
- set the character mapping for a given device (page 230).

Start the **International Settings Manager** in one of these ways:

- Double-click on the **International Settings Manager** icon in the *System* folder in the *System Administration* window on the Desktop.
- Start the SCOadmin launcher by entering **scoadmin** on the command line, then select the *System* folder, and then select the **International Settings Manager**.
- Enter **scoadmin international settings manager** on the command line (or abbreviate to **scoadmin i**).

For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

Setting locales

A locale is a name used to refer to a group of settings that influence the behavior of the library routines used by programs to control the presentation of dates, currency, time, printable characters, and other data that vary between countries. By specifying a different locale, you can change the way programs present country-specific information. See the **locale**(C) manual page for more information.

> **NOTE** After you change a locale (by using the **International Settings Manager** or by setting the LANG environment variable), you must stop and restart the **xmvtcld** daemon. **scoadmin** clients will not recognize the new locale setting until you restart the server.

Locales are software-specific. Character mapping for hardware devices (such as terminals and printers) is handled by a separate set of programs. See "Device mapping" (page 230).

See also:

- "Localization of system software" (page 223)
- "Setting the system locale" (page 223)
- "Setting user locales" (page 224)
- "About locales" (page 224)
- "Selecting codesets" (page 227)
- "Setting device character mapping" (page 230)

Localization of system software

SCO OpenServer is internationalized for 8-bit languages in the majority of the software components. It also provides French and German message catalogs and resource files for these components, as well French and German documentation for the runtime system.

The following components have not been translated: the kernel; the link-kit; **Installation Query Manager** (IQM); supplied drivers (such as Xdrivers and Network Drivers); layered products, such as the Development System and SCO Merge™, the supplied NCSA Mosaic™ (although **scohelp** is internationalized/localized); **mkdev** scripts; **boot**; **csh**, **sh** (we recommend that you use the POSIX shell (*/bin/posix/sh*) or **ksh** for localized messages).

Some utilities provided for backwards-compatibility (with XENIX® commands and SCO value added) are not localized.

No **mkdev** or kernel relink scripts are currently translated. When you turn your system on, all system startup information up to the point where you press ⟨Ctrl⟩**D** to proceed with normal startup, (or give the *root* password for system maintenance) will always appear in English.

Setting the system locale

The system default locale is originally configured during installation. To change the system default locale, log in as *root* and select a language from the "Language" list in the main window of the **International Settings Manager**. This setting determines the default locale for all programs and users on the system.

The languages available depend on the codeset in use. If you want a language that is not available using the current codeset, use the **International Settings Manager** to select a codeset that is compatible with your language. For example, you must be using the ISO8859-1 codeset in order to set the language to German or French. You can set the language to American English in the ISO8859-1 codeset or the US ASCII codeset.

In addition to establishing a system-wide locale, you can override the system defaults for each user and process.

NOTE **Vtcl**™ programs appear in English when run on a text screen even though the system is configured for a different language.

To work around this problem, explicitly set the **LANG** environment variable to the language desired. The **Vtcl** program will then display in the language desired.

This problem does not occur when the Desktop is run because the Desktop automatically sets the **LANG** environment variable.

In addition, the version of the C shell supplied cannot handle accented 8-bit characters. Entering accented characters within a C shell will cause the console window to close.

Setting user locales

In the **International Settings Manager**:

1. Select **Users** from the **Settings** menu.
2. Select a user from the "User" list.
3. Select a locale from the "Select new language" list, then click on **OK**.

Any subsequent logins by that user will take place using the new locale.

NOTE Unless you are logged in as *root*, you can change only your own locale. See "Setting the system locale".

About locales

The settings you can configure within a locale are:

collating sequence
: The order in which a local character set is sorted. This is used by the **sort**(C) command and by programs that use regular expressions. See "Regular expressions and locales" (page 225).

currency format
: The character used to denote a unit of currency and the format used for printing monetary values.

character classification table
: The table used to determine whether a given character is an upper- or lowercase letter, a number, space, or some other class of symbol.

time/date format
: The format in which the time and date are presented.

number format

The format in which numbers are printed (whether groups of digits are separated by a delimiter, and the type of delimiter to use for decimals).

response strings

The standard strings to print in place of the English words "yes" and "no".

Because the locale in use governs the interpretation of data rather than its representation, the same data might appear differently when presented under a different locale. In particular, electronic mail might be affected when it is sent from one locale to another; see "How mail translates between locales" (page 226).

See also:

- the **locale**(M) manual page
- the **locale**(C) manual page
- the **localedef**(C) manual page

Regular expressions and locales

Regular expressions are interpreted differently for different locales. Locale definitions of the collating order of a character set may differ, so that regular expressions containing collating elements or ranges evaluate differently. If letters are defined as being equivalent in collating order, this might change the order of evaluation. Character classes also vary between locales. For example, the extended regular expression,

[A-z]

is intended to recognize all upper- or lowercase characters in English. However, this fails to recognize accented characters in the ISO8859-1 character set (with values from 0xC0 to 0xFF in hexadecimal).

To recognize all upper- or lowercase characters, use:

[[:alpha:]]

This expression recognizes all characters in the set that match the set **alpha** defined within the current locale. In the POSIX locale, this includes the defined sets **upper** and **lower**. In other locales, it should include all the letters of the alphabet.

Because the interpretation of regular expressions is dependent on the locale, take care when using regular expressions in shell scripts that might be used in more than one locale. Also, when constructing a new locale definition ensure that the character classes you define correspond to the desired regular expressions.

See the **regexp**(M) manual page for rules on constructing regular expressions.

How mail translates between locales

If you are using a locale definition that recognizes characters that are not in the standard US ASCII character set, you might have difficulty sending mail to a user on a system that is using a different locale (or one that does not recognize locales). Characters outside the core of alphanumeric characters common to ISO8859-1 might be ignored or mistranslated under other locales.

More problematically, if your user name or machine name contains an 8-bit character, a user on a 7-bit system cannot send any messages to you because they cannot input the 8-bit character in the address. Therefore, it is important not to create user names containing 8-bit characters.

Setting the system keyboard

To change the system keyboard (i.e., graphical console keyboard) configuration, log in as *root* and select a keyboard from the "Keyboard" list in the main window of the **International Settings Manager** (page 221). This specifies the keyboard configuration file used by the system keyboard for conversion of each keystroke from scancodes to the codeset currently in use on the console.

NOTE Once you have changed the system keyboard setting, restart the X server. (A simple way to do this is to log out and log back in.)

For example, a French keyboard and an American English keyboard may both have the same physical layout, and the keys in any given position may return the same codes, but the keycodes have different symbols ("glyphs", or printable characters) attached to them. The French keyboard returns different characters than the American English keyboard.

The keyboard files listed in the main window of the **International Settings Manager** specify the country-specific layouts of AT®- and PS/2®-style keyboards. All the keyboard files are stored in */usr/lib/keyboard*. These files map the system keyboard to the given national standard. The keyboard file for a particular national standard might need to be modified for a specific keyboard. If you need to modify the keyboard map, or create a new one, copy the appropriate file in */usr/lib/keyboard* to a new file in the same directory and modify the new file. Name the file according to this convention:

keyboard_type.codeset.country

See also:

- the **mapkey**(M) manual page

Selecting codesets

SCO provides console fonts for ISO8859-1 through 10, ISO8859-15, IBM codepages 437, 850, 852, 860 and 865, and X fonts for ISO8859-1 and IBM 437, 850 and 858. To support, for example, ISO8859-2 under X and **scoterm**, you must supply your own fonts.

NOTE The ISO8859-2 to ISO8859-10 codesets are only supported on the character console.

The **International Settings Manager** allows you to specify both the codeset used internally by the system (in other words, the way in which data is represented when it is written to disk and manipulated by various programs) and the codeset used on the system console.

The single-byte codesets supported by SCO OpenServer systems can represent a maximum of 256 characters. For this reason, you might benefit by setting the internal system and console codesets differently for different uses. For example, the IBM codesets (codepage 437 and codepage 850) contain better line-drawing characters and are useful as console codesets. The ASCII and ISO8859-1 codesets, however, contain all the characters necessary to represent the American English and Western European languages, respectively. Selecting a console codeset which is different from the internal system codeset will set up mappings to ensure that data continues to be interpreted correctly.

When the system is run in single-user mode, the terminal type defaults to *ansi*. This can cause characters to appear incorrectly (for example, letters may be displayed instead of linedrawing characters when **scoadmin** is run).

To solve this problem, if your console codeset is set to IBM850, issue this command immediately on entering single-user mode:

TERM=ansi-850 export TERM

If your console codeset is set to IBM860 or IBM865, enter:

TERM=ansi_intl export TERM

Setting the internal system codeset

To set the internal system codeset, log in as *root*, invoke the **International Settings Manager**, and:

1. Select **Codeset** from the **Settings** menu.
2. Select the name of the codeset you want to use and click on **OK**.
3. Reboot the system (page 178) after exiting the **International Settings Manager**.

Codesets assign a value to each character in a character set. Changing the internal system codeset changes how each character in every file is interpreted.

> **NOTE** Changing the internal system codeset will dynamically change the list of the console codesets. The internal codeset is used as a primary selection upon which the secondary codeset depends. Therefore, the default console codeset might change if you change the internal system codeset selection.
>
> Changing the internal system codeset also changes the list of available locales. It might also change the way that data previously in use on the system is interpreted. After selecting the internal system codeset you should review the device mappings and user locales under the **Settings** menu to ensure that the mappings set up for each device are still appropriate and that the language each user has selected is still supported by the system.

Setting the console codeset

To set the console codeset, log in as *root*, invoke the **International Settings Manager**, and:

1. Select **Codeset** from the **Settings** menu.
2. Select **Console** from the **Codeset** submenu.
3. Select the name of the codeset you want to use and click on **OK**.
4. Select **Save** from the **File** menu.
5. Exit the **International Settings Manager**.
6. Reboot the system.

The system console is not actually a single device, but rather a combination of both the console keyboard and the console monitor. Selecting the console codeset will install a console font (see **vidi**(C)), establish the list of available system keyboard mapping files, and establish any additional mapping required if the console codeset is not the same as the internal system codeset.

Translating files between different codesets

Use **iconv(C)** to translate files between different codesets. For example:

iconv -f local8 -t ISO8859-1 < ***infile*** > ***outfile***

This converts ***infile*** from the **local8** codeset to ***outfile*** in ISO8859-1 encoding. The character encoding in either the **-f** (from) codeset or the **-t** (to) codeset is in single-byte values (such as ISO8859-1 or ASCII).

You might need to translate files between different codesets if:

- the files were written under 7-bit software that does not conform to the ISO8859-1 character set.
- the files were generated by software using IBM437 characters which you need to use with a program using ISO8859-1 characters.
- the files contain one character set and you need to use them with a device (such as a printer) that uses a different character set.

Although **iconv** is the recommended translation filter, the older **trchan**(M) utility is still available. **trchan** is a filter that acts in the same way as **mapchan**(M) and uses the same mapping files. For example, to translate a file from ISO8859-1 to US ASCII, where US ASCII is the character set currently in use, enter:

trchan -i /usr/lib/mapchan/ISO8859-1 < ***inputfile*** > ***outputfile***

This command uses the input section of */usr/lib/mapchan/ISO8859-1* to translate ***inputfile***, and writes the result to ***outputfile***.

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Setting device character mapping

To set the character mapping for each device, log in as *root*, invoke the **International Settings Manager**, and:

1. Select **Devices** from the **Settings** menu.
2. Select a device to configure from the "Device" list.
3. Select a device type from the "Map file" list and click on **OK**.

This specifies the *mapchan*(F) file to be used by the peripheral device (such as a printer or terminal). The specified device now displays or prints all characters sent to it in accordance with the selected *mapchan*(F) entry. See the *mapchan*(F) manual page for a description of the functionality provided in the individual *mapchan* files.

NOTE Any serial line which is used by the UUCP system should not have an associated channel mapping.

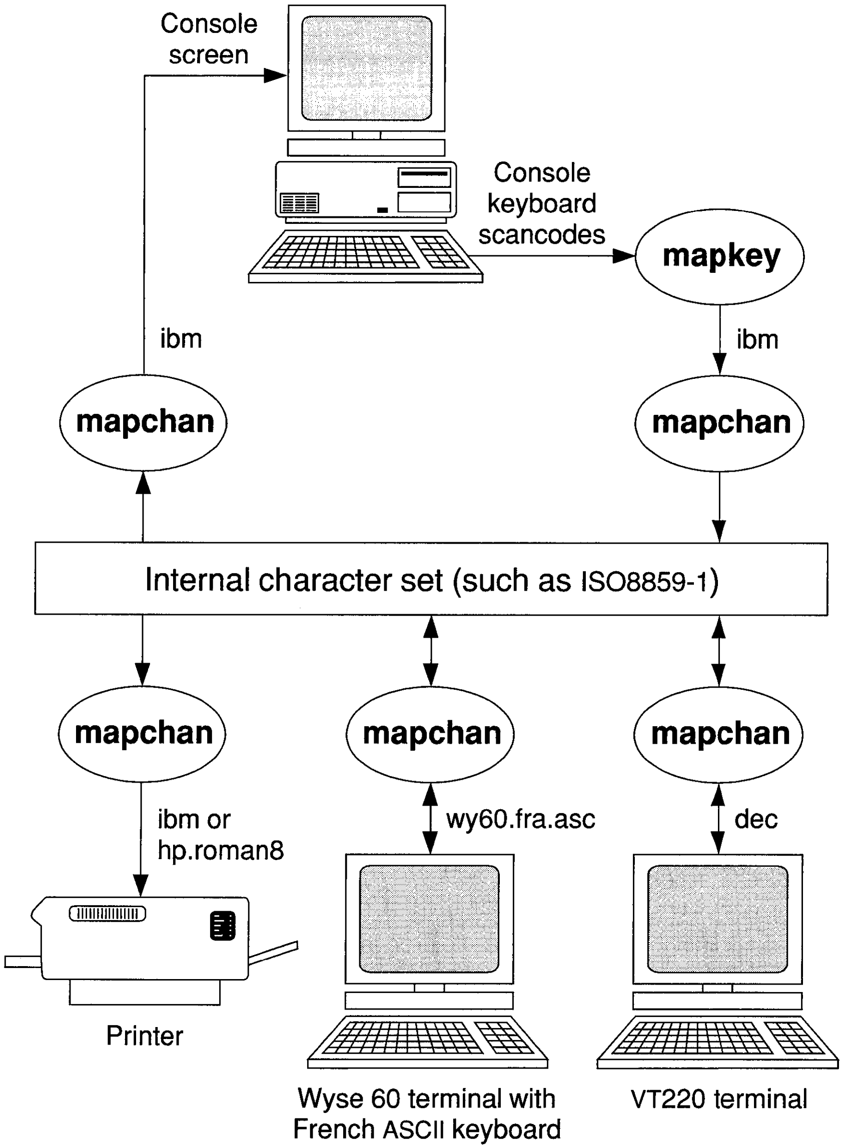
See also:

- "Device mapping" (this page)
- "Creating a character mapping table" (page 232)
- the **mapchan**(M) manual page

Device mapping

Device mapping provides a method for ensuring that character input and output devices (such as printers and terminals) connect to the system through a standard codeset. When you select a device type from the "Select a device type" list in the **International Settings Manager**, you are defining the mapping between the codeset supported by the external device and the internal system codeset.

The following diagram shows a typical example of the flow of information:



To set up device mapping, see "Creating a character mapping table" (page 232). To configure the system keyboard, see "Setting the system keyboard" (page 226).

Creating a character mapping table

It might be necessary to modify the provided *mapchan*(F) files to support new hardware or software which requires character sets other than ISO8859-1. **mapchan**(M) works on characters coming from or going to a device, translating them to and from the internal system codeset.

The *mapchan* files are stored in subdirectories in */usr/lib/mapchan*. The subdirectories are named for the supported SCO OpenServer internal system codesets. (The files in */usr/lib/mapchan/ISO8859-1* are duplicated in */usr/lib/mapchan* itself for backward compatibility.) The default *mapchan* file for each device on the system is listed in */etc/default/mapchan*. To create a new character mapping table, copy an existing *mapchan* file and modify it, then reinstall it in the appropriate subdirectory in */usr/lib/mapchan*.

mapchan files contain several divisions, each of which controls some aspect of the mapping between the internal character set used by the system and the character set used by the terminal or device. You might want to change one or more of these divisions.

For details, see:

- "Mapping input characters" (this page)
- "Getting input from mapchan" (page 233)
- "Mapping output escape sequences" (page 233)
- "Mapping dead key sequences" (page 234)
- "Mapping compose sequences" (page 234)
- "Mapping function keys" (page 235)

Mapping input characters

Use **mapchan**(M) to filter characters from peripheral devices to and from an internal codeset that is used by software running on the system. See "Device mapping" (page 230) for more information.

To switch off **mapchan** filtering, enter:

mapchan -n

To switch it on, enter:

mapchan -f *mapfile*

Here, ***mapfile*** is the path and filename of the mapping file you want to use.

Alternatively, create a shell script for each program to switch **mapchan** off, run the program, and then reset **mapchan** on exiting from the program.

If you have a number of users who have different **mapchan** configurations, you must create individual scripts for each of them. A typical script for a program called **seven**, which saves and then restores the current mapping, is:

```
tmpfile=/tmp/map$$
trap "rm $tmpfile" 0 1 2 3 15
mapchan > $tmpfile
mapchan -n
seven
mapchan -f $tmpfile
```

Getting input from mapchan

The input section of a *mapchan*(F) file determines how input codesets are translated into the internal system codeset. The left column contains the input character code generated by the keyboard. When this character is input, the corresponding character in the right column is returned by **mapchan**(M) (it is sent as input to the running program on the terminal, or used for storing data in the filesystem).

If you have the ISO8859-1 set as the internal character set, you need to map the 8-bit characters (characters with values greater than 127 decimal).

If you are using the IBM437 codeset internally you need to map only the "§" symbol. This symbol is normally mapped into the 0xb2 instead, because it has the same code as ⟨Ctrl⟩**u**, which the system treats as a command to clear the line. Configure **mapchan** to translate this symbol back to the 8-bit PC code.

Mapping output escape sequences

The output section of the *mapchan*(F) file controls the way in which characters are mapped from the internal character set to the character set configured for the device in use. For example, the default console display configuration understands 8-bit IBM437 characters. The paragraph, section, and cent symbols use codes which have a special meaning to the UNIX console driver. To make them print, you must translate them to graphic escape sequences.

The output section is:

```
output
20      0x1b '[' '2' '0' 'g'        # paragraph sign
21      0x1b '[' '2' '1' 'g'        # section sign
155     0x1b '[' '1' '5' '5' 'g'    # cent sign
```

If you are simply mapping from an ISO8859-1 character set to the IBM437 set, typical characters are:

```
output
0xc0    'A'     # use A since no A grave available
0xc4    0x8e    # A umlaut
```

The *mapchan* files have been written so that the closest printable character is used if a character is not available.

Mapping dead key sequences

The dead key section of the *mapchan*(F) file maps the characters for each dead key on a serial terminal. (A dead key is a key that generates no output when pressed, but that displays a character when a subsequent key is pressed: for example, pressing the "`" followed by an "a" prints a "à".) Dead keys are similar to compose sequences but are used for entering accented characters. Compose sequences are more commonly used for entering non-standard characters.

Typical mappings for a dead key for caret characters using ISO8859-1 are:

```
dead    0xb0    # declare the caret character
 'a'    0xe2    # character for a with caret
 'e'    0xea    # character for e with caret
```

For details on the dead key section and a table of available dead key sequences, see the *mapchan*(F) manual page.

Mapping compose sequences

Compose sequences allow you to press a number of keys to compose a particular character. The sequence starts when the compose key is typed and is completed by two further keys that specify the character input. For example, the supplied map files allow you to generate the registered trademark symbol " ® " by pressing:

⟨compose key⟩ r o

Compose sequences are not the same as dead keys; a dead key produces no output when you press it, but applies an accent to the next character you enter. See "Mapping dead key sequences" (this page).

Compose sequences (and dead keys) are configured on terminals or the console using **mapchan**(M).

The supplied mapping files all use ⟨Ctrl⟩_ ("control underscore") as the character to introduce a compose sequence. The PC console might also use the ⟨Alt⟩⟨SysReq⟩ key to introduce a compose sequence. On keyboards with 12 function keys, the alternative compose key is the " * " symbol on the numeric keypad.

The compose key section in the **mapchan** configuration file (like the dead key section) declares the compose key, followed by a list of the characters to be mapped. In all cases, two characters follow the compose key. For example, mapping compose keys within the 7-bit range of characters common to the ASCII, ISO8859-1, and IBM437 character sets:

```
compose        0x1f    # compose key is ^_
__             0x1f    # output the compose key value
++             '#'     # two + characters generate a #
```

For more information on compose key mapping and a table of available compose key sequences, see the *mapchan*(F) manual page.

Mapping function keys

Function keys usually generate a control sequence of an escape character followed by one other character. If one of these characters is changed by **mapkey**, problems might result. For example, if a function key outputs "^A 1", programs that recognize that function key will not work correctly if the "1" is changed.

The control section of the **mapchan** file enables a specific number of characters to be ignored by **mapchan** when encountered as part of a terminal escape sequence or function keystroke. The following control section shows some typical sequences:

```
CONTROL
input
^A      1       # Function keys: ^A followed by one character
\E      1       # Function keys: Escape followed by one character

output
\Ea     4       # cursor control: Escape a and 4 other characters
\EG     1       # set attributes: Escape G and one character
```

For full details of the control section of the **mapchan** file, see *mapchan*(F).

Configuring SCOterm for European languages

scoterm is codeset-aware and automatically configures the user's font, **mapchan**, and keyboard mapping at startup. There is very little to configure.

System changes such as keyboard and codeset changes made via the **International Settings Manager** will affect the way **scoterm** behaves.

Here is a list of common **scoterm** problems that can be fixed via the **International Settings Manager**:

Character-based applications with character line graphics do not look right
scoterm is running with the wrong font. Using the **International Settings Manager**, reconfigure the console codeset to either IBM850 or IBM437.

Cannot get European characters with my character applications

If running an application that uses line graphics, use the **International Settings Manager** to set the console codeset to IBM850 (if the currently configured console codeset is IBM437).

If running an application that uses no line-drawing characters, use the **International Settings Manager** to set the console codeset to ISO8859-1 or IBM850 (if currently configured console codeset is IBM437).

Using a keyboard made for another locale. Keys are not sending the right characters

Select the new keyboard type with the **International Settings Manager**, or **scoterm**'s keyboard menu (**Options** ⇨ **Keyboard**).

Graphical environment session not saved correctly

If a graphical environment session is run with a German locale set, the state of the session may not be saved correctly when the user logs out. Any **scoterm** windows started by clicking on the desktop UNIX icon will not be restarted in subsequent sessions. This problem does not affect the standard X windows terminal emulator **xterm**. Nor does it affect UNIX windows started from the **Window Manager** menu, the desktop menu, or the command line.

To fix this problem, edit the file:

/usr/lib/X11/IXI/XDesktop/tools/System.ts/Shell.obj/de_DE/text,

and change the following lines:

```
t1='Unix'
m1='Ablegen nicht möglich '
m2=' hier '
```

to:

```
t1='Shell'
t2='UNIX'
m1='Ablegen nicht möglich '
m2=' hier '
```

Language behavior in SCOadmin

Note the following considerations when using SCOadmin in other locales:

- **scoadmin -t** displays titles from an index file. To use command-line invocation of SCOadmin managers and make use of short name matching for managers, use **scoadmin -t** to see a listing of all registered manager titles, then enter **scoadmin *title*** on the command line.

  scoadmin -t will only display manager titles in English regardless of the language selected. Table 12-1, "French and German name equivalents for SCOadmin managers" (page 238) shows the equivalent manager names in English, French, and German.

- The **Backup Manager** and **custom** display device names in English.
- **scoadmin** stores information about user locales in the shell environment files of those users. Users who use **scosh** as their login shell do not have any shell environment files in their home directory, so user locales cannot be set using the **International Settings Manager** in the usual way.

  To solve this problem, follow these steps:

  1. Create accounts for all **scosh** users specifying a shell other than **scosh**.
  2. Run **scoadmin International Settings Manager** and select the required locale for each user.
  3. For each **scosh** user, add the following line to the end of their *.profile* file (Bourne or Korn shell) or the *.login* file (C shell):

     ```
     /usr/bin/scosh
     ```

- The following managers are English-only and will be localized in a future release:
  - **Floppy Filesystem Manager**
  - **UUCP Manager**
  - **HP Network Print Services Manager**
  - **Cron Manager**
  - **Terminal Manager**
  - **Sendmail Configuration Manager**

Table 12-1 French and German name equivalents for SCOadmin managers

English	French	German
Account Manager	Gestionnaire de comptes utilisateurs	Benutzer-Manager
Address Allocation Manager		
Audit Manager	Gestionnaire d'audits	Audit-Manager
Backup Manager	Gestionnaire de sauvegardes	Backup-Manager
Cron Manager	Gestionnaire Cron	Cron-Manager
DHCP Server Manager		
Filesystem Manager	Gestionnaire de systèmes de fichiers	Dateisystem-Manager
Floppy Filesystem Manager	Gestionnaire de systèmes de fichiers sur disquette	Dateisystem-Manager für Disketten
Hardware/Kernel Manager	Gestionnaire du matériel et du noyau	Hardware-/ Kernel-Manager
HP Network Print Services Manager	Gestionnaire de service d'impression de réseau HP	HP Netzwerk-Druckauftrags-Manager
HP Network Printer Manager	Gestionnaire d'impression de réseau HP	HP Netzwerk-Drucker-Manager
International Settings Manager	Gestionnaire de configuration internationale	Internationale Einstellungen
IPX Configuration Monitor	Moniteur de Configuration IPX	IPX Konfigurations-monitor
License Manager	Gestionnaire de licences	Lizenzmanager
MMDF Alias Admin	Administration d'alias MMDF	MMDF Alias-Verwalter
MMDF Channel Admin	Administration de canaux MMDF	MMDF Kanal-Verwalter
MMDF Configuration	Configuration de MMDF	MMDF Konfiguration
MMDF Domain Admin	Administration de domaines MMDF	MMDF Domain-Verwalter
MMDF Host Admin	Administration d'hôtes MMDF	MMDF Host-Verwalter

English	French	German
MMDF Table Admin	Administration de tables MMDF	MMDF Tafel-Verwalter
MOTD Manager	Gestionnaire MOTD	MOTD-Manager
NetWare NVT Login Manager	Gestionnaire de login NVT NetWare	NetWare NVT-Login-Manager
NetWare NVT Monitor	Moniteur NVT NetWare	NetWare NVT-Monitor
NetWare RIP Monitor	Moniteur RIP NetWare	NetWare RIP-Monitor
NetWare SAP Monitor	Moniteur SAP NetWare	NetWare SAP-Monitor
Network Configuration Manager	Gestionnaire de configuration de réseau	Netzwerk-konfiguration
Node Check	Gestionnaire de contrôle de noeuds	Knotentest
NetWare Login Manager	Gestionnaire de login NetWare	NetWare Login-Manager
NetWare Logout Manager	Gestionnaire de déconnexion NetWare	NetWare Logout-Manager
NetWare Access Manager	Gestionnaire d'accés NetWare	NetWare Zugriffsmanager
NetWare Password Manager	Gestionnaire de mots de passe NetWare	NetWare Paßwortmanager
NetWare Local Users Monitor	Moniteur d'utilisateurs locaux NetWare	NetWare Lokale-Benutzer-Monitor
PPP Manager		
ISA PnP Configuration Manager		
Print Job Manager	Gestionnaire de tâches d'impression	Druckauftrags-Manager
Printer Manager	Gestionnaire d'imprimantes	Drucker-Manager
Reports Manager	Gestionnaire de rapports	Protokoll-Manager
SCOadmin Event Logs Manager	Gestionnaire de logs d'événements SCOadmin	Ereignisprotokoll-Manager
Security Profile Manager	Gestionnaire de niveau de sécurité	Sicherheitsprofil-Manager

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English	French	German
SNMP Agent Manager	Gestionnaire d'agent SNMP	SNMP Agent-Manager
Software Manager	Gestionnaire de logiciels	Software-Manager
Sysadmsh Legacy	Sysadmsh	Sysadmsh
System Defaults Manager	Gestionnaire des valeurs systèmes par défaut	Systemstandard-Manager
System Logs Manager	Gestionnaire de logs systèmes	Systemprotokoll-Manager
System Shutdown Manager	Gestionnaire d'arrêt du système	System-Shutdown-Manager
System Startup Manager	Gestionnaire de lance-ment du système	Systemstart-Manager
System Time Manager	Gestionnaire d'heure système	Systemzeit-Manager
Terminal Manager	Gestionnaire de terminal	Terminal-Manager
User Equivalence Manager	Gestionnaire d'équivalence utilisateur	Benutzeräquivalenz-Manager
UUCP Manager	Gestionnaire UUCP	UUCP Manager
Video Configuration Manager	Gestionnaire de configuration vidéo	Videokonfigurations-Manager

Using mail in 8-bit (European) locales

An 8-bit locale is any locale that contains characters not present in US-ASCII. The MMDF mail system and **scomail** need to be configured properly for this to work. If they are not configured correctly, the 8-bit characters will not display properly at the receiving end.

The two kinds of data corruption that can be seen are as follows:

- **The high-bit was stripped by an intermediate mail gateway**

  By default, MMDF strips the high-bit on outgoing mail and **sendmail** does not, so if you are in a locale that uses any characters that are not present in US English, you must enable 8-bit data in MMDF as follows:

  1. In the file */usr/mmdf/mmdftailor*, set the **confstr** parameter to **charset=8bit** for the SMTP, badhost, and baduser channels (if present).
  2. If the **charset=7bit** parameter is present or there is no charset parameter (the default is 7bits), add a **confstr** parameter similar to the following to your *mmdftailor* file:

     `confstr="charset=8bit, other confstr parameters"`

     Alternatively, the **mmdf** configuration utility generates an *mmdftailor* file with the **7bit** parameter present. In a file of that format, you must change the "7" to an "8".

- **7-bit MIME encoded characters not displayed correctly in non-MIME mailers**

  By default, **scomail** generates 7-bit MIME encoded characters which display in a form similar to "=C7" on non-MIME mailers, such as **mailx**. To correct this, set the X resource **pass8bits** to TRUE. This parameter can be found in the file */usr/lib/X11/%L/app-defaults/ScoMail*.

  Additionally, external mail generated by MIME mailers using the 7-bit encoding will also cause this problem. The problem must be corrected at the source or (preferably) you can use a MIME capable mailer (such as **scomail**) to read the mail. However, it is recommended in 8-bit locales that you always generate 8-bit data for new mail because that format is compatible with most mailers.

  Also, **scomail** will convert "=C7" style mail to 8-bit encoding on replies or forwards when the message is included as text, but it will not convert them to 8-bits when the message is included as an attachment.

  Conversely, if **scomail** is configured to send mail in the 7-bit encoding style, it will only convert 8-bit messages when the message is included as text in the reply or forward operation.

- In general, non-MIME mailers send 8-bit data but do not include any MIME headers to mark the message as 8-bit data. MIME mailers should cope with this without any problems.

UUCP dialer scripts

The **uucp**(C) dialer scripts provided assume that the **getty/login** is running in English. If a line is intended for **uucp**, then the user should either specify that that terminal should run in English, or should define a new dialer script in the incoming client.

Calendars

- You can only administer the calendar database if the administration utilities are running in the same locale in which database was created. If you change your LANG variable, change the system locale using the **International Settings Manager**, or edit */etc/default/lang*, you cannot administer the calendar. Also, the calendar server will not start if the system locale has been changed. If this is the case, you may see "Fatal Error" messages from the calendar server when bringing up the machine in multiuser mode.

  To work around this problem, you can start the calendar server with the **LANG** variable temporarily defined as it was when the database was created.

  Typically, the calendar database is created at initial system load. To determine what **LANG** was set to during initial system load, examine the file */usr/adm/ISL/iqm_file*. Search for the variable **IQM_LANGUAGE**. This will probably be the language that was used when the calendar database was created.

  If you find that you need to restart the calendar server with the initial **LANG** setting, follow these steps as *root*:

  1. Change directories (**cd**) to */usr/lib/sco/oadb/caldata*.
  2. Remove all the data files in this directory; they will be rebuilt by **calbuild**:

     rm ./*

  3. Enter **cd /etc/rc2.d**.
  4. Edit the file *P95calserver*.
  5. Go to line 20 (following the comments) and find the line:

     ```
     DBKEY=6373;     export DBKEY
     ```

6. Before this line, add:

   IQMFILE=/usr/adm/ISL/iqm_file
   export IQMFILE
   LANG='grep IQM_LANGUAGE $IQMFILE | awk '{ FS="\"" }{ print $2 }''
   export LANG

   This will enable the calendar server to start using the locale that was set at installation time, regardless of the system locale setting.

- In French and German locales, **scocal** does not display in 24-hour time format as it should. You can select 24-hour time format by selecting **Preferences ⇨ Time & Weekends** and clicking on the 24-hour toggle button under Time Format. This change must only be made once.

Timezones

The start and end dates for daylight savings time (summer time) for all timezones are correct at the time of publishing. However, European timezones are being reviewed by the European Union and some of these start and end dates might change. The correct algorithm for these dates can be set in *timezone.stz,* which is located in */usr/lib/nls/msg/**lang**/sa,* where ***lang*** is one of the following directories: *english, french_france.8859,* or *german_germany.8859.*

To set the timezone rules for daylight savings time correctly, edit each of the language specific timezone files (above) and change the following lines: in the "gmt:" section from:

```
SUMMER_TOO              =GMT0BST,M3.5.0/1,M9.5.0/1
```

to:

```
SUMMER_TOO              =GMT0BST,M3.5.0/1,M10.5.0/1
```

In the "europe_west:" section from:

```
SUMMER_TOO              =WET0WETDST,M3.5.0/1,M9.5.0/1
```

to:

```
SUMMER_TOO              =WET0WETDST,M3.5.0/1,M10.5.0/1
```

In the "europe_middle:" section from:

```
SUMMER_TOO              =MET-1METDST,M3.5.0/2,M9.5.0/2
```

to:

```
SUMMER_TOO              =MET-1METDST,M3.5.0/1,M10.5.0/1
```

Then, run the **scoadmin System Time Manager**, and select **Change Timezone** from the **Time** menu. Select your correct timezone, click on **OK** and exit the manager.

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Clients

The following X clients have not been localized: **fsinfo**(X), **rgb**(X), **startx**(X), **xauth**(X), **xhost**(X), **xinit**(X), **xmodmap**(X), **xsconfig**(X), **xset**(X), and **xswkey**(X). Usage messages from clients have not been localized.

Documentation and scohelp

- No translated manual pages are shipped with this product, but translated manual pages can be installed into */usr/lib/scohelp/**lang**/man/**section***. However, these manual pages will not be properly accessed by **man**. They will be viewable from **scohelp** using **Open Reference Page** if an index is provided for them.
- There are some limitations with hyperlinks from French and German homepages. When layered products that are not translated (such as Merge) are installed, their links on the English library page are activated, but the links to the French and German library pages are not activated. You can only access this documentation using context sensitive help and internal hyperlinks or the manual pages using the **Open Reference Page** command of **scohelp**.

Enabling Euro currency symbol support

SCO OpenServer is capable of displaying the Euro currency symbol on the console and in graphical displays, and printing the symbol to all PostScript printers. Euro currency symbol support is implemented using the ISO8859-15 codeset.

To enable Euro support, you must first set the ISO8859-15 codeset (page 245) and reboot your system. You can then display (page 246) and print (page 246) the Euro currency symbol.

Setting the ISO8859-15 codeset

To access the fonts containing the Euro symbol, you must set the internal and console codesets to ISO8859-15 using the **International Settings Manager** (page 221). As *root*:

1. Determine your current console codeset setting. It is the second setting listed in the file */etc/default/codeset*.
2. Start the **International Settings Manager** by selecting **System Administration ⇨ System ⇨ International Settings Manager** on the desktop, or by entering the following at the command-line prompt:

   scoadmin international

3. From the scroll lists on the **International Settings Manager** main window, select a language and a keyboard.
4. From the **Settings** menu, select **Codeset...Internal**, then select "ISO8859-15". Click on **OK**.
5. From the **Settings** menu, select **Codeset...Console**.

   If your current console codeset starts with "ISO8859", accept the default of "ISO8859-15". If you have a PS/2®-style keyboard (that is, your current console codeset is "IBM850"), select "IBM858".

   Click on **OK**.
6. Exit the **International Settings Manager** and reboot the machine. The new system settings take effect after you reboot.

See also:

- "Selecting codesets" (page 227).

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Using the Euro currency symbol

To display the Euro symbol on the console:

- For most keyboards, enter ⟨Right-Alt⟩**E** (that is, hold down the right-hand ⟨Alt⟩ key and simultaneously press **E**).
- For British keyboards, enter ⟨Right-Alt⟩**3**.
- For United States keyboards, enter ⟨Right-Alt⟩**4**.

In the graphical environment, **scoterm** uses the Euro symbol fonts by default when invoked from an ISO8859-15 locale. Some X applications may require additional arguments to get an ISO8859-15 font. For example, to invoke **xterm** using the 10x20 fixed-width ISO8859-15 X font, enter the following:

xterm -fn 10x20-15

The default font "fixed" is unchanged from the default ISO8859-1 fixed-width font.

See also:

- **locale**(C) manual page.

Printing the Euro currency symbol

To print text files that contain the Euro symbol:

- If you use a DECColormatePS, DEClasar1150, DEClasar2250, or DEClasar3250 printer, simply enter the **lp**(C) command:

  lp ***filename***

- For PostScript printing, enter:

  lp -o postscript ***filename***

- For network PostScript printing, enter:

  lp -o network.ps ***filename***

- For any PostScript printer, you can enter:

  cat ***filename*** **|** **text2post** **|** **lp**

See also:

- the **lp**(C) manual page
- the **text2post**(ADM) manual page
- Chapter 4, "Managing printers and print jobs" in the *System Administration Guide*

Chapter 13

Troubleshooting system-level problems

Troubleshooting is the general term for studying and resolving system problems. This chapter provides general information about analyzing and recovering from general system problems:

- "Other troubleshooting documentation" (page 248)
- "Preparing to recover from problems" (page 248)
- "Restoring a corrupted root filesystem" (page 250)
- "System crashes" (page 253)
  - "Recovering from a system panic" (page 254)
  - "Recovering after a power failure" (page 256)
  - "Automatic reboot" (page 256)
- "Analyzing system failures" (page 256)
- "Examining a memory dump with crash(ADM)" (page 262)
- "Common system-wide problems" (page 264)
- "cron, at, and batch troubleshooting" (page 265)
- "Runaway processes" (page 267)

Other troubleshooting documentation

In addition to system-level troubleshooting, there are various conditions that can arise within individual system components. This information is included in the documentation that discusses the specific components. Command-specific error messages and problems are discussed on the manual page for the command; information about resolving problems with a procedure or subsystem is provided in the guides that describe the procedure or subsystem. You can use the global searching features to look up the error message or condition and find where in the documentation it is discussed.

Major troubleshooting sections of interest include:

- Chapter 3, "Troubleshooting the installation" (page 53) contains information about solving problems that may arise when installing SCO software.
- "Troubleshooting system startup" (page 184)
- "Troubleshooting network configuration" (page 494)
- The *System Administration Guide* discusses troubleshooting issues related to the security facilities, filesystems, printers, UUCP, and virtual disks.
- *Networking Guide* contains information about troubleshooting various networking packages.
- *Graphical Environment Guide* includes information that is useful when troubleshooting the SCO graphical environment.
- *Performance Guide* discusses how to analyze and improve system performance.

Preparing to recover from problems

"Summary of system administration tasks" (page 164) describes a number of practices that can help you avoid system problems and minimize the impact of system failures that happen. A few of these points are summarized here:

- Make an emergency boot floppy disk set as discussed in Chapter 5, "Creating an emergency boot floppy disk set" (page 81). If the root filesystem or a critical booting file are corrupted by a system crash, the emergency boot floppy disk set can be used to recover the system. Otherwise, you may need to reinstall the software before you will be able to boot the system.
- Record your root disk information as described in "Recording your root disk layout" (page 249). This information is vital for restoring your system after a root disk failure.

- Monitor system performance, error logs, and the system log book regularly. This can enable you to correct problems before they cause a hard failure. See "Checking system files with error histories" (page 260) for a list of useful error log files.
- Install an uninterruptible power supply (UPS) on the system to protect the system from damage during power surges and failures.
- Back up the system regularly. Consider running full system backups every week or two. Because incremental backups are usually faster than full backups, it is tempting to run full backups only rarely. However, if you need to restore files, you may need to restore the most recent full backup plus all incrementals run since then, which could be a long and tedious process.
- Understand the purpose of the "override" terminal in dealing with the security subsystem. The override terminal is used to correct errors that prevent access to other terminals. By default, the console multiscreen (*/dev/tty01*) is the override terminal. For more information, see Chapter 10, "Starting and stopping the system" (page 169).

Recording your root disk layout

You should record the details of your root disk layout in case of a hard disk failure. If you have this information, you can rebuild your system without reinstalling.

Record the divisions of your UNIX partition in your system log with **divvy**(ADM), using this command:

```
divvy -P -N
```

The output will look like this:

```
0          0      14999  boot      EAFS
1      15000      39574  swap      NON FS
2      39575     346775  root      HTFS
3     346776    1022965  u         HTFS
6    1022966    1022975  recover   NON FS
7          0    1023983  hd0a      WHOLE DISK
```

If you have multiple partitions on the root disk, record them with **fdisk**(ADM), including the start and end locations. Use this command:

```
fdisk -p
```

The output looks like this:

```
1 1 63999 UNIX Active
```

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Restoring a corrupted root filesystem

If your root filesystem is so corrupted that **fsck**(ADM) cannot run when you boot the system, or the system displays error messages that make no sense, you must restore the root filesystem from backups. To do this, you need an emergency boot floppy disk set, which you should have created as described in Chapter 5, "Creating an emergency boot floppy disk set" (page 81). If you do not have these diskettes, you must do a partial reinstallation as described in "Replacing the root hard disk" (page 339).

NOTE The emergency boot floppy disk set must have a kernel with the correct tape drivers installed. If you have changed the type of tape drive since creating your emergency boot floppy disk set, you will need to configure the tape drive at the `Boot:` prompt as described in "QIC-02 tape drive bootstrings" (page 279) and "SCSI peripheral bootstrings" (page 280).

To restore your root filesystem:

1. Shut the system off.
2. Insert your boot floppy (or a single boot/root floppy disk) in the floppy disk drive and power up the system.
3. At the `Boot:` prompt, press ⟨Enter⟩.
4. When prompted, insert the root floppy disk and press ⟨Enter⟩.
5. The system creates a RAM disk and loads a rudimentary root filesystem into memory. After you see the startup messages that list the devices configured into the kernel, the root prompt (#) is displayed. Enter this command:

   fsck /dev/hd0root

   If **fsck** appears to be successful, shut down the system with **haltsys**(ADM) and try booting from the hard disk again by pressing ⟨Enter⟩ at the `Boot:` prompt. If the check fails, continue with the next step.
6. Enter this command to reconfigure your root disk from scratch:

   mkdev hd

   NOTE You may see a few error messages like these:

   ```
   /usr/lib/mkdev/hd: uniq: not found
   mv: cannot access /tmp/DKINIT21: No such file or directory (error 2)
   ```

   These are a consequence of operating from the limited RAM disk filesystem and can be ignored.

This runs all the programs necessary to initialize your disk as described in "Installing a hard disk" (page 327), including:

- setting disk parameters with **dkinit**(ADM) if necessary; this is skipped for SCSI disks
- partitioning the disk with **fdisk**(ADM). If you had multiple partitions, you should use the information you recorded as described in "Recording your root disk layout" (page 249). If only the root filesystem is corrupted, it is not necessary to repartition the drive and you can simply quit out of **fdisk**.
- mapping bad blocks or sectors with **badtrk**(ADM). You can choose quick or thorough and destructive or non-destructive scans. If you destructively scan the disk, you will overwrite the boot sectors of the drive — see "System fails to boot or displays "NO OS" message" (page 188) for more information.
- recreating the filesystems and swap space with **divvy**(ADM). Use the information you recorded in "Recording your root disk layout" (page 249). If you want to change the sizes, ensure they are at least as large as before.

If the hard disk or filesystem information is still valid, you do not need to recreate it. For example, if your hard disk still has a valid **badtrk** table, you do not need to run a **badtrk** scan. Intact filesystems will be preserved if possible.

7. Soon after you see the `Making filesystems` message, the root prompt is returned. Enter:

   fsck /dev/hd0root

   This cleans the root filesystem on the hard drive.

8. Enter:

   mount /dev/hd0root /mnt

   This mounts the root filesystem on the hard disk.

9. Insert the first volume of the root filesystem backup and restore the filesystem with the following commands:

   cd /mnt
   cpio -ivmkBud -I/dev/*xxx*

   where *xxx* is either **rct0** (for a 1/4-inch cartridge tape) or **rctmini** (for a mini-cartridge tape).

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NOTE If you see an error message like this when you attempt the restore:

```
NOTICE: HTFS: No space on dev ram (31/7)
cpio: cannot write /_BACKUP_CONTENTS_:...
...No Space left on device (error 28)
```

This means the files were written to the tape device using absolute instead of relative pathnames. You are attempting to write to the root filesystem loaded onto the ramdisk instead of the root filesystem on the hard drive. You must add the **-A** option to the **cpio** command line:

cpio -ivmkBudA -I/dev/*xxx*

This suppresses absolute pathnames on the files passed to **cpio**.

10. After the restore is complete, make sure there is a *stand* directory at the top of the root filesystem. If there is not, create it with the following command:

    mkdir stand

NOTE If your system is un upgrade from a release prior to SCO OpenServer Release 5, you do not have a boot filesystem (*/stand*) and you should not create it. You should also skip steps 12-14.

11. Unmount and clean the newly restored filesystem with the following commands:

    cd /
    umount /dev/hd0root
    fsck /dev/hd0root

    You may see this message, which can be ignored:

    `umount: warning: /dev/`***filesystem*** `was not in mount table`

12. Check the boot filesystem (*/stand*):

    fsck /dev/boot

13. Mount the filesystem and change directories:

    mount /dev/boot /mnt
    cd /mnt

14. Insert your backup tape of the boot filesystem and restore it using the same command you used for the root filesystem. When the restore is complete, unmount the filesystem and check it:

    cd /
    umount /mnt
    fsck /dev/boot

15. Restart your system from the root disk. Power-cycle the computer and boot normally.
16. Restore any secondary filesystems using the **Backup Manager**. When this process is complete, your system should be returned to its original state.

System crashes

A "system crash" is the system going down without unmounting filesystems and doing other cleanup operations. This is also called an "abnormal shutdown." Three types of system crashes occur:

panic
: The system "panics" when it encounters a hardware problem or kernel inconsistency that is so severe that the system cannot continue functioning.

powerfail
: If the power to the system fails even briefly, the system crashes.

operator crash
: If the system "hangs" due to operator error, you usually need to reset the system and reboot it to solve the situation. Recovering from an operator-induced crash is similar to recovering from a system panic.

  Note that a system that has NFS-mounted files from a system that is down may behave as if it is hung; in that case, rebooting the other system or, if possible, unmounting the filesystems from your system will usually solve the problem.

When the system is shut down normally, the **shutdown**(ADM) program stops all daemons, kills the active processes, unmounts any mounted filesystems, runs the **sync**(ADM) command, and tells **init**(M) to bring the system down to the appropriate state (either single-user or "safe to power off"), or to reboot.

If the system goes down before this shutdown procedure completes, filesystems may be corrupted, resulting in lost data. Some data may be lost because the buffer cache was not flushed to disk. The operating system flushes the buffers to disk fairly regularly, so the amount of data lost due to an abnormal system shutdown should be minimal. However, filesystem corruption is a common problem. If the root filesystem is corrupted, the system may not function properly.

When the system crashes for any reason, record the relevant data in the system log book and then reboot the system.

Recovering from a system panic

To recover from a system panic:

1. Copy the full PANIC message and the EIP number (address of the instruction being executed) from the console screen to your system log book. See "Getting the EIP number" (page 258) for instructions on determining the EIP number.
2. Reset or power-cycle the machine and press ⟨Enter⟩ at the `Boot:` prompt to reboot the system.
3. When the system prompts you, respond **yes** to save a copy of memory at the time of the PANIC.

   NOTE We recommend that you save this dump to tape so you have a record of the panic in case you need to compare it to the dump from another PANIC that happens later, and so that you have the dump to send to SCO Support as discussed in "Additional help from SCO Support" (page 264).

   The following illustrates how to save the dump to tape. This example uses */dev/rct0*, but using */dev/rctmini* works well if you have such a device on your system.

```
There may be a system dump memory image in the swap device.
Do you want to save it? (y/n) y

Use Floppy Drive 0 (/dev/rfd0) by default
Press ENTER to use default device.
Enter valid Floppy Drive number to use if different.
Enter "t" to use tape.
> t

Enter choice of tape drive :
1 - /dev/rct0
2 - /dev/rctmini
n - no, QUIT
> 1

Insert tape cartridge and press return, or enter q to quit. >
                <insert tape

Wait.
dd if=/dev/swap of=/dev/rct0 bs=120b count=751 skip=0

Done.  Use /etc/ldsysdump to copy dump from tape or diskettes
Press return to continue >
```

We strongly recommend that you use tapes rather than floppy disks to save system dump images. The typical SCO system has many megabytes of memory, so it takes several floppy disks to save a single image. Problems can arise if you do not have enough floppy disks, or if you insert them in the wrong order. You can run **crash**(ADM) on the dump from the *dumpdev* device, or reboot the system and copy this data to disk for study. See "Examining a memory dump with crash(ADM)" (page 262).

When it panics, the system writes the kernel image to the *dumpdev* device, which is usually the same as the *swap* device. The data will be overwritten as soon as any paging occurs on the system. See "Defining the default dump device" in the *System Administration Guide* for more information.

4. If you want to study the dump image with the **crash**(ADM) command, use the **ldsysdump**(ADM) command to copy the image to disk. In the sample session that follows, *06May94* is the name of the file to which the dump will be copied, but you can use any name that is meaningful:

```
# cd /tmp
# ldsysdump 06May94

Use Floppy Drive 0 (/dev/rfd0) by default.
Press ENTER to use the default.
Enter valid Floppy Drive number to use if different than default.
Enter "t" to use tape drive.
> t

Enter choice of tape drive:
1 - /dev/rct0
2 - /dev/rctmini
n - no, QUIT
> 1

Insert tape cartridge and press return, or enter q to quit. >

Wait.
dd if=/dev/rct0 bs=120b count=751

System dump copied into image.  Use crash(ADM) to analyze the dump.
```

5. At the prompt to check the root filesystem, answer "y." This will check and, in most cases, fix any corruption on the root filesystem. In rare cases, the operating system becomes corrupted and must be restored or reinstalled. See "Cleaning filesystems" (page 171) for more information.

6. Run **fsck**(ADM) on those filesystems that were mounted when the system panicked. This happens automatically for all filesystems that are marked dirty when the system is brought up to multiuser state, but by running **fsck** manually, you can control the response to problems that are found. See the **fsck**(ADM) manual page for more information.
7. Verify the integrity of the security system. See "System file integrity checking: integrity(ADM)" in the *System Administration Guide.*

Recovering after a power failure

When the power fails, turn the machine off — unless an uninterruptible power supply (UPS) is configured. This minimizes potential damage to your system if the power fluctuates.

Once the power comes back on, your filesystems may require cleaning as described in "Cleaning filesystems" (page 171).

Automatic reboot

SCO OpenServer systems can be configured to reboot automatically after a panic or power outage as described in "Changing the system restart options" (page 182).

NOTE If you set the system to automatically reboot after a panic, you will lose the memory dump that enables you to analyze the cause of the problem.

Analyzing system failures

In addition to restoring the system, it is important to analyze why the system failed so you can correct problems before they cause another system failure. SCO systems provide a number of tools to help in this analysis.

Traps, faults, and exceptions

Traps, faults, and exceptions are special conditions detected by the CPU while it is executing an instruction on behalf of a user process (running in either user mode or system mode), a system process running in system mode (for example, a system daemon such as **sched**, **vhand**, or **bdflush**), or an interrupt routine. These special conditions cause the CPU to switch into system mode and execute a trap handler inside the kernel.

If the trap happens in user mode (in other words, if the trap is caused by a user process), the kernel usually sends a signal to the process. For example, if a process executes an instruction that causes a divide-by-zero error, the CPU raises a divide-by-zero exception, and the trap handler ultimately sends a **SIGFPE** (floating point error) signal to the process. (See the **signal**(S) manual page for a complete list of supported signals.) Some user exceptions are legal and do not cause a signal. For example, a process may de-reference a valid pointer that identifies a piece of data in the process's data segment that is currently paged out of main memory. The CPU raises a page fault, and the trap handler then loads the page of data from the swap area into memory and restarts the instruction that caused the fault. In this case, the trap handler does not send a signal to the process.

However, if a process dereferences an invalid pointer (the pointer may be corrupt or uninitialized), the trap handler will determine that there is no corresponding page to load from either the filesystem or the swap area, and will send a **SIGSEGV** (segmentation violation) signal to the process.

Except for a few special circumstances, the kernel is not allowed to cause traps, faults, and exceptions "by itself," (in other words, when it is executing system calls, system processes, and interrupt routines). If the kernel does cause a fault, the situation is considered to be so serious that the system cannot continue to run. The trap handler calls a special **panic**( ) routine inside the kernel, which stops the system.

When the system panics because of an addressing violation, the current contents of the CPU registers are displayed on the console, the contents of the machine memory is written to *dumpdev* (usually the swap device) and the system makes an internal call to the kernel **haltsys**( ) function.

Console panic information

The information written to the console usually contains the current contents of the CPU registers, along with a kernel error message and a trap number that provide valuable information for analyzing the panic. The same display is available through the **panic** function of the **crash**(ADM) command run on a postmortem dump. Note that some crashes may not generate a register dump.

The console display when the system panics looks something like the following. The line numbers are included for reference only; they do not appear on the actual display.

```
 1 PANIC:
 2 cr0 0xFFFFFFEB   cr2  0x00FFFFFF   cr3 0x00002000   tlb  0x00500E80
 3 ss  0x00000038   uesp 0xD0119554   efl 0x00010282   ipl  0x00000000
 4 cs  0x00000158   eip  0xD0070488   err 0x00000000   trap 0x0000000E
 5 eax 0x00FFFFFF   ecx  0x00000000   edx 0x00000305   ebx  0xD00CD780
 6 esp 0xE0000D40   ebp  0xE0000D64   esi 0xD0119554   edi  0x00000038
 7 ds  0x00000160   es   0x00000160   fs  0x00000000   gs   0x00000000

 8 PANIC: Kernel mode trap.  Type 0x0000000E
 9 Trying to dump NNNN Pages.
10 &..............................................................
11 &..............................................................
12 NNNN Pages dumped


13 **   Safe to Power Off   **
14            - or -
15 ** Press Any Key To Reboot **
```

The value of *NNNN* depends on the amount of memory configured in your system. Each dot displayed on the screen corresponds to a 64KB block of memory (or 16 4K pages). Therefore, systems with more memory configured will have more dots than systems with less memory.

Getting the EIP number

The **EIP** (instruction pointer) value can be calculated from the contents of the CPU registers that are displayed on the console when the system panics. The **EIP** value is the address of the instruction the kernel was executing at the time of the panic.

To calculate the **EIP** value, join the register values for the Code Segment (**cs** register) and the Instruction Pointer (**eip** register) as a pair of numbers, separated by a colon, and without the leading zeros. In the sample above, these two values are at the beginning of line 4. The value of **cs** is `0x00000158` and the value of **eip** is `0xD007488`. Therefore, the **EIP** value is `158:D0070488`.

The **EIP** values of several panics can be compared to indicate whether the panics are being caused by a software or hardware condition. Three or more identical **EIP** values usually indicate a software problem; successive panics with different **EIP** values indicate a hardware problem such as a bad memory board. This is not a hard and fast rule; defective RAM can cause multiple panics with the same **EIP** value, for example.

Checking error messages

In most cases, the **PANIC** error message is displayed on the console (line 8 in the example). Look in the */usr/adm/messages* file for other messages that preceded the panic and may contain valuable information about what went wrong.

Kernel error messages report driver errors and errors in other parts of the kernel such as the process scheduling subsystem and the file subsystem. Monitoring these message regularly is an important step in preventing serious system problems; studying these messages after a system problem develops is an important part of troubleshooting the system. Reading the **PANIC** error message can give valuable information about the cause of the system failure.

Kernel error messages usually have the format:

class: [*ddname*:] [*routine*] *message*

class is usually one of the following: **CONFIG**, **NOTICE**, **WARNING**, **FATAL**, or **PANIC**. A number of these messages are documented on the **messages**(M) manual page.

Messages that have **INIT** for ***class*** are generated by the **init**(M) process and are documented on the **init**(M) manual page. These messages usually occur during system initialization. A few of the **init** messages indicate error conditions, but many more are just informational messages.

ddname names the driver or subsystem having problems. The actual peripheral is usually identified by a pair of numbers of the form ***major*/*minor***. This identifies the device number of the peripheral where the error occurred. The ***routine*** element indicates the subsystem that detected the condition; these portions of the error message are included mostly to help support staff in tracking difficult system problems.

PANIC messages are not usually logged in the */usr/adm/messages* file, but other messages that occurred before the panic are usually logged and can provide valuable information about the cause of the panic. The **PANIC** message is usually displayed on the system console or can be viewed with the **panic** function of the **crash**(ADM) command.

In the example console dump on "Console panic information" (page 257), the **PANIC** message does not follow the standard format. This usually means that the error is from the main kernel code and not a driver. In this case, the message includes a definition of the type of trap that caused the panic. The meaning of these trap numbers is defined in the */usr/include/sys/trap.h* file and documented on the **messages**(M) manual page. In this case, it is a paging violation, which usually occurs when an errant pointer is dereferenced in a driver or other kernel code.

Checking system files with error histories

The system maintains a number of files that contain historical information that may give you a clue as to what is causing the problem. The most useful are:

/usr/adm/messages
: log of all console messages logged by the kernel, including error messages and system startup information.

/etc/conf/cf.d/config.h
: list of kernel parameters with current values. This same information can be viewed with the **configure**(ADM) command. This information is useful when the system is giving **CONFIG** error messages.

/dev/string/cfg
: list of installed drivers. This same information can be viewed with the **hwconfig**(C) command.

Checking system configuration

System configuration errors can cause a wide range of problems: the system may not link right, processes may fail, or the system may just behave in peculiar ways. If you experience system problems after tuning the kernel or adding new software packages or hardware devices, check the system configuration. All such activities should be noted in a system log book (page 139). You can also study the startup statistics that are logged in the */usr/adm/messages* file; if the size of the kernel changes between boots, it indicates that the configuration was modified. The operating system includes a number of commands to help you check facets of the system configuration. Some of the more useful of these are:

/etc/conf/cf.d/configure -x | more
: value of kernel parameters. You can also view the */etc/conf/cf.d/config.h* file directly for this information.

  You can use the **sar**(ADM) command to get performance statistics about how tunable resources are being utilized. The **strstat** function of the **crash**(ADM) command or the **netstat -m** command displays statistics about the configured STREAMS resources, including information about structures that have overflowed since the system was last booted. See the **configure**(ADM) manual page and the *Performance Guide* for more information.

/etc/sysdef
: current value of some tunable parameters that affect kernel data structures.

/usr/bin/swconfig -p history and verification of software packages installed and/or removed from the system.

/usr/bin/hwconfig -h installed drivers. Some memory maps and drivers that are installed in the **/etc/rc.d** script are excluded. This information can also be viewed in the */dev/string/cfg* file.

/etc/custom whether packages are totally or partially installed.

/etc/custom -v quick SCO:Unix:RTS -x
verifies the presence, permissions and ownership of runtime system files. The **-x** flag specifies that fixes be made (where possible). Most importantly, this command repairs any broken symbolic links that may have rendered files unreachable. The above command only checks the operating system run time package. To check the entire system, use this command:

/etc/custom -V quick -x

custom leaves a copy of the verify output in *custom.VerifyReport*. There are other verify options available that perform different levels of checking. See the **custom**(ADM) manual page or "Verifying software" (page 77) for instructions on invoking the **Software Manager**.

/usr/bin/displaypkg information about software installed with the **installpkg**(ADM) utilities. Such packages do not show up in the **custom**(ADM) or **swconfig**(ADM) reports.

/tcb/bin/fixmog -v correct system file permissions to match the *Authentication* database. Use the **-i** option to run in interactive mode so you are prompted before any inconsistencies are corrected.

/tcb/bin/cps *pathname*
Similar to **fixmog**, but only checks the files specified rather than all system files.

Generating a system dump image with sysdump (ADM)

The **sysdump**(ADM) command generates a system dump image of a live system without disrupting normal operation of the system. The system dump image is saved to a file for later analysis with the **crash**(ADM) utility. To generate a system dump of a live system into the file *livedump* type:

/etc/sysdump -i /dev/mem -n /unix -o livedump

To use the crash utility to analyze the file:

/etc/crash -n livedump -d livedump

The **sysdump**(ADM) command can also generate a smaller system dump file on larger memory systems by ignoring portions of data that are not needed for analysis. The resulting "deflated" dump should be small enough to transfer electronically, which is convenient in situations calling for direct support-level analysis of panic dumps. This "deflated" file cannot be read with the **crash**(ADM) command. You must restore the reduced dump image to a file that can be read by the **crash**(ADM) command. For example, to create a live system dump image, excluding user memory pages (-u), free memory pages (-f), multiphysical tape buffers (-m), and process page tables (-t) to the file minidump:

/etc/sysdump -i /dev/mem -n /unix -fumto minidump

This file should be small enough to transfer between machines. To inflate the system dump file so it can be read by the **crash**(ADM) utility, use **sysdump**(ADM) to inflate the file *minidump* to *maxidump*:

/etc/sysdump -i minidump -O maxidump

You can use the **crash**(ADM) utility to analyze the file *maxidump*:

/etc/crash -n maxidump -d maxidump

For more information, please see the manual page for **sysdump**(ADM)

Examining a memory dump with crash(ADM)

The **crash**(ADM) command provides a great deal of information that is useful when implementing drivers or doing other kernel development, and requires a good understanding of UNIX system internals to take full advantage of the information provided. The notes in this section enable you to get some basic information about a system panic from the **crash** output.

To run **crash** on the memory dump on the */dev/swap* device (after the system has been rebooted to single-user state but before it goes to multiuser state), issue a command similar to the following. This command assumes that the system had been booted on the */unix.test* kernel image when it panicked, and saves all output to the */tmp/crash.out* file:

```
/etc/crash -d /dev/swap -n /unix.test -w /tmp/crash.out
```

For example, to run crash on the copy of the memory dump that was written to the */tmp/06May94* file with the **ldsysdump**(ADM) command using the */unix* kernel image file, you would use the command:

```
/etc/crash -d /tmp/06May94 -w /tmp/crash.out
```

For more information on **ldsysdump**, see "Recovering from a system panic" (page 254).

WARNING The argument to the **-n** option must be the name of the executable kernel file on which the system was last booted. If the **-n** option is not specified, **crash** assumes the */unix* file.

Studying a panic

The following list outlines the process for determining which kernel component caused a system panic. For detailed information about interpreting **crash**(ADM) output, see Appendix D, "Using the crash(ADM) diagnostic tool" in the *System Administration Guide*.

1. **PANICBOOT=NO** must be set in the */etc/default/boot* file for this to work.
2. When the system panics, write down the type of panic (see the **trap**(M) manual page), the EIP number, and the size of the dump in pages from the console display.
3. When the machine reboots, save the kernel dump that is on the *dump* device as shown in "Recovering from a system panic" (page 254).
4. Put the machine in single-user mode.
5. Run **crash**(ADM) on the image.
6. Use the **panic** command in **crash** to find the routine in which the panic happened. Be sure to verify that the trap type and EIP match those copied from the console screen after the panic.
7. Note the name (symbol name) of the routine that was executing when the system panicked. This is the function listed first under the `Kernel Stack before Trap` line.
8. Quit the **crash** command.
9. Use **strings**(C) or **nm**(CP) to determine the driver in which that routine is located. You can run a script such as the following, which uses **strings**.

```
:
for FILE in 'find /etc/conf/pack.d -name '*.[oa]' -print'
do
     strings $FILE | grep $1 && echo $FILE
done
```

If this script were installed as *findpanic*, you would run it with one argument that gives the name of the kernel routine:

```
findpanic symbol_name
```

This script will output something like:

```
routine_name
/etc/conf/pack.d/foo/Driver.o
```

This indicates that the **foo** driver may have been responsible for the system panic.

Admin

Additional help from SCO Support

If you are unable to determine the cause of a system panic, you may want to contact SCO Support for assistance. In addition to the installation checklist and the other configuration information you will be asked to supply in "Before calling for help" (page 64), it is useful to have a memory dump available. To provide this:

1. Save the memory dump to tape and restore it to disk with the **ldsysdump**(ADM) command, as discussed in "Recovering from a system panic" (page 254).
2. Extract the key troubleshooting reports from the dump with a command sequence similar to the following:

   ```
   # crash -d /tmp/06May94 -w /tmp/crash.out
   > panic
   > trace
   > user
   > quit
   ```

   Remember that the " > " prompt is generated by the **crash** command, so do not type them in. This will create the */tmp/crash.out* file that contains the output from the **panic, trace,** and **user** functions from the **crash** command.
3. Print out the */tmp/crash.out* file and fax it to your support provider or email the file itself.

Common system-wide problems

The following list summarizes some of the more common system-wide problems that can happen:

- Systems running graphical terminals or many different networking protocols often need to have the value of STREAMS tunables adjusted. Exceeding STREAMS resources generates error messages on the console and in the */usr/adm/message* file, and may cause graphical screens to be corrupted or networking operations to fail. This can cause a number of odd conditions such as random vertical lines on the graphical display. If you have intermittent odd problems on the system, use the **netstat**(TC) **-m** command or the **strstat** function in **crash**(ADM) to see if there have been overflows for any STREAMS resources.

- If files from system A are NFS-mounted on system B and system A is stopped, System B may be virtually non-functional. This is especially true if several processes on system B are trying to access the NFS-mounted files; most system resources will be dedicated to attempts to access the missing files and log their failures. Unmounting the NFS filesystems or rebooting system A will resolve the problem. In most cases, it is not necessary to reboot system B.
- Unless you are testing new drivers on your system, a large number of obscure kernel messages on the console and in the */usr/adm/messages* file that seem unrelated to any executing process may indicate a hardware failure on a key system component such as a memory board or the disk on which the root filesystem is located.
- If you are using memory-mapped peripherals that work well with DOS but behave erratically with your SCO system, try reinstalling the device and driver very generically. In other words, put the VGA card in an 8-bit slot; turn off RAM caching, disk caching, and shadow RAM; use 1 wait state, and ATCLK(* Mhz) on the card bus. Any cards that need to be software configured (such as the wd8003e or 3c503) should be checked in DOS. Move any shared IRQs to non-shared positions and do not use IRQ2 if you can avoid it. Check that port addresses overlap, and remember that intelligent memory mapped serial cards cannot have their memory maps cached.

  When the device is installed generically, it should work. You can then put back the special features, one at a time, until you determine which one is causing the problem.

cron, at, and batch troubleshooting

cron(C) is the clock daemon that schedules jobs to run automatically at a set time. The **at** and **batch** commands can be used by users to run non-interactive jobs once. See the **at**(C) manual page for more information.

cron daemon is not running

The **cron** daemon executes commands submitted with the **at**(C), **batch**(C), and **crontab**(C) commands at specified dates and times. (The **cron** daemon is started automatically by a script in the */etc/rc2.d* directory when the system is started in multiuser mode.) If **cron** is not running and you try to submit a job with one of these programs, the system displays the following message:

```
cron may not be running - call your system administrator
```

Admin

Another indicator that **cron** is not running is if previously scheduled jobs are not being executed. Use the following command to see if the **cron** daemon is running:

ps -ef | grep cron

If there is no **cron** process, then the daemon is not running. To start **cron**, log in as *root* and enter the following command:

sd cron

If this does not start the **cron** process, simply reboot the system. During startup, the system displays a message like the following:

```
! *** cron started *** pid = 140 Wed Aug 31 14:02:47 PDT 1994
```

The jobs scheduled with **at**, **batch**, and **crontab** should now execute properly. If **at** and **batch** continue to report error messages, refer to "at command fails: cannot change mode of job" (this page) for more information.

> **NOTE** If this is a persistent problem, you can start **cron** logging by entering **CRONLOG=YES** in the */etc/default/cron* file. After **cron** is started, the */usr/spool/cron/log* file will hold a record of all **cron** transactions. This information may help you determine why **cron** is halting.

at command fails: cannot change mode of job

If you do not have the kernel privilege, **chmodsugid**, the system displays the following message when a user tries to invoke **at**(C) or **batch**(C):

```
can't change mode of job
```

To grant **chmodsugid** privilege so that the user can use **at**, use the **Account Manager** as described in "Changing system privileges" in the *System Administration Guide.*

To allow the changes to take effect, the user must log out and then log in again.

This is different from the situation in which the user is not *authorized* to use **at**. If a user who is not authorized tries to use **at**, the system displays:

```
at: you are not authorized to use at.  Sorry.
```

To allow a user to use **at**, see "Changing the job scheduling permissions for a user" in the *System Administration Guide* for more information.

Runaway processes

A "runaway process" is a process that enters an infinite loop and spawns new processes. This can cause an overflow in the **proc** table that causes other processes to fail with the `No more processes:` error message.

A runaway process can cause an error that locks up the keyboard, preventing anything that the user types from reaching the system. Because of this, a runaway process cannot be stopped from the invoking terminal.

To continue, you must identify and stop the runaway process:

1. Log in as *root* on a terminal (or console screen) that is not locked.
2. Enter the **ps -ef** command and press ⟨Enter⟩. The system displays full information on all the current processes and their process identification numbers (PIDs). Find the PID of the runaway program. You may see a program that is consuming more CPU time than is reasonable, or may find a large number of processes with a common parent who are running the same program.
3. Enter the **kill** ***PID*** command. The program should stop in a few seconds. If the process does not stop, enter the **kill -9** ***PID*** command.

The last command may leave temporary files that are usually removed when a program terminates normally, or a non-echoing terminal. Refer to "Restoring non-echoing terminals" (page 448) to restore the terminal to normal operation.

If the runaway process does not stop when you enter **kill** with the **-9** option, the process is considered "unkillable". If the unkillable process is a user's shell, you must stop the process before that user can continue working. To stop an unkillable process, you must reboot the system. Use the following procedure:

1. Log in as *root* and send a message using **wall**(ADM) to the other system users notifying them of the impending shutdown.
2. When all the users have logged out, shut down the system by entering **init 6**. The root prompt (#) is returned, but the shutdown process begins soon afterward.
3. Reboot the system by pressing ⟨Enter⟩ at the `Boot:` prompt.

The unkillable process no longer appears when you run **ps**.

Hardware configuration

Chapter 14

Basic hardware configuration

This chapter presents general hardware configuration information, including:

- new and updated driver support (page 273)
- supported architectures (page 274)
- general compatibility issues (page 274)
- device interrupts (page 275)
- configuring devices with bootstrings (page 276)
- using boot-time loadable drivers (page 284)
- configuring drivers with the **Hardware/Kernel Manager** (page 286)
- relinking the kernel (page 290)
- configuring power management (page 291)

You may also need to configure other hardware components, as illustrated in Figure 14-1, "The major hardware components of a typical system" (page 272).

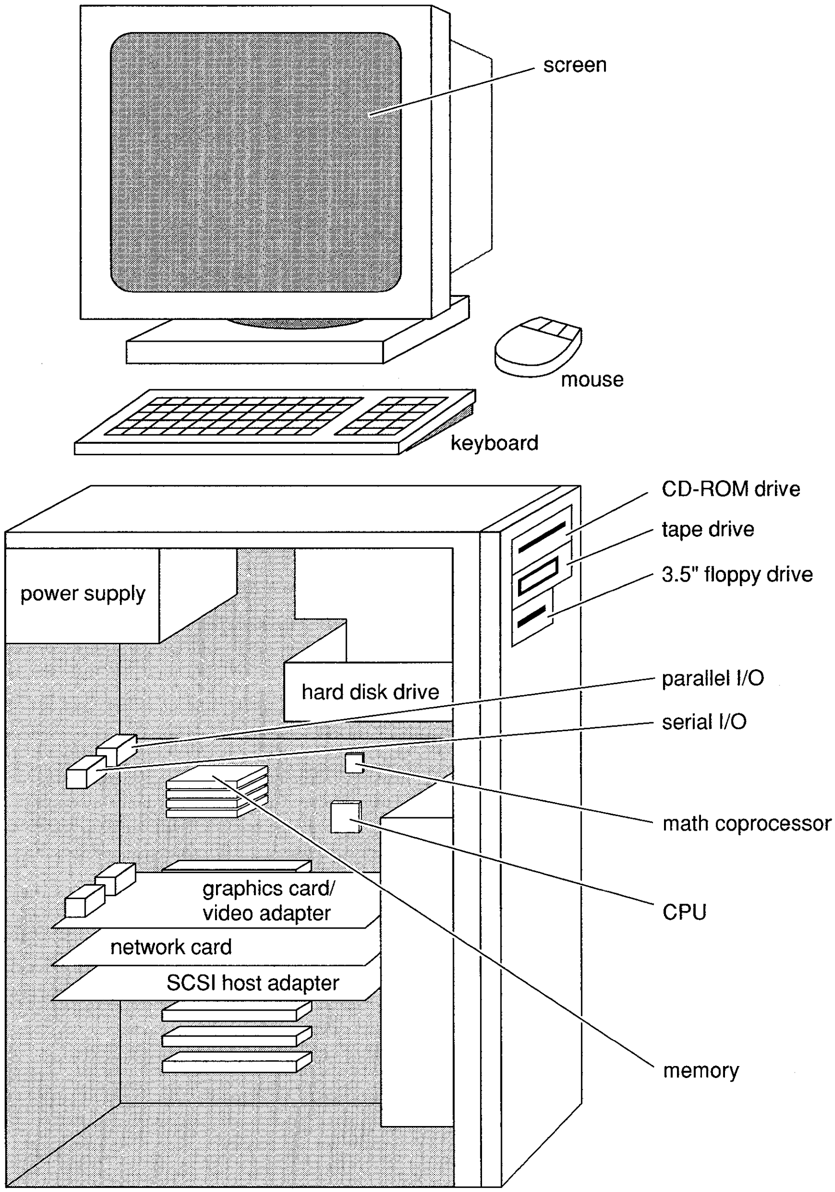


Figure 14-1 The major hardware components of a typical system

Information on installing and configuring these components is provided in later chapters. See:

- **CD-ROM drive** (page 307)
- **graphics adapter** (page 355)
- **hard disk drive** (page 323)
- **ISA Plug and Play (PnP) device** (page 311)
- **math coprocessor** (page 299)
- **memory** (page 297)
- **mouse** (page 387)
- **network adapter** (page 481)
- **parallel I/O** (page 376)
- **power supply** (page 291)
- **SCSI host adapter** (page 303)
- **serial I/O** (page 368)
- **tape drive** (page 343)

Accessing the SCO Compatible Hardware Web Pages

The most current information about SCO hardware support is available on the SCO Compatible Hardware Web Pages (CHWP). Their URL (Uniform Resource Locator) is:

http://www.sco.com/chwp

The CHWP include:

- listings of devices supported on SCO platforms
- notices of new and updated drivers for supported devices
- technical information concerning driver installation, configuration, and troubleshooting

New and updated drivers for current and previous SCO OpenServer releases can be downloaded from the SCO Software Library:

ftp://ftp.sco.com/pub/drivers/

Because today's computer hardware market changes rapidly, we recommend that you consult these web pages regularly. In particular, we recommend that you verify support for your devices before installing or upgrading drivers or operating system products.

Supported architecture

Except where otherwise noted, the hardware information in this book applies to the PC bus architectures supported by SCO: Industry Standard Architecture (ISA), Extended Industry Standard Architecture (EISA), Micro Channel Architecture (MCA), and Peripheral Component Interconnect (PCI). SCO OpenServer systems support a limited number of Personal Computer Memory Card Interface Association (PCMCIA) cards but do not currently support the complete PCMCIA subsystem.

In addition to the specific devices mentioned here, there are many others which require additional vendor supplied software. These are available from, and supported by, independent hardware vendors. Call your reseller or sales representative and ask for the latest *SCO Hardware Compatibility Handbook* or the *SCO Directory*. These are also available online from the SCO World Wide Web homepage and can be accessed with a suitable browser. The URL (Uniform Resource Locator) is:

http://www.sco.com/chwp

General compatibility issues

If your computer is listed as a supported machine in the SCO list of compatible hardware it should run SCO OpenServer systems. However, if you are adding additional hardware such as host, video, or network adapters you may require new or updated device drivers. New and updated drivers are supplied with each SCO OpenServer release; see *SCO OpenServer Features and Limitations* for details about devices supported in this release. See also "Accessing the SCO Compatible Hardware Web Pages" (page 273) for more information about device support on SCO platforms.

> **NOTE** Supported machines are not always supplied with video adapters from the same manufacturer. Check the video adapter for compatibility.
>
> The hardware described in this book has been tested with SCO OpenServer systems. However, because the manufacturers of compatible machines or add-on peripherals may change configuration, functionality, or firmware at any time, no guarantee is implied.

To determine whether hardware components are compatible with your machine, you must know the processor (for example, 386, 486 or Pentium™) and the bus architecture (ISA, EISA, MCA and PCI) that it uses. You should also be aware of the type of disk controller in your system.

Some computers arrive with the hard disk only partially formatted. If you have such a machine, use the correct low-level or hard format procedure as described in the manual for your hard disk controller before installing an SCO OpenServer system. This does *not* apply to most SCSI or IDE hard disk drives.

We recommended that you install the operating system without any additional or unnecessary hardware installed on the system and with any switch settings at their factory defaults. Hardware configuration conflicts can make installation of an SCO OpenServer system difficult or impossible.

If you have added any boards, make sure that all switches or software-controlled settings are set as recommended in the manufacturer's hardware manual for that board. Some computers require specific switches or software-controlled settings to run SCO OpenServer systems. If your computer does not run the SCO OpenServer system with the settings as shipped, contact your computer hardware representative for the proper settings.

Typical device interrupts

One of the most common causes of problems both during and after installation is a device interrupt conflict. Make sure device interrupts do not conflict and do not use the reserved interrupts indicated in Table 14-1 or your system will probably fail to boot.

Table 14-1 Typical device interrupts

Interrupt	Octal	Device
0*	0	Clock
1*	1	Console
2	2	Networks, tapes and others
3	3	Serial COM2
4	4	Serial COM1
5	5	Alternate parallel port (lp2)
6*	6	Floppy disk
7	7	Main parallel port (lp0 or lp1)
9*	11	Chain from IRQ2
10	12	
11*	13	SCSI host adapter 0
12	14	SCSI host adapter 1
13*	15	FPU
14*	16	ST506/ESDI/IDE controller 0
15	17	ST506/EDSI/IDE controller 1

* Do not attempt to use these interrupts for any other purpose.

Configuring devices with bootstrings

You should read "Using bootstrings" (this page) if any of these conditions are true:

- You are planning to install a combination of devices in your computer and do not want to install the operating system on the default device.
- You want to install an SCO OpenServer system from a tape distribution and you wish to configure your tape drive at a location other than the default.
- You want to disable any erroneous device presence tests or driver actions.
- Following installation, you need to boot from a device that was not configured at the time your kernel was created. For example, the tape configuration on your emergency boot floppy set no longer matches your system's current tape drive configuration.

Using bootstrings

A bootstring is a special command or text string that is entered at the `Boot:` prompt displayed at system startup. Normally this process is transparent to the operator because when you press ⟨Enter⟩ at the `Boot:` prompt, the system uses a pre-defined bootstring such as **hd(40)unix** specified by **DEFBOOTSTR** in */etc/default/boot*.

There are special bootstrings that permit you to define device configurations that override system defaults (without relinking the kernel). For example, you might be using a tape drive at a non-standard address or the system might not be recognizing your host adapter correctly. In a similar way, new device drivers that are not supplied with SCO OpenServer systems can be installed from a floppy disk using the **link** bootstring.

To define or redefine a device at boot time:

1. Decide which bootstring you need to use, the most common are listed here:
   - **apm** (page 277)
   - **ct** (page 279)
   - **Sdsk, Stp, Srom** (page 280)
   - **adapter** (page 281)
   - **hd** (page 281)
   - **disable** (page 282)

- **mem** (page 283)
- **cache** (page 283)
- **systty** (page 284)

Make certain the bootstring parameters you use match your hardware configuration. Additional bootstrings are documented in the **boot**(HW) manual page.

2. Turn the machine on and wait for the `Boot:` prompt. If you are performing an installation, note that this is the only time the `Boot:` prompt appears; you are not given the opportunity to reboot during the installation unless you are installing from tape.

   Now enter the necessary bootstrings separated by spaces. For example:

   defbootstr Stp=wdha(1,1,0)

defbootstr is not shown in the following examples, but remember that it should be included on the boot line. The system then boots according to the information you provided. If you entered the bootstring incorrectly, an error message is displayed.

For additional information on the boot process and bootstrings, see the **boot**(HW), **boot**(F), **bootstring**(HW), **link**(HW), and **mem**(HW) manual pages.

Advanced Power Management bootstrings

If you need to configure, control, or query the operating system's power management facilities after it has booted, you should use the Power Management control shell, **pwrsh**(ADM). See "Configuring Power Management" (page 291).

Access to your system's BIOS-APM at boot time by **boot**(HW) is controlled by the **apm.*cmd*=** bootstring. When **boot** runs, it executes any **apm.*cmd*=** lines found in */etc/default/boot* (see the *boot*(F) manual page); these define the default APM handling. Any stand-alone **apm.*cmd*=** commands issued at the boot prompt override these settings. Alternatively, **apm.*cmd*=** may be specified as an argument to most stand-alone commands.

The following bootstring arguments can be used to configure APM if it is accessible:

apm.boot=*test*
: Only boot if ***test*** is true.

apm.check=no
: Do not check for APM support. Any BIOS-APM will be ignored.

apm.check=verbose
: Same as **apm.check=yes**, but prints error messages.

Hardware

apm.check=yes
Check for APM support (default).

apm.exists=disable
Try to disable any BIOS-APM found. The APM is not used again.

apm.exists=ignore
Do not get power status. The BIOS-APM will not be used again.

apm.exists=status
Try to get power status (default). The various internal parameters that store the status of the batteries and mains power can be tested using the **apm.warn** and **apm.boot** bootstrings. These allow booting to be aborted and a warning issued if there is insufficient power available.

A status error does not stop APM being used; in that case, the **apm.warn=** and **apm.boot=** conditions are not tested.

apm.exists=verbose
Print messages on failure; otherwise, **apm.exists=status** is silent on errors.

apm.warn=*test*
Issue a warning if the ***test*** is true. The syntax of the boolean ***test*** is defined on the **hasapm**(ADM) manual page.

The **apm.warn=*test*** and **apm.boot=*test*** strings are used typically to prevent booting when the batteries are exhausted.

The default **apm.boot** test is:

```
ac.online | charge.high | charge.low | (!charge.unknown & % >= 15)
```

which permits the boot process to proceed if AC mains power is being used or the batteries have sufficient charge (greater than or equal to 15%).

The default **apm.warn** test is:

```
!ac.online & (charge.low | charge.critical | (!charge.unknown & % <= 25))
```

which issues a warning if AC mains power is not being used and the BIOS-APM reports that the charge in the batteries is low (less than or equal to 25%).

These tests should work on systems where the APM firmware can deduce the approximate status of the battery without knowing the percentage charge remaining.

On some machines, the APM firmware does not know the condition of the battery. It may then report no charge remaining (% = 0 is true) rather than admitting that the charge is unknown (**charge.unknown** is true). Consequently, either of the above test conditions may always be true when such machines are using batteries rather than AC power.

To try to overcome this problem, the **apm.warn** test could be changed to:

```
!ac.online & !battery.unknown & (charge.critical | % <= 25)
```

However, this may not work on all such machines.

Different manufacturers interpret different percentages of remaining charge or approximate battery status as being "high", "low", or "critical". These interpretations may have been designed to be used with proprietary software, and so may be misleading. They may not produce satisfactory results if they are used as indicators of the battery's charge state. Checking the percentage of remaining charge should be more satisfactory, but is not possible on all machines.

The kernel can only use APM if it supports a 32-bit Protected Mode interface. If such an interface is available, one of the following bootstrings can be used:

apm.connect=disable
: Try to disable BIOS-APM interface. Proceed with boot.

apm.connect=must
: Try to connect, and stop booting if this fails.

apm.connect=no
: Do not use the BIOS-APM interface. Proceed with boot.

apm.connect=yes
: Try to use the BIOS-APM interface, and continue to boot even if this fails (default).

In the absence of such an interface, the following bootstrings are obeyed:

apm.no32pm=disable
: Try to disable APM.

apm.no32pm=ignore
: Print warning message and proceed to boot. APM will not be used (default).

apm.no32pm=ok
: Same as **ignore**, but no warning is printed.

QIC-02 tape drive bootstrings

Use the **ct** driver bootstring to override the default tape configuration included on the SCO OpenServer tape cartridge distribution. It is intended for use during installation and does not replace the functions of the **Hardware/Kernel Manager** or **mkdev tape** described in "Installing a tape drive" (page 344). If you later run the **Hardware/Kernel Manager** or **mkdev tape** to add a cartridge tape drive, you are prompted as to whether you wish to modify the current tape bootstring, retain it, or remove it entirely.

> **NOTE** The **ct** bootstring only applies to QIC-02 cartridge tape drives; it does not work for SCSI, QIC-40, or Irwin drives. SCSI bootstrings are described in "SCSI peripheral bootstrings" (page 280).

The **ct** bootstring has the general format:

ct=*controller*(*base*,*irq*,*dma*)

where:

controller	is the brand name of the tape drive controller
base	is the base address of the controller
irq	is the controller's interrupt request number (IRQ)
dma	is the controller's DMA channel number

Numbers prefixed with **0x** are assumed to be hexadecimal, other numbers are assumed to be decimal. You must also specify the kernel boot device. A complete boot line could look like this:

```
Boot: hd(40)unix ct=wangtek(0x338,5,1)
```

When you invoke the tape bootstring manually, you must specify **hd(40)unix** or **fd(64)unix**, not just **unix**. The tape bootstring is not checked until the driver is initialized. If the configuration information supplied in the bootstring appears to be invalid (for example, the controller named in the bootstring is not supported), then a warning message is printed, and the tape driver ignores the bootstring and uses the default configuration.

SCSI peripheral bootstrings

SCSI device bootstrings allow you to install the SCO OpenServer system from a device connected to the system at a SCSI address other than the default. For example, you should use the **Stp** bootstring during installation if your tape drive is configured at a SCSI ID that is not currently allowed as a boot device by the installation kernel.

The syntax for SCSI bootstrings is:

***periph*=*adapter*(*hanum*,[*bus*,]*id*,*lun*)**

where:

periph	is the SCSI peripheral driver name:	
	Sdsk	hard disk
	Sflp	floptical
	Srom	CD-ROM
	Stp	tape
adapter	is the host adapter driver prefix	
hanum	is the host adapter number: 0–7	
bus	is the number of the bus on a dual or multichannel host adapter: 0 for the primary, 1 for the secondary, and so on. This field is optional. The default value is 0 which is suitable for single bus adapters.	

id	is the peripheral's SCSI id: 0–7 on SCSI 1 bus, 0–15 on 16-bit-wide SCSI 2 bus
lun	is the peripheral's SCSI logical unit number (LUN): 0–7

Valid host adapter driver prefixes are defined in the file */etc/default/scsihas*.

For example, to define a SCSI tape device connected to the first Future Domain adapter at id 4, lun 0, use the following bootstring:

Stp=fdha(0,4,0)

SCSI host adapter bootstrings

The **adapter** bootstring overrides the kernel's default configuration for a given host adapter. It has the following syntax:

adapter=*driver*(*base, int, dma*)

where:

driver	is the host adapter driver prefix
base	is the adapter I/O base address
int	is the adapter interrupt vector
dma	is the adapter DMA channel

A list of host adapter driver prefixes appears in */etc/default/scsihas*.

If the kernel fails to recognize, or incorrectly identifies, your SCSI adapter at boot time, you can use the **adapter** bootstring to define it. For example, if you have an Adaptec 1522 board installed and the system fails to recognize it as configured, you would use a bootstring similar:

adapter=spad(0x340,11,0)

NOTE Many EISA, MCA and PCI drivers get configuration data exclusively from CMOS RAM, ignoring bootstrings.

Root hard disk bootstrings

The **hd** bootstring overrides the default search sequence used by the **hd** driver to determine the root disk. The syntax of the bootstring is:

hd=*driver*

where ***driver*** is the disk driver prefix.

Valid *driver* prefixes are:

esdi	ESDI disk controller on MCA machines
ida0	Compaq IDA controller
st506	ST506 disk controller on MCA machines
Sdsk	generic SCSI disk driver for all machine architectures
wd0	generic Western Digital WD1010 disk driver for controllers such as ESDI and IDE that present a ST506 interface on ISA and EISA machines

This bootstring is required by those controllers (such as some Compaq IDA and some SCSI host adapters) that appear to be WD1010-style controllers. By default, **hd** recognizes the **wd** driver before the **Sdsk** or **ida** drivers. This prevents these disks from being configured as the root disk.

To boot from a Compaq IDA drive, you would use the bootstring **hd=ida0**.

You should add this bootstring to the definition of **DEFBOOTSTR** in the file */etc/default/boot* so that the system uses the correct root disk configuration when it boots.

Disabling drivers with bootstrings

Sometimes the system may detect a device that is not actually present. You can use the **disable** bootstring to disable the driver. The syntax of the bootstring is:

> disable=*driver*[,*driver* ...]

For example, if you wanted to disable the **dpt** driver and boot from another device on the system, you would use the bootstring **disable=dpt**.

If you are having trouble installing SCO OpenServer due to errors with specific drivers, you can disable these drivers with the **disable** bootstring. Provided that these drivers are not required to install the system, use the following:

To disable machine architecture checking, type:

> **boot: defbootstr mcheck.disable**

To prevent the retrieval of information about hardware on the PCI bus, type:

> **boot: defbootstr pci.bios32**

To prevent scanning the SCSI bus for additional hard drives, type:

> **boot: defbootstr scsi.noscan**

To prevent scanning the ATAPI interface on the IDE bus for additional hard drives, type:

> **boot: defbootstr wd.noscan**

Specifying the location of an EIDE (IDE) CD-ROM

The **srom** bootstring allows you to specify the location of a CD-ROM on the EDIE (IDE) bus:

srom=wd(<IDE Controller>, <Master/Slave>, <LUN>, <BUS>)

The valid options for any of the above arguments are "1" or "0". For example, to specify a CD-ROM that is on the secondary IDE controller that is set to master, type:

srom=wd(1,0,0,0)

If the CD-ROM is the only device on the IDE interface, it must be set to master.

NOTE Please note that you cannot specify IDE hard drives in the same manner. If IDE hard drives are present, the installation uses the Primary / Master IDE hard drive as the root drive.

Memory bootstrings

The **mem** bootstring enables you to discover how much memory **boot** thinks your system has, and to reconfigure this if necessary. To find out how much memory **boot** thinks your system has, enter **mem=/p**.

NOTE **boot** ignores memory definitions below 1MB. The operating system cannot address high memory from 640KB to 1MB, and its upper address limit is 4GB.

To define your system as having 12MB of memory starting at 1MB in addition to its 640KB base memory, enter **mem=1m+12m** or, alternatively, **mem=1m-13m** You can use this to limit the memory size of your machine artificially — for example, to test the performance of an application on a machine with a smaller amount of memory. You can only allocate memory as pages aligned on 4KB boundaries.

Memory above 16MB is not addressable by DMA for those peripheral controllers that only support 24-bit addressing. To mark memory above 16MB on a 24MB machine as non-DMAable, enter **mem=1m-16m,16m+8m/n**.

For more information about the **mem** bootstring, see the **mem**(HW) manual page.

cache bootstring

Both 486 and Pentium processors have an internal on-chip cache and an optional external cache. **boot** can control the cache behaviour with the **cache** bootstring. The following options are available:

/d Disable flushing the cache. Booting will take less time if flushing is disabled. However, this may cause some machines to incorrectly size memory or fail to boot.

/e Enable flushing the cache (default).

/n Switch off the cache before loading the kernel. This may be necessary for some machines which have problems with cache coherence (this occurs when DMA does not notify the internal cache that memory has been written to directly).

/y Switch on the cache after the kernel is loaded (default). Machine performance is enhanced if caching is enabled.

System console bootstring

You can select the system console at boot time using the **kernel.systty** bootstring:

kernel.systty=cn	selects the main console (the default)
kernel.systty=sio	selects COM1 (*/dev/tty1a*) operating at 9600bps with no parity.

See the **bootstring**(HW) manual page for further details. You can also set these bootstrings as arguments to a defined bootstring in */etc/default/boot* such as **DEFBOOTSTR** (see the *boot*(F) manual page.)

Using boot-time loadable drivers

Boot-time loadable drivers (BTLDs) provide access to hardware devices that are not supported by the current kernel. The **boot**(HW) program invokes the separate **link**(HW) program to link-edit the new driver into the kernel after it has been loaded, but before it runs. You would typically use a BTLD package to add a driver needed for installation, although you can use a BTLD at any subsequent time to add a driver to your system. Using a BTLD, you can install onto new hardware, or use new hardware as soon as a driver is available. New and updated BTLDs for current and previous SCO OpenServer releases can be downloaded from the SCO Software Library:

ftp://ftp.sco.com/pub/drivers/

There are two ways to install BTLD disks on your system:

- at the `Boot:` prompt (page 285)
- after initial installation using **installpkg** (page 286).

Adding BTLDs at boot time

To add a driver at boot time (for example during installation) use the **link**(HW) program. This can only be accessed from the `Boot:` prompt; it cannot be executed once the kernel has loaded.

Invoke **link** by typing **link** at the `Boot:` prompt and pressing ⟨Enter⟩, or by using the **link=** bootstring argument.

If you invoke **link** directly, it prompts for the names of the packages to load:

```
What packages do you need linked into the system,
or q to quit?: pkg1 pkg2
```

The **link** command ignores any **link=** bootstring arguments.

Alternatively, you can use a **link=** bootstring argument which has the syntax:

link="*pkg1 pkg2* . . ."

where ***pkg1***, ***pkg2*** and so on are the names of BTLD packages to be linked into the loaded system kernel.

If the package names do not include the name of the ***device*** from which to read the BTLDs, you can define the device using the **bltd** (or **btlddev**) bootstring. The default device is usually the same as the one from which the **boot** program was loaded.

After the kernel loads but before it runs, **link** prompts you to insert the appropriate floppy disk for each BTLD package you specified.

You may now be prompted to enter any tuneable parameters and hardware-dependent parameters such as the interrupt vector (IRQ), DMA channel, and base I/O address. If any conflicts occur (for example, if the interrupt vector that the boot-loaded driver wants to use is already occupied by another driver), **boot** explains the problem, lists the possible resolutions, and prompts you to choose.

If any errors occur while the BTLDs are being extracted, you must reboot the system. Insert the N00 (installation boot) floppy, and enter **restart** at the `Boot:` prompt to restart the installation or upgrade from the beginning.

NOTE Retain the BTLD disk(s) for use later in the installation. You will need them to configure the drivers into the Link Kit.

Adding BTLDs after initial installation

To add BTLD drivers after installation:

1. Login as *root*, put the system into system maintenance mode, and run **installpkg**(ADM) from the command line.
2. If prompted, select the floppy drive from which to install.
3. Insert the BTLD disk when prompted and press ⟨Enter⟩.
4. Enter the names of the packages to be added. When prompted, insert the appropriate floppy disk into the drive.
5. You may now be prompted to enter any tuneable parameters and hardware-dependent parameters such as the IRQ, DMA channel, and base I/O address. If any conflicts occur (for example, if the IRQ that the boot-loaded driver wants to use is already occupied by another driver), **boot** explains the problem and lists the possible resolutions.
6. On returning to the command prompt, relink the kernel as described in "Relinking the kernel" (page 290) and reboot the system.

Configuring drivers with the Hardware/Kernel Manager

To add support for a device (such as a hard disk or mouse) to your system, configure the driver for that device and then link the driver into the kernel.

In the **Hardware/Kernel Manager** (page 287), select a driver to configure from the list, then click on the **Configure Driver** button. Follow the prompts. For more information, see "About device driver configuration" (page 288).

Once you configure the driver, click on the **Relink Kernel** button; click on **Relink** to confirm. See "Relinking the kernel" (page 290) for more information. To activate the new kernel once it is relinked, reboot your system using the **System Shutdown Manager** or the **shutdown**(ADM) command.

You can also use the **Hardware/Kernel Manager** to tune the kernel parameters. To do this, click on the **Tune Parameters** button. See "Configuration tools" in the *Performance Guide*.

See also:

- "The Hardware / Kernel Manager interface" (this page)
- "The UNIX system kernel" in the *Operating System User's Guide*
- **mkdev**(ADM) manual page for command-line interface

The Hardware/Kernel Manager interface

Use the **Hardware/Kernel Manager** to configure drivers, tune system parameters, and relink the kernel. You can start the **Hardware/Kernel Manager** in any of these ways:

- Double-click on the **Hardware/Kernel Manager** icon in the *System Administration* window on the Desktop.
- Start the SCOadmin launcher by entering **scoadmin** on the command line, then selecting **Hardware/Kernel Manager**.
- Enter **scoadmin hardware/kernel manager** on the command line.

For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

Hardware

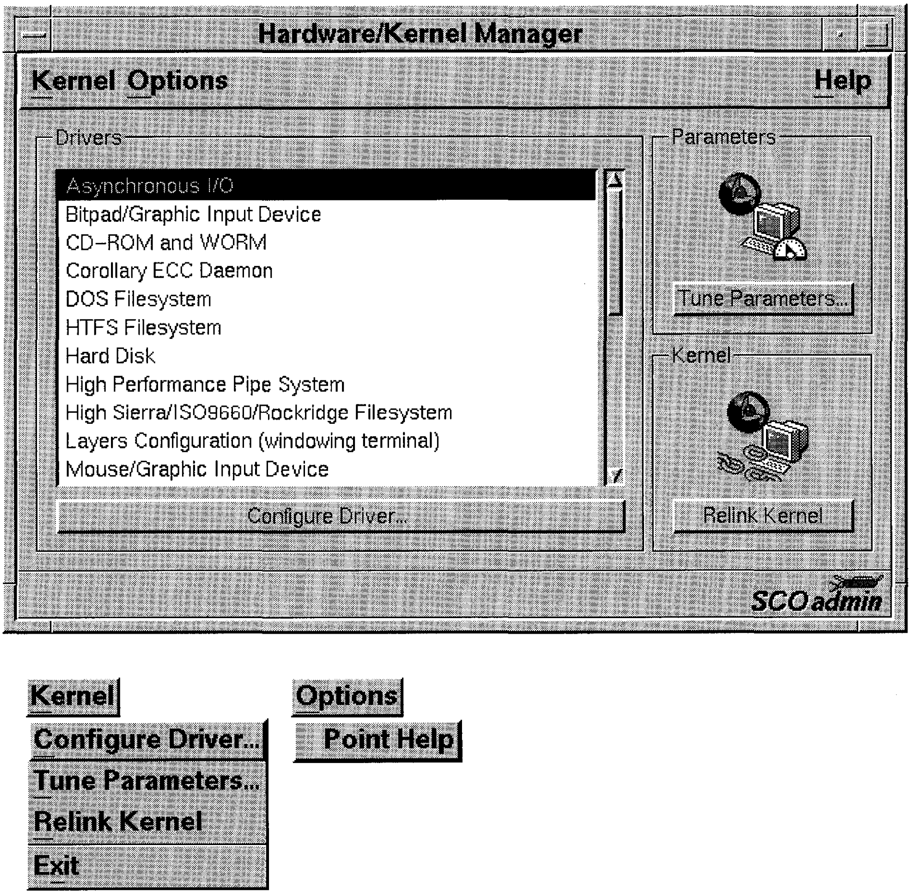


Figure 14-2 The main Hardware/Kernel Manager screen

About device driver configuration

Use the **Hardware/Kernel Manager** (page 286) to configure device drivers into the kernel. For a detailed description of driver configuration by device type, see:

Asynchronous I/O
"Asynchronous I/O" in the *Performance Guide*

Bitpad/Graphic Input Device
"Installing a bitpad" (page 394)

CD-ROM and WORM
"Adding SCSI/EIDE CD-ROM drives" (page 307)

Corollary ECC Daemon
the **eccd**(ADM) manual page

DOS Filesystem
"Adding support for different filesystem types" in the *System Administration Guide*

HTFS Filesystem
"Adding support for different filesystem types" in the *System Administration Guide*

Hard Disk
"Installing a hard disk" (page 327)

High Performance Pipe System (HPPS)
the **pipe**(ADM) manual page

High Sierra/ISO9660/Rockridge Filesystem
"Adding support for different filesystem types" in the *System Administration Guide*

Layers
the **layers**(C) manual page

Mouse/Graphic Input Device
"Configuring a mouse" (page 389)

Parallel Port
"Adding and configuring parallel ports" (page 376)

Power Management (PM)
"Configuring Power Management" (page 291)

Pseudo-ttys
"Adding or removing pseudo-ttys" in the *Networking Guide*

SCSI Floptical
"Adding floptical drives" (page 309)

SCSI Tape Drive
"Installing a SCSI tape drive" (page 347)

Serial Port
"Adding and configuring SCO-supported serial cards" (page 368)

Shell Layers
the **shl**(C) manual page

Streams
"STREAMS resources" in the *Performance Guide*

Tape drive
"Installing a tape drive" (page 344)

XENIX Filesystem
"Adding support for different filesystem types" in the *System Administration Guide*

See also:

- "Configuring drivers with the Hardware/Kernel Manager" (page 286)
- **mkdev**(ADM) manual page for command-line interface
- Chapter 20, "Configuring video adapters" (page 355)
- Chapter 29, "Configuring network connections" (page 481)

Relinking the kernel

During the boot process, the operating system uses drivers that have been built into the kernel (unless these are bypassed using specific bootstrings). To specify drivers for new or additional hardware that has been added to your system, you must add these drivers into the kernel using the **Hardware/Kernel Manager** or the **mkdev** utility. The kernel must then be relinked so that these new drivers are available next time the system is booted.

It is also possible to relink the kernel by hand. You might do this when, for example when you have added several different drivers to the system and chosen not to relink as part of the **mkdev** process, or you have installed BTLDs using **installpkg**(ADM). In order to relink the kernel you must be logged in as *root*, and the Link Kit must be installed on your system.

To relink the kernel by hand:

1. Enter:

   cd /etc/conf/cf.d
   ./link_unix

   The linking process will now begin. The speed with which the kernel relinks depends on a number of factors; the process can take several minutes on slower machines.

   Once the kernel has been rebuilt you will see the following message:

   ```
   The UNIX kernel has been rebuilt.

   Do you want this kernel to boot by default?
   ```

   Enter "y" if you want this to be the boot kernel.

The system now backs up the old kernel by moving the current */unix* file to */unix.old*, then asks whether you also want the kernel environment rebuilt. This will make any necessary changes to the */etc/inittab* and device node files. Enter "y" to rebuild the kernel environment.

The system will respond with a message that the kernel has been successfully linked and installed and that you must now reboot the system for any changes to take effect.

2. Use the **shutdown** command to shut the system down then reboot it.

Configuring Power Management

Some machines (typically laptops and Energy Star or "green" systems) provide facilities for controlling power consumption. SCO OpenServer systems can use APM if it supports a 32-bit Protected Mode interface, and it resides in the computer's BIOS (that is, APM is not loaded as a separate driver).

On laptops, the power management facilities usually provide a report on the battery charge level, permitting you to shut down the machine before the batteries are completely discharged. Some systems may be able to turn off hard disks or monitors after a period of inactivity, or by explicit command.

NOTE APM is not configured in the kernel by default. You must run the **mkdev pm** command or use the **Hardware/Kernel Manager** to install the APM driver and support utilities.

If your system has the required APM hardware, and this was recognized and enabled by **boot**(HW) at boot time, see "Advanced Power Management bootstrings" (page 277). The Power Management daemon, **pwrd**(ADM), runs to handle system events notified by the BIOS-APM firmware, such as low power. Possible events are defined in the file */etc/pwr/sys/events*, the format is defined on the *pwrevents*(F) manual page. An action is defined for each event that allows the system to respond appropriately. Possible actions are defined in the file */etc/pwr/sys/actions*, the format for which is defined on the *pwraction*(F) manual page. You can find the scripts invoked by the *action* file in the directory */etc/pwr/lib*. An example is **battery** which shuts the system down if the power is low. Edit the *actions* file and scripts to tailor the response of your system to the various power events. However, events are pre-defined in the BIOS; you cannot configure the thresholds at which they occur yourself.

Configuring APM using pwrsh

As an alternative to configuring the **pwrd** daemon, you can use the **pwrsh**(ADM) command to configure, control, or query the power management facilities of your system after it has booted. Typically, you would run **pwrsh** regularly as a **crontab**(C) entry for *root* to check the charge status of the batteries and take appropriate action if necessary. To prevent interaction with **pwrd**, change the command (***cmd***) associated with the appropriate event's action to "exit 0". See "Checking battery status regularly" (page 293) for an example of how to do this.

> **WARNING** BIOS-APM firmware from different manufacturers varies considerably in operation and efficacy. What may be a safe or useful sequence of commands on one machine may be ineffectual or worse on another.

pwrsh can read commands from the command line (using the **-c** option) from a specified file, from the standard input, or interactively. If you run **pwrsh** interactively, use the **?** or **help** command for information about other commands. Enter **quit** or ⟨Ctrl⟩**D** to leave **pwrsh**. You can use the **status** command to obtain the boot-time, previous, or current power status of the machine's AC supply and batteries:

```
/etc/pwr/bin/pwrsh -c "status -b -AB # print boot-time power status"
/etc/pwr/bin/pwrsh -c "status -n -AB # print previous power status"
/etc/pwr/bin/pwrsh -c "status -AB    # print current power status"
```

You can also specify a power test condition to the **status** command in the style of **hasapm**(ADM) — see also the description for the **apm.boot** and **apm.warn** in "Advanced Power Management bootstrings" (page 277). **pwrsh** exits with a value determined by the last command executed. When a test is used with the **status** command, this is the result of the test:

```
[ /etc/pwr/bin/pwrsh -c "status -s \
!ac.online & (!charge.low | !charge.critical | \
(!charge.unknown & % <= 25))" ] \
&& echo "No AC power and battery charge is low!"
```

You can use the **state** command to turn the system or peripheral devices on (**Ready**) or **Off**, make them **Idle** but automatically ready for use, or **Freeze** them to conserve data.

> **NOTE** Some BIOS-APM firmware can only **Freeze** the entire system or turn **Off** individual peripherals.

For example, the following command idles the entire system if battery power is low and the AC supply is not being used:

**[/etc/pwr/bin/pwrsh -c "status -s **
**!ac.online & (charge.low | charge.critical)"] **
&& /etc/pwr/bin/pwrsh -c "state -i all"

The following command freezes the video screen and keyboard and idles the hard and floppy disks:

**/etc/pwr/bin/pwrsh -c "state -f display **
state -i storage"

Checking battery status regularly

The following **crontab** entry for *root* calls the executable file */usr/local/bin/check_batts* every 15 minutes:

```
15 * * * * /usr/local/bin/check_batts 2>&1 | mail root
```

The **check_batts** script checks the charge status of the batteries. If the batteries are low, it warns all users and shuts down the system:

```
:
[ /etc/pwr/bin/pwrsh -c "status -s !ac.online &
   ( charge.low | charge.critical )" ]
/etc/shutdown -y -i0 -g00:05 -f "No AC power and battery charge is low!
System will shut down in 5 minutes - log off now!"
```

You should also disable **pwrd**'s handling of low battery charge. To do this, edit the entry for the "apm/batteries-are-low" (***classname/event***) entry in */etc/pwr/sys/actions*. Change the entry to read:

```
system/lowbattery-1:apm/batteries-are-low::exit 0
```

then shut down and reboot the system.

WARNING If you turn off the power to the entire system or to the hard disk(s), you risk losing valuable data and damaging the integrity of filesystems.

Hardware

Chapter 15

Adding memory and bus cards

Bus cards can hold extra memory for your system, host adapters, multiport serial adapters for extra terminals, and controller boards for peripheral devices such as hard disks, tape drives, graphics adapters and mouse controllers.

This chapter explains how to:

- add bus cards to your system (this page)
- add memory to your system (page 297)
- add a math coprocessor (page 299)
- and install an IBM PS/2 external floppy drive (page 301)

Serial and parallel adapters are discussed in Chapter 21, "Adding serial and parallel ports" (page 367). Installation of other types of devices with bus cards is explained in detail in other chapters of this book.

Installing bus cards

To install a bus card, first shut down the system and power down the computer.

WARNING Make sure the computer is unplugged from the power supply or you could injure yourself.

Before you begin working on the computer, ground yourself by touching an earthed metal object close at hand (*not* the computer), or wear a proper grounding strap. Static electricity can destroy sensitive electronic components such as integrated circuits.

DIP switches and jumpers

Before you plug your card into the bus, reset any switches or jumper settings that must be changed. The documentation that comes with it should list the default settings and how to change them.

NOTE SCO OpenServer systems are designed to work with most hardware using default settings. You will rarely have to change the settings on a card.

Micro Channel Architecture (MCA), Extended Industry Standard Architecture (EISA), and Peripheral Component Interconnect (PCI) bus cards do not have DIP switches and jumpers. You should use the setup program provided by the manufacturer as described in "Using the manufacturer's setup program" (page 297) to adjust settings.

Installing the hardware

Open your computer to gain access to the expansion slots. Your hardware documentation should explain this in detail. Depending on your system's architecture there may be slots of different lengths and even of different types (for example, you may see machines with both ISA and PCI slots). At the rear of the computer, at the end of each slot, there will normally be a blanking plate which must be removed before a new card is fitted. Select a slot which fits the card you wish to add and remove its blanking plate. The edge connector plugs into the slot, and the plate on the rear of the card, often with connectors mounted on it, replaces the blanking plate at the rear of the computer. Gently, but firmly, seat the card into position and press it home. Screw down the rear plate to hold the card securely.

When you have finished inserting cards, replace the computer's case, turn the power on and boot the operating system.

You may need to use the manufacturer's setup program to change the system's configuration before you can use the new hardware. The **eisa**(ADM) utility can be used to list cards currently installed on an EISA bus system. The **slot**(C) utility does the same thing for MCA machines.

Avoiding interrupt clashes on PCI/ISA bus machines

On machines with both PCI and ISA buses, the PCI auto-configuration code cannot read the configuration of cards in the ISA bus slots. You must use the computer manufacturer's setup program to tell the auto-configuration code which interrupts are in use by ISA bus cards. If you do not mark these interrupts as "used", it is possible that there will be an interrupt clash between an ISA bus card and a PCI bus card.

Using the manufacturer's setup program

Many systems, particularly those using either a Micro Channel Architecture (MCA), Extended Industry Standard Architecture (EISA) or Peripheral Component Interconnect (PCI) bus, include a setup program which is provided on a bootable floppy disk, in the BIOS, or as a hidden file on the hard disk. This program configures the permanent memory on your computer to describe the system hardware setup. Whenever you add a hard disk, serial card, or other device, you may need to run your setup program to tell your computer about the new hardware. Some computers automatically recognize the presence of new hardware. The documentation provided with your computer's hardware should tell you if you need to run a setup utility.

Adding more memory

You can often improve system performance and run larger programs by increasing the amount of memory available.

WARNING Memory chips are very susceptible to static electricity damage.

To increase a system's memory:

1. Bring your system down using the **shutdown**(ADM) command and turn off the computer when prompted to do so.
2. Install extended memory according to the manufacturer's instructions. Make sure you have set all switches as noted in the instructions.

   With memory cards it is important to check the switch settings (or software setup) on both the card and motherboard. Refer to the hardware manuals for your computer and for the memory card to find the correct switch settings or software setup.

   NOTE Memory cards must be configured for extended, not expanded mode. SCO OpenServer systems use only "extended," not "expanded," memory.

3. Boot the operating system. The boot screen details how the additional memory has affected your system.

Many system resources depend on the amount of memory installed. For example, the "kernel i/o bufs" value displayed at boot time is determined by the **NBUF** kernel parameter. When this parameter is set to zero, the number of kernel buffers is determined at boot time based on the amount of memory installed. For more information on system resources related to RAM, refer to the *Performance Guide*.

If the memory hardware reports an error, the following message is displayed:

```
PANIC: memory parity error
```

You then see the software reboot message:

```
     ** Safe to Power Off **
            - or -
** Press Any Key to Reboot **
```

If the system repeatedly panics from parity errors, consider replacing the memory chips.

NOTE Some machines have a hardware limitation on the maximum amount of memory that can be installed. Refer to your computer hardware manual to determine the maximum amount of memory you can install. SCO OpenServer systems can support up to 4GB of main memory.

Memory card compatibility notes

Most memory cards will work with SCO OpenServer systems. If you experience "panic: parity" errors, it is often because of low quality or mixed types and speeds of memory chips or cards. This problem is especially prevalent with the 32-bit static RAM chips used in older 386 machines.

Disabled high memory on Corollary architectures

On Corollary EISA-based systems with ROM-Resident Diagnostics (RRD) prior to version 5.5, a problem can occur when you use the EISA configuration utility to enable the 15th megabyte address range as memory. The default behavior is for this memory range to be disabled. When this memory range is enabled the kernel attempts to map this memory twice resulting in the panic message:

```
PANIC: smp_meminit - Adding overlapping memory segment 0x4f00000 - 0x5000000
```

If you have previously enabled this memory range through the EISA configuration utility, you can avoid the problem by disabling it before installing an SCO OpenServer system. This memory range is reclaimed after the machine is booted, so it still uses all the memory in the system. The problem can be permanently rectified by upgrading the RRD to the 5.5 version.

32-bit memory

It is *strongly* recommended that you use 32-bit memory approved by your machine manufacturer. Using 16-bit memory instead will degrade overall machine performance.

NOTE Certain manufacturers reserve the upper 384KB of the first megabyte for DOS. On some machines, this "shadow" RAM cannot be accessed by SCO OpenServer systems. You may need to install additional memory to run SCO OpenServer systems. If possible, "BIOS shadowing" and "video shadowing" should be disabled.

If you see one of the following messages:

```
FATAL: parity error on the Motherboard

FATAL: parity error on add-on card

PANIC: Parity error address unknown

PANIC: Parity error at address 0xxxxxx
```

some part of your hardware is sending a "non-maskable interrupt" (a signal sent by the hardware that halts the operating system). The precise message will depend on your particular system. You should run your system's hardware diagnostics tests, if available. In addition, physically reseat your memory cards, SIMMs, or individual memory chips, checking for bent pins. If these measures fail to correct the problem (or you do not feel comfortable in checking your hardware yourself), seek professional hardware support.

High-speed cache memory

If installation failures are experienced on a system with high-speed cache memory, turning off the cache memory often enables the installation to proceed normally. Once the SCO OpenServer system has been installed, the cache memory can be re-enabled.

Adding math coprocessors

If your computer includes an 80387 math coprocessor, it is automatically detected and supported by SCO OpenServer systems. These coprocessors improve the efficiency of floating point calculations. Pentium, 80486DX2, and 80486DX CPUs include an on-chip floating point unit that is recognized and used as a floating point coprocessor. 80386DX, 80386SX, and 80486SX CPUs do not include a on-chip floating point unit.

If you are going to upgrade your system to include a math coprocessors, it is important to choose one which matches your machine's CPU speed. Follow the manufacturer's recommendations.

At boot time, the SCO OpenServer system announces the presence of a math coprocessor with the message:

```
%fpu  - 13 - TYPE=80387
```

Note that switches on the main system board must be set properly to enable 80387 interrupts, and/or your system must be reconfigured with the manufacturer's setup disk. Ensure that the system diagnostics recognize the coprocessor's presence, and check your hardware manual for the proper switch settings.

On some motherboards, the operating system incorrectly recognizes the presence of an 80387 coprocessor even if the chip is not installed. This problem is prevalent on machines that use the Intel 302 motherboard. If your computer incorrectly recognizes the presence of an 80387 chip, make sure that blocks E48 and E49 are not connected with a jumper.

Some 80387 exceptions are masked. Refer to the **fp**(HW) manual page for more details.

Specific math coprocessor issues

There are many possible combinations of math coprocessors and systems, some of which are known to cause problems under specific circumstances.

Intel 387 coprocessor

Because of design defects in the Intel 80386 chip (B1 stepping, part numbers 540344 and 540362), the Intel 80387 math coprocessor may not operate correctly in some computers, causing the CPU to hang during DMA, paging, or coprocessor access. You can work around this problem by changing the tunable kernel parameter **DO387CR3** from 0 to 1 using the **configure**(ADM) utility. For more information, see "Miscellaneous device drivers and hardware parameters" in the *Performance Guide*.

You can replace the 386 chip with a newer release of the 386 chip (a D-step part), or bypass the 387 chip by adding the **ignorefpu** keyword to the boot command:

```
Boot :
unix ignorefpu
```

This means that the operating system will not use the 387 chip, but you need not remove it physically; the coprocessor can still be used by other operating systems. To bypass the 387 chip automatically every time you boot your system, add the **ignorefpu** keyword to the defbootstr option in the */etc/default/boot* file. See the **boot**(HW) manual page for more information.

Intel Pentium processors

SCO OpenServer systems are not known to be affected by the reported problems with Pentium math functions. However, users who intend to run math-intensive applications on SCO OpenServer systems are advised to check with their system supplier.

Intel RapidCAD Coprocessor

The Intel RapidCAD Engineering Coprocessor for Intel 386DX PCs is supported.

Weitek coprocessors

Weitek numeric coprocessors are also supported. This support extends only to runtime; there is no current development support for creating binaries that take advantage of numeric coprocessors.

In order for the Weitek chip to be recognized by the system, one file needs to be edited in the following way:

1. In the file */etc/conf/sdevice.d/weitek*, there should be a line similar to the following:

   ```
   weitek N 1 0 0 ...
   ```

   Change the "N" (for no) to a "Y" (for yes).

2. Relink the kernel, then reboot the machine. The Weitek chip will now be recognized.

Adding an external floppy to an IBM PS/2

The IBM PS/2 systems based on the MCA bus can support an external 5.25-inch floppy drive which is recognized by the SCO OpenServer system. IBM has produced three different adapters for the external 5.25-inch drive:

External Diskette Drive Adapter
: This is the earliest version of the adapter and is not supported.

Model 80 Adapter, part number 72x6753
: This was shipped for use with the PS/2 Model 80 only and is supported.

5.25-inch Diskette Adapter/A
: This is the latest version of the card and is supported.

To configure the drive once the adapter has been installed:

1. Log in as *root*.
2. Edit the file */etc/conf/sdevice.d/fl5* to change the "N" in the second column to a "Y".
3. Relink the kernel, then reboot the system.

Chapter 16

Adding SCSI host adapters and peripherals

A SCSI host adapter provides the interface between the PC system bus and the SCSI bus. It controls access to SCSI peripherals connected to the SCSI bus, transfers data between the peripherals and main memory, and relays commands, status information, and messages. For more information about SCSI, see "SCSI addresses" (page 304).

You may need to run a setup program or configuration utility to configure a new adapter. On ISA and some MCA bus machines, you may need to change the interrupt vector and I/O addresses set on the host adapter to avoid conflicts with existing adapters. You should also disable the BIOS on secondary controllers that you install. See "Using the manufacturer's setup program" (page 297) and refer to your hardware documentation for detailed instructions.

A host adapter is configured into the system when you first install one of the peripheral devices connected to the SCSI bus that it controls. See "Adding a SCSI peripheral device" (page 305).

The number of different SCSI host adapters that can be configured for use with your system should be specified in the hardware documentation. See *SCO OpenServer Features and Limitations* for information about supported mass storage drivers.

Information on diagnosing and fixing problems is presented in "Troubleshooting SCSI host adapters" (page 309).

SCSI addresses

Each controller on the SCSI bus (including the host adapter) has an address referred to as its "controller" ID or "target" ID. Up to eight controllers may be present on a SCSI 1 bus with IDs from 0 to 7; up to 16 controllers may be present on a 16-bit-wide SCSI 2 bus with IDs from 0 to 15. The host adapter itself is usually assigned ID 7.

Controllers may be placed in any order on the bus, but they must have a unique controller ID. The controller ID is usually set on the SCSI peripheral device using jumpers, DIP switch, or thumb-wheel. Refer to the adapter documentation for specific instructions.

A peripheral device connected to a controller is identified by its "logical unit number" (LUN). Bridge controllers can support up to eight devices with unique LUNs 0 to 7. However, most SCSI devices have a single embedded controller with a LUN of 0. The SCO SCSI device drivers have only been tested on SCSI devices with embedded controllers.

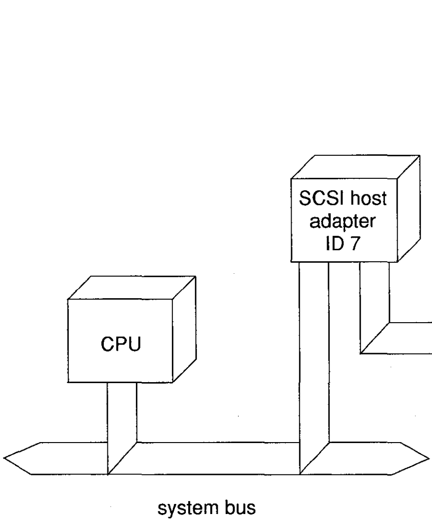


Figure 16-1 SCSI bus addressing

SCSI host adapter drivers are configured into the kernel when you configure the first SCSI peripheral connected to a adapter. See "Adding a SCSI peripheral device" (page 305). Host adapters of the same type as one already installed use the same driver; their only requirement is memory space for configuration information that is internal to the driver. If you wish to use the ability of certain host adapters to emulate other adapters, you must specify the correct device driver for the host adapter being emulated when configuring peripherals.

The SCO modular SCSI interface provides a generic set of SCSI peripheral drivers that may be used with any of the supported hosts' adapter drivers. Each different type of host adapter that is installed requires its own driver to be configured into the kernel.

Adding a SCSI peripheral device

Use the **Hardware/Kernel Manager** or a **mkdev**(ADM) command (such as **mkdev tape**) to inform the system that you have added a peripheral device to the SCSI bus. This updates the system configuration files that are used in building a new kernel to support the new device:

- */etc/conf/cf.d/mscsi* defines the host adapter type, peripheral type, host adapter number, peripheral controller ID, LUN, and bus number for each device on every SCSI bus.
- */etc/conf/sdevice.d/**xnamex*** contains information about the hardware settings of each host adapter of type ***xnamex***.

Supply the following information about the device to update the *mscsi* file:

- Host adapter type (the internal name of the device driver for the host adapter). Supported types are listed in */etc/default/scsihas*. For example, **eiad** is the driver for the Adaptec AHA-174x. If you have installed a host adapter driver using a BTLD, the host adapter type is the same as the name of the driver that you linked into the kernel.
- Host adapter number. Use 0 for the first adapter of a given type, 1 for the second, and so on.
- Peripheral's SCSI bus number. Use 0 for the primary bus, 1 for the secondary bus. This information is required for host adapters that control more than one SCSI bus, such as those that use the Adaptec 7770 chipset. The bus number for host adapters with only a single bus is 0.
- Target ID of the device's controller. ID 7 is usually reserved for the host adapter.
- Logical unit number (LUN). Set this to 0 for devices with embedded controllers.

If the disk is the first peripheral device that you are adding to the SCSI bus, you must also supply some of the following information about the hardware configuration of the host adapter (this information is used to update the file */etc/conf/sdevice.d/***xnamex**):

- Interrupt vector (IRQ) (needed for ISA bus machines only).
- Start I/O hexadecimal address (needed for ISA and some MCA bus machines).
- End I/O hexadecimal address (needed for ISA and some MCA bus machines).

You are presented with the default values for the first host adapter of this type or the values for the previous host adapter of this type that was configured on the system. If you have changed the values physically set on the host adapter, you must enter these instead of the displayed values.

You are not prompted for configuration values for most EISA and PCI bus host adapters. These are assigned by the EISA or PCI configuration utility into CMOS RAM and read by the device driver at boot time.

See also:

- "Adding SCSI/EIDE CD-ROM drives" (page 307)
- "Adding floptical drives" (page 309)
- "Adding secondary hard disks" (page 324)
- "Installing a tape drive" (page 344)

Boot time messages from host adapter drivers

When the host adapter drivers register the host adapters that they find at boot time, they print a line with the following format for each adapter found:

`%adapter` ***start-end IRQ DMA*** `type=`***ha*** `ha=`***number*** `id=`***ID*** `[[fts=]`***string***`]`

where:

start is the start I/O address in hexadecimal

end is the end I/O address in hexadecimal

IRQ is the interrupt vector; this appears as " - " if the host adapter is polled

DMA is the DMA channel; this appears as " - " if Bus Master DMA is used. The default DMA channel is defined in the file */etc/conf/cf.d/mdevice*. Host adapters that use Bus Master DMA define the channel with value "-1".

ha is the host adapter driver internal name (*xnamex*)

number is the number of the host adapter as defined in the file */etc/conf/cf.d/mscsi* (see the *mscsi*(F) manual page for more details).

ID is the address of the host adapter on the SCSI bus (usually 7)

string is the description of the host adapter. If the driver uses the feature string (`fts=`) form, the single-letter feature codes are:

- `b` buffers commands
- `d` supports 32-bit DMA addresses
- `n` does not require Corollary maps
- `s` supports scatter-gather read/writes
- `t` supports tagged commands

For example, consider the following example boot-time driver initialization message:

```
%adapter  0x8000-0x8CDC 11      -       type=eiad ha=0 id=7 fts=std
```

This is the first Adaptec AHA-174x host adapter on a system that uses the **eiad** driver (`type=eiad ha=0`). Its start and end I/O addresses are 0x8000 and 0x8CDC, it uses interrupt 11, and it performs Bus Master DMA (`0x8000-0x8CDC 11 -`). It also supports scatter-gather, tagged commands, and 32-bit DMA addresses (`fts=std`).

Adding SCSI/EIDE CD-ROM drives

When installing a SCSI CD-ROM drive, you must use a SCSI host adapter supported by SCO OpenServer systems. You should also check with your hardware supplier that the drive will work with the host adapter.

NOTE ATAPI-2-compliant drives connected to an EIDE controller are also supported using the same driver used for SCSI devices. At boot time, IDE controllers and CD-ROM drives are listed as in this example:

```
%adapter 0x01F0-0x01F7 14 - type=IDE ctlr=primary    dvr=wd
%cd-rom  -             -  - type=IDE ctrl=pri cfg=slv dvr=Srom->wd
```

You can mount an ISO 9660, High Sierra, or Rock Ridge format CD-ROM as a read-only filesystem. This allows access to files which are described by the primary volume descriptor on the CD-ROM. Access to files described by secondary volume descriptors is not supported.

A maximum of 255 SCSI CD-ROM drives per system are supported; seven per SCSI 1 bus, or fifteen on a 16-bit-wide SCSI 2 bus. The device files used for access to the CD-ROM drive are documented on the **cdrom**(HW) manual page.

CD-ROM filesystems containing extended attribute records are supported. You can access record format information and the file access permissions in an extended attribute record using options to **mount**(ADM).

For EIDE/ATAPI drives, you will need to specify whether it is attached to a primary or secondary controller and whether it is configured as master or slave.

For SCSI drives, you will need to specify the SCSI host adapter type, the host adapter number, target ID, and logical unit number (LUN) as described in "SCSI addresses" (page 304). If this is the first SCSI peripheral that you are adding to the SCSI bus controlled by a host adapter, you may need to supply additional hardware information about the adapter as described in "Adding a SCSI peripheral device" (page 305).

To add a CD-ROM drive:

1. Log in as *root* and put the system into maintenance mode.
2. Select **CD-ROM** from the devices listed by the **Hardware/Kernel Manager**, or enter the command **mkdev cdrom**.
3. Select to install the appropriate CD-ROM type from the main menu.
4. If the CD-ROM driver is not already configured into the kernel, choose to configure it for use.
5. For EIDE/ATAPI drives, enter the controller number and identify the drive as master or slave.
6. For SCSI drives, enter the type and number of the host adapter. If the adapter driver is not already configured into the kernel, enter the requested hardware configuration information. Confirm the values displayed. When prompted, enter the details of the SCSI address of the drive and confirm the information.
7. Do not enable support for the CD-ROM/tape installation device driver. (You would only require this driver to read an install CD-ROM supplied with an earlier version of the operating system.)
8. If this is the first CD-ROM drive on your system, specify that you want to add support for the High Sierra filesystem. DOS CD-ROMs generally use the High Sierra format, so you will also be able to access data from these with this setting.
9. Relink the kernel, then reboot the system. You can defer relinking if you have other devices to configure.

NOTE To bring the CD-ROM drive online, you must insert a disk. If you attempt to bring up the drive without inserting a disk, the message `cannot open` is displayed.

Adding floptical drives

When installing a floptical drive, you must use a SCSI host adapter supported by SCO OpenServer systems. You should also check with your hardware supplier that the drive will work with the host adapter.

A maximum of seven floptical drives on a single SCSI bus per system are supported. The device files used for access to the floptical drive are documented on the **floptical**(HW) manual page. You will need to specify the SCSI host adapter type, the host adapter number, target ID, and logical unit number (LUN) as described in "SCSI addresses" (page 304). If this is the first SCSI peripheral that you are adding to the SCSI bus controlled by a host adapter, you may need to supply additional hardware information about the adapter as described in "Adding a SCSI peripheral device" (page 305).

To add a floptical drive:

1. Log in as *root* and put the system into maintenance mode.
2. Select **SCSI Floptical drive** from the devices listed by the **Hardware/Kernel Manager**, or enter the command **mkdev flopti**.
3. Select **Install a floptical drive** from the menu.
4. If the floptical driver is not already linked into the kernel, configure it for use.
5. Enter the type and number of the host adapter. If the host adapter driver is not already linked into the kernel, enter the requested hardware configuration information. Confirm the values displayed.
6. Enter the details of the SCSI address of the drive and confirm the information.
7. Relink the kernel, then reboot the system. You can defer relinking if you have other devices to configure.

Troubleshooting SCSI host adapters

If you have problems when installing SCSI host adapters or when adding peripherals to the SCSI bus, see:

- "Installing when SCSI host adapters share interrupts" (page 310)
- "Mixing scatter-gather and non scatter-gather host adapters" (page 310)
- "SCSI peripherals not recognized" (page 310)
- "Troubleshooting hard disks" (page 340)
- "Problems with SCSI tape drives" (page 352)

Hardware

Installing when SCSI host adapters share interrupts

Installation may fail on an EISA system with two SCSI host adapters that share the same interrupt. If possible, move the second host adapter to a different interrupt for the duration of the installation process. If no spare interrupts are available, remove the second host adapter from its slot until installation is complete.

Mixing scatter-gather and non scatter-gather host adapters

You can mix scatter-gather and non-scatter-gather host adapters on the system. Alternatively, you can disable scatter-gather in the driver by logging in as *root* and changing the line:

```
int Sdsk_no_sg=0;
```

in the file */etc/conf/pack.d/Sdsk/space.c* to read:

```
int Sdsk_no_sg=1;
```

The change will not take effect until you relink the kernel and reboot the system.

SCSI peripherals not recognized

The likely causes for a SCSI peripheral not being recognized are:

- The SCSI bus is terminated at some point between the host adapter and the controller for the peripheral that is apparently missing. The bus must be correctly terminated at both ends only; no terminating resistors must be present at any other place on the bus. Controllers usually use plug-in terminating resistors or DIP switch settings to allow termination. Check the intermediate controllers on the bus for premature termination. Incorrect termination can also lead to data corruption.
- The target ID set on the controller board is the same as that of another controller on the same bus.
- The target ID set on the controller board differs from that defined in the file */etc/conf/cf.d/mscsi.*

Chapter 17

Installing Plug and Play devices

To configure ISA cards, including sound cards, SCSI host adapters, multiport serial boards, and others that conform to the Plug and Play ISA Specification Version 1.0A, use the SCOadmin **ISA PnP Configuration Manager** (page 312):

- immediately after you install the system, if you have any devices to configure
- immediately after you install an ISA PnP card
- any time you want to modify device configuration on a previously installed card

When you configure a card with the **ISA PnP Configuration Manager**, you set the card's resources to match values compatible with existing UNIX® ISA drivers.

Configuration consists of:

1. physically adding the card (page 313)
2. selecting a card and device to configure (page 314)
3. resolving configuration conflicts (page 316)
4. relinking the kernel and rebooting the system (page 317)

You can also use the **ISA PnP Configuration Manager** to disable a device on a specified card (page 316).

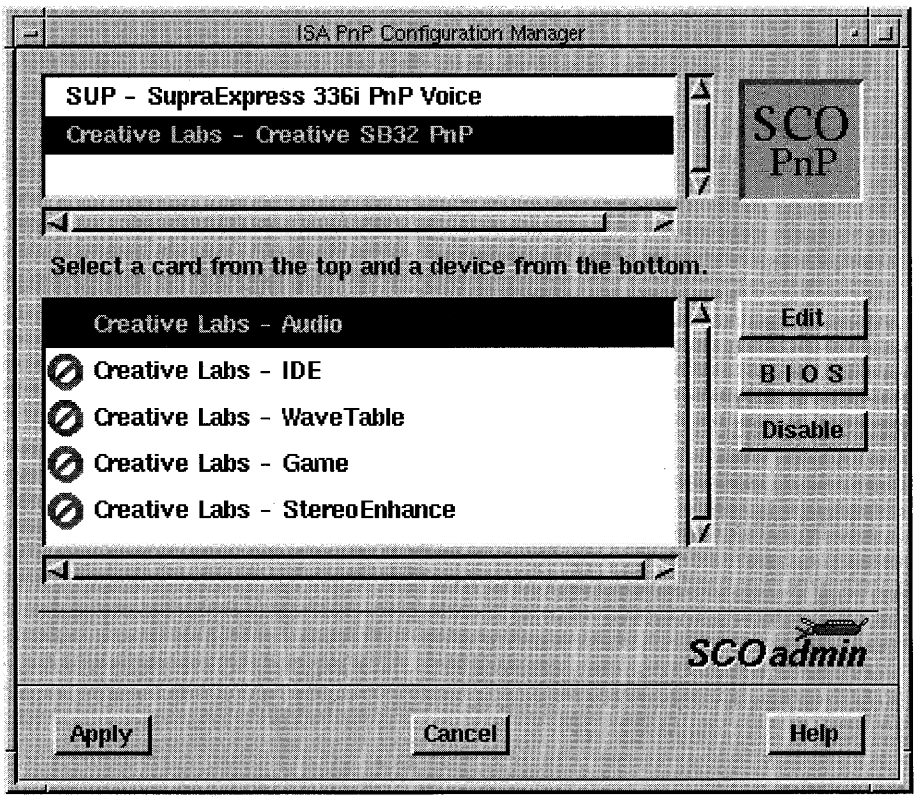
See "Terminology and concepts" (page 319) for a glossary of terms and information on which files the manager uses and updates.

The ISA PnP Configuration Manager interface

After you install the appropriate ISA PnP card(s), log in as *root* and start the **ISA PnP Configuration Manager** in one of these ways:

- Double-click on the **ISA PnP Configuration Manager** icon in the System Administration window on the Desktop.
- Start the SCOadmin launcher by entering **scoadmin** on the command line, then select **ISA PnP Configuration Manager**.
- Enter **scoadmin isa plug and play** on the command line (or abbreviate to **scoadmin isa**).
- Enter **/etc/pnp** on the command line.
- Enter **mkdev isapnp** on the command line.

When you start the **ISA PnP Configuration Manager**, this window displays the cards currently detected on your system:



Detected cards are shown in the top point-and-pick list.

Devices available for use with that card are shown in the bottom point-and-pick list.

The names of these cards and devices are generated from the cards themselves.

For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

NOTE If you attempt to start the **ISA PnP Configuration Manager** and no cards are found on your system, an error message appears. See **No ISA PnP cards detected** (page 318) for more information.

Physically adding an ISA PnP card

You can physically add a card either before you install the system or at any time after the installation.

The card should be enabled for Plug and Play mode. Check the card's documentation to determine whether or not you need to set jumpers on the card to enable this capability.

If you installed the card before you installed the system, start the **ISA PnP Configuration Manager** and skip to "Selecting a card and device to configure" (page 314).

To add a card to an already installed system:

1. Log in to the system as *root*.
2. Halt the system with the **System Shutdown Manager** (page 178) or the **shutdown**(ADM) command.
3. Turn the power off and disconnect the power cord to your system.
4. Physically add the card to an empty ISA slot on your motherboard. Be sure that the card is enabled for Plug and Play mode.
5. Turn the power on and restart the system (page 169).

Selecting a card and device to configure

The main window of the **ISA PnP Configuration Manager** displays cards and the devices they support. If only one card is available for configuration, it is already highlighted when you start the manager.

Each time you highlight a different card, the list of devices below changes to contain the devices associated with the selected card. For example, a sound card might support audio, an IDE CD-ROM, and a joystick.

Each device displays an icon which reflects its current state:

- **A circle with a slash through it** indicates that the device has not been configured or has been disabled.
- **A circular arrow** indicates that the device has been chosen for BIOS resource allocation and is waiting to have those values applied.
- **A check mark** indicates that the device has been configured with appropriate values and is waiting for those values to be applied.

If no icon is displayed, the device is configured correctly into the kernel.

For each selected device, you can:

- modify resource allocation (this page)
- enable BIOS resource allocation (page 315)
- disable the device (page 316)

Modifying resource allocation for a device

You can choose from pre-set resource allocations defined by the card's manufacturer, or manually modify those settings, by using the Edit feature of the **ISA PnP Configuration Manager**.

When you click on **Edit**, a list of resource descriptions and resource settings appear for the selected device.

Resource descriptions might include:

Current	the current state of the device when you entered the manager
Good	a set of resource settings designed to work well with this device
Acceptable	another set of resource settings designed to work well with this device
Sub-Optimal	resource settings which will work, but are not as optimal as the other choices

The list you see might contain other choices defined by the manufacturer, and there can be multiple versions of each type.

To select or change settings:

1. Click on a set of resource settings.
   - To accept these settings, click on **OK**.
   - To modify these settings, choose a value from the active pull-down menus. In some cases, only one choice is available.

   When you are finished modifying settings, click on **OK**.
2. If you click on **OK** and the changes you made do not conflict with other devices on your system, you return to the main window, where the device now appears with a check mark icon.

   If the changes you made do conflict with other devices on your system, the Possible Conflicts window appears (page 316).
3. After you return to the main window, you must apply these changes and relink the kernel (page 317).

Enabling BIOS resource allocation

You can enable your device to be configured with resources allocated by the system BIOS. This ensures that only valid, available resources are allocated.

In the **ISA PnP Configuration Manager**:

1. Highlight a card.
2. Highlight the device to enable.
3. Click on **BIOS**.

   The device appears with a circular arrow icon.
4. Configure other devices as desired.
5. When finished configuring all devices, click on **Apply** to relink the kernel and reboot the system (page 317).

NOTE Not all system BIOSs are Plug and Play aware. If yours is not, you will need to manually configure the device using the **Edit** button (page 314).

If the BIOS is Plug and Play aware, it allocates resources to Plug and Play devices each time the system boots. When you enter the **ISA PnP Configuration Manager** after the system reboots, the device might or might not appear to be configured. This is because the SCO OpenServer *PnP* driver is not managing the device directly; instead, the system BIOS handles all configuration. What the BIOS reports to the manager is BIOS-dependent.

If you want to permanently assign resources to your Plug and Play device, you must specifically set them using the **Edit** button (page 314).

Disabling a device

To disable a device you previously configured with the **ISA PnP Configuration Manager**:

1. Highlight the card.
2. Highlight the device to disable.
3. Click on **Disable**.
4. Configure and disable other devices as desired.
5. When finished disabling and configuring desired devices, click on **Apply** to relink the kernel and reboot the system (page 317).

Resolving configuration conflicts

If you allocate resources in the Edit window which are in conflict with those used by another device on your system, the Possible Conflicts window appears when you click on **OK**.

This window provides a list of hardware configured on your system, along with an indication of the conflicting parameters. For example, if you allocate IRQ 5 to a sound card when it is used by your tape drive, the Possible Conflicts window appears with the conflicting value indicated.

From this window, you can:

- Click on **Re-edit** to modify the resource allocation.

  This returns you to the Edit window, where you can try another set of resource allocations or change the conflicting resource to another acceptable value.

- Click on **OK** to accept the conflict and continue.

  Do this when you are reconfiguring an existing card and driver, or when you know that the conflict is acceptable; for example, some devices can successfully share interrupt vectors.

After you return to the main window, apply any changes and relink the kernel (this page).

> **NOTE** The Possible Conflicts window is generated using system information stored in */dev/string/cfg*. To view this information at any time, enter **/etc/hwconfig** on the command line. This data shows which resources are in use before you run the **ISA PnP Configuration Manager**, and can alert you in advance to possible conflicts.

Relinking the kernel and rebooting the system

After allocating resources and resolving conflicts, enabling BIOS resource allocation, or disabling a device, you must relink the kernel and reboot the system to put these changes into effect.

In the **ISA PnP Configuration Manager**:

1. Click on **Apply**.

   Messages appear as system files are updated.

2. Click on **OK** to create a new kernel which reflects the changes you made.

   If you click on **Cancel** instead, you can create the kernel manually at a later time. See "Relinking the kernel" (page 290) for more information.

   > **NOTE** The changes you made will not be in effect until you relink the kernel and reboot the system.

3. To halt the system, use the **System Shutdown Manager** (page 178) or the **shutdown**(ADM) command.

4. Boot the system into multiuser mode.

Hardware

Troubleshooting card configuration

The following list of possible error messages describes common causes and workarounds.

`No ISA PnP cards detected`

Cause: The manager did not detect an ISA PnP card in your system, either because no cards are physically present or a physically present card is not jumpered into ISA PnP mode.

Solution: Shut down your system, then ensure that the cards present are seated correctly and jumpered (if necessary) to support ISA PnP mode.

`Problem running /etc/isapnpslot`

Cause: This command is run automatically by the manager to extract ISA Plug and Play information about the system. Its failure could be caused by a corrupt binary, incorrect permissions, or a disabled or missing *PnP* driver.

Solution: Verify that the *PnP* driver is configured in the kernel. You should see `%PnP` in the hardware list when you boot the system. You can also run **hwconfig**(C) to view the same information.

If the driver is present, check the permissions on the device */dev/pnp*. You should see a listing similar to this:

```
crw-------   1 root     root     117, 0  Jan 21 15:03 /dev/pnp
```

If the device is present and has the correct permissions, verify that the command **/etc/isapnpslot -T** provides output.

`Verification of HW settings failed`

Cause: The settings you specified could not be verified against the settings that have been detected on the card. Faulty hardware is the most likely cause.

Solution: Try one or all of the following:

- Re-configure the device to use a different set of resources.
- Shut down the system, turn the power off, then turn it back on and reboot.
- Replace the card.

`File is not present`, `File is zero length`, `Directory is not present`, or `Source file is corrupted`

Cause: These four error messages indicate that the file */etc/conf/pack.d/PnP/space.c* is missing or corrupt or that the */etc/conf/pack.d/PnP* directory is missing.

Solution: Copy either */etc/conf/pack.d/PnP/space.bak* or */etc/conf/pack.d/PnP/space.orig* to */etc/conf/pack.d/PnP/space.c*

Ensure that the file has the following permissions and ownership:

```
-rw-r--r--   1 root    sys      4713 Jan 29 17:17 space.c
```

`View only mode`

Cause: Only the *root* user is authorized to change resources within the **ISA PnP Configuration Manager**.

Solution: Exit the manager, log in to the system as *root*, and restart the manager.

`Kernel relink failed`

Cause: The required kernel relink failed, which results in your changes not going into effect.

Solution: Boot your system from the old, functional kernel (for example, */boot.old*), then run the manager again to try to create a bootable kernel. See "Booting an old kernel" (page 184) for more information.

Terminology and concepts

Read this section if you are unfamiliar with Plug and Play terminology and concepts or you want to understand how the manager uses and updates system files and utilities.

Plug and Play Glossary

Card
: A physical card, also called an adapter, board, or node, that controls one or more Plug and Play "devices".

Device
: A functional hardware subset resident on a Plug and Play card. Multiple devices, such as CD-ROM and joystick controllers, may reside on a single card.

Resources
: One of the following hardware parameters that can or must be set for each configured device:

  DMA
  : direct memory access channel

  IRQ
  : interrupt vector

  I/O address
  : input/output address through which this device communicates

Mem address
: memory address for this device

Each resource can be set to either a value, to NONE (meaning that no value is required), or to OFF (meaning that the device is currently disabled).

For detailed descriptions of these parameters, see Appendix A, "Configuration parameters" (page 503).

Resource configuration names
: A set of resource values which the card manufacturer has defined. Each set of values is defined as one of the following:

  Current
  : existing device configuration

  Good
  : preferred configuration (highest priority)

  Acceptable
  : lower priority configuration that is still valid

  Sub-optimal
  : configuration that will function but should only be used if other good or acceptable configurations are not available or cause conflicts

  A given device can have multiple instances of Good, Acceptable, and Sub-optimal settings.

Plug and Play files and utilities

/dev/Pnp Kernel device driver used to recognize and query ISA Plug and Play hardware, and to allocate resources to that hardware. Any settings specified in */etc/conf/pack.d/PnP/space.c* are used as directives.

/etc/isapnpslot
: Utility which uses */dev/PnP* to extract current and possible resource information. When new resources are specified by the **ISA PnP Configuration Manager, isapnpslot** verifies that the resource allocation is valid.

/etc/pnp The **ISA PnP Configuration Manager**. This utility uses information provided by **isapnpslot** to display card and device resource selections. When the user sets resources, disables devices, or otherwise modifies the Plug and Play hardware, **/etc/pnp** rewrites */etc/conf/pack.d/PnP/space.c* to reflect the changes.

/dev/string/cfg
A special file (not directly viewable) that contains existing driver settings. The data contained in this file is normally displayed during system boot or by using the **hwconfig**(C) command.

/etc/hw A utility used by **isapnpslot** to obtain system hardware information about EISA, ISA, MCA and PCI buses.

/usr/lib/hw
A database used by **isapnpslot** to obtain system hardware information about EISA, ISA, MCA and PCI buses.

Chapter 18

Adding hard disks

If the capacity of the root disk is insufficient or you want to reduce an I/O bottleneck on a disk, you may need to install additional hard disks on your system. See "Supported hard disk configurations" (this page).

If you have multiple hard disks in your system, you can manage your data storage more effectively by configuring them as virtual disks. See "About virtual disks" in the *System Administration Guide* for details.

This chapter explains how to:

- add an IDE, EIDE, Compaq IDA, ESDI, or SCSI hard disk to your system (page 324)
- overcome the BIOS restrictions on the number of cylinders that it can read on the root disk (page 335)
- replace the root hard disk (page 339)
- and diagnose and fix hard disk problems (page 340)

Supported hard disk configurations

Many hard disks can be used with SCO OpenServer systems. Most IDE, EIDE, ESDI, Compaq IDA, and SCSI disk controllers are supported.

NOTE The SCO OpenServer system supports large (more than 528MB) EIDE disks that use logical block addressing (LBA) but it does not support the full EIDE command set.

On ISA, EISA, MCA, and PCI bus machines, the **wd** device driver is used with disks which present a WD1010 or ST506 interface. This includes IDE and EIDE drives. The **Sdsk** device driver is used with all SCSI disks.

On MCA bus machines, the **esdi** device driver is used with ESDI disks. The **st506** device driver is used with ESDI disks which are configured to present an ST506 interface.

Refer to the *SCO Hardware Compatibility Handbook* for a list of supported disk drives.

NOTE The **MAX_DISK** dynamic kernel parameter limits the number of disks that are supported by the kernel. You may need to use the **Hardware/Kernel Manager** or the **configure**(ADM) command to change its value if you previously set **MAX_DISK** to limit the maximum number of disks. A value of 0 allows the kernel to support more disks dynamically.

Adding secondary hard disks

Here are some possible configurations for systems containing multiple hard disks:

- **Root disk on the primary SCSI host adapter:** only other SCSI host adapters can be added. Each host adapter, including the primary, is capable of supporting up to seven disk drives with embedded controllers on a SCSI 1 bus, and up to 15 on 16-bit-wide SCSI 2 bus.
- **Root disk on an IDE, EIDE, or ESDI controller:** ISA, EISA, and MCA bus machines can support up to two IDE or EIDE controllers. Each controller can support two disk drives. SCSI host adapters can also be added and configured as shown in Figure 18-1 (page 325).
- **Root disk on a Compaq IDA-III controller:** a maximum of five more IDA-III controllers can be added. Each controller can support 14 disk drives.

To install an IDE, EIDE, ESDI, or IDA disk, follow the procedure in "Installing a hard disk" (page 327). For SCSI disks, first set up the SCSI configuration files and link the correct device drivers into the kernel using the **Hardware/Kernel Manager** or **mkdev hd** as described in "Configuring a SCSI hard disk" (page 325). Then proceed to "Installing a hard disk" (page 327), where you invoke the same command a *second* time to partition the disk and make the filesystems.

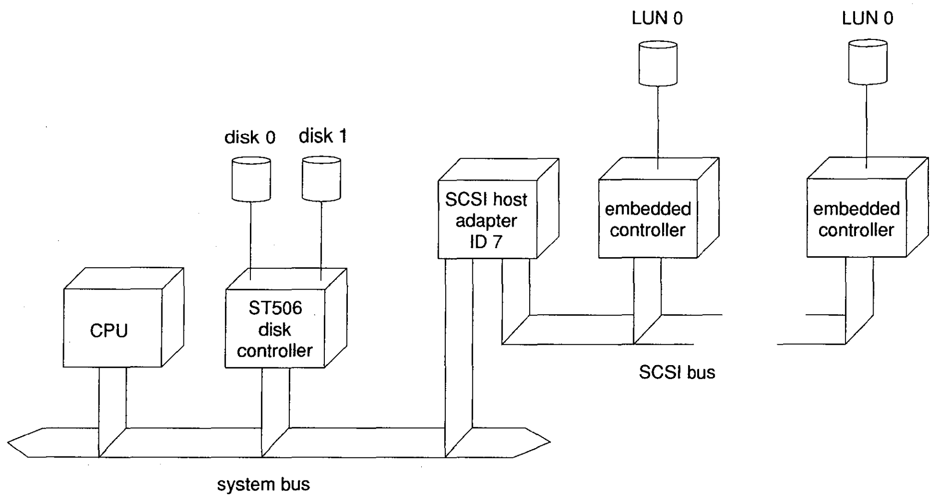


Figure 18-1 Example of a mixed ST506-interface disk controller and SCSI configuration

NOTE Configure the hardware according to the documentation provided with your machine. EISA bus machines have a configuration utility to do this; ISA machines require you to change jumper settings on the hardware. SCSI hard disks must have the correct target ID set on their controller card. The SCSI bus must also be correctly terminated at both ends.

Ensure that the additional drive is formatted and passes the manufacturer's diagnostic tests before installing the system. If it does not pass the diagnostic tests, you should not use it with your system.

Configuring a SCSI hard disk

1. Obtain the following information about the SCSI hard disk:
   - host adapter type
   - host adapter number
   - number of the bus on the host adapter
   - target ID of the disk controller
   - logical unit number (LUN) of the disk

   See "SCSI addresses" (page 304) and "Adding a SCSI peripheral device" (page 305) for an explanation of what this information means and how to obtain it.

Hardware

If the disk is the first peripheral device that you are adding to the SCSI bus, you must also supply the following hardware configuration information about the host adapter:

- interrupt vector
- start I/O hexadecimal address
- end I/O hexadecimal address

2. Log in as *root* and put the system into maintenance mode.
3. Select **Hard Disk** from the devices listed by the **Hardware/Kernel Manager**, or enter the command **mkdev hd**. (Enter **mkdev hd -u** or **mkdev hd -h** if you require detailed usage and help information for **mkdev**.)
4. If your root disk is attached to an ST506-interface controller (IDE, EIDE, or some ESDI configured to use this interface) or an ESDI controller, specify that you want to add a hard disk to the SCSI bus.

   If your root disk is attached to a SCSI controller, specify that you want to add another SCSI disk.
5. Enter the SCSI host adapter type, and the number of the host adapter.
6. If you are adding the first device to a host adapter, confirm that you wish to change its setup parameters, enter the hardware details about the host adapter card and confirm that you want to save these values.

   You can exit at this point if you have entered the wrong details.
7. To install a controller on a host adapter that controls two SCSI buses, specify to which bus (0 or 1) the controller is connected.
8. Enter the SCSI bus number, target ID of the controller and the LUN of the disk on the controller.

   The information you have supplied is displayed:

   ```
   Host
   Adapter          Adapter
   Type     Device  Number   ID      LUN     Bus
   --------------------------------------------
   ad       Sdsk    0        1       0       0
   ```

   This example shows a SCSI hard disk with controller ID 1 being added to the first Adaptec AHA-154x host adapter on a system. The bus number is shown as 0 as this is a single bus host adapter.

   If the information is correct, confirm that it should be used to update the SCSI configuration. Otherwise, start the configuration again, or exit.
9. You are given the option of relinking the kernel. If you have more devices to add, you can defer doing this until later.
10. When you have relinked the kernel, use the **System Shutdown Manager** or the **shutdown** command to shut down the system, then reboot.

After rebooting the system, you must run **mkdev hd** or the **Hardware/Kernel Manager** a second time to partition the disk as described in "Installing a hard disk" (this page).

Installing a hard disk

This section describes how to install an additional IDE, EIDE, ESDI, IDA, or SCSI hard disk. If the disk is SCSI, you must already have updated the system configuration files as described in "Configuring a SCSI hard disk" (page 325). For all disk controller types, it is assumed that you have already physically installed the hard disk and booted the system.

NOTE If you are installing a disk that already contains filesystems, you can retain the data they contain by preserving the disk's existing partition and division information. However, as a precaution, you should back up the data before removing the disk from the old system.

1. Log in as *root* and put the system into maintenance mode.
2. Select **Hard Disk** from the devices listed by the **Hardware/Kernel Manager**, or enter the command **mkdev hd**. (Enter **mkdev hd -u** or **mkdev hd -h** if you require detailed usage and help information for **mkdev**.)
3. Select the type of hard disk that you want to add to the system.
4. **IDA disks:** Enter the logical number of the disk and the number of the controller to which it is connected.

   SCSI disks: Enter the host adapter type and number, the bus number, the disk controller ID, and the LUN of the disk.

   ST506-interface (IDE, EIDE, and some ESDI), or ESDI disks: Enter the number of the disk on the controller. If you are installing IDE or EIDE disks on ISA or EISA bus machines, you must also enter the number of the controller to which the disk is attached.
5. Choose to continue the installation, or exit. If you choose to continue the installation, the driver outputs a message to show it has been initialized.

   The **mkdev hd** script now runs the programs **dkinit**(ADM), **fdisk**(ADM), **badtrk**(ADM), and **divvy**(ADM) in sequence to configure the hard disk for use.

   - If your disk has an IDE, EIDE, ESDI, or IDA controller, **mkdev hd** runs **dkinit**(ADM) to allow you to change the physical parameters defined for the disk such as its geometry, and whether it supports error correction. See "Changing default disk parameters using dkinit" (page 328) for more information.

dkinit is not run for SCSI disks. If you move a SCSI disk between machines or change the host adapter, you may need to run **dparam**(ADM) on the disk to change the geometry defined in the masterboot block. See "Writing a new masterboot block" (page 337) for more information.

- If your disk has an IDE, EIDE, or ESDI controller, **mkdev hd** runs **fdisk**(ADM) to allow you to create disk partitions. See "Partitioning a hard disk using fdisk" (page 330) for more information.
- If your disk has an IDE, EIDE, or ESDI controller, **mkdev hd** runs **badtrk**(ADM) to allow you to scan the disk and map bad tracks to the bad track table reserved within a UNIX system partition. For SCSI disks, **mkdev hd** uses **badtrk** to reserve a table for bad SCSI logical blocks but it does not allow you to scan the disk. See "Scanning a disk for defects using badtrk" (page 331) for more information.

  If the virtual disk driver is linked into the kernel, and you want to configure your multiple hard disks as virtual disks, choose to exit at this point and run the **Virtual Disk Manager**. See Chapter 8, "Administering virtual disks" in the *System Administration Guide* for details.
- The **mkdev hd** script runs **divvy**(ADM) to allow you to divide a UNIX system partition into separate filesystems and swap areas. See "Dividing a disk partition into divisions using divvy" (page 333) for more information.

The installation and configuration of your hard disk is now complete. You can return the system to multiuser mode. See Chapter 2, "Administering filesystems" in the *System Administration Guide* for details of how to mount the new filesystems for use.

Changing default disk parameters using dkinit

dkinit allows you to display, modify, or select default disk parameters if you are installing an unusual or nonstandard disk.

If you have a standard hard disk (one that is supported by your computer hardware or special motherboard ROM), select the default disk configuration and quit. The installation continues by running **fdisk**(ADM) to allow you to partition the disk. See "Partitioning a hard disk using fdisk" (page 330).

> **NOTE** If you are not sure whether your disk is nonstandard, check the default parameters using the **dkinit** display option. Calculate the size of your disk in bytes using the formula:
>
> size = ***cylinders*** x ***heads*** x ***sectors per track*** x 512

Some drives are sold by formatted size, others by unformatted size. The formatted size of a drive is approximately 85% of its unformatted size. The parameters displayed by **dkinit** may not match the drive manufacturer's documentation. Some controllers have optional *translation, mapping,* or *63-sector* modes. If one of these modes was chosen during low-level formatting, your SCO OpenServer system must be initialized with the translated parameters and not those of the physical drive. In all cases, the known size of the drive should approximately match the size calculated above from the disk parameters.

If your disk is nonstandard, you must enter information to replace the disk configuration information in ROM. If you are unsure of what parameters to enter for your nonstandard disk, contact your disk manufacturer for this information.

You will need to supply the following information:

Disk parameter	Description
cylinders	number of cylinders on the entire disk
heads	number of disk read/write heads
write reduce	starting cylinder for reducing the current to the disk head when writing to inner cylinders
write precomp	starting cylinder for adjusting the spacing of certain bit sequences when writing to inner cylinders
ecc	number of bits of error correction on I/O transfers
control	controller type number
landing zone	cylinder where heads are parked
sectors/track	number of sectors per track

NOTE Most modern IDE and EIDE disk drives have integrated disk controllers which handle write-current reduction and write-precompensation automatically. If this is the case, enter 0 for these values.

Quit **dkinit** to save the disk parameters you have changed.

Figure 18-2 shows the internal architecture of a hard disk and its associated terminology.

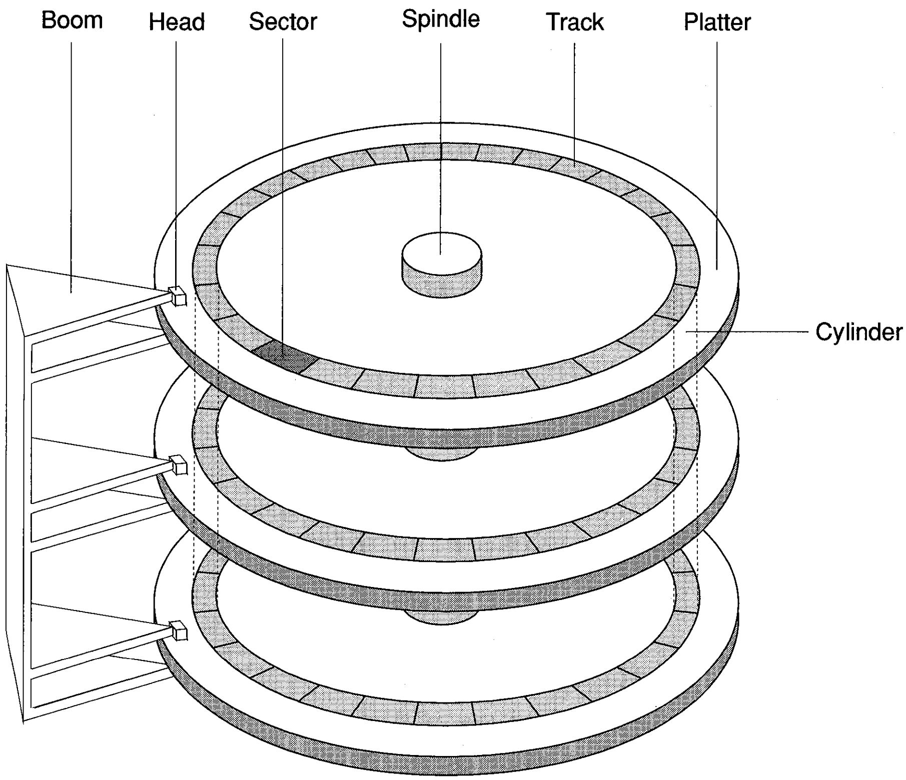


Figure 18-2 Hard disk geometry and terminology

Partitioning a hard disk using fdisk

Use **fdisk**(ADM) to create partitions on the hard disk. You can use the whole disk for the SCO OpenServer system, or you can preserve existing partitions that are used by other operating systems, such as DOS. The maximum partition size is 2 terabytes (2TB). The maximum useful size may be further limited by the maximum filesystem (division) size.

With **fdisk** you can:

- display the current partition table, showing partitions that exist on the disk (if any). There can be a maximum of four partitions. For each partition, the table lists:
  - the partition number
  - whether the partition is active
  - the type (UNIX system or other)
  - the start track of the partition
  - the end track of the partition
  - the size of the partition in tracks.
- use the entire disk for a UNIX system. This will destroy any existing partitions. Select this if you want the SCO OpenServer system to occupy the whole disk.
- use the rest of disk for a UNIX system. This preserves any existing partitions. You must make this partition active.
- create a UNIX system partition on the disk with a size you specify. Do not allocate the tracks that the system has reserved for the masterboot and diagnostic programs.
- make a partition active.
- delete a partition.
- create a partition for a specified operating system

If you want to create just a single UNIX system partition on the entire disk, select that option, check it using the display option, then quit.

Scanning a disk for defects using badtrk

Use **badtrk**(ADM) to scan IDE, EIDE, and ESDI disks for defective tracks. It maps any flawed tracks to good ones elsewhere on the disk. It also creates a table of all the bad tracks on your hard disk.

NOTE Do not run **badtrk** on IDA disks. IDA controllers handle bad tracks automatically.

When you first install a SCSI disk, **badtrk** creates a table of bad blocks in the partition but it does not scan the disk. To scan a SCSI disk for bad SCSI logical blocks, you must run **badtrk** on it after you have installed the disk. On SCSI disks, **badtrk** tries to use spare disk blocks that are maintained by the disk controller as replacements for bad blocks. If bad blocks cannot be mapped out in this way, the disk driver maps out bad blocks using the spare blocks and the bad block table in the disk partition. You can force it to use this table by specifying the **-O** option to **badtrk**. You can also enable Automatic Read/Write Remapping (ARR/AWR) for the entire SCSI disk if the disk controller supports this feature. Any defects that arise will be remapped without notifying you.

badtrk can:

- display the current bad track/block table. This is an example of a bad track table with a single entry:

```
Defective Tracks

+------------------------------------------------+
|     Cylinder   Head     Sector Number(s)       |
+------------------------------------------------+
|1.      190       3          12971-12987        |
+------------------------------------------------+
```

- scan the disk for flaws. The scan can be "quick" or "thorough", destructive or non-destructive. Typical scan rates are 18MB per minute for quick, and 6MB per minute for thorough. Do not choose a destructive scan if you want to preserve existing data on the disk.

  Whenever **badtrk** finds a defective track, it displays its location on the disk, for example:

```
WARNING : wd: on fixed disk ctlr=0 dev=0/47 block=31434 cmd=00000020
    status=00005180, sector = 62899, cylinder/head = 483/4
```

  You can interrupt the scan at any time and return to the main **badtrk** menu.

- add entries to the current bad track/block table.

  On some IDE and EIDE drives which remap the disk geometry, the cylinder, head, sector reported for a bad sector or block may not correspond to the actual physical values of these quantities. In such a case, you should determine an absolute block address for the sector(s) or block(s) to be remapped using the formula:

  logical address = ((***cylinder***+1) x (***head***+1) x (***sectors per track***)) + ***sector***

  Note that this assumes that the first ***cylinder, head,*** and ***sector*** are all numbered from 0.

- delete individual entries from the current bad track/block table.

- delete all entries from the bad track/block table.

- enable Automatic Read/Write Remapping on SCSI disks that support this feature. Any bad blocks that develop on the disk will be reallocated automatically to the defect list managed by the disk controller.

When installing a new disk, you should perform a thorough destructive scan on the complete UNIX system partition. It may take several hours to scan a 1GB disk.

WARNING If you run **badtrk**(ADM) yourself, take care not to run a destructive scan on the wrong disk by mistake. For example, to specify the first partition of the third hard disk, you would enter:

/etc/badtrk -f /dev/rhd21 -s td

See **hd**(HW) for a description of hard disk naming conventions.

When using **mkdev hd** to install a hard disk, if **badtrk** finds a flaw in the first few tracks of the UNIX system partition, it returns you to **fdisk** (page 330). You can then repartition the disk to exclude the defective tracks from any partition. When you leave **fdisk**, **badtrk** runs again to allow you to scan the disk for further flaws. This process continues until **badtrk** finds no flaws in the first few tracks. You may have to experiment to determine how many tracks to exclude.

When you quit **badtrk** while first installing a disk, it prompts you for the number of tracks to reserve as replacements for flawed ones. Allocate at least as many tracks as **badtrk** recommends. This number is based on the current number of bad tracks plus an allowance for tracks that may go bad. If you ever exceed the number of allocated bad tracks, you must reinstall the hard disk.

WARNING If you run **badtrk** on a disk which already contains filesystems, the data in these will be lost if you change the size of the bad block table. In such a case, remake the filesystems and restore the data from a backup archive.

Dividing a disk partition into divisions using divvy

Use **divvy**(ADM) to divide a UNIX system partition into a maximum of seven divisions (0 to 6). You can use these divisions as filesystems or swap areas. Division 6 (recover) is reserved for use by **fsck**(ADM) on the root disk only. Division 7 is reserved and refers to the entire partition.

divvy displays a table of the current divisions within a UNIX partition. To change this table, use the following one-letter commands to:

n name a division. This creates a corresponding block device file for accessing the division, for example, */dev/x* for a division named *x*. Do not name a division *usr*.

c create a division. Used to bring a division into use.

t select the filesystem type of a division. Divisions can be one of the supported filesystem types such as HTFS or DTFS, and NON FS for a swap or recover area.

p prevent a filesystem from being created on a division.

s define the start logical block for a division. **divvy** displays the total number of filesystem logical (1KB) blocks available. Note that a filesystem logical block is not the same as a physical disk block or a SCSI logical block (which are typically 512 bytes in size). Do not allow any of divisions 0 to 6 to overlap; a division cannot start on or before the end block of the previous division.

e define the end logical block for a division.

r restore the division table to the state it was in when you entered **divvy**.

Changes are not final until you quit **divvy** and select install (**i**) from the closing menu. To leave **divvy** without saving your changes, select exit (**e**) from the closing menu.

Creating and resizing divisions

If you are partitioning your primary hard disk at install time, you can reallocate the space used by the default root division to create multiple filesystems. Do not change the other divisions (including swap, recover, and boot) unless you are an experienced administrator. For the primary hard disk, you would first shrink the root division using the **e** command to define the new ending block. You can then **c**reate and **n**ame a new division that starts after the ending block of the resized root division and ends at the old ending block for the root division.

NOTE The maximum filesystem size that you can create using **divvy** is 1 terabyte for DTFS and HTFS, and 2GB for other filesystems.

Example: secondary hard disk

The following example of the information displayed by **divvy** shows a 1GB SCSI disk configured as the second disk in a system, with one 635MB HTFS and one 354MB DTFS filesystem:

```
+----------+-------------+--------+---+-------------+------------+
| Name     | Type        | New FS | # | First Block | Last Block |
+----------+-------------+--------+---+-------------+------------+
| u        | HTFS        |  no    | 0 |            0|      649999|
| x        | DTFS        |  no    | 1 |       650000|     1012734|
|          | NOT USED    |  no    | 2 |            -|           -|
|          | NOT USED    |  no    | 3 |            -|           -|
|          | NOT USED    |  no    | 4 |            -|           -|
|          | NOT USED    |  no    | 5 |            -|           -|
|          | NOT USED    |  no    | 6 |            -|           -|
| hd1a     | WHOLE DISK  |  no    | 7 |            0|     1013743|
+----------+-------------+--------+---+-------------+------------+

1012735 1K blocks for divisions, 4008 1K blocks reserved for the system
```

Overcoming BIOS limitations

Some disk controllers and SCSI host adapters extend the capabilities of the system BIOS with their own BIOS. This allows the system to boot from an ESDI disk or a SCSI disk on the SCSI bus controlled by a SCSI host adapter.

A limitation of the system BIOS is that it will not boot an operating system that lies on or past the 1024th cylinder on the root hard disk. See "BIOS support for disks larger than 1024 cylinders" (page 337) for more details.

The disk device drivers of some operating systems (but not the SCO OpenServer system) use the BIOS to access the hard disk in regular use. This means that they cannot access disk blocks that lie past the 1024th cylinder. Disk controllers which support logical block addressing or LBA (IDE drives with more than 1024 cylinders, most EIDE drives, and all SCSI drives) can remap or translate the geometry of the disk so that it appears to the system to have less than 1024 cylinders.

On some machines, the disk geometry is stored in CMOS RAM (parameter RAM) on the motherboard. See "Defining IDE and ESDI disk geometry in the BIOS" (page 336) for information on what you should do if the disk geometry information becomes lost from CMOS RAM. If a BIOS extension is used, the disk geometry may be stored on the disk controller or SCSI host adapter.

When booting from the hard disk, the BIOS reads the masterboot block to find out which active partition it should boot the system from. If the partition contains the SCO OpenServer system, the **hdboot0**, **hdboot1**, and **boot** bootstrap programs execute in sequence. If necessary, these programs can translate between different geometries defined for the root disk in the BIOS and the masterboot block. The **boot** program also passes on the geometry information obtained from the BIOS for use by disk device drivers.

If you move a root disk between machines or change its host adapter (if SCSI), the geometry defined in the BIOS may no longer match the geometry that the operating system previously used to access the disk. This may happen if you move a SCSI disk to a new host adapter that assumes a different disk geometry, or if you move an IDE drive to a different computer. In such cases, you may be able to boot the machine but be subsequently unable to use the disk because the information about the disk geometry stored in the masterboot block does not match that defined in the BIOS. You can write the BIOS disk geometry information to the masterboot block on the root hard disk as described in "Writing a new masterboot block" (page 337).

If you do not want to change the geometry information stored in the masterboot block because you need to define the disk as having less than 1024 cylinders, you can override the root disk geometry information stored in the BIOS when you boot the system as described in "Overriding the root disk geometry stored in the BIOS" (this page).

Defining IDE and ESDI disk geometry in the BIOS

The geometry of IDE or ESDI disks is stored by the BIOS in CMOS or parameter RAM. If this information is either not present in the first place, or is lost due to the failure of the on-board battery, you must enter the disk drive type or disk geometry information using the setup program supplied with the computer. Check your computer hardware reference manual for the appropriate ROM table entries or drive type for your computer.

Overriding the root disk geometry stored in the BIOS

At boot time you can override the geometry information that the BIOS stores about the root disk using the **biosgeom** bootstring:

> **defbootstr biosgeom=(*cylinders,heads,sectors*)**

This bootstring passes your definition of the disk's geometry (number of ***cylinders***, ***heads***, and ***sectors***) to the hard disk device driver (rather than using the values stored in the BIOS). It does not change the disk geometry defined in the BIOS (either unextended or extended).

You may need to use the **biosgeom** bootstring to override the geometry defined for large SCSI disks when used with host adapters which assume a standard disk geometry. If you do not redefine the geometry passed to the device driver, the values defined for the number of ***heads*** and ***sectors*** in the BIOS of the host adapter may imply that the disk has more than 1024 cylinders. See "BIOS support for disks larger than 1024 cylinders" (page 337) for more information.

To find out the current numbers defined for the disk's ***cylinders, heads,*** and ***sectors,*** enter the **biosgeom** command at the boot prompt.

Once the disk geometry has been redefined in this way, you can boot the SCO OpenServer system or any other operating system on the root disk using the **bootos**(HW) command from the boot prompt.

To add this geometry definition to the default bootstring, edit the definition of **DEFBOOTSTR** in */etc/default/boot*. For example:

```
DEFBOOTSTR=hd(40)biosgeom unix=(255,255,63)
```

Alternatively, if the BIOS defines the disk as having less than 1024 cylinders, or the *boot* filesystem and all other operating system partitions lie within the first 1024 cylinders, you can redefine the disk geometry stored in the masterboot block on the disk as described in "Writing a new masterboot block" (this page).

Writing a new masterboot block

To change the disk geometry defined on the masterboot block of the root disk:

1. Put the system in single-user maintenance mode.
2. Enter the following command to write a new masterboot block to the root disk:

   /bin/dparam -w /dev/rhd00

3. Overwrite the root disk geometry information in the masterboot block with the values expected by the device driver:

   /bin/dparam /dev/rhd00 \`/bin/dparam /dev/rhd00\`

4. Reboot the system using the command:

   /etc/reboot

BIOS support for disks larger than 1024 cylinders

Disks with more than 1024 cylinders are supported with the following restrictions:

- The disk controller must support disks with more than 1024 cylinders.
- If the disk is configured as the primary hard disk, the *boot* filesystem (*/stand*) for SCO OpenServer software and the bootable disk partition for any other operating system must lie within the first 1024 cylinders. This is because the BIOS in ROM cannot access information that lies beyond the 1024th cylinder. If the *boot* filesystem falls outside the first 1024 cylinders, an error message will be displayed by **boot**(HW) as follows:

  ```
  Error: request outside range of BIOS (1023 cylinders)
  ```

You can use the rest of the disk for swap space, the *root* filesystem and additional filesystems.

The BIOS on some IDE, most EIDE, and all SCSI disk controllers allows remapping or translation of large disks so that they appear to have less than 1024 cylinders. For example, the extended BIOS for the Adaptec 1542, 1742, and 274x controllers allows 2GB SCSI disks to be mapped as 255 heads, 63 sectors and 255 cylinders.

If you are upgrading your system rather than performing a new installation, the *root* filesystem must fit within 1024 cylinders because there is no separate *boot* filesystem in this case.

Configuring IDE disks and disk controllers

The Integrated Drive Electronics (IDE) interface design consists of an adapter (frequently embedded in the motherboard) connected to a maximum of four IDE hard drives.

The drives are connected to the adapter by a single 40-conductor cable that carries both control and data information.

You must set the jumpers on the drives according to the number of drives installed. If two or more drives are connected, one must be jumpered for master mode, the others for slave mode. A single drive connected to an IDE adapter must be jumpered for single drive mode.

You must also select the ST506 interface on the drive if this can be set using jumpers. Refer to your drive documentation for details.

The embedded controller on most IDE drives can perform automatic sector translation. This allows the drives to be configured with several different head/cylinder/sectors per track settings. You may want to use some settings other than the factory defaults if your drive has more than 1024 cylinders or if the new settings more closely match some drive type in the BIOS. This is an important issue if you are also installing another operating system such as DOS. See "BIOS support for disks larger than 1024 cylinders" (page 337) for more information.

WARNING Automatic sector translation means that many IDE hard drives should not be low-level formatted. A formatting utility will not understand the underlying hardware of the drive and may render it useless. Check with the manufacturer of a IDE hard drive before attempting to reformat it.

Replacing the root hard disk

You may need to replace the *root* hard disk if an existing disk is no longer large enough for your needs, or if it suffers a head crash or some other irreparable failure.

WARNING You should perform regular full and incremental system backups of the filesystems on the root disk to be able to restore these in case of a *root* disk crash.

1. Install the new disk. If the drive is not a SCSI drive and is not identical to the original, be sure you change the BIOS settings with the setup program provided with your computer hardware to record the new disk parameters. See the documentation provided with your system hardware.
2. Start a fresh installation. From the **Preparing your disk and choosing software** screen, select **Hard Disk Setup**. From the **Disk 0 Partitions and filesystems** screen, select **Customize**. Recreate each of your old filesystems. Make the sizes of your filesystems at least as large as the originals, otherwise your backups will not fit when you restore them.
3. When you are returned to the **Preparing ...** screen, select **Optional software**. You can omit installation of all optional software by typing **n** for Operating system services, Graphical environment, and so on.
4. When installation is complete, put the system into single-user mode and restore your *root* filesystem backup. For example, to restore a **cpio**(C) backup, enter:

   cpio -imucvdB -I/dev/rct0

   If your tape drive is not yet configured, run **mkdev tape** to reconfigure your tape drive so that you can restore your backups. As an alternative, you can reboot and specify the appropriate bootstring for the tape device. For example, to configure a Wangtek drive:

   ```
   Boot
   : hd(40)unix ct=wangtek(0x338,5,1)
   ```

5. If you have a SCSI system and you changed the host adapter in addition to changing the root disk, follow these additional steps:

   a. Remove your old host adapter driver from your kernel configuration by editing the file:

      /etc/conf/sdevice.d/*adapter*

      where ***adapter*** is the name of the SCSI driver for your old host adapter (see */etc/default/scsihas* for a list of host adapter drivers).

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b. Change the **Y** to **N** in the second column, as in this example:

```
ad    N    1    5    0    0    330    332    0    0
```

c. In the same directory, edit the file that corresponds to your new host adapter. Change **N** to **Y** in the second column.

d. Edit the file */etc/conf/cf.d/mscsi*, replacing each instance of the old host adapter driver name (first column) with the new name, as in this example that uses the Adaptec driver, **ad**:

```
*ha     attach  number  ID      lun     bus
*
ad      Stp     0       2       0       0
ad      Sdsk    0       0       0       0
```

6. Relink your kernel to restore your system configuration using the following commands:

   cd /etc/conf/cf.d
   ./link_unix

7. Stop the system:

   /etc/haltsys

8. After rebooting your system, restore the backups for your other filesystems on the *root* disk (if any). Any non-*root* disks should be accessible after the restore of the *root* filesystem.

Configuring the root hard disk

When you install the operating system, the root disk is configured as the first disk on the first IDE, EIDE, or ESDI controller, or controller ID 0 on the SCSI bus controlled by the primary host adapter. IBM SCSI host adapters on the MCA bus are exceptions; these expect to find the root hard disk controller at ID 6.

Troubleshooting hard disks

If you have problems when installing or configuring additional hard disks on your system, see:

- "Fixing bad tracks and bad blocks on hard disks" (page 341)
- "Setting hard disk interleave" (page 341)
- "Formatting hard disks" (page 342)

Fixing bad tracks and bad blocks on hard disks

A bad track is an area of the hard disk that is not reliable for data storage. The hard disks supported by SCO OpenServer systems allow you to map the bad track into the bad track table that lists any areas of the hard disk that should not be used. The bad tracks listed on the table are aliased to good tracks so that the operating system avoids the areas of the disk that cannot be read or written.

If your hard disk develops a bad track after the system is installed and running, an error message like the following is displayed on the console:

```
wd: ERROR on fixed disk ctlr=0 dev=0/47 block=31434 cmd=00000020
    status=00005180, sector = 62899, cylinder/head = 483/4
```

For a SCSI disk, the message is like this:

```
NOTICE: Sdsk: Unrecoverable error reading SCSI disk 2 dev 1/64
           (ha=0 id=1 lun=0) block=219102
           Medium error: Unrecovered read error
```

If such an error occurs, use **badtrk**(ADM) to create a new bad track table so that the system can avoid the new bad track(s). The **badtrk** utility is a menu-driven utility for viewing, adding, or deleting entries in the bad track table. **badtrk** automatically enters any flaws it detects in the table, provided there is room. SCSI disks have a similar mechanism that maps bad SCSI logical blocks instead of bad tracks. By default, **badtrk** will try to add bad blocks to the drive's own internal defect list (G-list) if the drive supports this. You can use the **-O** option to **badtrk** to force **badtrk** to add the bad block to the table managed by the operating system. If your SCSI disk controller supports Automatic Read/Write Remapping (ARR/AWR), you can use **badtrk** to enable this feature. This allows recoverable errors to be automatically remapped whenever they occur.

To use **badtrk**, reboot the system and enter single-user mode. (Do not use **shutdown su** to do this.) Run **badtrk**, scan the disk, and the entire UNIX system partition. Choose either a quick or thorough scan; a thorough scan is recommended if new bad tracks have appeared. Select nondestructive mode to preserve the data on your hard disk. When the scan completes, quit, and return the system to multiuser mode.

Setting hard disk interleave

Most modern disk controllers implement track caching and support the preferred interleave of 1:1. An interleave of 6:1 or 3:1 may be more suitable for older single-buffered disk controllers that store data using the MFM encoding method. An inappropriate disk and controller combination formatted with a 1:1 interleave can degrade disk I/O performance by a factor of four or more.

Note that some SCSI and IDE disk controllers have their own cylinder/head/sector translation logic, and will probably ignore any reformat command sent to them.

WARNING Some manufacturers warn against low-level reformatting of their disks. Consult the disk controller documentation first if you intend to reformat your disk.

Formatting hard disks

Some IDE and ESDI hard disks are only partially formatted when received from the factory. This may cause **badtrk**(ADM) to indicate that every sector past a certain cylinder/head location is bad at installation. You should contact the manufacturer to determine whether the disk is completely formatted.

WARNING Automatic sector translation means that many IDE hard drives should not be low-level formatted. A formatting utility will not understand the underlying hardware of the drive and may render it useless. Check with the manufacturer of a IDE hard drive before attempting to reformat it.

Some SCSI host adapter controllers (for example, the Adaptec AHA-154x) have a set of BIOS routines that allows you to format or redefine the geometry of a SCSI hard disk. Refer to your hardware documentation for more information.

Chapter 19
Adding tape drives

It is possible to have one QIC-02 cartridge tape drive plus one Irwin mini-cartridge, one QIC-40, or one QIC-80 drive configured on a system. You can also add up to seven SCSI tape drives with embedded controllers on a SCSI 1 bus, or 15 SCSI tape drives on a 16-bit-wide SCSI 2 bus.

When installing a SCSI tape drive, you must use a SCSI host adapter that is supported by SCO. Refer to the *SCO Hardware Compatibility Handbook* for a list of supported host adapters and drives. You should also verify with your hardware supplier that the drive will work with the host adapter. See *SCO OpenServer Features and Limitations* for information about supported mass storage drivers.

Using the tape device

The **tape**(C) utility allows you to perform various tape control functions (such as rewind, erase, format, retension, and so on) if they are supported by the device. Access to tape drives is via character (raw) special device files only; there is no block device access. A no-rewind device exists for writing multiple tape archives to a single QIC-02 or SCSI tape.

You can also use tape compression, partitioning, and variable block size with SCSI tape drives that support these features.

Generic and specific tape support

The **tape**(HW) manual page describes generic support for tape drives. The manual pages listed below contain specific information about each type of tape drive:

Compaq CPQS	**cpqs**(HW)
Irwin	**irwin**(HW)
QIC-02	**cartridge**(HW)
QIC-40/80	**floppytape**(HW)
SCSI	**scsitape**(HW)

For more information on using tape drives, see the *System Administration Guide*.

See also "Troubleshooting tape drives" (page 349).

Installing a tape drive

Read your tape drive hardware manual for physical installation instructions and general information.

AT bus tape drive controllers use jumpers or switches to set the interrupt vector, DMA channel, and so on.

EISA and MCA bus settings are configured using a software utility provided with the machine although you may also need to set jumpers or switches on some MCA cards.

To add a tape drive:

1. Log in as *root* and put the system into maintenance mode.
2. Select **Tape Drive** from the devices listed by the **Hardware/Kernel Manager** or enter the command **mkdev tape**.
3. Select to configure either a SCSI or a non-SCSI tape drive.
4. Select **Install a tape drive** or **Install a SCSI tape drive** from the main menu.
5. To install a SCSI tape drive see "Installing a SCSI tape drive" (page 347) for more instructions.

   To install a non-SCSI tape drive, see one of these sections:
   - "Installing a QIC-02 cartridge tape drive" (page 345)
   - "Installing an Irwin mini-cartridge tape drive" (page 346) — including the Accutrack 250 and 120 pc/mc
   - "Installing a QIC-40/80 floppy tape drive" (page 347)
   - "Installing a Compaq CPQS tape drive" (page 348)

Installing a QIC-02 cartridge tape drive

If you have not changed the settings on the controller card, select the default tape parameters for your card and quit from the menu.

If you need to change any parameters, change them one at a time from the modification menu.

Table 19-1 Default and suggested alternate settings for ISA and EISA controllers

Type	Manufacturer	DMA channel	Interrupt vector (IRQ)	Base I/O address
1	Archive	3	3	0x220
		1	4	0x200
		1	3	0x200
3	Wangtek	1	5	0x338
		1	5	0x300
4	Emerald	3	9	0x300
5	Mountain	1	3	0x28C
6	Tecmar	1	5	0x330
7	Everex or Tandberg	1	5	0x2C0

Enter **0** (zero) values to accept the default hardware settings for the tape controller card.

The following notes apply to ISA and EISA tape controller cards:

- Typically, DACK and DRQ are set to the same channel value.
- Set the interrupt vector (IRQ) to a value between 2 and 7 that is not in use by another card. You can use **vectorsinuse**(ADM) to find a suitable value. See Table 14-1, "Typical device interrupts" (page 275) for details of typical interrupts use by the system. The most commonly available interrupt is 5, as most systems do not have a second parallel port.
- Set the base I/O address to a value that is not in use by any other card. Most common tape controller I/O addresses are not used by other devices.

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For MC tape controller cards, the controller type, manufacturer, and default hardware settings are shown in the following table:

Type	Manufacturer	DMA channel	Interrupt vector (IRQ)	Base I/O address
1	Mountain	1	5	0x200
2	IBM 6157	2	6	0x3120
3	Everex, Archive or Tandberg	1	3	0x300
4	Tecmar or Wangtek	3	5	0x300

Enter **0** (zero) values to allow the hardware settings to be configured automatically for the tape controller card.

Quit from the configuration menu to create the device files.

The installation script prompts you to change the default bootstring if you want to alter the configuration settings used for the tape device at boot time. See the **boot**(HW) manual page for more details.

You can now relink the kernel and reboot to use the tape drive. You may defer relinking if you have other devices to configure.

Installing an Irwin mini-cartridge tape drive

Mini-tape drives use the floppy disk drive controller or are connected to the Irwin 4100 controller. Make certain your drive and controller jumpers are set correctly; refer to your hardware documentation for more information.

Irwin drives differ significantly from standard QIC tape drives in that they are not configurable and do not require you to enter any hardware parameters while installing them.

1. Specify that you want the drive to be unit 1. The appropriate device files are now created.
2. The installation script prompts you to change the default bootstring if you want to alter the configuration settings used for the tape device at boot time. See the **boot**(HW) manual page.
3. You can now relink the kernel and reboot to use the tape drive. You can defer relinking if you have other devices to configure.
4. You must create the Irwin configuration file */etc/default/mcconfig* if you want to specify debugging, hardware-specific options, and other features. See the *mcconfig*(F) manual page.

Installing a QIC-40/80 floppy tape drive

These units are specialized mini-cartridge units that follow the QIC-40/80 specification. They do not use the same format as Irwin mini-cartridge drives. Refer to your tape drive documentation for instructions on how to specify the drive by resetting jumpers.

1. Specify whether you are installing a QIC-40 or QIC-80 drive, and whether you wish to enable extended tape length mode. Do not enable extended length mode if your drive does not support it. See the **floppytape**(HW) manual page for information on extended length mode.
2. Enter the hardware configuration option for your drive. Archive and Mountain drives can use Soft Select mode. Wangtek drives may be configured to use Phantom select mode. Refer to your tape drive's documentation for the necessary jumper settings to use these modes. Quit from the configuration menu to create the device files.
3. The installation program prompts you to change the default bootstring if you want to alter the configuration settings used for the tape device at boot time. See the **boot**(HW) manual page for details.
4. You can now relink the kernel and reboot to use the tape drive. You may defer relinking if you have other devices to configure.

Installing a SCSI tape drive

SCSI tape drives are added to the system as SCSI devices. You must specify the SCSI host adapter type, the host adapter number, target ID, logical unit number (LUN), and bus number as described in "SCSI addresses" (page 304).

If this is the first SCSI peripheral that you are adding to the SCSI bus controlled by a host adapter, you may need to supply additional hardware information about the adapter as described in "Adding a SCSI peripheral device" (page 305).

1. Select SCSI tape device installation. If the SCSI tape driver is not already configured into the kernel, the installation does this automatically.
2. Enter the type and number of the host adapter. If the host adapter driver is not already configured into the kernel, enter the requested hardware configuration information. Confirm the values displayed to update the Link Kit.
3. Enter the details of the SCSI address of the drive and confirm the information.

4. Specify the following information to configure the tape drive optimally for the system. To select a generic SCSI configuration, press ⟨Enter⟩ when asked for these values:

   vendor-specific ID string
   : The string returned by the SCSI device **INQUIRY** command.

   SCSI version
   : Enter 1 for SCSI 1, or 2 for SCSI 2.

   response data format
   : Enter 0 for SCSI 1, 1 for the common command set (CCS) **REQUEST SENSE** command, or 2 for SCSI 2.

   Obtain this information from the documentation that was supplied with the tape drive or by contacting the manufacturer.

5. Choose one of the following entries that describes the type of tape drive you are installing:

   - Generic SCSI 1/SCSI 2 (including 9-track)
   - Exabyte 8mm (8200 or 8500)
   - IBM rebadged Exabyte 8mm (8200)
   - DAT (compressing and non-compressing)
   - QIC cartridge

   This will enable the SCSI tape device driver to make best use of the drive's capabilities. If you are unsure, choose the default generic SCSI 1/SCSI 2 option.

6. The installation prompts you to change the default bootstring if you want to alter the configuration settings used for the tape device at boot time. See the **boot**(HW) manual page for details.

7. You can now relink the kernel and reboot to use the tape drive. You may defer relinking if you have other devices to configure.

Installing a Compaq CPQS tape drive

To install a Compaq CPQS tape drive:

1. Enter the target ID of the tape drive and the base I/O address, DMA channel, and interrupt vector values set on the controller card. Select the default parameters if you have not altered the settings on the card.

2. Quit from the configuration menu to create the device files.

3. The installation script prompts you to change the default bootstring if you want to alter the configuration settings used for the tape device at boot time. See the **boot**(HW) manual page for details.
4. You can now relink the kernel and reboot to use the tape drive. You can defer relinking if you have other devices to configure.

Changing the default tape drive

If you install more than one tape drive, **mkdev** prompts you to specify the drive that you want linked to the default tape device files. For example, if you have both a SCSI cartridge tape drive and a DAT tape drive installed, only one of them can be linked to the default device */dev/rct0*. You can change the drive linked to the default device using a menu option of the **mkdev tape** command.

Troubleshooting tape drives

If you have problems when using tape drives see:

- general problems (this page)
- QIC-02 drives (page 350)
- SCSI drives (page 352)
- Irwin and QIC-40/80 drives (page 353)

Note that these problems generally occur immediately after installing your tape drive.

General problems with tape drives

You may encounter the following general problems with tape drives:

- Tapes written on higher capacity drives (for example, 150MB) cannot be read on lower capacity drives (for example, a 60MB drive).
- All QIC-02 and SCSI cartridge tape drives supported by SCO will read the QIC-24 (60MB) format tape install product.
- High density 150MB drives require DC6150 or DC600XTD tapes for writing.

Problems with QIC-02 cartridge tape drives

You may encounter the following problems with QIC-02 cartridge tape drives:

- "QIC-02 cartridge tape drive not recognized at bootup" (this page)
- "Use of interrupts with the Archive drive" (this page)
- "Settings required by the Olivetti drive" (page 351)
- "Bad octal digit" (page 351)
- "Tape commands hang" (page 351)
- "Cannot open /dev/rct0 error message" (page 351)

QIC-02 cartridge tape drive not recognized at bootup

The system recognizes a cartridge tape drive if it displays a message similar to this at boot time:

```
%tape    0x338-0x33C     05      1       type=wangtek
```

If it cannot find the tape drive, the system displays a message such as this:

```
NOTICE: ct: Tape controller (type=wangtek) not found
```

For a cartridge tape drive:

1. Verify that the tape controller card is physically configured to the base address that you gave when you installed the tape drive. If necessary, reinstall the drive and change the parameters.
2. Verify that the tape controller is seated properly on the motherboard. If necessary, you may need to insert the controller in a different slot.
3. Some tape drives (particularly external drives) require that the drive be attached to the tape controller and powered on at boot time.
4. Verify that the cartridge tape drive is supported by SCO. See the SCO list of compatible hardware for a list of the compatible tape drives.
5. If your system still does not recognize the tape controller card at boot time, see your hardware documentation.

Use of interrupts with the Archive drive

Archive drives using the SC402 controller on ISA bus machines do not use the default type A interrupt 4. Reset the jumpers on the controller card or use the **mkdev tape** command to change the interrupt.

Settings required by the Olivetti drive

The Olivetti tape controller on ISA bus machines uses the following settings:

DMA	Interrupt	Base I/O address (hex)
1	9	0x288

Bad octal digit

After installing a cartridge tape drive, the system may display the following message during the kernel relink process:

```
/etc/conf/pack.d/ct/space.c line 46 bad octal digit
```

To fix this problem, verify that the base address for the tape controller is entered with a leading "0x" rather than a trailing "H". Install the tape again to modify the cartridge tape parameters.

Tape commands hang

If the tape drive hangs when you test it with the command **tape reset**:

1. Verify that the cartridge tape controller card is physically configured for the DMA value that you gave when you ran **mkdev tape**. To fix this, either physically reconfigure the tape controller DMA setting to agree with the address that you gave with **mkdev tape**, or run **mkdev tape** again and specify the DMA value on the tape controller.
2. Do the same for the interrupt vector.
3. Verify that the cable between the tape controller and the tape drive is properly attached.
4. If the **tape reset** command still hangs, see your hardware documentation.

Cannot open /dev/rct0 error message

If a **tar**(C) command (or other commands which access the tape drive) fail to write the contents of a directory to a tape, and the system displays the following message:

```
Cannot open /dev/rct0
```

To correct the problem:

1. Use **hwconfig** to verify that the interrupt vector for a cartridge tape drive does not conflict with any other device on your system. Refer to "QIC-02 cartridge tape drive not recognized at bootup" (page 350) for information on the available interrupt vectors. To change the interrupt vector, run **mkdev tape** and indicate a new interrupt vector value.
2. Verify that the actual physical interrupt (IRQ) setting on a cartridge tape controller card agrees with the interrupt vector that you specified with **mkdev tape**.

3. Make sure that the proper device for the tape drive is located in the */dev* directory. Enter:

   l /dev/rct0

   The output should look like this:

   ```
   crw-rw-rw   1 root  root  10, 0 Feb 14 12:00 rct0
   ```

   (The major device number (10) may differ.) If the listing of */dev* does not contain a line similar to this, run **mkdev tape** again to create the device.

4. Verify that all cables are connected correctly.

5. If the **tar** command still does not work, the tape may be broken. See your hardware documentation.

Problems with SCSI tape drives

You may encounter the following problems with SCSI tape drives:

- "SCSI tape drive not recognized" (this page)
- "Using the dd(C) command with Exabyte 8mm tapes" (page 353)
- "Waiting for DAT and Exabyte 8mm tape drives to initialize" (page 353)

SCSI tape drive not recognized

For SCSI tape drives, a message similar to the following is displayed at system startup even if the tape drive is not present on the SCSI bus:

```
%tape   -              -      -       type=S ha=0 id=2 lun=0
```

A message similar to the following is displayed when you try to access the tape when there is a problem:

```
NOTICE: ha: No controller response on SCSI adapter (ha=n id=n lun=n)
NOTICE: Stp: Stp_call_oemtab - Inquiry failed on SCSI type n dev minor/n
(ha=n id=n lun=n)
/dev/rct0: cannot open
```

To correct the problem:

1. If the tape drive is external to the computer, check that it is powered on and that the SCSI bus is correctly terminated.

   If the tape drive is internal to the computer, check that it initializes a tape when you insert one in the drive.

2. Verify that the ID number for the controller of the device is correct and does not clash with the ID of any other device on the SCSI bus. The ID number is determined by the jumper settings on the controller. The valid range is 0–7 for SCSI 1 and 0–15 for a 16-bit-wide SCSI 2 bus. SCSI tape drives are often configured for ID 2.
3. Make sure that the host adapter number is correct. The first SCSI host adapter of a given type is 0; the second is 1.
4. Check that the LUN (Logical Unit Number) is correct. In most cases, the controller is embedded in the same physical unit as the device and supports one device with LUN 0. If the controller is not embedded, it supports up to eight devices. If this is the case, the LUN is determined by the jumper settings on each device. The valid range is 0–7.
5. Verify that the host adapter itself is recognized at boot time.
6. Verify that the tape drive is supported. Refer to the SCO list of compatible hardware for a list of supported tape drives.

Using the dd(C) command with Exabyte 8mm tapes

Do not use **dd** to put individual data files onto Exabyte 8mm tapes; extracting the files may cause extraneous characters to be appended to the original data. You can, however, use **dd** with Exabyte 8mm tapes to store and extract **tar**(C) or **cpio**(C) archives.

Waiting for DAT and Exabyte 8mm tape drives to initialize

You should wait for a DAT or Exabyte 8mm drive to finish its initialization sequence before attempting to access the device. This may take 30 seconds or more.

Problems with Irwin and QIC-40/80 tape drives

You may encounter the following problems with Irwin and QIC-40/80 tape drives:

- "Irwin or QIC-40/80 tape drive not recognized at bootup" (this page)
- "Difficulty backing up Irwin and QIC-40/80 drives" (page 354)
- "Tape formatting fails" (page 354)

Irwin or QIC-40/80 tape drive not recognized at bootup

The system recognizes a Irwin or floppy tape drive if it displays a message similar to one of the following at boot time:

```
%ctmini -             -     -     type=ir
%ctmini -             -     -     type=QIC-40
%ctmini -             -     -     type=QIC-80
```

Hardware

If it cannot find the tape drive, the system displays a message such as:

```
ir: ERROR: Tape controller (type=irwin) not found
```

Verify that the settings you supplied when you installed the drive match the actual jumper settings on the back of the floppy tape drive. Refer to the hardware documentation.

Difficulty backing up Irwin and QIC-40/80 drives

For most efficient use, we recommend that you perform tape backups in maintenance mode.

NOTE When backing up files in maintenance mode, you must explicitly mount non-*root* filesystems.

1. If you see a `cannot allocate buffer` or `not enough space` error message while using the tape drive, you have run out of memory.
2. If you are using an Irwin mini-cartridge tape drive, reboot your system into maintenance (single-user) mode, run **/etc/mcdaemon**, and restart the backup. The Irwin drive requires **mcdaemon** to be run before the drive may be used.

   If you are using a QIC-40 or QIC-80 drive, see the **floppytape**(HW) manual page for information on **ft.alloc.switch**, **ft.minbufs**, and **ft.maxbufs**. These values give an indication of how to allocate more memory at system initialization time for QIC-40 and QIC-80 tape drivers.

Tape formatting fails

The **tape format** command is only supported for use with Irwin, QIC-40 and QIC-80 tape drives. You must bulk-erase tapes before using the **tape format** command to re-format them. This means that if a tape has been format-written previously, you must erase it with a bulk eraser before you can format-write it again. (See **tape**(C) for more information.) If the **tape format** command fails, the drive light flashes rapidly. You must reset the drive by removing the tape cartridge. The driver does not detect this condition and no error message is generated. All tape operations fail until the tape is removed and reinserted.

Chapter 20

Configuring video adapters

Configuring video adapters and monitors is the process of connecting new hardware to your system and modifying the system software to recognize that hardware. Two separate activities are required:

1. Physically install the adapter and monitor, following the instructions in the hardware documentation.
2. Run the **Video Configuration Manager** (page 356) to configure the SCO video subsystem software. The video configuration window displays the configured adapters, monitors, and resolutions, together with the function (⟨F⟩) keys that are associated with each configured video adapter.

New and modified video adapter drivers are made available periodically; see "Accessing the SCO Compatible Hardware Web Pages" (page 273). For the new graphics features and drivers included with this SCO OpenServer release, see *SCO OpenServer Features and Limitations*.

This chapter describes how to use the **Video Configuration Manager** to configure video adapters and monitors. It includes:

- "The Video Configuration Manager interface" (page 356)
- "Understanding video configuration" (page 357)
- "Adding a new video adapter" (page 361)
- "Modifying monitors, resolutions, and function keys" (page 362)
- "Removing a video configuration" (page 365)
- "Configuring unsupported adapters" (page 366)

Hardware

The Video Configuration Manager interface

Use the **Video Configuration Manager** to add adapters to the system (page 361), add or modify monitors and resolutions already on the system (page 362), and remove adapters from the system (page 365).

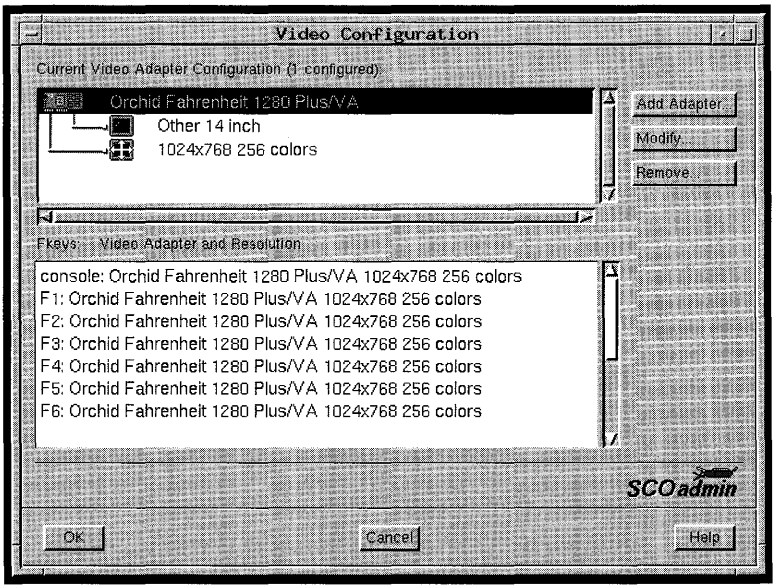
You can start the **Video Configuration Manager** in any of these ways:

- Open the Desktop's System Administration window (double-click on the *System Administration* icon) and double-click on the **Video Configuration Manager**.
- Start the SCOadmin launcher by entering **scoadmin** on the command line, then selecting the **Video Configuration Manager**.
- Enter **scoadmin video configuration** on the command line.

NOTE While any user can view the system's video configuration, only *root* can modify video configuration.

If this task is performed in multiuser mode, users currently logged in and running the X server will not see any changes until their next session.

When the **Video Configuration Manager** starts, you see:



For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

Problems exiting the Video Configuration Manager

If the manager fails unexpectedly and you cannot get a prompt, see "Recovering from SCOadmin failures in character mode" (page 156) for instructions.

Understanding video configuration

The **Video Configuration Manager** derives the configuration choices it provides from three sources:

- *grafinfo* (graphics adapter information) files
- *moninfo* (monitor information) files
- *device* (function key) files

When you run the **Video Configuration Manager** (page 356), it stores your configuration settings in the */usr/lib/grafinfo/grafdev* and */usr/lib/grafinfo/grafmon* files. On startup, the X server uses the information in these files and the appropriate *grafinfo* and *moninfo* files to interact correctly with your system's video hardware.

The *grafinfo* and *moninfo* files are ASCII text files that are located in subdirectories of the */usr/lib/grafinfo* directory. These files describe the attributes of the graphics adapters and monitors that are supported by the Graphical Environment. The *grafinfo* files use the name of the particular adapter they describe and an *.xgi* extension (for example, *wonder.xgi*); the *moninfo* files use the name of the particular monitor they describe and a *.mon* extension (for example, *8514.mon*).

NOTE The *grafinfo* files for adapters that have *.tmpl* template files are recreated when you select them during graphics configuration. That is, the corresponding *.xgi* file is rebuild whenever configuration changes are entered with the **Video Configuration Manager**.

The **Video Configuration Manager** reads the function key (or *devices*) files at system startup to associate *ttys* with function keys (page 365). These text files are located in the */usr/lib/vidconf/devices* directory and contain the device driver names for all the programmed function keys on the console (⟨F1⟩ through ⟨F12⟩), as well as the device driver name for the console. The console driver is used when the system is running in single-user mode.

See also:

- "Understanding resolutions" (page 358)
- "Generic driver configuration" (page 358)
- "Understanding multi-monitor configuration" (page 359)

Understanding resolutions

Some resolutions only work if you have enough video adapter memory. Make sure you have at least the minimum DRAM or VRAM to support the desired number of colors at the specified resolution:

Table 20-1 Memory requirements for color support at specified resolutions

Resolutions	Colors				
	16 (4 bits)	256 (8 bits)	32K/64K (15/16 bits)	16M (24 bits)	16M (32 bits)
1600x1200	N/A	2MB	4MB	6MB	8MB
1280x1024	1MB	2MB	4MB	4MB	6MB
1024x768	.5MB	1MB	2MB	4MB	4MB
800x600	.5MB	.5MB	1MB	2MB	2MB
640x480	.5MB	.5MB	1MB	1MB	2MB

NOTE Some drivers may require memory above these minimum levels for off-screen memory.

Refer to your video adapter documentation for additional information on memory requirements.

If you select resolutions of 1024x768 or higher, you may need to determine if your monitor works in interlaced or non-interlaced mode at these resolutions. Consult your monitor's documentation for information regarding supported resolutions.

WARNING Although your video adapter supports the resolutions listed, your monitor may not. Do not select a resolution that is higher than the maximum resolution supported by your monitor. Selecting a resolution that is too high can cause double or jumbled images to display on the monitor; it can also severely damage your non-multi-synch monitor. If this occurs, try selecting a lower resolution or a lower scan rate frequency.

Generic driver configuration

SCO OpenServer provides the **svga** graphics driver, which is used by the VESA graphics driver to support video adapters which conform to the Video Electronics Standards Association (VESA) Video BIOS Extension (VBE) 3.0. You can use the **svga** driver when you don't know what graphics adapter is installed or to configure an unsupported adapter (page 366).

This driver supports VESA VBE 3.0/2.0 graphics adapters:

- at 256 or 64K colors at resolutions of 640x480 to 1600x1200
- using a generic frame buffer to display graphics

The **mw** driver is used by the VESA graphics driver to support VESA VBE version 1.2 adapters:

- at 256 colors at resolutions of 640x480 to 1024x768
- using a windowed frame buffer to display graphics

Because of its generic nature, the VESA driver works on virtually any modern graphics adapter. No chipset-specific accelerations are provided; using high resolutions or 64K colors may cause a degradation in performance depending on machine and graphics adapter speeds. If a specific driver is provided for your adapter, you should use it to take advantage of accelerated features.

During initial system installation (ISL), the default graphics configuration is set to VESA at the mode 800x600 with 256 colors. If a specific driver is provided for your adapter, run the **Video Configuration Manager** (**scoadmin video**) to reconfigure it. Using an accelerated driver will provide increased graphics performance.

The actual resolutions and number of colors available using the VESA driver depends on the video adapter. The recommended mode is 1024x768 with 256 colors. Make sure your monitor supports this resolution prior to configuring it.

The refresh rate is not set by the VESA driver but is instead set by the adapter itself.

Understanding multi-monitor configuration

SCO systems provide limited support for "multi-monitor" configuration, also known as "multi-headed" configuration. Multi-monitor support means you can display one graphical environment on two (or more) monitors, thus increasing your graphical work space.

To determine if your adapter will support multi-monitor configuration:

- Ensure that your graphics adapters support multi-monitor configuration and have no hardware conflicts. They must not use the same I/O ports (page 505) or base addresses (page 509). Your graphics adapter documentation may indicate if your adapter supports multi-monitor (or "multi-headed") configuration. Install each adapter individually to verify that the graphical environment functions properly.
- Consult your adapter documentation to ensure that VGA can be disabled.

NOTE SCO OpenServer systems support up to 32 monitors on one system, but for the purposes of this procedure we will assume the user is installing only two. You must complete the configuration process for each installed adapter, monitor, and resolution.

To set up a multi-monitor configuration:

1. Once you have verified that both adapters work, and you have ensured that there are no hardware conflicts, install the adapters in the system and proceed with multi-monitor configuration.
2. Install the monitors.
3. Configure the first adapter, using the normal procedure (page 361).
4. While configuring the second adapter, select **Multi-monitor configuration — specify function keys** from the Function Key Setup window.
5. From the Specify Function Keys window, select the function key(s) that you want to control the multi-monitor environment.
6. Finish the normal configuration procedure for the second adapter.
7. After you finish configuring the last installed adapter, you must configure the SCO Panner window manager (**pmwm**) to use the added screens. To do so, add this line to your *.Xdefaults-**hostname*** file, where ***-hostname*** refers to your system name:

   ```
   Pmwm*multiScreen: True
   ```

NOTE If you configure a second video adapter in multi-monitor mode on some function keys and as the primary adapter on other function keys, configure the primary function keys first. If you configure the multi-monitor function keys first and then configure the remaining function keys for the primary video adapter, the multi-monitor configuration will be changed to be the primary adapter.

See also:

- "Understanding video configuration" (page 357)
- "Function keys and video configuration" (page 365)
- **mwm**(XC) manual page
- "Setting SCO Panner resources" in *Using SCO Panner*
- Appendix A, "OSF/Motif window manager resources" in the *Graphical Environment Guide*
- Chapter 5, "Understanding resources" in the *Graphical Environment Guide*

Adding a new video adapter

To add a new video adapter:

1. Start the **Video Configuration Manager** (page 356).
2. Click on **Add Adapter**.
3. If you do not have a PCI adapter installed in your system, go to Step 4.

   The **Video Configuration Manager** automatically detects PCI adapters and presents any detected adapters on the graphics adapter list instead of the complete list of supported adapters.

   To configure a PCI adapter, select it from the list and continue.

   To configure an adapter not on the PCI autodetected list, click on the **Configure adapter not listed above** button and continue with the configuration process.
4. When the graphics adapter list displays, select the graphics adapter that you want to configure, then click on **OK**.

   The displayed list includes all of the supported adapters and adapter chip sets. Use the scroll bar to move up and down in the list; in character mode, type the first letter of the adapter's manufacturer.
5. Add a monitor to the new adapter configuration by selecting "Monitor Not Configured", then clicking on **Monitor**.
6. When the monitor list displays, select the new monitor, then click on **OK**.

   The monitor list includes all the monitors supported for use on your SCO system. Use the scroll bar to move up and down in the list; in character mode, type the first letter of the monitor's manufacturer.

   For more information, see "Changing the configured video monitor" (page 363).
7. Specify a resolution by selecting "Resolution Not Configured", then clicking on **Resolution**.
8. Select the new resolution in the Resolution Selection window, then click on **OK**.

   For more information, see "Changing a configured resolution" (page 363).

   WARNING Ensure that the resolution you select is appropriate for your monitor; see "Understanding resolutions" (page 358) for more information.

Hardware

9. Assign one or more console function (⟨F⟩) keys to the adapter/monitor/resolution combination. This creates a link between the particular graphics adapter, monitor, and resolution, and the assigned function key, as described in "Function keys and video configuration" (page 365)
   - To assign all function keys to the selected monitor and resolution, select **Assign all function keys**, then click on **OK**. This is the option most users choose.
   - To assign specific function keys (page 364) to the current adapter, monitor, and resolution, select **Specify function keys**, then click on **OK**.
   - To use multiple monitors simultaneously (page 359), select "Multi-monitor configuration - specify function keys"

Some adapters require additional configuration information. For example, the Number Nine GXi adapter requires an I/O address (page 505). If you are prompted for additional configuration information specific to your graphics adapter, see your adapter's documentation.

See also:

- "Configuring unsupported adapters" (page 366)
- "Understanding video configuration" (page 357)

Modifying monitors, resolutions, and function keys

Use the Modify window to:

- change a configured monitor (page 363)
- change a configured resolution (page 363)
- add a new resolution (page 363)
- configure console function keys (page 364)

Display the Modify window by selecting **Modify** in the main **Video Configuration Manager** (page 356) window.

See also:

- "Understanding video configuration" (page 357)
- "Function keys and video configuration" (page 365)
- "Understanding resolutions" (page 358)
- "Understanding multi-monitor configuration" (page 359)

Changing the configured video monitor

To change the monitor:

1. Select the monitor to change, then click on **Modify** in the main **Video Configuration Manager** (page 356) window.
2. Select either "Monitor Not Configured" or the monitor you want to change and click on **Change Monitor**.
3. Select your new monitor from the Monitor Configuration window and click on **OK**.

   The monitor list includes all the monitors supported for use on your SCO system. Use the scroll bar to move up and down in the list; in character mode, type the first letter of the monitor's manufacturer.

NOTE If you do not find your monitor in the list, choose the "Other ..." selection that most closely resembles your own.

Changing a configured resolution

To change a resolution:

1. Select the resolution to change, then click on **Modify** in the main **Video Configuration Manager** (page 356) window.
2. Click on **Change Resolution,** then select the new resolution.
3. Select the new resolution in the Resolution Selection window, then click on **OK**.

   WARNING Ensure that the resolution you select is appropriate for your monitor; see "Understanding resolutions" (page 358) for more information.

4. Assign function keys as described in "Assigning function keys" (page 364).

Adding a resolution

To add a new resolution:

1. Select a resolution, then click on **Modify** in the main **Video Configuration Manager** (page 356) window.
2. Click on **Add Resolution**.
3. Specify the new resolution in the Resolution Selection window, then click on **OK**.

> **WARNING** Ensure that the resolution you select is appropriate for your monitor; see "Understanding resolutions" (page 358) for more information.

4. Assign function keys as described in "Assigning function keys" (this page).

Assigning function keys

After you choose a monitor and resolution, you must assign one or more console function keys (⟨F⟩) to them. This creates a link between the particular graphics adapter, monitor, and resolution, and the assigned function key, as described in "Function keys and video configuration" (page 365)

- To assign all function keys to the selected monitor and resolution, select **Assign all function keys** and click on **OK**. This is the option most users choose.
- To assign specific function keys (this page) to the current adapter, monitor, and resolution, select **Specify function keys** and click on **OK**.
- If you are configuring a second adapter and monitor and want to display applications on both monitors at the same time (using the same function key), select "Multi-monitor configuration - specify function keys" and click on **OK**.

See also:

- "Understanding multi-monitor configuration" (page 359)
- "Understanding video configuration" (page 357)
- "Running programs simultaneously with multiscreen displays" (page 141)

Assigning specific function keys

If you elected to specify function keys in the Function Key Setup window, when the Specify Function Keys window appears, select the function key or keys you want to associate with the current adapter, monitor, and resolution, then click on **OK**.

If you are unsure about the current adapter and resolution, look in the "Current selection" field at the top of the window.

See also:

- "Function keys and video configuration" (page 365)

Function keys and video configuration

In multiuser mode, each function key on the SCO system console corresponds to a different graphical environment. To achieve this "multiscreen" capacity, each function key is associated with a different device driver. For example, ⟨F1⟩ is associated with *tty01*, ⟨F2⟩ is associated with *tty02* and so on up to ⟨F12⟩. Each function key controls a different UNIX login session, so you can configure each session as if it were a different graphical system. In single-user mode, because access is restricted to a single user, all of the function keys are controlled by the *console* device driver and only one login session using ⟨F1⟩ is available.

Essentially, video configuration consists of creating links between a graphics adapter, a monitor and resolution (for example, Fahrenheit 1280 Plus, ViewSonic 15 at 1024x768), and a console function key. In most cases, you will use the same configuration for every function key. However, there are situations when you might want to have different graphical environments attached to different function keys. For example, you might want to use fewer colors at a higher resolution, or more colors at a lower resolution. Or, you might have more than one graphics adapter and monitor attached to your system.

See also:

- "Assigning function keys" (page 364)
- "Configuring unsupported adapters" (page 366)

Removing a video configuration

To remove a complete video adapter configuration:

1. In the main **Video Configuration Manager** (page 356) window, select the adapter, monitor, or resolution of the video system to remove and click on **Remove**.
2. When the Remove window appears, click on **OK** to confirm the removal of the entire configured video system.

CAUTION Unless you have more than one configured resolution, removing the associated monitor or the only configured resolution removes the entire selected graphics configuration.

Hardware

Configuring unsupported adapters

If your graphics adapter is not on the list of supported adapters and is not compatible with the VESA (page 358) driver:

- Check your adapter's documentation to see if it is compatible or uses the same chip set as a supported adapter. If your adapter is compatible, select the supported adapter.
- If your adapter is not compatible with one of the supported adapters or chip sets, try selecting the IBM VGA adapter using 640x480 with 16 colors. This will usually get your graphics system up and running, but it does not provide access to higher resolutions or any enhanced capabilities of your graphics adapter.

NOTE You may also be able to adjust an existing *grafinfo* file to fit your graphics adapter. However, if you copy a compatible *grafinfo* file and try to adapt it, you may have to supply details about your adapter not commonly found in adapter user documentation (for example, the coordinates of off-screen memory). Further information about developing graphics drivers and grafinfo files can be found in *Developing NFB graphics adapter drivers,* which is included with the Hardware Development Kit (HDK).

See also:

- "Understanding video configuration" (page 357)
- "Adding a new video adapter" (page 361)

Chapter 21
Adding serial and parallel ports

Support for a single-port "dumb" (or "non-intelligent") serial card on COM1 and COM2 is configured into the kernel by default. A single-port serial I/O card on COM1 will work as expected with an SCO system provided that it conforms to the standard IBM specification. See "Adding and configuring SCO-supported serial cards" (page 368) and "Adding and configuring parallel ports" (page 376).

In the standard IBM interrupt scheme, serial ports on COM1 use IRQ 4, and serial ports on COM2 use IRQ 3. Serial ports on COM3 can share IRQ 4 with COM1, and serial ports on COM4 can share IRQ 3 with COM2. Alternatively, serial ports on COM3 and COM4 can use polling.

The serial driver in SCO OpenServer allows serial ports on COM1 to use IRQ 4, and serial ports on COM2 to use IRQ 3. It does not allow serial ports on COM3 or COM4 to share interrupt vectors with COM1 or COM2, and it does not support polling.

For ISA and EISA bus machines, the serial driver in SCO OpenServer supports several serial cards on COM3 and COM4 that can use IRQs other than 4 and 3. You may be able to adjust jumpers on the serial card to change the IRQ and base I/O address. See the documentation provided with the card for more information. For MCA machines, the serial driver only supports cards on ports COM1 and COM2. For PCI machines, the serial driver supports cards on ports COM1 through COM4 and assigns configuration values automatically. See "Serial cards on ISA and EISA machines" (page 373) and "Serial cards on Micro Channel Architecture machines" (page 375) for details.

The ways in which you can combine dumb single port and multiport serial cards is limited by the minor numbering scheme of the devices. See "Combining single port and multiport serial cards" (page 372) for details.

NOTE Before adding a single-port serial card or a multiport expansion card, determine whether the card is a "smart" (or "intelligent") serial card or a SCO-supported dumb serial card. If it is a smart card (such as the Arnet Smartport), the manufacturer will have supplied installation software and a driver. This should be all you need to add the card to an SCO OpenServer system. Follow the instructions provided with your card, referring to your computer hardware manual if necessary.

Some vendor-supplied drivers may not print a recognition message at system startup.

Different models of multiport dumb serial I/O adapter have unique hardware settings; SCO OpenServer systems provide hardware-specific driver code for each card that is supported. Only cards with status poll registers can work with the high-performance driver scheme chosen, and new cards require additional driver support.

If your system does does not report the configuration of a serial card correctly at system startup, the card may not be configured correctly. Check the card's hardware documentation for the proper settings.

NOTE An error message such as "cannot create" or "cannot open" is displayed if you attempt to access a serial port that is not physically installed and defined.

Known problems with specific SCO-supported serial cards are listed in Appendix C, "Serial adapters" (page 527).

Adding and configuring SCO-supported serial cards

To install an SCO-supported serial card:

1. Shut down the system using the **System Shutdown Manager** or the **shutdown**(ADM) command.
2. Install the serial card(s) and configure your hardware according to the manufacturer's instructions. If your system includes a configuration disk or BIOS setup program, use it as instructed. If your system is configured with switch settings on the main system board (motherboard), define the new ports by setting the proper switches (refer to your hardware manuals for the settings).
3. Reboot the system, and log in as *root*. The next step is to define the configuration of the serial card hardware using the **Serial Manager** (page 369).

The Serial Manager interface

The **Serial Manager** allows you to configure SCO-supported serial cards (this page) and individual serial ports (page 370). You can start the **Serial Manager** in any of these ways:

- Enter **mkdev serial** or **scoadmin serial manager** on the command line.
- Double-click on the *System Administration* icon on the Desktop, then on **Hardware/Kernel Manager**, and select **Serial Port** from the devices listed.
- Start the SCOadmin launcher by entering **scoadmin** on the command line, then select **Hardware/Kernel Manager**, and select **Serial Port** from the devices listed.
- Select **Configure** from the **Ports** menu in the **Modem Manager** (page 408).

For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

The **Serial Manager** shows:

- the "units" (serial controllers) in use, which correspond to COM ports:

unit number	COM port
0	COM1
1	COM2
2	COM3
3	COM4

- the dumb serial cards that are currently configured for each serial controller
- the ports that are controlled by the card that is currently highlighted

Information displayed by the **Serial Manager** corresponds to the output of **hwconfig**(C) for serial devices.

Configuring a serial card

To configure an SCO-supported dumb serial card on your system, in the **Serial Manager**:

1. **To add a serial card**, click on **Add** and choose a board from the list that has a free unit number (this page). If necessary, change the interrupt vector (IRQ) and base I/O address settings to match those configured on the card. Possible interrupt and address conflicts are shown by a "*" next to the listed value. Some serial cards are listed several times because they have several possible base I/O addresses. Click on **OK** when you have finished defining the serial card.

NOTE Serial boards can only be configured on COM ports that map to supported unit numbers (page 369). Depending on the capabilities of the boards installed on your system, you might need to disable a board on an existing controller or add a new one. For example, if the board you wish to add is listed as supporting only unit 0 or 1 and there are already boards configured on those units (that is, on COM1 and COM2), you must disable the board on unit 1 before configuring a new one. However, if the new board supports unit 2, you can configure that board at COM3.

If you select a PCI board, IRQ and base I/O values are dimmed (cannot be selected) because they are assigned automatically.

To modify the configuration of a serial card, select the card from those listed, and click on **Modify**. Change the configuration of the board, and click on **OK** when you have finished.

To delete a configured serial card, select the card from those listed, and click on **Delete**.

2. If you want to change the speed or interrupt trigger level, or to enable or disable a login for any of the ports on a serial card, follow the instructions in "Configuring a serial port" (this page).
3. Click on **Close**.

NOTE If the **Serial Manager** relinks the kernel because you changed the configuration of the serial ports, you must shut down and reboot the system for the changes to take effect.

Configuring a serial port

To change the settings for a serial port, in the **Serial Manager**:

1. Select the card from the "Configured serial boards" list, select the port from the "Ports controlled by" list, and then click on **Modify**.

NOTE You cannot select a serial port which has a mouse or other pointing device attached.

2. You can change the information for any of the following fields:

Speed (bps)
Select the default speed for the serial port. The selected speed should not be greater than the capabilities of the UART (universal asynchronous receiver/transmitter) chip that controls the port. Table 21-1 shows how the maximum speed is limited by the capabilities of the UART hardware.

Table 21-1 Serial port speeds, line-mode labels, and UART limitations

Speed (bps)	Line-mode label	Limitations of UARTS
1200	2	
2400	3	
9600	m or 6	Highest speed for 8250
19200	n	Highest speed for 16450 when used with fast modems
38400	o	
57600	p	
115200	r	Highest speed for 16450 and 16550
230400	s	
460800	t	
921600	u	

The table shows the highest speeds that can be used with ports controlled by 8250, 16450, and 16550 UARTs on normally loaded systems. The 16450 and later chips in the series can achieve higher speeds than the 8250 chips. The specification for the 16450 chip allows it to run at speeds of up to 115,200bps when used with terminals and printers. It is unreliable at speeds over 19,200bps when used with high-speed modems because it does not have a receive buffer. The 16550 has a 16-byte receive buffer which allows it to be used with modems at speeds up to 115,200bps.

NOTE The speed limitations shown may be too high for heavily loaded systems which cannot react quickly enough to move data from the UART's receive buffer.

To determine the type of UARTs your computer uses, use the Microsoft **MSD** program (available under DOS) to discover this.

Line-mode label

Click on **Change** to change the line mode for the serial port. Select a line-mode label from the list displayed and click on **OK** to confirm.

NOTE You cannot change the line mode if it is the only one that is defined for the currently selected line speed.

The "line mode" determines the default characteristics of the serial port such as parity, and number of bits per character. Each line-mode label corresponds to a separate entry in */etc/gettydefs*. Table 21-1 shows commonly used line-mode labels for each speed. See "Installing serial terminals" (page 432) and the *gettydefs*(F) manual page for more information.

Login/Answer
Select **On** to enable a login on the port. Select **Off** to prevent anyone logging in.

Receive buffer
Adjust the slider bar to one of the values 1, 4, 8, or 14. Select a lower value if characters are being lost in incoming data. Select a higher value to improve system performance by reducing the number of interrupts that the serial port generates. See "Changing the interrupt trigger level" in the *Performance Guide* for more information.

3. Click on **OK** to confirm.
4. Click on **Close**.

> **NOTE** If the **Serial Manager** relinks the kernel because you changed the configuration of the serial ports, you must shut down and reboot the system for the changes to take effect.

Serial ports on multi-function cards

The serial ports on many multi-function cards can be used if they can be configured with the standard specifications for COM1 and COM2.

Combining single port and multiport serial cards

Although the kernel imposes an upper limit of 24 on the number of dumb serial devices that it can support, you can configure a maximum of 16 serial ports on ISA and EISA bus machines, and a maximum of 17 serial ports on MCA machines using SCO-supported serial cards. The device numbering scheme for dumb single and multiport ISA serial cards also limits the number of ways that you can combine the supported dumb serial cards. Table 21-2 shows the possible ways of combining SCO-supported single and multiport serial cards assuming that their base I/O addresses do not clash.

Table 21-2 Possible combinations of ISA and EISA serial cards

COM1	COM2	COM3	COM4
1, 2, 4, 5 or 8 ports	-	-	-
1, 2, 4, 5 or 8 ports	1, 2, 4, 5 or 8 ports	-	-
1, 2 or 4 ports	1, 2 or 4 ports	1 or 4 ports	-
1, 2, 4, 5 or 8 ports	1, 2 or 4 ports	-	1 or 4 ports
1, 2 or 4 ports	1, 2 or 4 ports	1 or 4 ports	1 or 4 ports

Serial cards on ISA and EISA machines

Serial cards on COM1 should be configured to use IRQ (interrupt vector) 4. Serial cards on COM2 should be configured to use IRQ 3. Check your serial card hardware manual or contact the manufacturer for the correct switch settings.

Table 21-3 and subsequent tables list the IRQ vectors and I/O addresses associated with various serial cards. Additional information for cards marked with an asterisk (*) is given in Appendix C, "Serial adapters" (page 527).

Table 21-3 ISA and EISA serial cards installed as COM1

Physical port	Board type	Number of ports	IRQ vector	Base I/O address	Alternative addresses
COM1	AMI lamb*	4	4	0x540-0x55F	-
		8	4	0x540-0x57F	-
	Arnet	2	4	0x100-0x10F	0x280-0x28F
		4	4	0x100-0x11F	0x280-0x29F
		8	4	0x100-0x13F	0x280-0x2BF
	AST*	4	4	0x2A0-0x2BF	-
	CTC*	4	4	0x160-0x17F	-
		8	4	0x160-0x19F	-
	Digiboard*	4	4	0x110-0x12F	-
		8	4	0x110-0x14F	-
	Equinox	4	4	0x240-0x25F	-
		8	4	0x240-0x27F	-
	Hostess	4	4	0x140-0x15F	0x500-0x51F 0x680-0x69F
		8	4	0x140-0x17F	0x500-0x53F 0x680-0x6BF
	IBM	1	4	0x3F8-0x3FF	-
	Kimtron	4	4	0x120-0x13F	-
	Olivetti*	4	4	0x2A0-0x2BF	-
	Quadram*	1	4	0x280-0x28F	-
		5	4	0x280-0x2CF	-
	Stallion	8	4	0x118-0x157	-
	Stargate	4	4	0x290-0x2AF	-
		8	4	0x290-0x2CF	-
	Tandon*	4	4	0x2A0-0x2BF	-

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Table 21-4 ISA and EISA serial cards installed as COM2

Physical port	Board type	Number of ports	IRQ vector	Base I/O address	Alternative addresses
COM2	AMI lamb*	4	3	0x2C0-0x2DF	-
		8	3	0x2C0-0x2FF	-
	Arnet	2	3	0x180-0x18F	0x300-0x30F
		4	3	0x180-0x19F	0x300-0x31F
		8	3	0x180-0x1BF	0x300-0x33F
	AST*	4	3	0x1A0-0x1BF	-
	Chase DB	4	3	0x100-0x11F	0x180-0x19F 0x280-0x29F 0x300-0x31F
		8	3	0x100-0x13F	0x180-0x1BF 0x280-0x2BF 0x300-0x33F
	CTC*	4	3	0x218-0x237	-
		8	3	0x218-0x257	-
	Digiboard*	4	3	0x210-0x22F	-
		8	3	0x210-0x24F	-
	Equinox	4	3	0x140-0x15F	-
		8	3	0x140-0x17F	-
	Hostess	4	3	0x200-0x21F	0x580-0x59F 0x700-0x71F
		8	3	0x200-0x23F	0x580-0x5BF 0x700-0x73F
	IBM	1	3	0x2F8-0x2FF	-
	Kimtron	4	3	0x2E0-0x2FF	-
	Olivetti*	4	3	0x1A0-0x1BF	-
	Quadram*	1	3	0x288-0x297	-
		5	3	0x288-0x2D7	-
	Stallion	8	3	0x218-0x257	-
	Stargate	4	3	0x190-0x1AF	-
		8	3	0x190-0x1CF	-
	Tandon*	4	3	0x280-0x29F	-

Table 21-5 ISA and EISA serial cards installed as COM3

Physical port	Board type	Number of ports	IRQ vector	Base I/O address	Alternative addresses
COM3	HP	1	10	0x3E8-0x3EF	-
	IBM	1	12	0x2F0-0x2F7	-
	Mitsubishi	4	11	0x400-0x41F	-

Table 21-6 ISA and EISA serial cards installed as COM4

Physical port	Board type	Number of ports	IRQ vector	Base I/O address	Alternative addresses
COM4	HP	1	11	0x2E8-0x2EF	-
	Mitsubishi	4	12	0x408-0x427	-

Serial cards on Micro Channel Architecture machines

Table 21-7 lists the addresses associated with each serial card. Additional information for cards marked with an asterisk (*) is given in Appendix C, "Serial adapters" (page 527).

Table 21-7 MCA serial card addresses and notes

Physical port	Board type	Number of ports	IRQ vector	Base I/O address	Alternative addresses
COM1	IBM	1	4	0x3F8	-
COM2	Arnet*	2	3	0x140	-
		4	3	0x140	-
		8	3	0x140	-
		16	3	0x140	-
	AST	4	3	0x2F8	-
	Digiboard	4	3	0x3000	0xDB80
		8	3	0x3000	0xDB80
		16	3	0x3000	-
	Hostess MC	4	3	0x500	0x540 0x580
		8	3	0x500	0x540 0x580
	IBM	1	3	0x2F8	-
		8	3	0x2F8	-
	Stargate*	4	3	0x400	-
		8	3	0x400	-

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Adding and configuring parallel ports

No parallel drivers are configured into the kernel by default so you must configure all parallel ports using the **Hardware/Kernel Manager** or the **mkdev parallel** command. The first parallel port configured becomes */dev/lp0*, the second */dev/lp1* and so on. Table 21-8 lists the addresses and interrupts associated with the three possible parallel ports.

Table 21-8 Parallel port addresses and interrupts

Machine type	Physical port	Device name	IRQ vector	Base I/O address
ISA	LPT1	/dev/lp0	7	0x378
	LPT2	/dev/lp1	5	0x3bc
EISA	LPT1	/dev/lp0	7	0x378
	LPT2	/dev/lp1	5	0x3bc
	LPT3	/dev/lp2	5	0x278
MCA	LPT1	/dev/lp0	7	0x378
	LPT2	/dev/lp1	7	0x3bc
	LPT3	/dev/lp2	7	0x278

NOTE Some EISA and MCA machines can assign any interrupt vector to the parallel ports. MCA machines and some others may swap the default addresses for LPT1 and LPT2.

To configure an additional parallel port on your system:

1. Shut down the system using the **System Shutdown Manager** or the **shutdown**(ADM) command.
2. Install the card that holds the parallel port (if it is not already present), and configure your hardware according to the manufacturer's instructions. If your system includes a configuration disk or BIOS setup program, use it as instructed. If your system is configured with switch settings on the main system board (motherboard), define the new ports by setting the proper switches (refer to your hardware manuals for the settings).
3. Boot the system, and enter system maintenance mode by entering the *root* password.
4. Enter the command **mkdev parallel** or start the **Hardware/Kernel Manager** and select **Parallel Port** from the devices listed.

   The system determines what parallel ports (if any) are configured and displays the results (this may take several seconds). You can choose between installing a new parallel port or removing an existing one.

5. If you are installing a new parallel port, select the type of card you are installing. Select the base I/O address it uses from the menu or specify a non-standard address.
6. Unless you are installing on an MCA machine, enter the interrupt vector.
7. Relink the kernel as described in "Relinking the kernel" (page 290).
8. If you have no further changes to make, use the **System Shutdown Manager** or the **shutdown**(ADM) command to shut down the system and reboot.

Troubleshooting serial cards

Older computers or add-on serial I/O cards use the slower 8250 or 16450 UARTs to control their serial ports. Some revisions of the 8250A chip do not handle interrupts properly and should not be used with SCO OpenServer systems.

Problems with slow UARTs can show up when using UUCP or **cu**(C) over a modem connection at high line speeds. Examples are:

- incoming characters are lost intermittently
- UUCP generates unkillable **uucico** processes
- **cu** stops executing and will not exit
- an intermittent "double echo" is seen

These problems rarely show up when a serial port is used with a terminal. They are more often associated with high-speed serial input over a modem link. Avoid connecting high-speed modems to ports that are controlled by slow serial control hardware such as 8250 or 16450 UARTs.

NOTE We strongly recommend that you use 16550 (or better) UARTs on serial ports that are connected to high-speed modems. The 16550 has a 16-byte receive buffer that allows it to operate reliably at much higher speeds than the 8250 and 16450 (see Table 21-1).

See "Serial device resources" in the *Performance Guide* for information about how to monitor and tune the performance of dumb serial ports.

Chapter 22

Configuring audio adapters

You can configure an audio adapter on your SCO OpenServer system to run audio-enabled applications. Two separate activities are required:

1. Physically install the adapter, speaker system, and any input devices, following the instructions in the hardware documentation.
2. Run the **Audio Configuration Manager** (page 380) to configure the SCO audio subsystem software. The audio configuration window displays the configured adapters.

NOTE You can only configure a single audio adapter in SCO OpenServer systems.

Most audio device configuration should be completed using the **Audio Configuration Manager**. However, you must use the **ISA PnP Configuration Manager** if you want to configure:

- any Plug and Play audio adapters
- non-audio devices on the audio adapter board (such as IDE or SCSI ports)

See Chapter 17, "Installing Plug and Play devices" (page 311) for more information.

This topic describes how to use the **Audio Configuration Manager** to configure audio adapters. It includes:

- "The Audio Configuration Manager interface" (page 380)
- "About the audio subsystem" (page 380)
- "Adding and modifying audio configurations" (page 382)

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- "Removing adapters" (page 383)
- "Common audio subsystem tasks" (page 383)
- "Troubleshooting audio configuration" (page 385)

The Audio Configuration Manager interface

Use the **Audio Configuration Manager** to add (page 382) and remove (page 383) adapters from the system, and to examine and test audio configurations.

NOTE Do not modify or remove an audio configuration while audio-enabled applications are running.

You can start the **Audio Configuration Manager** in either of these ways:

- Open the Desktop's System Administration window (double-click on the *System Administration* icon) and double-click on the **Audio Configuration Manager.**
- Start the SCOadmin launcher by entering **scoadmin** on the command line, then select the **Audio Configuration Manager**.
- Enter **scoadmin audio** on the command line.

NOTE While any user can view the system's audio configuration, only *root* can modify audio configuration.

For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

About the audio subsystem

The audio subsystem consists of:

Audio device drivers

Modern audio adapters (and sound controllers integrated on the motherboard) often comprise a set of independent devices. SCO OpenServer audio drivers support these devices:

- the basic device for digital/analog conversion. This allows digital sound files to be converted to analog signals for playback, and analog signals from a recording device to be stored digitally.
- synthesizers, used for playing music

  NOTE Only FM synthesizers are currently supported.

- MIDI (Musical Instrument Digital Interface) interfaces, used to connect external electronic musical instruments to a computer

Each of these devices requires its own I/O address and other configuration parameters.

Play and record utilities

Computer audio subsystems must include software to control input and output sound characteristics such as volume levels, stereo separation, and sound sources. Sound-enabled applications often include such capabilities, which can communicate directly with the audio driver.

SCO OpenServer includes these command-line utilities for playing and recording sounds:

mixer(C)
sets volume levels, and selects input and output devices

vplay(C)
plays sound files

vrec(C)
records sound files

An audio driver must be installed before these utilities can be used.

SCO OpenServer audio adapters drivers are based on Open Sound System (OSS), a sound driver architecture for UNIX systems developed by 4Front Technologies. Because the SCO audio subsystem conforms to the OSS API (Application Programming Interface), you can run OSS-compliant audio-enabled applications on SCO systems. For more information and examples of audio-enabled applications, see their web site:

http://www.4front-tech.com/

NOTE SCO Skunkware® includes audio-enabled applications, as well as many other useful utilities. For more information, see the SCO Skunkware website:

http://www.sco.com/skunkware/

However, the 4Front sound drivers included in Skunkware are not supported on SCO OpenServer systems; see "Compatibility with earlier SCO audio drivers" (page 386).

Adding and modifying audio configurations

To add a new audio adapter:

1. Physically install the audio adapter in your system.
2. If you are not configuring a Plug and Play device, go to step 3.

   Use the **ISA PnP Configuration Manager** to configure your Plug and Play device; for more information, see Chapter 17, "Installing Plug and Play devices" (page 311).

   > **NOTE** To save time configuring Plug and Play audio devices, write down the configuration parameters presented by the **PnP Configuration Manager** and do not relink and reboot after Plug and Play configuration. When you start the **Audio Configuration Manager**, enter the configuration parameters manually for your device, then continue with step 6.
   >
   > The alternative is to relink and reboot after Plug and Play configuration; your device will then be auto-detected as described in step 5. You must then relink and reboot again after audio configuration.

3. Start the **Audio Configuration Manager** (page 380). We recommend starting it in single-user mode, as you will need to relink the kernel and reboot your system to enable your audio device.
4. Click on **Add Adapter** in the **Soundcard** menu.
5. When the adapter list displays, select the audio adapter that you want to configure, then click on **OK**. You have the option to configure any adapter auto-detected in your system or any of the supported adapters; currently only ISA Plug-and-Play adapters can be auto-detected. For your Plug-and-Play device to be auto-detected, you must first configure it using the **ISA PnP Configuration Manager** (page 312).
6. Supply the device-specific configuration parameters (page 380) required by your adapter.
7. When you have finished configuring the adapter, exit the **Audio Configuration Manager**, relink the kernel, and reboot your system.
8. Restart the **Audio Configuration Manager** and click on **Test** in the **Soundcard** menu to confirm that the adapter was configured correctly. You should hear an uninterrupted sound sample. Click on **Stop** when you have completed the test.
9. Click on **OK** to confirm your selection and exit the **Audio Configuration Manager**.

To modify an audio configuration:

1. Start the **Audio Configuration Manager** (page 380).
2. Click on **Modify Adapter** in the **Soundcard** menu.
3. Select your adapter from the display, then reset any required configuration parameters.
4. Exit the **Audio Configuration Manager**, relink the kernel, and reboot your system.
5. Restart the **Audio Configuration Manager** and **Test** your modified configuration.
6. Confirm your selection and exit the **Audio Configuration Manager**.

Removing adapters

To remove an audio adapter configuration:

1. In the main **Audio Configuration Manager** (page 380) window, select the adapter to remove and click on **Remove** in the **Soundcard** menu.
2. When the Remove window appears, click on **OK** to confirm the removal of the entire configured audio system.

You can now remove the audio device from your system.

Common audio subsystem tasks

You can use the audio subsystem to:

- play a sound file (page 384)
- record a sound sample (page 384)
- play an audio CD from your CD-ROM drive (page 384)
- configure Netscape Communicator to play sound files (page 385)

Each of these require to use the SCO play and record utilities (page 381) (or others of your choice). If you use **vplay**(C) or **vrec**(C), you must always have a command line prompt available to control recording and playback. You may also find it helpful to have a command line prompt available to set and test initial levels with **mixer**(C), or you can use another mixing program, such as **xmmixer** from SCO Skunkware.

Playing sound files

1. Set volume levels with **mixer**(C).
2. Enter:

   vplay ***sound_file***

Recording sound samples

1. Ensure that an input device (such as a microphone or CD-player) is connected to your audio adapter.
2. Use **mixer**(C) to set the input device and recording levels.
3. Enter:

   vrec ***sound_file***

4. Start the sound input (for example, start talking or play the CD.
5. Stop the sound input and recording utility when complete.

See **mixer**(C) or your mixer program's documentation if you want to record more than one channel at a time.

> **NOTE** A "recording overrun" may result if the sound source generates data faster than the computer can process it. See **vrec**(C) for more information.

Playing audio CDs from your CD-ROM drive

If your CD-ROM drive has external start and stop controls:

1. Use **mixer**(C) to set the sound source and volume level.
2. Press the **Play** button on your CD-ROM drive.

If your CD-ROM drive does not have external controls, you must have additional software to control your drive for audio reproduction. SCO Skunkware includes **Xmcd**, an excellent audio CD control utility; other applications are available commercially and through freeware.

Configuring Netscape Communicator to play sound files

By default, Communicator will prompt you to download a sound file when you click on it. However, you can configure Communicator to play sound samples directly from the browser:

1. Make sure that **mixer**(C) is set to the desired levels; you might want to have it available on a command line to control playback volume.
2. In the **Edit** menu, select **Preferences** ⇨ **Navigator** ⇨ **Applications**
3. Select the type of audio file you would like to play, then click on **Edit**.
4. Click on **Application**, then enter:

   /usr/bin/vplay %s

5. Confirm your selections to exit the **Edit** menu. You can repeat Steps 3 and 4 for each audio file type.

Troubleshooting audio configuration

If you have problems with your audio configuration:

1. Verify basic hardware functionality (page 274) and the integrity of your sound playback equipment.
2. Check for error messages in */usr/lib/audio/drivers/soundon.log*.
3. If available, run any diagnostic utilities that were shipped with your audio adapter.

You must also be aware of these issues:

- "Compatibility with earlier SCO audio drivers" (page 386)
- "Errors after initial sound reproduction" (page 386)

Compatibility with earlier SCO audio drivers

These audio drivers are not compatible with the SCO OpenServer audio subsystem:

- 4Front drivers supplied with SCO Skunkware
- 4Front OSS drivers for UnixWare

Installing them on SCO OpenServer systems may cause unpredictable behavior not limited to the audio subsystem.

However, playback and mixing utilities for older drivers do work with the SCO OpenServer audio subsystem.

Errors after initial sound reproduction

If you hear sound briefly after configuring your adapter but you immediately receive an error and sound ceases, you probably have your interrupt vectors (page 504) set incorrectly; for example, if they were set using utilities other than the **Audio Configuration Manager** (page 380). Run the **Audio Configuration Manager** to set them correctly.

Chapter 23

Adding mice and bitpads

This chapter explains how to:

- install bus mice (this page)
- install serial mice (page 388)
- install keyboard mice (page 388)
- configure mice (page 389)
- install bitpads (page 394)
- troubleshoot mice and bitpads (page 395)

Consult your hardware manufacturer's documentation for specific instructions on hardware configuration. Note the brand and type of your mouse or bitpad and whether it is attached to a serial port, keyboard port, or adapter plugged into the system bus.

Bus mice

Bus mice come with controller cards that are plugged into a slot in the computer's bus. They have jumpers or switches that may need to be set to allow the computer to communicate with the mouse correctly.

The manuals that come with your bus mouse should contain information about the jumpers and what the correct jumper settings should be.

It is important to set the jumpers before you run **mkdev mouse** because resetting jumpers usually requires removal and reinstallation of the mouse driver. If you are unfamiliar with bus cards, see "Installing bus cards" (page 295).

Check your system to see which interrupts are being used by other devices, so you will know the interrupts you cannot use. See Table 14-1, "Typical device interrupts" (page 275) for a list of standard interrupts. You should select the interrupt you want to use for your mouse and set the jumpers to that interrupt. You can use the **hwconfig**(C) command to display your current system configuration. The interrupts in use will be under the "vec" column; be sure to avoid using an interrupt belonging to another device. The **vectorsinuse**(ADM) utility can also be used to obtain this information.

For information on specific bus mice configurations see Appendix D, "Mice and bitpads" (page 531).

Serial mice

Serial mice (including wheel mice) are connected to either the COM1 or COM2 port, or to a port in a multiport board. They usually require either 9-pin or 25-pin RS-232 connections.

NOTE The Microsoft serial/PS2 mouse can be configured as either a serial mouse or a keyboard mouse if a converter adapter is installed.

If you have a COM1 or COM2 port, plug the mouse into one of those ports. If you have a non-intelligent multiport card, plug the mouse into the appropriate port on the card.

It is important that you know the name of the port on which the mouse is to be installed. COM1 uses **tty1a**, and COM2 uses **tty2a**. Multiports that are connected to COM ports have similar names but use different letters for each port. For example, a four-port multiport board in COM1 would typically have device names **tty1a, tty1b, tty1c,** and **tty1d** to correspond with its four ports. Multiport cards provided with special drivers, often called "smart cards", have their own device names; check your multiport manual to find them.

Keyboard mice

Keyboard mice, also known as PS/2 mice (including wheel mice), connect to a dedicated port at the back of your computer. They usually use 6-pin or 9-pin mini-DIN connectors. Check your manual to find the port to which the mouse should be connected.

When installing a mouse using **mkdev mouse**, choose the keyboard mouse option only if you have a machine and mouse capable of using this port. On some AT-type machines that do not have a keyboard mouse port, installing a keyboard mouse driver causes the keyboard to lock up after booting. If this happens, boot the previous kernel (*unix.old*) and remove the keyboard mouse driver from the system using the remove option of **mkdev mouse**.

Configuring a mouse

To install a mouse on your system:

1. Install the mouse in the computer according to the manufacturer's instructions.
2. Log in as *root*, put the system into maintenance mode.
3. Select **Mouse/Graphic Input Device** from the devices listed by the **Hardware/Kernel Manager**, or enter the command **mkdev mouse**.
4. Select **Install a mouse** from the menu.
5. Select the type of mouse you will use from the options listed. When prompted:
   - For a serial mouse, select the port on which the mouse is installed.
   - For a bus mouse, select the type of mouse to be installed and its parameters. If you wish to change the default parameters, Take special care when changing the interrupt vector for the mouse. Select an unused interrupt vector. See "Typical device interrupts" (page 275).
   - For a keyboard mouse, select the resolution you require. See "Changing the keyboard mouse resolution setting" (page 391) and "Solving slow or no response from keyboard mice" (page 395) for more about high resolution mice.)
   - For wheel mice, select an entry that contains the string "wheel".
6. Specify the terminals and multiscreens that are allowed to accept input from the mouse. Do not specify any tty ports where mice are actually connected. You may choose to allow any or all other terminals and console multiscreens to use the mouse. The default associates the mouse with all of the console multiscreens.

   If you install more than one mouse, make sure the terminal specifications for each mouse do not overlap. Only one mouse can be allowed for input on a given tty.

   See "Using a mouse" (page 392) for more information on sharing the mouse between several terminals or multiscreens.
7. Relink the kernel to install the mouse driver.
8. If you have no more changes to make to your mouse configuration, quit the **mkdev** utility and use the **System Shutdown Manager** or the **shutdown**(ADM) command to shut down the system and reboot.

You can invoke the **Hardware/Kernel Manager** or **mkdev mouse** at any time to allow or prevent input on different terminals, remove mice, or check your current configuration.

NOTE Many system utilities (for example, **usemouse**(C)) and applications (for example, SCO Shell) which use a mouse require pseudo-ttys to be installed on the system. If you wish to run such an application, see "Testing a mouse" (page 390). If necessary, use the **mkdev ptty** command to create more than the 32 pseudo-ttys that are generated by default when an SCO OpenServer system is installed.

Changing mouse ports

If you change your mouse's port after installing an SCO OpenServer system, use **mkdev mouse** to change the port.

Testing a mouse

NOTE Pseudo-ttys must be installed on the system in order to use **usemouse**. See "Adding pseudo-ttys" in the *System Administration Guide* for more information.

1. Log in as *root* in multiuser mode on the terminal you wish to test.
2. Enter the following at the system prompt:

   usemouse echo

3. As you move the mouse and click the buttons, characters should be echoed to the screen. For example, output might include:

`l`	mouse left
`r`	mouse right
`u`	mouse up
`d`	mouse down
`ld lu`	left mouse button (button 1) pressed and released
`wf`	wheel forward
`wb`	wheel back

   See the **usemouse**(C) manual page for a complete listing of **usemouse echo** output.

   NOTE If you are using a two button mouse, pressing both buttons at once emulates the middle button.

4. To stop the **usemouse** utility, press the interrupt key, usually ⟨Del⟩ or ⟨Ctrl⟩-C.

NOTE Because **usemouse** starts a new shell when executed, it is important to exit this shell before starting a graphical application.

If **usemouse** does not produce the behavior described here, or you see the following error messages, your mouse is not installed correctly.

```
Open event driver failed:: No such file or directory Open
event driver failed:: Not enough space...giving up
```

To fix the problem:

- First, verify that your mouse is supported by SCO OpenServer systems.
- Confirm that you have run **mkdev mouse** and that your mouse selection corresponds to the connected mouse hardware.
- Make certain the cable is attached securely and, if you are using a bus mouse, that the adapter card is properly installed.
- If you are using a bus mouse, verify that the bus mouse card is recognized during the boot process and that there is no conflict with the interrupt vector or base address. Check the hardware configuration information using the **hwconfig**(C) command.
- If you are using a serial mouse, verify that the serial card to which your mouse is attached is recognized during the boot process (by running **hwconfig**). If the mouse is on a multiport board that uses its own drivers, make certain the board works. Try the mouse on a COM port to eliminate the possibility of a third-party driver being the problem.

Removing a mouse

To remove a mouse or mouse drivers on your system, use the **Hardware/Kernel Manager** or select the appropriate option from the main **mkdev** mouse menu. After you have removed the mouse or mouse drivers, the kernel must be relinked for the change to take effect.

Changing the keyboard mouse resolution setting

The file */etc/conf/pack.d/kbmouse/space.c* contains two parameters that affect the performance of the high-resolution keyboard mouse, **kbm_resolution** and **kbm_poll**. You can use a text editor to edit the *space.c* file and change the **kbm_resolution** parameter to adjust the resolution setting. The **kbm_poll** parameter, however, is automatically set by the **mkdev mouse** utility. Normally, **kbm_poll** should not be changed. Refer to "Solving slow or no response from keyboard mice" (page 395) for more information about **kbm_poll**.

Hardware

The **kbm_resolution** parameter determines how many reports, or counts, are made from the mouse to the mouse driver each time that you move the mouse one millimeter. Increasing the number of counts per millimeter increases the sensitivity of mouse performance.

The allowable values for **kbm_resolution** are:

Table 23-1 High-resolution keyboard mouse

Parameter	Counts/millimeter
kbm_resolution=0	1
kbm_resolution=1	3 (default)
kbm_resolution=2	6
kbm_resolution=3	12

The parameters for a low-resolution keyboard mouse do not correspond to the same counts/millimeter parameters as for a high-resolution keyboard mouse. The allowable values for a regular keyboard mouse are:

Table 23-2 Low-resolution keyboard mouse

Parameter	Counts/millimeter
kbm_resolution=0	1
kbm_resolution=1	2
kbm_resolution=2	4
kbm_resolution=3	8 (default)

The low-resolution default value of 3 specifies 12 counts/millimeter for a high-resolution keyboard mouse, which causes the mouse to behave too sensitively. Therefore, you must use the **mkdev mouse** utility when you add or remove a high-resolution mouse. You must relink the kernel and reboot the system if you want the new parameter values to take effect.

Using a mouse

If a program accepts mouse input and the terminal is allowed to use a mouse, the mouse should work when you invoke the program. If the terminal or multiscreen is not allowed to use a mouse, or the program is not configured to accept mouse input, using the mouse has no effect.

Using a mouse with multiscreens

If a mouse is associated with the multiscreens on your main system console, the mouse input is associated with the currently active multiscreen. For example, if your system has four multiscreens enabled on the main system console and each of those screens is allowed to use a mouse, the input from the mouse goes to the program running on the active multiscreen.

Multiscreens on serial terminals and serial consoles can also be configured to use a mouse.

Remember that programs that do not accept mouse input are unaffected by moving the mouse, even on a mouse-allowed multiscreen.

Using a mouse on serial terminals

When you install a mouse, you are prompted to list the ttys that are allowed to use mouse input. You can allow terminals on serial lines to use the mouse just as you allow multiscreens. You must not specify any ttys where mice are physically connected.

Sharing a mouse with several terminals

When a mouse is shared among several terminals, the mouse is associated with the first user to invoke a mouse-enabled program for the duration of that program. For another user to use the mouse, the first user must quit the program to close the input queue from the mouse.

NOTE Note that other users on ttys allowed to use a mouse can use programs that accept mouse input while the mouse is busy. The programs are unable to receive input from the mouse but should otherwise function normally.

Using a mouse with keyboard-based programs

The **usemouse**(C) utility maps mouse movements and operations to key strokes used by keyboard-based programs. Refer to the **usemouse**(C) manual page for more information.

WARNING Do not use the **usemouse** utility while in single-user (maintenance) mode.

Using the pseudo-mouse driver

A pseudo-mouse is configured automatically during installation when you run **mkdev mouse**. This allows you to use applications that expect mouse input within a **scoterm** window.

To demonstrate the use of the pseudo-mouse, run **usemouse** in a **scoterm** window, then press ⟨Ctrl⟩⟨Alt⟩⟨Bksp⟩. Notice your pointer disappears, but the cursor in the window now moves with the mouse. Press the same keys again to get the pointer back.

Installing a bitpad

NOTE Bitpads are not supported by the X server. They cannot be used in place of mice.

To install a bitpad:

1. Install the bitpad according to the manufacturer's instructions.
2. Log in as *root*, put the system into maintenance mode
3. Select **Mouse/Graphic Input Device** from the devices listed by the **Hardware/Kernel Manager**, or enter the command **mkdev bitpad**.
4. Select **Install a bitpad** from the menu.
5. Specify the type of bitpad you wish to install.
6. Select the specific model that you wish to install.
7. Select the port to which you wish to attach the bitpad.
8. Specify the terminals and multiscreens that are allowed to accept input from the bitpad. Do not attempt to allow bitpad input on any tty to which any bitpads are physically connected or you receive an error message. You may choose to allow any or all other terminals and console multiscreens to use the bitpad. Press ⟨Enter⟩ to associate all of the console multiscreens.

   Note that only one bitpad can provide input on a terminal or multiscreen.

   See "Using a mouse" (page 392) for more information on sharing these devices between several terminals or multiscreens.
9. Relink the kernel to install the bitpad driver.
10. If you have no more changes to make to your bitpad configuration at this time, you can quit the **mkdev** utility and use the **System Shutdown Manager** or use the **shutdown**(ADM) command to shut down the system and reboot.

You can invoke the **Hardware/Kernel Manager** or **mkdev bitpad** at any time to allow or prevent input on different terminals, remove a bitpad, or check your current configuration.

Troubleshooting mice and bitpads

If you are having problems with a mouse, first test it. See "Testing a mouse" (page 390). The following sections explain how to solve known problems that might occur when using a mouse or bitpad.

Solving slow or no response from keyboard mice

If your keyboard mouse responds too slowly or not at all, use a text editor to edit the file */etc/conf/pack.d/kbmouse/space.c*. Reduce the **kbm_poll** value to improve keyboard mouse response. For example, if the value 0xb0 produces very slow mouse response, try 0xa0, 0x90, 0x80, and so on in turn until the mouse performance is satisfactory. A recommended starting value is 0x400. Refer to "Changing the keyboard mouse resolution setting" (page 391) for more information.

NOTE Some **kbm_poll** values lower than 0xb0 may cause your system to freeze. If this occurs, increase the **kbm_poll** value.

After modifying parameters in *space.c*, you must relink the kernel and use the **shutdown**(ADM) command to reboot the system. When the system boots, the new keyboard mouse parameters take effect.

Chapter 24

Adding printers

To set up a printer on your system, see "Installing parallel and serial printers" (page 398).

Once you have installed the printer, configure it for the print service as described in "Adding local printers" in the *System Administration Guide*. If required, you can customize the printer spooling software as described in "Customizing printer configuration" in the *System Administration Guide*.

Information about the network printing capabilities of SCO OpenServer systems is presented in "Distributed printing" in the *Networking Guide*. If you are installing a Hewlett-Packard network printer, refer to the network installation instructions that accompany the printer. To configure the networking and printer spooling software, see "Configuring Hewlett-Packard network printers and print services" in the *System Administration Guide*.

For information on remote printing, see "Connecting to remote UNIX system printers" in the *System Administration Guide* and Chapter 16, "Printing remotely over TCP/IP" in the *Networking Guide*. For information on dialup printers see "Configuring an UUCP dialup printer" in the *System Administration Guide*.

See also "Troubleshooting printers" (page 399).

Installing parallel and serial printers

To install a printer:

1. Find a safe location for your printer. Make sure that it is properly assembled and plugged into a power outlet.
2. Log in as *root* (you do not need to put the system into maintenance mode).
3. **If you are connecting a serial printer**, connect the RS-232 cable from a serial port on your computer to the port on your printer. Serial printers must be capable of supporting XON/XOFF or hardware flow control; they must also be configured to use the correct handshaking protocol. Consult your printer hardware manual for more information.

   Next, enter the following command substituting the correct port number for ***nn*** (for example, **1a** for */dev/tty1a*):

   disable /dev/tty*nn*

   This disables logins on the port you have connected to your printer and allows the port to be used for serial communication.

   If you are connecting a parallel printer, you must first run the **Hardware/Kernel Manager** or use the **mkdev parallel** command to create a parallel port. The printer must use a standard Centronics interface cable. The main parallel port is typically a built-in port or on a parallel/serial adapter (as opposed to being on a monochrome video card). The parallel port should have been configured to use interrupt vector 7 and be recognized as */dev/lp0* after running **mkdev parallel**. See **parallel**(HW) and "Adding and configuring parallel ports" (page 376) for more information.
4. Verify that you have connected the printer correctly by sending data directly to the device.

   For serial printers, enter the following command:

   date > /dev/tty*nn*

   where ***nn*** identifies the serial port you are using (for example, **1a** for */dev/tty1a*).

   You may need to specify the printer's **stty**(C) settings (speed, parity, data length and so on) if these differ from the serial line's default settings, For example, to test a 4800 baud printer on */dev/tty1a* which is set to 9600 baud:

   (stty 4800 ; date > /dev/tty1a) < /dev/tty1a

   For parallel printers, enter the following command:

   date > /dev/lp*n*

   where ***n*** is the number of the parallel port you are using (for example */dev/lp0*).

Certain laser printers, such as the HP LaserJet, need to be sent a form feed at the end of a print job; this tells them to eject the page. For example, for a serial printer:

(date ; echo "\014") > /dev/tty*nn*

or for a parallel printer:

(date ; echo "\014") > /dev/lp*n*

Laser printers that are in PostScript mode can be tested by sending them a PostScript file. For example, to send the file *foo.ps* to the serial port ***nn*** enter the following command:

cat *foo.ps* > /dev/tty*nn*

To send the file to the parallel port ***n*** enter the following command:

cat *foo.ps* > /dev/lp*n*

Troubleshooting printers

If you do not see the expected output printed, the most likely cause is some type of hardware malfunction. The following troubleshooting procedures may help you to isolate the problem.

For serial printers:

- If the printer uses the XON/XOFF flow control protocol, make certain you specify the non-modem control device for the serial port (such as */dev/tty1a*).
- If the printer uses hardware flow control, specify the modem control device (such as */dev/tty1A*). You will also need a cable capable of supporting hardware flow control — see "Setting up RTS/CTS protocol (hardware flow control) printers" (page 401). (For more information on the naming convention for serial ports, see the **serial**(HW) manual page.)
- A printer that uses XON/XOFF flow control, and that is configured as Data Circuit terminating Equipment (DCE) should require a serial cable with only pins 2, 3, and 7 connected straight through (assuming 25-pin connectors are used).

  See **serial**(HW) for a description of the pin connections if the printer is configured as Data Terminal Equipment (DTE). This manual page also describes the equivalent 9-pin connections.
- Recheck your printer configuration by verifying the switch positions in the printer manual.

- Make certain that the system recognizes your serial port. You can verify this by running the **hwconfig**(C) command, or by checking the file */usr/adm/messages*. If your port is one of the non-intelligent boards supported by the built-in serial driver, you will see a message similar to this:

  ```
  %serial 0x03F8-0x03FF 04 - unit=0 type=Standard nports=1
  ```

  If `unit=0` is displayed, the serial port is considered to be COM1. If the unit is 1, the port is considered to be COM2. `nports=` denotes how many ports the driver recognized on the adapter. If you connect your serial printer to the first port on COM1, the associated device name will be **tty1a**. The second device on COM1 is **tty1b**, and so on. Devices on COM2 are named **tty2a**, **tty2b**, etc.

  Intelligent serial adapters may display different bootup messages specific to their drivers; they may also use a different scheme for device names. The message displayed in this case may look similar to this:

  ```
  %ONBOARD  0x0230-0x023F 34  0 unit=0 mem=0x000D0000 nport=16
  ```

  Be sure to read the documentation for the adapter and its drivers before attempting to install serial devices such as printers.

- Recheck the switch settings on your serial port. If you are using a multiport adapter, try other lines on that card and be sure it does not conflict with the standard COM ports. Try attaching the printer to a standard serial port, COM1 or COM2, to see if the printer and cabling are functioning correctly.

For parallel printers:

- Make certain your cable is securely connected.
- Check that no wires in the cable are broken. One way of testing this is to use the cable on another system that is known to be working correctly.
- Recheck your printer configuration by verifying its switch settings in your printer hardware manual.
- Recheck the switch settings on your parallel card. It must also be recognized at bootup. You can verify this by running the **hwconfig**(C) command, or by checking the file */usr/adm/messages* for a message similar to this:

  ```
  parallel 0x378-0x37A   07    -    unit=0
  ```

  `unit=0` refers to */dev/lp0*, `unit=1` refers to */dev/lp1*, and so on.

To confirm that your card is recognized, enter the following command:

hwconfig name=parallel

If the card is recognized, an entry will be printed that has similar information to the entry above. The interrupt vector is listed in column 3 (or with "vec=" for the **hwconfig** display); make certain that it does not conflict with other hardware.

You can now set up and customize the printer spooling software as described in "Adding local printers" and "Configuring Hewlett-Packard network printers and print services" in the *System Administration Guide.*

Setting up RTS/CTS protocol (hardware flow control) printers

The Ready To Send (RTS) and Clear To Send (CTS) lines for the RS-232 serial interface were originally intended as handshaking signals between a DTE device (computer, printer, and so forth) and a DCE device (almost always a modem). This section describes unidirectional handshaking between two DTE devices: a computer and a printer. The computer asserts its RTS (Ready To Send) line when it is ready to send data to the printer. The printer asserts its RTS when it was ready to receive data.

If the printer's input buffer is nearly full, it lowers its RTS line (connected to the computer's CTS (Clear To Send) line). If the computer sees CTS go low, it stops sending data until it goes high again when the printer has caught up.

Some printers use the DTR (Data Terminal Ready) line for handshaking rather than RTS or CTS. For these devices, the cable must be wired to connect the printer's DTR pin to the computer's CTS pin — see Figure 24-2 (page 402).

To set up for RTS/CTS handshaking:

1. Use the modem-control port (such as */dev/tty1A*). When you configure the printer to use the print service, make sure you specify the modem control port rather than one of the standard serial devices.
2. **For a device that uses the RTS and/or CTS lines for handshaking,** wire the cable as shown in Figure 24-1 (page 402).

   For a device that uses the DTR line for handshaking, wire the cable as shown in Figure 24-2 (page 402).

   For equivalent 9-pin connections, see the **serial**(HW) manual page.

Hardware

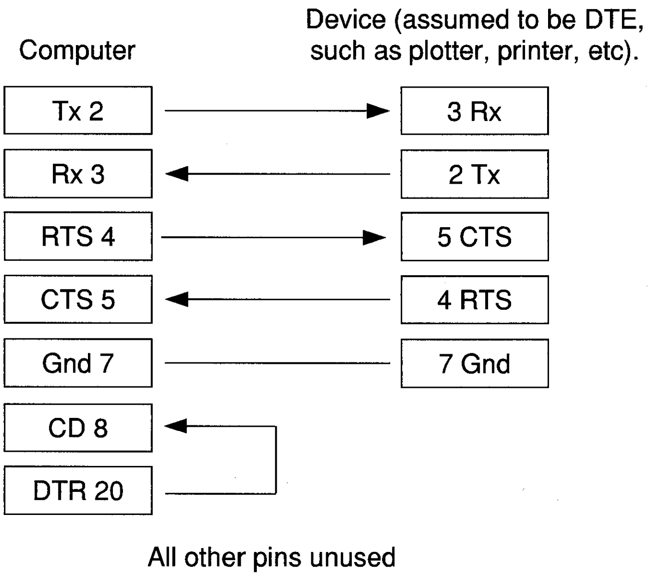


Figure 24-1 RTS/CTS handshaking for 25-pin connector

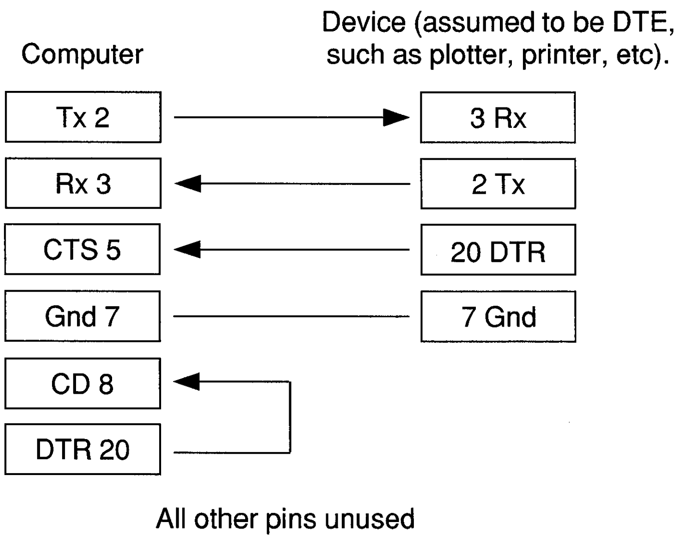


Figure 24-2 DTR handshaking for 25-pin connector

3. To enable unidirectional hardware flow control using RTS/CTS handshaking, make sure the **stty**(C) settings on the port include **-ixon -ixoff -clocal ortsfl rtsflow ctsflow**.

   To enable unidirectional hardware flow control using DTR handshaking, make sure the **stty**(C) settings on the port include **-ixon -ixoff -clocal -ortsfl -rtsflow ctsflow**. This form of unidirectional flow control stops transmission when CTS sees the printer drop DTR.

   To enable the **stty** settings when the system goes to multiuser mode, place the appropriate command in the file */etc/rc2* or */etc/rc2.d/P88USRDEFINE*:

   stty ***stty_settings*** **<** **/dev/tty*nn***

Chapter 25
Adding modems

Modems enable you to communicate over phone lines with remote systems.

> **NOTE** The UUCP package must have been installed on your system to support modem connections whether these are used with **cu**, UUCP, SLIP or PPP. Use the **Software Manager** or **custom**(ADM) to install this package if necessary.

To set up a modem on your system, follow these steps:

1. Install the modem (page 406).
2. Configure UUCP (page 414).
3. Test the modem (page 421).

See also "Troubleshooting modems" (page 424).

Supported modems

Any external 100% Hayes-compatible modem should work provided that it is connected to a serial port that is capable of supporting modem control protocols. All SCO-supported serial devices can provide modem control. Some third-party multiport smart serial cards cannot be used as they do not support modem control.

SCO has successfully tested several Hayes-compatible internal and PCMCIA modems. Some older models of internal modem have compatibility problems which prevent them from working properly. For example, they may flood the system bus with spurious interrupts, or they may not support the quiet, no-echo, or auto-answer modes.

Support for modems is provided by **atdialer** configuration files. Additionally, your SCO OpenServer system provides several dialer programs; see "Using dialers" (page 414). If you have a modem that is not Hayes-compatible or is not officially supported, you can create a custom dialer as described in "atdialer and dialer programs" (page 416).

For information on specific modems, see Appendix E, "Modems" (page 533). Also see "Guidelines for non-supported modems" (page 412).

Installing a modem

To install a modem, follow the steps:

1. Choose a serial port for your modem (this page).
2. Connect the modem to your system (page 407).
3. Run the **Modem Manager** (page 408).

Choosing which serial port to use

Before adding a modem, ensure there is a port available on your system — either directly on the COM1 or COM2 serial ports, or on a third-party multiport card. If you are installing a supported modem, use the **Modem Manager** to configure an SCO-supported serial card. Otherwise, you can use the **Hardware/Kernel Manager** or the **mkdev serial** command to add support for additional serial ports, or a vendor-supplied configuration utility for third-party intelligent serial port devices and drivers. See Chapter 21, "Adding serial and parallel ports" (page 367) for more information.

For systems with two dumb (non-intelligent) single-port serial cards, */dev/tty1a* and */dev/tty2a* are the non-modem control devices associated with COM1 and COM2 respectively. */dev/tty1A* and */dev/tty2A* are the corresponding modem control devices for these ports. The operating system gives these ports different device names because it uses different device-driver routines for each.

NOTE Always use the modem control device with a modem.

For systems with dumb multiport serial cards, */dev/tty1a* through */dev/tty1h* and */dev/tty2a* through */dev/tty2p* are non-modem control devices, and */dev/tty1A* through */dev/tty1H* and */dev/tty2A* through */dev/tty2P* are modem control devices.

Vendors of multiport smart serial cards implement their own drivers and device naming schemes; consult the documentation supplied with your smart serial card for details.

Make sure the serial port you have chosen for your modem is recognized at bootup (check */usr/adm/messages* or use **hwconfig**(C)) and, if the modem is internal, make sure that the interrupt vector (IRQ) and base I/O address of the COM port do not conflict with any other device.

If you attempt to use both modem and non-modem control ports at the same time you will see the warning:

```
cannot open: device busy
```

See also "Adding and configuring SCO-supported serial cards" (page 368).

Connecting a modem to your computer

You can obtain suitable modem cables from most computer stores and suppliers. You cannot connect modems using the three-wire cables that are often used to connect terminals to the computer. To connect a modem to a 25-pin serial port, pins 2, 3, 7, 8, and 20 must be wired *straight through* (meaning the pins are connected: pin 2 to pin 2, pin 3 to pin 3, and so on). In addition, pins 4 and 5 must be connected straight through if RTS/CTS flow control is used. If you are unsure what to use, a cable that connects all pins straight through should work correctly. See the **serial**(HW) manual page for details on 9-pin connections.

A COM port on a computer is usually DTE (Data Terminal Equipment) type, and a modem port is usually DCE (Data Communications Equipment) type, so that a straight-through cable is suitable for connecting the two. However, COM ports on some serial expansion boards are DCE type. If this is the case, you need a null-modem cable to connect a modem. Check your hardware documentation if you are unsure.

NOTE When you are hooking up your modem (or any other serial device), ensure that serial wires connected to your computer are not left hanging. An unterminated line connected to your computer can considerably reduce system performance. Always unplug a modem cable at the computer end, *not* at the modem end.

Physical connections between a device and the system may depend on the hardware configuration. For specific information about connecting a modem, refer to the hardware manuals provided with the modem and with your computer.

Your modem may have DIP switches to configure various settings when it is first powered on. One of the settings may allow you to choose whether the modem uses the default factory settings in read-only memory (ROM) or settings you have written to non-volatile memory (NVRAM). If so, select DIP switch and NVRAM settings that are close to the normal operating state of the modem. If necessary, you can normally override these settings by sending commands to the modem.

The factory default settings are normally suitable for installing the modem. Do not adjust these settings until you have tested that the modem operates successfully with your system.

Though unlikely, you may have to physically configure the modem to allow dial-in connections as follows:

- Set the modem to auto-answer. A few modems do not have this setting and can only make outgoing calls.
- Set the modem so that it does not answer when DTR (Data Terminal Ready) is low, and so that it drops the current connection when DTR goes from high to low.
- Set CD (Carrier Detect) to go high when a carrier is present, low when a carrier is not present.
- Turn off echoing of characters sent to the modem.
- Select quiet mode so that the modem sends no response codes.

The Modem Manager interface

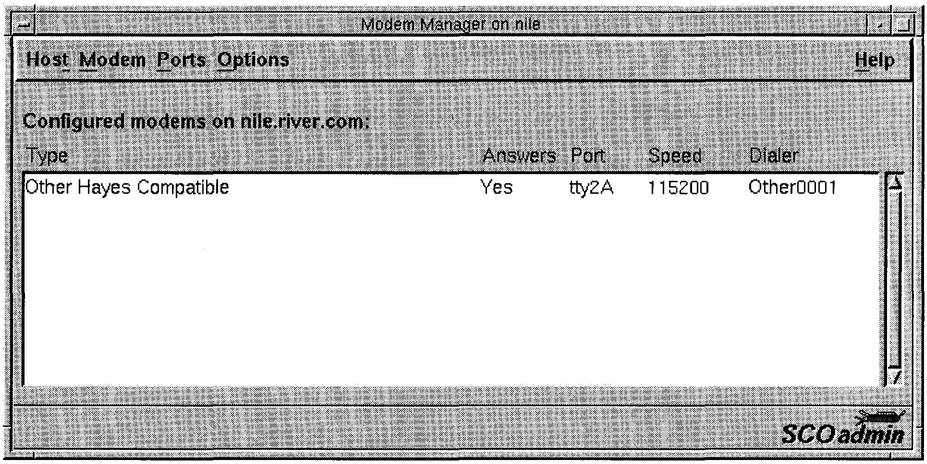
The **Modem Manager** allows you to configure modems for your system. You can start the **Modem Manager** in any of these ways:

- Double-click on the *System Administration* icon on the Desktop, then on **Networks**, and finally on **Modem Manager**.
- Start the SCOadmin launcher by entering **scoadmin** on the command line, then select **Networks**, and finally **Modem Manager**.
- Enter **scoadmin modem manager** on the command line.

For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

By default, you configure the local host. To configure a different host, select **Open Host** from the **Host** menu, and choose another host.

The **Modem Manager** shows the details of any modems that are currently configured on your system, and allows you to modify this configuration:



Configuring modems

You can choose how to add the configuration information for modems:

- Let the **Modem Manager** search for modems **automatically** (this page).
- Enter the configuration information for the modem **manually** (page 410).

Detecting a modem automatically

To detect a modem automatically, in the **Modem Manager**:

1. Verify that the modem is connected and switched on.
2. Select **Add** from the **Modem** menu, and then select **Automatic detection**.
3. Select the serial port to which the modem is attached, or select **Any** to have the system examine all serial ports.

   You can enter a third-party serial device name for your serial port once that device has been configured into your system; see your serial device documentation for installation and configuration information.

NOTE A driver for the serial port must have been configured into the kernel. If a suitable driver is not available, and the serial port is on an SCO-supported serial card, click on **Add port** to define the serial card and its ports. Follow the instructions in "Configuring a serial card" (page 369). If the serial port is on a non-SCO supported or an intelligent serial card, it must be configured to use a third-party driver. Refer to the instructions for installing the driver provided with the serial card.

After you relink the kernel with the correct serial driver, exit the **Modem Manager**, and then shut down and reboot your system.

You must re-invoke the **Modem Manager** after your system has rebooted to be able to detect a modem automatically.

You do not need to reboot the system to add a modem manually to a newly defined port, but you will not be able to use the modem or the port until you reboot the system.

4. Click on **OK** to start the system searching for the modem. As the serial port is probed, the indicator lights on the modem should flicker on and off for several seconds. While the **Modem Manager** probes the serial port(s), it updates the list of the modems that it has detected.
5. When it finishes probing the ports, select the modems to add, and click on **Add**.

   If the system does not detect a modem, check that the modem is connected correctly and is switched on. Some older models of modem are not capable of being detected. If automatic detection still fails, enter the configuration manually as described in "Adding a modem manually" (this page).

Adding a modem manually

To add the configuration information for a modem, in the **Modem Manager**:

1. Select **Add** from the **Modem** menu, and then select **Manual configuration** to bring up the **Modem Configuration** window.
2. Enter the following information:

   Modem vendor
   Select the manufacturer of your modem. If this is not listed, select **Standard Modem Types**.

   Modem model
   Enter the modem model. If you selected **Standard Modem Types** for the **Modem vendor**, select **Standard Modem**.

   Line speed (bps)
   Enter the serial line speed at which you want to the computer and modem to communicate. The default speed is 38,400bps. You can set the speed as high as 115,200bps if the serial port uses a 16550 UART or

higher specification UART. Do not set the speed higher than 9600bps if the serial port uses a 8250 UART. Select **Any** to use the default speed for the serial line (this is usually 9600bps). See Table 21-1 for more information.

Modem port

Select the modem control serial device (such as *tty2A*) corresponding to the port to which the modem is connected. If the port is not listed, click on **Add port** to configure the serial port for your system, and follow the instructions in "Configuring a serial card" (page 369).

You can enter a third-party serial device name for your serial port once that device has been configured into your system; see your serial device documentation for installation and configuration information.

To change the speed or interrupt trigger level, or to enable or disable a login on a port, follow the instructions in "Configuring a serial port" (page 370).

Answer mode

Select **On** to have the modem answer incoming calls. This allows your system to provide remote access PPP or incoming SLIP connections. It enables a **getty** process on the serial line attached to the modem to allow incoming connections to log into your system.

Select **Off** if you want to prevent your system accepting incoming calls.

3. Click on **OK** to accept the configuration.

Modifying the configuration of a modem

To modify the configuration information for a modem, in the **Modem Manager**:

1. Select the modem to modify.
2. Select **Modify** from the **Modem** menu to bring up the **Modem Configuration** window.
3. Click on **OK** to confirm.

Removing a modem

To remove the configuration information for a modem, in the **Modem Manager**:

1. Select the modem to remove.
2. Select **Delete** from the **Modem** menu.
3. Click on **OK** to confirm.

Guidelines for non-supported modems

When configuring non-supported modems:

- You may need to disable or reduce the level of data compression and error correction when using a modem for UUCP. If throughput seems too low, or you have failed transfers, disable these features.
- Disable XON/XOFF flow control when using the modem for UUCP. The stop character (XOFF or DC3) can occur in the UUCP protocol data stream, and cause the transfer to fail. XON/XOFF passthrough mode may be usable.
- Use "Setting hardware flow control" (page 420) with your modem.

If you want to enable XON/XOFF when using the modem for **cu**(C), you must define an alternative dialer to that used with UUCP. This can be done by modifying and renaming the *Dialers* file entry, or by modifying and renaming the dialer program, such that you have one dialer definition for UUCP and another for **cu**. See the *sysfiles*(F) manual page for instructions.

To install your modem for dial-in or dial-out:

1. Make sure the serial port you have chosen for your modem is recognized at bootup (check */usr/adm/messages* or use **hwconfig**(C)) and, if the modem is internal, make sure that the COM port does not conflict with any other device.
2. Use the **disable**(C) command to disable the modem and non-modem control ports, for example:

   disable tty1a
   disable tty1A

3. If you are going to use the line for dial-out, ensure that the serial port is owned by *uucp*, for example:

   chown uucp /dev/tty1A
   chgrp uucp /dev/tty1A

4. If you intend to use the modem for dial-in, check the */etc/inittab* file and confirm it has an entry for your port similar to this:

   ```
   Se1A:2:off:/etc/getty -t60 tty1A m
   ```

   /etc/inittab determines whether the port has a login prompt and defines the serial line characteristics. There should already be an entry for the line you are using; all you need to do is check the last field. This field is a number or letter (label) from the */etc/gettydefs* file. See Table 21-1 for a list of the more commonly used labels.

Do not alter any fields other than the *gettydefs* label. For example, if you want to connect to the modem at 19,200bps on the first standard serial port, the line should be similar to this:

```
Se1A:2:off:/etc/getty -t60 tty1A n
```

If you make any changes, use the following command to check the entries:

grep -i *tty* /etc/inittab

where ***tty*** is the serial port being used. This should generate only two lines: one for the modem control port (such as *tty1A*) and one for the non-modem control port (such as *tty1a*).

For more information on the */etc/inittab* file and the various control codes, see the **getty**(M) and **inittab**(F) manual pages.

5. Duplicate any changes you make to */etc/inittab* in the */etc/conf/init.d/sio* file.

> **WARNING** Each time the kernel is relinked (when a driver is added or a tunable parameter is changed), */etc/inittab* is reconstructed from the entries found in */etc/conf/init.d/sio*.

Add the correct entries to the */usr/lib/uucp/Devices* file. This file should have two entries for each serial port being used for a modem. One of the entries is used when you start a call using the modem (the Automatic Calling Unit (ACU) line), and the other line is used to connect directly with the modem to issue commands manually (the direct line). For a Hayes-compatible modem connected at 19,200bps on COM1, the entries in */usr/lib/uucp/Devices* should be:

```
ACU  tty1A - 19200 /usr/lib/uucp/dialHA24 \T
Direct  tty1a - 19200 direct
```

The */usr/lib/uucp/dialHA24* entry is the dialer program for the modem. Two types of dialer programs are included to support a wide variety of modems; see "Using dialers" (page 414) for more information.

Now follow the procedures in "Configuring UUCP for modems" (page 414) and "Testing your modem connection" (page 421) to complete the installation of your modem.

Configuring UUCP for modems

Correct entries in the UUCP configuration files are vital when using **cu** and UUCP. This also applies when SCO SLIP and SCO PPP are configured to use incoming and outgoing connections that use UUCP (it does not apply to dedicated serial line connections). The **PPP Manager** edits the UUCP files to insert the correct entries but you need to edit these files by hand to be able to use **cu**, the UUCP utilities, and SLIP.

To configure the UUCP files:

- Edit */usr/lib/uucp/Systems* to ensure that the correct line speed is specified for your modem. See "Adding entries for remote sites to the Systems file" in the *System Administration Guide* for more information.
- Edit */usr/lib/uucp/Devices* to enter the correct speed range and inbuilt dialer, *Dialer* file entry, or the name of a dialer program used by the modem. See "Specifying dial-up parameters with the Devices file" in the *System Administration Guide* for more information.
- Obtain and install a suitable dialer program for your modem.

  If a dialer program does not exist, or */usr/lib/uucp/Dialers* does not contain a suitable entry, you must create one or the other. See "Using dialers" (this page) for more information.

See Chapter 7, "Connecting to other computers with UUCP" in the *System Administration Guide* for more information.

Using dialers

For dialing, both **cu** and UUCP use a dialer defined by an entry in */usr/lib/uucp/Devices*. The dialer can be:

- an entry in the */usr/lib/uucp/Dialers* file, see "Dialers file entries" (page 415)
- a symbolic link to **atdialer** together with a suitable configuration file in */usr/lib/uucp/default*, see "atdialer and dialer programs" (page 416)
- a stand-alone program such as */usr/lib/uucp/dialHA12*, see "atdialer and dialer programs" (page 416)

Dialers file entries

Table 25-1 lists dialer types that are available as *Dialers* entries.

Table 25-1 Dialers file entries

Modem or data switch	Dialers entry
AT&T DATAPHONE II 2212C	att2212c
AT&T DATAPHONE II 2224	att2224
AT&T Programmable 300/1200 Model 4000	att4000
Develcon network dataswitch	develcon
Direct line; dialer not used	direct
Hayes Smartmodem 1200 or compatible	hayes1200
Hayes Smartmodem 2400 or compatible	hayes2400
Micom network dataswitch	micom
Network Listener Service	nls
Penril	penril
Racal Vadic 3451	vadic
Rixon Intelligent	rixon
Vadic 9600VP	vadic9600
Ventel 212+	ventel

If you are experimenting with an unsupported modem, the "hayes2400" entry in the *Dialers* file is a good starting point; it can be used even with high-speed modems. The following example *Devices* entry is for a modem that uses a *Dialers* file entry but operates at 19,200bps:

```
ACU tty1A - 19200 hayes2400
```

NOTE If you intend to use an outgoing PPP link over a modem that uses the "hayes2400" entry in the *Dialers* file, change the word `Speed` to `CONNECT`.

The following *Dialers* file entry, **standard**, should also be suitable for many V.32bis and higher speed modems:

```
standard        =W-,  "" AT&F1  OK\r  ATB0M1X4  OK\r  ATDT\T\r\c  CONNECT
```

Although it is possible to create or modify an entry in the *Dialers* file yourself, the syntax can be difficult to follow. Consult the *Dialers*(F) manual page for more information.

Hardware

atdialer and dialer programs

There are two types of dialer binaries, named *dial** and *atdial**, in */usr/lib/uucp*. The *dial* binaries (for example, *dialHA24*) are separate executable programs that must be recompiled from source files if you wish to customize them. The *atdial* dialers (for example, *atdialHAY*) are implemented as symbolic links to a single executable (*/usr/lib/uucp/atdialer*) together with an editable configuration file in */usr/lib/uucp/default*.

Table 25-2 lists symbolic links to **atdialer** and dialer programs provided with SCO OpenServer systems. Both **atdialer** and the dialer programs are supplied in binary and source form.

Table 25-2 atdialer and dialer binaries

Modem	atdialer or dialer
Hayes Smartmodem 1200 or compatible	dialHA12
Hayes Smartmodem 2400 or compatible	dialHA24
Hayes Ultra 96 modem 2000US	atdialHAY
Hayes V-series Smartmodem 9600	dialHA96V
MICC 9610	atdialMICC
Multitech MT932EA	atdialMT
Multitech MultiModem 224 EH or V.32	dialMUL
Racal Vadic 3451	dialVA3450
Telebit T2500	atdialT25
Telebit Trailblazer	dialTBIT
Trailblazer TB1500	dialT1500
US Robotics Courier V.32bis	atdialUSR
US Robotics World Port 9600	atdialW96

The sections that follow explain how to create both types of dialers.

Understanding modem commands and setup strings

To create a new dialer, you need to understand how modem commands are used. You can enable or disable desired features by sending commands in a setup string to the modem. For example, the following setup string is used in the *dialHA24* dialer:

```
ATQ0E0T&D2&C1S0=0X4S2=043
```

You can change these strings to suit a different communications protocol or modem-specific commands by consulting the documentation for your modem. Though the setup commands may seem confusing because they are concatenated, there are two basic types of Hayes commands:

- basic modem commands (for example, Q0 and &D2)
- modem S-registers (for example, S0=0)

Hayes-compatible command strings always begin with the **AT** (attention) command.

Creating a new atdial dialer

You can create a new *atdial* dialer without having the SCO OpenServer Development System installed. An *atdial* dialer is actually a link to the binary */usr/lib/uucp/atdialer* that calls a configuration file in the */usr/lib/uucp/default* directory. The configuration file contains all the commands specific to that modem. For example, *atdialHAY* is linked to *atdialer* and the configuration file is in */usr/lib/uucp/default/atdialHAY*. To create a new *atdial* dialer, *atdialMINE* for example, follow these steps:

1. Log in as *root*.
2. Copy one of the *atdial** files in */usr/lib/uucp/default* to use as a template for the new configuration file *atdialMINE* in the same directory. For example, to use *atdialW96* as the template, enter:

   cp /usr/lib/uucp/default/atdialW96 /usr/lib/uucp/default/atdialMINE
3. Edit */usr/lib/uucp/default/atdialMINE* to add and alter the parameters that are appropriate for your modem. See the **atdialer**(C) manual page for more information.
4. Create a symbolic link */usr/lib/uucp/atdialMINE* to */usr/lib/uucp/atdialer* using the command:

   ln -s /usr/lib/uucp/atdialer /usr/lib/uucp/atdialMINE

When you invoke **atdialMINE**, **atdialer** reads the */usr/lib/uucp/default/atdialMINE* file.

Alternatively you can use the **make.dialer** script to create an **atdial** dialer. See **make.dialer**(C) for more information.

Setting up the modem for FAX/DATA detection

Set the **MDM_MODE** parameter in */usr/lib/uucp/default/atdial** to "AUTO" to configure a modem to detect incoming FAX messages automatically. Use the **-f** option with the **getty**(M) program defined for the modem port to invoke an appropriate program defined in */etc/gettyacts* (see *gettyacts*(F)) if an incoming connection is a FAX message or another communications protocol such as PPP.

Editing connect speed strings

Most modern modems can perform *speed conversion* which allows them to negotiate a different connection speed with the remote modem than the serial line speed that they use with the local computer.

If you use hardware flow control with the modem, and the modem is capable of performing speed conversion, do not use the **RTC_*speed*** strings. Instead, use the **RTC_CONNECT** string and set it to the value "CONNECT". This will give you the fastest available connection speed. The computer to modem speed will be set by the value in the */usr/lib/uucp/Devices* file.

The **RTC_*speed*** strings in the */usr/lib/uucp/default/atdial** configuration files allow the dialer to recognize connect messages from the modem and map them to appropriate speed(s). For example:

```
RTC_9600=CONNECT 9600
```

The dialer then recognizes "CONNECT 9600" as a 9600bps connection. The connect messages for each speed must be unique. If the message is set to "CONNECT", the first speed mapped to the connect message is used. For unused speeds, simply set the **RTC_*speed*** string to "not used", for example:

```
RTC_300=not used
```

It is possible to specify all valid connect messages. For example:

```
RTC_2400=CONNECT 2400
RTC_9600=CONNECT 9600
```

For a modem that performs speed conversion, this more accurate setup is only necessary if you need to guard against long UUCP transfers at 2400bps. This is because the speed recognized by the dialer is matched against the speed range in the *Systems* file or the speed range on the **cu** command line. If it is out of range, an `EXECDIAL LOCAL FAILURE` will result. In the following command the speed range specified is 9600 – 9600:

cu -ltty1A -s9600 5551212

Connections at 2400bps using the above command will fail if separate RTC_*speed* lines are set up. Either of the following commands allow a 2400bps connection in this case:

cu -ltty1A -s2400 5551212

cu -ltty1A -s2400-9600 5551212

Creating a new dial dialer

You can customize a *dial* program by editing the source file (for example, *dialHA24.c*) and changing modem commands embedded in the C code and then recompiling the source.

The source and a makefile for recompiling *dial* binaries are included in the directory */usr/lib/uucp*. If you have any other kind of modem, you can modify any of the source files and create your own dialer program.

> **NOTE** You must have installed the SCO OpenServer Development System before you can compile a *dial* program.

To make a new *dial* program:

1. Change directory to */usr/lib/uucp*.
2. Copy the dialer program you wish to modify and make the desired changes. For example, the *dialHA24.c* setup commands are located in this code segment:

   ```
   #define MDSETUP         "ATQ0E0T&D2&C1S0=0X4S2=043\r"
   ```

   There are several "defines" in the program, each containing a different string, such as **MDHANGUP**, the command string to send that tells the modem to hang up (**ATQ0H**). Change each define as appropriate.

   > **NOTE** The \r is not a modem command, but a string that indicates a carriage return. All modem commands in a dialer program require a carriage return.

3. Edit the file *makefile* in the directory */usr/lib/uucp* and find the line that reads:

   ```
   EXES= dialHA12 dialHA24 dialHA96V dialMUL dialTBIT dialT1500 dialVA3450
   ```

   Add the name of the dialer program that you wish to use. When this is done, exit the file, saving the changes you made.

4. Next, enter the following command at your shell prompt:

   make

   When the **make** command is finished, you have a new dialer program. This can be used in the fifth field of an entry in the *Devices* file.

Setting hardware flow control

There are two types of flow control: hardware (RTS/CTS) and software (XON/XOFF). In XON/XOFF flow control, either end can send a stop (XOFF) or start (XON) character to the other end to control the rate of incoming data. In RTS/CTS flow control, the computer and the modem use the RTS and CTS lines respectively to control the flow of data (for example, when the modem's buffer is full). For modems, RTS/CTS flow control is the preferred method as it is more efficient and reliable.

Modems can usually be configured to use hardware flow control. For example, the *atdialHAY* dialer supports RTS/CTS flow control using the **&K3** command.

Setting hardware flow control on outgoing calls

Hardware flow control for outgoing calls is supported by the *atdialer, dialHA96V, dialMUL,* and *dialTBIT* dialers. All of these dialers recognize strings of the form **STTY=*settings*** in their */usr/lib/uucp/default* files. For example, you can enable bidirectional hardware flow control for the *dialTBIT* dialer by creating a file */usr/lib/uucp/default/dialTBIT* that contains the following line:

```
STTY= -ORTSFLOW RTSFLOW CTSFLOW
```

Setting hardware flow control on incoming calls

Hardware flow control for incoming calls is configured by adding the **-ORTSFLOW RTSFLOW CTSFLOW** flags to the appropriate */etc/gettydefs* entry referenced by the */etc/inittab* entry for the modem tty port.

The **CTSFLOW** flag is often used by itself to prevent the modem buffer from overflowing when speed conversion is used for incoming calls. For example, assume a MultiModem V.32 is set for a fixed speed of 9600bps to the computer. When a 2400bps connection calls in, the computer sends data to the modem at 9600bps, which the modem can only send out at 2400bps. The **CTSFLOW** flag in */etc/gettydefs* tells the serial driver to stop sending data when the modem drops CTS. This allows the modem to signal when it is busy and prevent data overruns.

Testing your modem connection

Follow these steps to test whether you can send commands to your modem:

1. Log in as *root*.
2. Add a "Direct" line entry for your modem to the */usr/lib/uucp/Devices* file if one does not already exist. You can specify either the modem or the non-modem control device for the port to which the modem is attached. For example, the following *Devices* entry is for a modem connected to a single port on COM1:

   ```
   Direct  tty1A - 9600 direct
   ```

3. Establish a direct connection to the modem so that you can send commands to it. This connection uses the "Direct" line in the *Devices* file. For example, if the modem is connected to a single port on COM1, enter the following command:

   cu -ltty1A dir

   You should see a message such as `OK` (Hayes-compatible modems) or `0` to indicate that the modem is ready to accept commands.

   If you see the message `cu: dir permission denied`, you do not have write permission on the */usr/lib/uucp/Devices* file. Set the correct ownership and permissions using the commands:

   chown uucp:uucp /usr/lib/uucp/Devices
   chmod 644 /usr/lib/uucp/Devices

   If you do not see a message indicating that the modem is ready to accept commands:

   - Check that you entered the **cu** command correctly.
   - Ensure the "Direct" entry in the *Devices* file is correct.
   - Use the **hwconfig** command to check that the serial port is configured.
   - Use the **l** command to check that the device files associated with the port (such as */dev/tty1a* and */dev/tty1A*) have owner and group both set to *uucp*. If not, change these using the commands:

     chown uucp:uucp /dev/tty1a
     chown uucp:uucp /dev/tty1A

NOTE The instructions that follow assume a Hayes-compatible command set and response codes. Other modems may use other conventions. Consult your modem documentation for further details. The instructions are illustrated by Figure 25-1, "Testing a modem connection" (page 422).

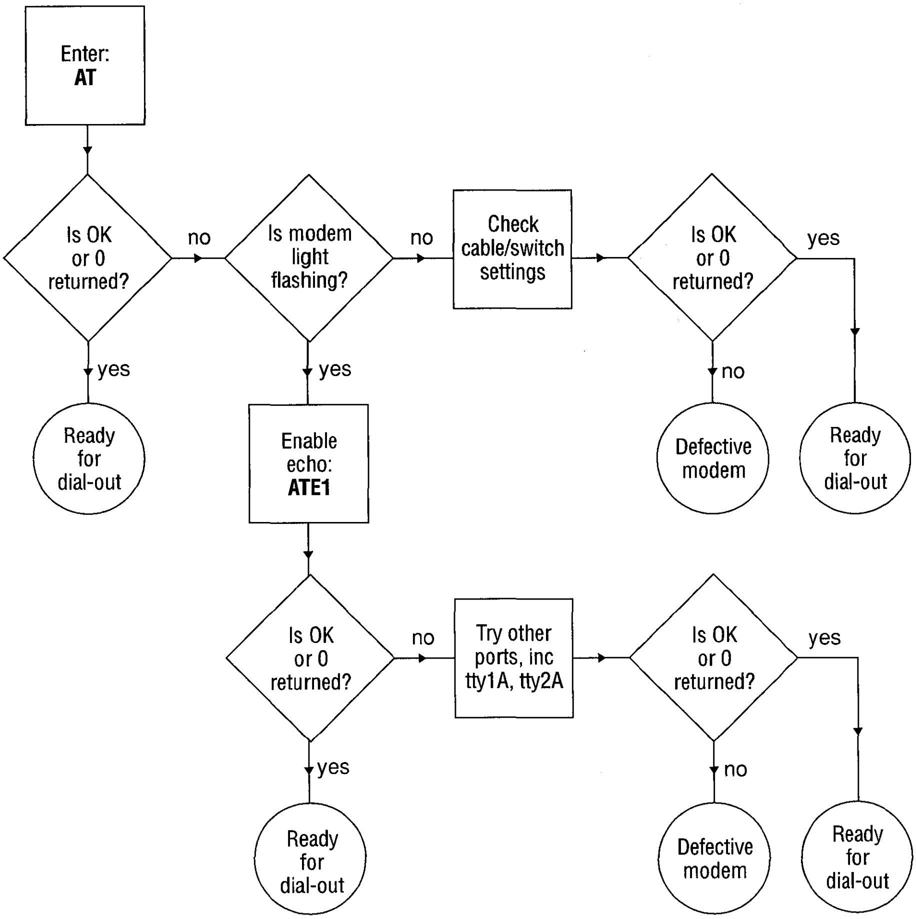


Figure 25-1 Testing a modem connection

4. If you see a message from the modem indicating that it is ready to accept commands, enter **AT**. A Hayes-compatible modem should return `OK`. If you have set the modem to return numeric result codes rather than text, you see `0`. If you do see `OK`, your modem is ready to dial out.

5. Check that the "Send Data" light on the modem flashes when you press a key. This indicates the modem is receiving signals from the computer. If this light is not flashing, check your cable and modem switch settings. If the "Send Data" light flashes, but you still do not get an `OK` response from the modem, enable the modem's echo capability and responses to commands by entering **ATE1Q0**

If your terminal still does not display `OK` or `0`, connect the modem to another port (COM1 or COM2). If the modem works with the new port, check that the device is using the correct interrupt vector. (Serial port COM1 uses interrupt 4; COM2 uses interrupt 3.)

If the terminal does not echo the `OK` message when it is connected to the new port, check your cable again. You can also connect a terminal to the port (with a proper terminal cable) and verify that the port works. If the modem returns garbage, then try connecting at different speeds; some modems can be set to communicate at the DTE connect speed, while others communicate at a fixed speed. If the modem still does not respond properly, the modem may be defective.

Testing whether you can dial out

Having established that you can send commands to the modem, follow these steps to test whether you can dial out to a another site:

1. Enable the modem's speaker so you can hear it dial out and connect:

   ATM2

   (Use **ATM0** to turn it off.)

2. Enter the following modem command:

   ATDT*phone_number*

   (This assumes that the connection can use tone dialing. Use the **ATDP** command for pulse dialing.)

3. Having confirmed that the modem can dial out, exit **cu** by entering:

   ~.

4. Dial into the other system using the appropriate modem control port, for example:

   cu -x9 -ltty1A ***phone_number***

   The **-x9** option generates useful debugging information.

   NOTE Use dashes in the telephone number to indicate a pause while dialing. Do not use the comma (,) from the Hayes command set.

5. If the connection is successful and logging in is allowed on the remote machine, you should see a login prompt.

If you have any problems, see "Problems dialing out" (page 424).

Hardware

Testing whether you can dial in

If you want to allow dial-in connections, follow these steps to test your system:

1. Check that the modem is set to auto-answer. There may be an "Auto Answer" light on the modem's front panel to show this.
2. Enable the modem control port, for example:

   enable /dev/tty1A

3. Dial this modem from another modem.

If you have any problems, see "Problems dialing in" (page 427).

See "Configuring your system for high-speed modems" in the *Performance Guide* if you find that you are losing incoming data on a high-speed modem.

Troubleshooting modems

If you have problems, first verify that the phone jack is plugged in and that you have a dial tone on the phone line. Note that, while other serial ports are often used, the examples in this section assume that the modem is attached to COM1.

The problems fall into these categories:

- "Problems dialing out" (this page)
- "Problems dialing in" (page 427)

If you find that you are losing incoming data on a high-speed modem, follow the tuning advice given in "Configuring your system for high-speed modems" in the *Performance Guide*.

Problems dialing out

The most useful tool for diagnosing dial-out problems is the **-x9** option to **cu**(C). This option causes **cu** to display diagnostic output when attempting to dial out. To get a debugging output, enter the command:

cu -x9 ***phone_number***

where ***phone_number*** is the phone number of the system you wish to dial.

You may experience one of the following problems on dialing out:

- "Modem dials, but does not connect" (this page)
- "NO DEVICES AVAILABLE message" (this page)
- "Modem answers, but terminal displays garbage" (page 426)
- "DEVICE LOCKED message" (page 426)
- "Modem does not hang up" (page 426)
- "Double echo" (page 427)

Modem dials, but does not connect

If your modem dials correctly, but the call never connects:

1. Verify that the phone number is correct and operational and that the phone line to which the modem is attached is not faulty. To do this, unplug the modem from the telephone line and plug in a regular telephone. Manually dial the number to make sure that the modem on the other end of the line is answering the call.
2. Listen carefully to your modem while it dials the call. Some business phone systems require a pause between certain numbers. Use a dash in the **cu** command to indicate a pause of two seconds. For example, if you enter: **9----4581234**, the modem pauses for 8 seconds after dialing the first number.

   The dialer translates the dash passed to the **cu** command into the appropriate code for your modem. For example, the dialer translates the dash into a comma before sending to a Hayes-compatible modem.

NO DEVICES AVAILABLE message

When you try to dial out on the modem, the following message is displayed:

```
Connect failed: NO DEVICES AVAILABLE
```

To solve the problem:

1. Verify that the modem port has an entry in the */usr/lib/uucp/Devices* file. Here are example entries for a Hayes-compatible modem running at 9600bps on */dev/tty1A*:

   ```
   ACU  tty1A  -  9600  /usr/lib/uucp/dialHA96V
   Direct  tty1A  -  9600  direct
   ```

   These lines must not being with pound signs (#) or whitespace.
2. Verify that the modem port in *Devices* has the correct line speed associated with it. If you specify the line speed with the **-s** option to **cu**, verify that there is an entry in *Devices* that corresponds to that line speed.

Hardware

Modem answers, but terminal displays garbage

If the modem answers, but the terminal displays garbage characters:

1. Verify that the site that you are calling is set to the same data bit and parity values that you are using. By default, **cu** uses 8 data bits, and no parity. To change the values to 7 data bits and even parity, enter **cu -e**. For 7 data bits and odd parity, use **cu -o**, and use **cu -oe** for 7 data bits and no parity.
2. Verify that the remote computer is set to the same line speed that you are using.

   If you are dialing into another UNIX system, you can force the remote site to switch to the next line speed by sending a break signal. To send the break signal during the login sequence, enter:

   ~%**b**
3. Check for noise on your phone line. Noise problems become more acute when operating at higher speeds. Normally, when there is a problem with line noise, garbage characters appear on the screen in short bursts or continuously, as if a system on the other end of the line is trying to send valid data.

DEVICE LOCKED message

UUCP and **cu** create a lock file named *LCK..**line*** in the */usr/spool/uucp* directory. This file is used to prevent anyone else using the modem connected to the serial device ***line*** if it is already in use. If the lock file is not removed after a connection has been closed, the modem may not be setting Carrier Detect (CD) correctly.

root must remove the lock file before anyone can use the modem again.

Modem does not hang up

If your modem does not hang up at the end of a call:

1. Verify that you are using a serial port with modem control that is configured in the */usr/lib/uucp/Devices* file and that the "ACU" entry for the modem port comes before the "Direct" entry for the direct line. If you are using a non-modem control port, change the port to the corresponding modem control port. For example, the modem control port associated with *tty1a* is *tty1A*.

   NOTE Non-modem control ports should only be used with terminals, and when configuring the modem.

2. If the CD (Carrier Detect) light on the modem does not go off when the call is disconnected, check the modem switches to verify that the modem is set to detect the incoming carrier. If your modem is Hayes-compatible, use the **AT&C1** command. This forces the carrier detect line to follow the presence of a carrier on the phone line.
3. Check the modem switches to verify that the modem is set to detect DTR (Data Terminal Ready). The modem should hang up when DTR goes from high to low. If the modem is Hayes-compatible, use the **AT&D2** command.
4. Some modems have a switch that can be set to ignore DTR; make sure that this switch is off.

Double echo

If you get a double echo when you dial out on your modem, check the setting for local echo. If local echo is enabled, disable it.

Problems dialing in

You may experience one of the following problems on dialing out:

- "Modem does not answer the phone" (this page)
- "NO DEVICES AVAILABLE message" (page 425)
- "Garbage or loose cable" (page 428)
- "Modem answers, but no login prompt is displayed" (page 429)
- "Screen displays a series of login prompts" (page 429)
- "System displays meaningless characters" (page 430)

Modem does not answer the phone

If the modem does not answer the phone:

1. Verify that the modem control port is enabled. To enable the modem port, enter the following commands:

   disable /dev/tty1a
   enable /dev/tty1A

2. Verify that the modem is configured to auto-answer. Check your modem switches. If the modem has a "Direct" entry in */usr/lib/uucp/Devices* (for the */dev/tty1A* device, for example) enter:

   cu -ltty1A dir

   Then, use the **ATS0=1** command to tell the modem to answer the phone on the first ring. (Remember to enter **AT&W** to save modem settings.)

Hardware

3. Verify that the DTR (Data Terminal Ready) line is connected from the computer to the modem. Make sure that pin 20 is connected. Pins 2, 3, 7, 8, and 20 are required for modem communication.
4. Make certain the ACU entry for this modem in the *Devices* file precedes any "Direct" entries for the port or the non-modem control counterpart.

Modem answers, but hangs up

If the modem answers, but hangs up immediately upon connection:

1. If the modem is set to auto-answer and to detect DTR, check to see that the DTR line is asserted.
2. Verify that the modem control port is enabled:

   disable /dev/tty1a
   enable /dev/tty1A

3. Verify that the cable is correct. If you are using a straight-through cable with at least pins 2, 3, 7, 8 and 20 connected, verify that pin 20 (DTR) is properly connected.
4. Check to see if the modems have data compression or error correction modes set. After a connection is established, modems that support special error correction or compression protocols attempt to negotiate which of these protocols to use. If the other modem is programmed not to use any of these modes (or does not support them), it may misinterpret this negotiation as actual user input. In general, modes such as MNP4 or v.42bis should only be enabled when connecting with a modem with the same modes enabled. Check the documentation for your modem.

Garbage or loose cable

If the console displays a message like

```
Garbage or loose cable on /dev/tty1A, port shut down
```

when a call comes into the modem:

1. Verify that your modem is not set to echo back data or send command responses. If the modem is not set up this way, it may be sending a **RING** signal to indicate that the phone you are calling is ringing. Because the **CD** signal is not active, the serial driver interprets this as random data on the serial line. The appropriate Hayes-compatible modem command is **ATE0Q1**.
2. If you have an internal modem and the above options do not eliminate the error message, your modem may be incompatible. Contact the manufacturer to see if a fix is available. If no fix is available, you may need to replace your modem with a standard Hayes-compatible external modem.

Modem answers, but no login prompt is displayed

If the modem answers, but does not display a login prompt:

1. Verify that the CD line is being asserted by the modem after the modem has answered the phone. Check the switches on your modem or, if your modem is Hayes-compatible, use the **AT&C1** command. (Remember to enter **AT&W** to save modem settings.)
2. Make sure that the port is enabled. Enable the port by entering the following command sequence:

   disable /dev/tty1A
   enable /dev/tty1A

3. Verify that the entry for the incoming line in the */etc/inittab* file is correct. The entry defines the characteristics of the **getty** process that monitors the modem control port. The final argument to the **getty** command is a single letter or digit that references an entry in the */etc/gettydefs* file. This defines a range of speeds, parity, number of stop bits, and so on, that can be used on the line.

   Refer to Table 21-1 for information about the limitations on the speed of a serial port that are imposed by the UART (universal asynchronous receiver / transmitter) chip that controls it.

   For details of the capabilities of ports on intelligent serial boards that use third-party device drivers, refer to the manufacturer's documentation.

   For example, the following entry in *inittab* spawns a **getty** process to allow incoming connections at 9600bps on the modem control port */dev/tty1A*:

   ```
   Se2A:2:off:/etc/getty -t60 tty1A m
   ```

   For more information on the */etc/inittab* file and the various control codes, see the **init**(M), **inittab**(F), **getty**(M), and **gettydefs**(F) manual pages.

   NOTE Each time the kernel is relinked (when a driver is added or a tunable parameter is changed), */etc/inittab* is reconstructed from the entries found in */etc/conf/init.d/sio*.

   Duplicate any changes you make to */etc/inittab* in */etc/conf/init.d/sio*.

Screen displays a series of login prompts

If the screen scrolls uncontrollably when you log in, usually displaying a series of login prompts, verify that only the modem device is enabled. If the non-modem device is enabled, disable it, for example:

disable /dev/tty1a

System displays meaningless characters

If the system displays the login prompt, but no password prompt, or meaningless characters are displayed after the login prompt, verify that the line settings are correct:

1. Determine the serial line settings on the system that you are calling. The standard settings that **cu** uses are 8 data bits, one stop bit, and no parity.

   - if the remote system uses even parity, use the **-e** option with **cu**. For UUCP, precede the login script defined for the system in */usr/lib/uucp/Systems* with the **PEVEN** keyword
   - if the remote system uses odd parity, use the **-o** option with **cu**. For UUCP, precede the login script defined for the system in */usr/lib/uucp/Systems* with the **PODD** keyword
   - if the remote system uses 7-bit no parity, use the **-oe** option with **cu**

2. If you are dialing into a UNIX system, check the */etc/inittab* file on the remote system to verify that the "pointer" into the */etc/gettydefs* file is correct. The serial line characteristics may not match between the stty settings defined in the third field of the selected *gettydefs* entry. Change the setup for the port to 8 data bits, one stop bit, and no parity.

   The entry should similar to the following:

   ```
   n # B19200  HUPCL # B19200  CS8 SANE HUPCL TAB3 IXANY #\r\nlogin: # n
   ```

Chapter 26
Adding serial terminals

Adding terminals lets more users access the system and adds to overall system capabilities.

This chapter explains how to:

- install a serial terminal (page 432)
- test a terminal connection (page 433)
- change the default terminal characteristics (page 436)
- set the terminal type at login (page 439)
- remove a terminal (page 441)
- set up a serial console (page 441)
- set up scancode terminals (page 442)
- troubleshoot problems with terminals (page 446)

Before you add a serial terminal to your system, follow the instructions in your terminal's manual for connecting the terminal to a serial line. (If you add a serial card, the possible names of the additional device files are listed in **serial**(HW) or in the documentation for cards that include driver software.)

Many types of terminals are supported; see the **terminals**(M) manual page for a comprehensive list. Support for terminals is provided through the **terminfo**(M) database, which contains the definitions and classifications of keystrokes and control sequences which vary from terminal to terminal. For a description of the *terminfo* database, see the **terminfo**(M) and *terminfo*(F) manual pages.

Hardware

Installing serial terminals

To install a terminal with the standard COM serial lines or with serial expansion cards:

1. Unless you are adding a terminal directly to the COM1 port, run the **Hardware/Kernel Manager** and select **Serial Port** from the **Drivers** menu or run **mkdev serial**. See "Adding and configuring SCO-supported serial cards" (page 368) for information on how to configure the serial ports for terminal connections.

2. Make sure you are logged in as *root* in multiuser mode.

3. Plug in your terminal and turn it on. Set its input and output speeds to 9600bps (or higher, see step 5 below), 8 data bits, 1 stop bit, no parity, full duplex, and XON/XOFF handshaking (software flow control). If your terminal does not work in this mode, look for advice on configuring your terminal in the **stty**(C) manual page.

   Most terminals will be connected directly to the computer using a cable, although it is possible for terminals to connect to the system via a modem link. DTE-type terminals connected directly to a DTE-type serial port, or DCE-type terminals connected directly to a DCE-type serial port require a cable in which the Transmit Data (TD) pin on the serial port is connected to the Receive Data (RD) pin on the terminal, the RD pin on the serial port is connected to TD pin on the terminal, and the Signal Ground (SG) wire is connected straight through.

   DCE-type terminals connected to a DTE-type serial port, or DTE-type terminals connected to a DCE-type serial port require a cable in which these three wires are connected straight-through.

   It may also be necessary to link the Data Set Ready (DSR), Data Terminal Ready (DTR), and Carrier Detect (CD) pins in the connector at the computer-end of the cable if the serial port hardware requires this. The operating system requires only that pins 2, 3, and 7 are connected if software flow control is used.

   For more information, see the **serial**(HW) manual page.

4. Enable the terminal using the **enable**(C) command. For example:

   enable tty2a

   The **enable** command starts a **getty** process that displays the `login:` prompt on your terminal.

5. Check that the entry for this serial port in the */etc/inittab* file looks like the following example for */dev/tty2a*:

   ```
   Se2a:234:respawn:/etc/getty tty2a m
   ```

The */etc/inittab* entry should appear as above. If the entry does not look like this example, edit the file to correct it. See *inittab*(F) for information on the */etc/inittab* format.

The last field in the */etc/inittab* entry is a line-mode label from an entry in the */etc/gettydefs* file. In the example above, "m" corresponds to the 9600bps entry in */etc/gettydefs*. The maximum speeds that the serial driver supports depends on the characteristics of the underlying serial port hardware as shown in Table 21-1 (page 371). Entries in */etc/gettydefs* for speeds from 230,400bps to 921,600bps may be used if supported by third-party serial drivers and hardware. For more information, see "Changing default terminal line characteristics" (page 436).

WARNING To make permanent any changes to */etc/inittab*, the same changes must also be applied to */etc/conf/init.d/sio*. This is because each time the kernel is relinked (as when a driver is added or a tunable parameter is changed), */etc/inittab* is reconstructed from the entries in */etc/conf/init.d/sio*.

6. If the port is enabled, press the ⟨Enter⟩ key a few times to see if a `login:` prompt appears. If so, you are ready to log in. If the prompt does not appear, see "Testing a terminal connection" (this page).

Testing a terminal connection

Use the following procedure (illustrated in Figure 26-1 (page 435)) to test the setup of a terminal connection:

1. Log in as *root* on the console or a working terminal other than the one you are testing.
2. Disable the port you want to test using the command: **disable *ttyname*** where ***ttyname*** is the non-modem control device name of the port (for example, */dev/tty1a*, not */dev/tty1A*).
3. Try to redirect output to the terminal by entering: **date > /dev/*ttyname***

   If you still do not see the date printed on the terminal:

   - Make certain that the terminal is plugged in.
   - Check that the cable is configured correctly for pins 2, 3, and 7 if the serial port has a 25-pin connector. The other pins are only used if you are using modem or hardware flow control on the line. See step 3 in "Installing serial terminals" (page 432) for more information.

     If your system or expansion card has a 9-pin connector, see the **serial**(HW) manual page for information on 9-pin connections.

- Check your terminal setup configuration. Try changing the speed.
- Check the switches on your serial port. If you are using a multiport card, try other lines on that card.
- Attach the terminal to a standard serial port (COM1 or COM2) to see if the terminal and cable are working correctly. If you are already using a COM port, try switching to another one.

  If you have successfully installed another terminal, switch hardware between the working and the nonworking terminal one piece at a time. This may help you isolate a hardware problem.

4. When the date is displayed on your terminal, enable the port by entering the command: **enable *ttyname***.

   If you do not see the `login:` prompt, enter the following command to verify that **getty** is running on the port and that the software is configured properly:

   ps -t *ttyname*

   Your screen should display a message similar to the one in the following example, with either "login" or "getty" listed in the command (CMD) column:

   ```
   PID     TTY     TIME    CMD

   2557    1a      0:06    getty
   ```

5. If you have typed the **enable** and **disable** commands many times, it is possible that a new **getty** cannot be spawned on that port. If so, shut the system down, reboot, log in as *root* in multiuser mode, and try again. For more information, see "Setting the terminal type at login" (page 439).

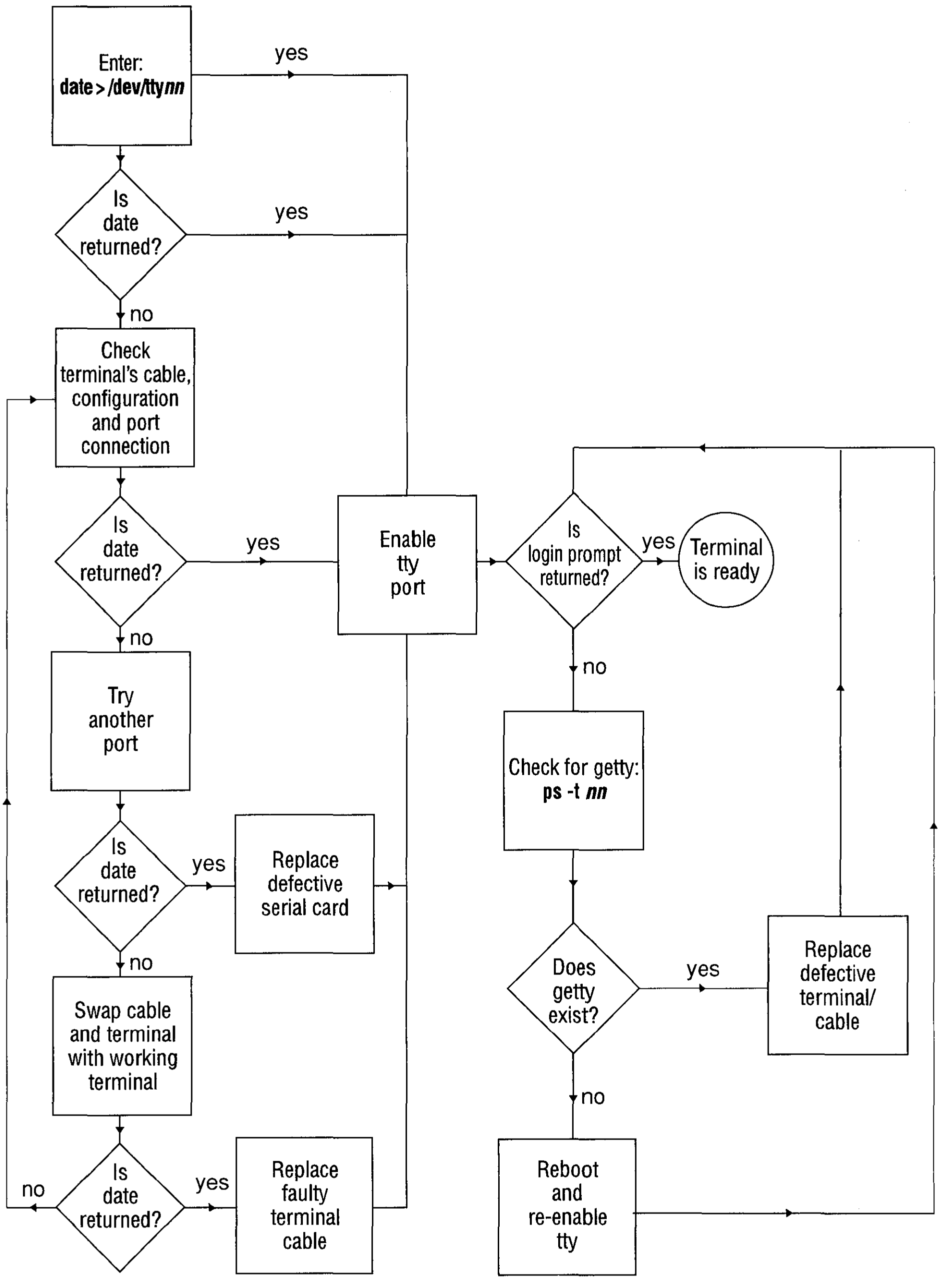


Figure 26-1 Testing a terminal connection

Changing default terminal line characteristics

Your system can automatically adapt to several different terminal speeds and settings. The same program that displays the login message, **getty**(M) reads these terminal line values from a table, trying each setting until one is successful, and the user can log in to the system. This table provides several default settings for different kinds of terminal lines.

getty automatically executes as part of the login process. The table of terminal settings is found in a file called */etc/gettydefs*. You can edit */etc/gettydefs* to add different sets of terminal characteristics or to change the existing ones. See the *gettydefs*(F) manual page for a description of the format of this file.

Changing entries in /etc/gettydefs

The */etc/gettydefs* file has sets of entries for the dial-up lines and terminal lines. These different sets correspond to line-mode settings in */etc/inittab*. The **init** program passes the line mode as an argument to **getty**.

You can edit */etc/gettydefs* to add new terminal settings or to change existing ones. For example, the settings for terminal lines might look like the following:

```
4 # B2400 HUPCL # B2400 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@!login: # 5
5 # B4800 HUPCL # B4800 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@!login: # 6
6 # B9600 HUPCL # B9600 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@!login: # 4
```

This example can be edited so that the first speed that **getty** attempts is 1200bps:

```
4 # B1200 HUPCL # B1200 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@|login:# 5
5 # B4800 HUPCL # B4800 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@|login:# 6
6 # B9600 HUPCL # B9600 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@!login:# 4
```

You can also add additional terminal line settings to *gettydefs*. Flags and permissible values for terminal settings are listed on the **termio**(M) manual page.

When you add a new entry, be sure that the groups of entries in *gettydefs* form a closed set, so the next-label field of the last entry directs **getty** back to the first entry in the group.

The following example adds an entry for a speed of 300bps to the previous *gettydefs* example:

```
4 # B1200 HUPCL # B1200 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@!login: # 5
5 # B4800 HUPCL # B4800 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@!login: # 6
6 # B9600 HUPCL # B9600 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@!login: # 7
7 # B300 HUPCL # B300 CS8 SANE HUPCL TAB3 ECHOE IXANY #\r\n@!login: # 4
```

NOTE A blank line must separate each entry in */etc/gettydefs*.

Checking terminal settings

Each time you change the terminal line settings or add new entries to *gettydefs*, you should check to make sure that the new values make sense to **getty**. To do this, you use the command **getty** with the check option, **-c**, and the filename.

For example, to check *gettydefs*, enter:

getty -c /etc/gettydefs

The file is scanned and the results are displayed. If any of the values and settings in *gettydefs* are not permitted, **getty -c** reports them. For more information on **getty** and *gettydefs*, see the **getty**(M) and *gettydefs*(F) manual pages.

Changing serial line operation

Whenever you enable a terminal with the **enable** command, the system automatically sets the operating characteristics of the serial line to a set of default values. Sometimes these values do not match the values used by the terminal and, therefore, must be changed to allow communication between the system and the terminal. You can display the operating characteristics of a serial line with the **stty** (set tty) command. If you need to change the characteristics of a port that is enabled, you should use the entires in the *gettydefs* file rather than the **stty** commands given below.

NOTE Any settings on a port using the **stty** command only last as long as the port in question is still open. As an example, if you want to change the speed of **tty2a**, and **tty2a** is not enabled, the **stty** command first opens the port, then changes the port settings, and finally closes the port. When it closes the port for the last time, the settings revert to the original. In the **stty** commands later in this section, the use of the **while** loop is to avoid this behavior of **stty**. If you run **stty** redirecting input without **< /dev/*ttyname***, it works on your current serial line, which you have open. In this case, because the serial line stays open after the **stty** command, the settings also stay in place.

You can display the current operating characteristics of a serial line by entering this command at the terminal connected to that line:

stty -a

If it is impossible to log in at that terminal, you can use another terminal to display the characteristics. Log in as *root* at another terminal, and enter:

stty < *ttyname*

where ***ttyname*** is the name of the device special file corresponding to the serial line (see "UNIX directories and special device files" in the *System Administration Guide*).

For example, this command displays the current characteristics of the serial line named */dev/tty1a*:

stty < /dev/tty1a

The command displays the speed, the parity scheme, and other information about the serial line. This information is explained in the **stty**(C) manual pages.

One common serial line characteristic to change is the speed. This is usually done from a terminal connected to another serial line because changing the rate disrupts communication between the terminal and the system. Before you can change the rate, you need to know the current speed of the terminal (review the terminal hardware manual to see how to determine the current speed). Once you have the speed, log in as *root* at the other terminal, and enter:

(stty *speed*; while : ; do sleep 3600; done) < *ttyname* &

where ***speed*** is the current speed of the terminal, and ***ttyname*** is the name of the device special file corresponding to the serial line you wish to change. The speed must be one of 50, 75, 110, 134, 150, 200, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, or 921600. For example:

(stty 9600; while : ; do sleep 3600; done) < /dev/tty1a &

This command changes the speed of the serial line */dev/tty1a* to 9600. Note that the symbol "<" is used for both displaying and setting the serial line from another terminal.

Another common change is the way the system processes input and output through the serial line. Such changes are usually made from the terminal connected to the serial line. For example:

stty tabs

This command causes the system to expand tabs with spaces (used with terminals that do not expand tabs on their own). Another example is:

stty echoe

This command causes the system to remove a deleted character from the terminal screen when you back over it with the ⟨Bksp⟩ key.

Note that the **stty** command may also be used to adapt a serial line to an unusual terminal, to another type of serial device that requires parity generation and detection, or to special input and output processing.

For a full description of this command, see the **stty**(C) manual page.

Setting the terminal type at login

UNIX systems require that the terminal type be clearly defined before any work is done at the terminal. The preferable method for setting your terminal type is to assign the type to the **TERM** variable, a special environment variable that associates the terminal you are using with a list of characteristics given in the */etc/termcap* file. The characteristics tell the system how to interpret your terminal's keys and how to display data on your terminal screen.

If you are using the Bourne or Korn shell (**sh**(C) or **ksh**(C)), the **TERM** assignment has the form:

TERM=*termtype*; export TERM

If you are using the C shell (**csh**(C)), the **TERM** assignment has the form:

setenv TERM *termtype*

The ***termtype*** must be one of the names associated with one of the terminals defined in the */etc/termcap* file. The assignment must be entered at the terminal whose type you are setting.

For example, to set the terminal type to "ansi" from the Bourne shell, go to the terminal you wish to set, enter at the $ shell prompt:

TERM=ansi; export TERM

From the C shell, enter at the % shell prompt:

setenv TERM ansi

If you are not sure which name you may use for ***termtype***, you can view the names either by displaying the */etc/termcap* file, or by reading the **terminals**(M) manual page which lists all terminals supported in the */etc/termcap* file. To display the file itself, enter:

more /etc/termcap

You can let the system define the terminal type automatically whenever you log in by including the **TERM** assignment in your *.profile* file.

For an alternate method of setting your terminal type, see the manual page for **tset**(C).

If you let the system set the terminal type, be careful when logging in on terminals that are not the same as your normal terminal. The system has no way of checking whether or not the terminal assignment is correct for the given terminal and assumes that it is the same as your normal terminal. If it is not, you must set the terminal type manually.

Setting the terminal type automatically

If you want to have the terminal type set automatically at login time:

1. Log in on the terminal in question and determine which ***ttyname*** you are using by entering the **tty**(C) command:

   tty

2. Log in as *root* and edit the file */etc/ttytype* with a text editor. Change the terminal type field for the line associated with the terminal in question to the terminal type you desire to use. Follow the model for the console. If you want your terminal type to be set to "wy50" for */dev/tty1a*, edit */etc/ttytype* as follows:

   ```
   wy50 tty1a
   ```

3. Edit the user's startup file to modify the appropriate **tset**(C) command line to set the terminal type automatically. In each C-shell user's *.login* file, add the following line:

   ```
   tset -s -Q > /tmp/tset$$; source /tmp/tset$$; /bin/rm /tmp/tset$$
   ```

   Be sure to remove the default **setenv** command line involving **TERM** and **TERMCAP** from the *.login* file.

   In each Bourne shell or Korn shell user's *.profile*, add the following line:

   ```
   eval `tset -s`
   ```

   Be sure to remove the existing **tset** command line from the *.profile* file.

4. Have all users log out, then log in again to test the new terminal type change. After they log in, have them verify the new term type by entering the **env**(C) command:

   env

Removing terminals

Before you can remove a terminal, you must disable it with the **disable**(C) command:

1. Turn off the power to the terminal.
2. Log in as *root* at another terminal.
3. Use the **disable** command to disable the terminal:

   disable *ttyname*

   where ***ttyname*** is the name of the serial line to which the terminal is attached. For example:

   disable tty1a

   disables the terminal connected to serial line */dev/tty1a*.
4. Disconnect the terminal from the system.

The serial line previously connected to the terminal is now free to accept another device.

Setting up serial consoles

You can configure a serial device, rather than a display adapter, as your system console. The **boot**(HW) program sets the default console at boot time according to this procedure:

1. The **boot** program looks for the entry **SYSTTY=*x*** (where ***x*** is a number that specifies the system console device) in the */stand/etc/default/boot* file.
2. If the **SYSTTY** entry is not found or the */stand/etc/default/boot* file is not readable, **boot** checks your system for a display adapter and designates it as your system console.
3. If no display adapter is found, **boot** looks for *tty1a*, sets the serial port to 9600bps, 8 data bits, 1 stop bit, and no parity, and uses it as the system console.

To change the console device to a serial terminal:

1. Enter system maintenance mode.
2. Enter the following commands (all 12 tty devices need to be specified on the second line):

   enable tty1a
   disable tty01 tty02 tty03 tty04 ... tty10 tty11 tty12

   This enables the serial device and disables the console multiscreen devices associated with a display adapter.
3. Edit the */etc/default/login* file to change the value of the parameter **OVERRIDE** from "tty01" to the tty line of the serial console (normally its value is "tty1a"). After editing, the line in */etc/default/login* (if the tty line is *tty1a*), should read:

   ```
   OVERRIDE=tty1a
   ```
4. Edit the file */etc/default/boot* (not */stand/etc/default/boot*) and add the following line to the end of the file:

   ```
   SYSTTY=1
   ```
5. Reboot.

To temporarily change the system console device from the command line, enter **systty=***x* at the boot prompt (where *x* is "cn" for a display adapter or "sio" for a COM1 serial port). This does not create or change a **SYSTTY** entry in the */etc/default/boot* file.

Setting up scancode-compatible terminals

Most terminals send information to the operating system only in the form of keytop values, which are the characters that appear on the faces of the keys. However, a few terminals can also send PC scancodes, which are unique values associated with the depression and the release of each key. Several applications and environments now use PC scancodes and more are under development.

A scancode application running on a terminal that is in PC-scancode mode can access more distinct keystrokes than character mode would provide. For example, if you set your terminal to character mode and press the key labeled "A", your terminal sends a single value (the ASCII value of " a ") to your application. However, if you set your terminal to scancode mode and press the key labeled "A", your terminal sends one value when you depress the key and a second value when you release the key. A scancode application translates these scancode values according to a predetermined map.

Installing scancode-compatible terminals

Your scancode-compatible terminal can be set to either character mode or scancode mode. If you choose to leave your terminal in character mode, then each time you start an application that uses scancodes (for example, Microsoft Word), the application switches the terminal to PC-scancode mode. When you quit the application, it returns the terminal to character mode. The screen flashes each time the terminal mode changes, and the switch adds a few seconds delay to starting and quitting your scancode application. For these and other reasons, we recommend that you run a terminal in scancode mode at all times, instead of letting the scancode application switch terminal modes.

NOTE You might encounter problems using PC-scancode mode with a smart serial card. For example, scancode mode might interfere with XON/XOFF flow control. If this happens, consult your card's documentation for the manufacturer's recommendations on resetting the flow control start and stop characters. If your card does not support changing the start and stop characters, or if you experience a problem unrelated to flow control, consult your card's documentation to determine whether you can reset the card so that it no longer takes on line-discipline processing for your scancode lines.

The following two subsections describe how to configure your system when you run a terminal in scancode mode at all times. If you choose to leave your terminals in character mode, you do not need to configure your system specially to use a scancode-compatible terminal.

Setting up scancode mode for one session

If you are unsure whether you want to run a terminal in scancode mode when you are not using a scancode application, you can experiment by using scancode mode for a single session. Use the **scanon** command to set your terminal and your line discipline to scancode mode. The **scanon**(M) manual page describes the **scanon** and **scanoff** commands.

Setting up scancode mode for all sessions

If you want a terminal to reside in scancode mode, you need to modify certain files. To determine which files you need to modify, enter the following command as *root*, where ***ttyline*** is the device to which your scancode terminal is connected:

disable /dev/***ttyline***

You see messages naming two initialization files associated with that tty. Write down the filenames. One file is */etc/inittab* and the other is either */etc/conf/cf.d/init.base* or a file from the */etc/conf/init.d* directory. Edit the files that the screen displays, and, on the line that corresponds to the correct tty, change the last field from "m" to "sc_m".

For example, if you want to run tty001 in scancode mode, change the line:

```
001:2:off:etc/getty tty001 m
```

to read:

```
001:2:off:etc/getty tty001 sc_m
```

For more information on modifying these initialization files, see Chapter 26, "Adding serial terminals" (page 431).

NOTE For each Wyse 60 or Wyse 150 terminal that you want to run in scancode mode, change the user's environment by specifying the "wy60-pc" **TERM** environment variable in the user's *.login* or *.profile* file or in */etc/ttytype*. (The Wyse 150 behaves the same in scancode mode as the Wyse 60.) For instructions on defining the **TERM** variable, see the section on setting terminal type earlier in this chapter.

Only Wyse terminals have the "-pc" names; others (for example, H-P700) are the same in scancode and ASCII mode.

After you edit the two initialization files, set the terminal itself to scancode mode (some manufacturers refer to "PC-personality"). Consult your terminal documentation for instructions on setting this mode.

Finally, enter the following command to re-enable the terminal line:

enable /dev/***ttyline***

Using function keys in scancode mode

When you set up your terminal and system to run in scancode mode, your function keys get set to their default values. If you want to program your function keys while you work in scancode mode, you must use the **setkey**(C) or **mapstr**(M) utility, rather than your terminal's setup procedure. The **setkey** command lets you program one key at a time, while **mapstr -f** reads a file containing the assignment for all the function keys. These utilities formerly affected only the console.

NOTE **scanon** does not run **mapstr**, so if you use **scanon** you also have to run **mapstr** to use the function keys, numeric pad and arrow keys.

The syntax for the **setkey** command is **setkey** ***keynum string***. The **setkey** command assigns the specified ANSI ***string*** to be the output of the function key ***keynum***. For example, for function key 1 (⟨F1⟩) to output the string "date", use the command: **setkey 1 "date"**. For a key assignment to last beyond the current login session, place the **setkey** command in your *.login* file.

The syntax for the **mapstr** command is:

mapstr [**-d**] [***datafile***] [**-f**] [***termtype***]

Without the **-d** option, **mapstr -f** reads the function key values from the file in */usr/lib/keyboard/strings.d* that corresponds to the terminal type.

To customize your function key assignments, create a new file for **mapstr** to read, using a file from */usr/lib/keyboard/strings.d* as a template. Then specify your new file in the **mapstr** command as follows:

mapstr -d ***newfile*** **-f**

For these key assignments to last beyond the current login session, place the **mapstr** command in your *.login* file.

For more information, see the **scancode**(HW) and **keyboard**(HW) manual pages.

Running applications on scancode terminals

SCO OpenServer systems support terminals, such as the Wyse 60 and the H-P700/44, which have a "PC-compatible" (scancode) mode.

mscreen

The **mscreen**(M) (terminal multiscreen) utility can be used on scancode-compatible serial terminals, but you should note that when it is used on a Wyse 60 terminal, the screen must be refreshed after a screen switch. This is because the Wyse 60 does not support hardware page switching when in PC-compatible mode.

You should also note that when running under **mscreen**, although the terminal itself may be in scancode mode, the login sessions are running on pseudo-ttys, which receive ASCII data from the **mscreen** utility. The effect of this is that applications that normally run in scancode mode, such as Microsoft Word, will actually start up in ASCII mode.

Telnet and rlogin

telnet or **rlogin** sessions to a remote host also transfer ASCII data via a pseudo-tty, even if the physical terminal or the console in use is in scancode mode.

usemouse(C)

The **usemouse**(C) utility can normally be used on a serial terminal in scancode mode, using the same default map file or application-specific map files (in */usr/lib/mouse*) as the console. However, when running on a Wyse 60 terminal in PC-TERM mode, use the same map files as when running on a Wyse 60 in native mode.

Troubleshooting terminals

If you are having a problem with a serial terminal, see:

- "Restoring non-functional terminals" (this page)
- "Fixing hung terminals" (page 447)
- "Fixing scrambled terminal display" (page 448)
- "Unlocking locked terminals" (page 448)
- "Restoring non-echoing terminals" (page 448)
- "Correcting hung scancode-compatible terminals" (page 449)
- "Wyse 60 terminal in scancode mode" (page 449)

Restoring non-functional terminals

A completely non-functional terminal displays no login prompt and does not respond to keyboard input. This situation is usually caused by hardware failure or configuration problems. To check a non-functioning terminal:

1. Check the brightness control on the terminal.
2. Check the power and communication connections at the terminal and computer.
3. If applicable, enter set-up mode on the terminal and verify the terminal configuration settings. The settings should include 9600bps, 8 data bits, 1 stop bit, and no parity.
4. Enable the port to which the terminal is connected. For example, to enable *tty2a*, use the following command:

   enable tty2a

5. Verify that there is a **getty** process associated with the terminal port. For example, enter:

   ps -t tty2a

6. Test the hardware communications by disabling the port and redirecting output to the non-functional terminal: for example, to test *tty2a*, use the following commands:

   disable /dev/tty2a
   echo hello > /dev/tty2a

If this fails to restore the non-functional terminal, check the terminal's documentation for troubleshooting suggestions.

Fixing hung terminals

A terminal is considered "hung" if the previous work session is still visible on the display, but it does not respond to keyboard input. To fix a hung terminal:

1. Wait a minimum of 60 seconds before trying to resurrect the terminal. (If the system is busy, the terminal may not respond immediately to keystrokes because the system response time has increased.)
2. Press ⟨Ctrl⟩**q** to re-enable transmission in case the ⟨Ctrl⟩**s** (transmit off) signal was inadvertently pressed.
3. Check to see that all power cords, keyboard cords, and communications cables are connected.
4. Reset the terminal hardware by recycling power to the terminal and then reinitialize it by running **tset**(C) with no arguments.
5. Verify the terminal set-up mode configuration settings (if available) as described in step 3 of the previous section.
6. Test the hardware communications by redirecting output from an operating terminal to the locked one as described in the step 6 of previous section.
7. Check the processes that are running on the locked terminal port with the following command:

   ps -t tty*line*

   Stop the process that the user was running when the terminal hung using **kill**(C). (See "Killing a process" in the *Operating System User's Guide*.) If the program does not die, you must reboot the system to stop the process.
8. Determine whether the current line characteristic parameters are correct. For example, use the following command to display these values for *tty2a*:

   stty -a < /dev/tty2a

   You can also compare the **stty** settings with those of a working terminal.
9. Reset the serial line characteristics with the following command:

   ⟨Ctrl⟩**j stty sane** ⟨Ctrl⟩**j**

   If you cannot enter the command on the terminal, you can redirect the **stty** command from another terminal as follows:

   stty sane < /dev/tty2a

If the **ps -t** command shows only a **getty** program, the terminal should display a login prompt. If it does not, check the terminal hardware again.

Fixing scrambled terminal display

A scrambled terminal responds to keyboard input but the display is incorrect. To fix a scrambled terminal:

1. Check the terminal type (**TERM**) for the user with the **env** command. If the terminal type is incorrect, reset it. For example, to set the terminal type for a Wyse 60, enter:

   TERM=wy60

   After resetting the terminal type, reinitialize the terminal by entering **tset** with no arguments.

2. Reset serial line characteristics with the following command:

   ⟨Ctrl⟩**j stty sane** ⟨Ctrl⟩**j**

Unlocking locked terminals

If a terminal has been locked by the system administrator to prevent logins on that terminal, or if the system locked the terminal because a user exceeded the number of unsuccessful logins attempts, the following message is displayed on that terminal:

```
Terminal is disabled -- see Account Administrator
```

For more information, see "Locking or unlocking a user account" in the *System Administration Guide.*

Restoring non-echoing terminals

A non-echoing terminal is a terminal that responds to keyboard input but does not display the characters entered at the keyboard. (This is different from a *locked* or non-functional terminal that does not respond to input at all.)

Sometimes, when a program stops prematurely as a result of an error, or when the user presses the ⟨Break⟩ key, the terminal stops echoing. To restore the terminal to normal operation, enter the following:

⟨Ctrl⟩**j stty sane** ⟨Ctrl⟩**j**

Enter this command accurately because the terminal does not display what you enter at the keyboard.

The terminal should now display keyboard input. If it does not, follow the steps outlined in "Restoring non-functional terminals" (page 446).

Correcting hung scancode-compatible terminals

If your PC-scancode application crashes, your terminal might hang with the terminal and the line discipline in incompatible modes. To correct this incompatibility, log into another terminal and use either the **scanon**(M) or **scanoff**(M) command as described below.

If you want to restore both your terminal and line discipline to PC-scancode mode, enter the following **scanon** command, where ***ttyline*** is the tty of the hung terminal:

scanon /dev/*ttyline*

If you want to restore both your terminal and line discipline to character mode, use the **scanoff** command:

scanoff /dev/*ttyline*

You do not need to be *root* to use **scanon** and **scanoff** to affect your own tty. For more information on **scanon** and **scanoff**, see the **scanon**(M) manual page.

Wyse 60 terminal in scancode mode

When a Wyse 60 terminal in PC-TERM (scancode) mode is connected via a serial line that is also in scancode mode, if you press any of the keys that generate ⟨Esc⟩ sequences (for example, ⟨Ins⟩, ⟨Home⟩, ⟨Left Arrow⟩) the terminal and the system will repeatedly send the sequence backwards and forwards. This fills the input buffer, making the terminal unusable until you log off the system, or until you set the serial line using the command **stty -echo**.

Network configuration

Chapter 27

Configuring Internet services

The **SCO Internet Manager** is used to configure the internet components on an SCO OpenServer Enterprise System or Desktop System. Use the **SCO Internet Manager** to manage World Wide Web access, e-mail forwarding, remote file transfer access, routing to and from the Internet, point-to-point connections with other systems, and network security (including data packet filtering, and local or remote administrative access).

To properly configure your system, read the instructions on:

- starting the Internet manager (page 454)
- configuring network connections (page 455)
- configuring Internet services (page 463)

NOTE When you install SCO OpenServer, you are given a choice of MMDF or SendMail as your Mail Transport Agent (MTA). To use the **Internet Manager** to configure electronic mail, you must choose SendMail. SendMail gives you full access to multihoming and other advanced mail features not available from MMDF.

If you installed MMDF, but now want to use SendMail, use the **Software Manager** (page 69) to remove the MMDF package, then add the **sendmail** package.

See also:

- Chapter 9, "Administering SCO systems" (page 137)
- Chapter 28, "Managing virtual domains" (page 473)

Starting the Internet Manager

NOTE You must be running an X session to configure Internet services.

To start the Internet Manager on the local system:

1. As *root*, do one of the following:
   - From the Desktop, double-click on the **Internet Configuration** icon.
   - From a UNIX window (**SCOterm** or **xterm**), enter:

     scoadmin internet
   - From the SCOadmin launcher, select **Internet Configuration**.
2. In the "User ID" field, enter *admin*. In the "Password" field, enter the **Internet Manager** password.

   This is set to the first eight characters of the *root* password by default. To change the Internet *admin* password, click on the **Security** button on the Internet Services page, then choose **Set Internet Manager Password** (or log in as *root* and enter **/etc/internetpw**).

   NOTE If you defer setting the *root* password during the initial installation procedure, the *admin* user's password is set to ⟨Enter⟩.

To start the Internet Manager from a remote system:

1. With a Web browser that supports tables (such as Netscape Navigator), open this URL:

   http://***system-name***:615/mana/mana/menu.mana

   For ***system-name***, substitute the fully-qualified name of the system that you want to configure.

   NOTE Only systems which have been specifically permitted remote access can use the **Internet Manager** remotely.

   To permit remote access by a system, select SYSTEM-WIDE on the Internet Services page of the **SCO Internet Manager**, click on the **Security** button, then click on the **Control Access From Remote Sites** button. (Or add the remote system's IP address to the */usr/internet/admin/access/site* file on the local system.)
2. In the "User ID" field, enter *admin*. In the "Password" field, enter the **Internet Manager** password.

Configuring network connections

Configuring network connections involves:

- "Accessing the network" (this page)
- "Configuring network cards " (this page)
- "Using a modem to connect to the Internet" (page 456)

Accessing the network

When you start the **Internet Manager** for the first time, it prompts for which interface connects your system to the Internet. The **Internet Manager** lists all network cards that you have configured and offers you the option of creating a PPP connection. If you are planning to use a network card to connect to the Internet or your LAN, select that card from the list. If you are using a modem to connect your system to the Internet, choose to add a PPP connection (page 457).

In addition to selecting an interface, you are given the option of whether the system should test your connection. It will do this by attempting to contact a known system on the Internet. If you do not want the system to perform this test (if, for example, you are configuring your system for use on a LAN that has no Internet connection), deselect the **Test Internet connection** checkbox.

Once you click **OK**, the system tests your connection (unless you have chosen not to do so) and configures several system services, such as the Domain Name System (DNS). If the test was successful, your system is on the Internet, and you are ready to configure specific system services, as described in "Configuring Internet services" (page 463). If the test is unsuccessful, you can chose to **Reconfigure** the settings. If the system timed out before the connection/dial completed, click on **Try Again**.

Configuring network cards

The **Internet Manager** does not support the installation or configuration of network cards directly. If you install a new network card or need to reconfigure it (for example, to change its IP address), you need to run the **Network Configuration Manager**. For more information about installing and configuring network cards, see Chapter 29, "Configuring network connections" (page 481) and **netconfig**(ADM).

Using a modem to connect to the Internet

If you plan to use a modem to connect to the Internet, you must configure an outbound PPP connection. To do this, you should have a PPP account with an Internet Service Provider (ISP). Your ISP will provide you with a telephone number to dial as well as other important information necessary to configure your link.

NOTE The Internet Manager is designed to configure SCO PPP from Morning Star Technologies, which you must install separately after installing SCO OpenServer. See the discussion of Internet Services components (page 33). in the installation procedure.

At a minimum, you need the following information to create a PPP connection:

- modem type
- phone number
- login account name
- password
- the IP address assigned to your system
- the IP address of the remote system

In addition, you must verify that the netmask of 255.255.255.0 is correct.

If your ISP does not provide you with these IP addresses, then the addresses are assigned to you dynamically each time you dial in, and you do not need to know them. However, you must enter the IP addresses when you create the link (the addresses you enter will be replaced with the correct ones when you dial in). If your ISP does not provide you with initial addresses to use, use 127.0.0.2 for the local site and 127.0.0.3 for the remote site.

You might also need to know the following additional security information:

- PAP/CHAP name
- PAP/CHAP secret
- chat script login sequences

Again, your ISP will give you this information if it is required to create the connection. In many cases, it is not required.

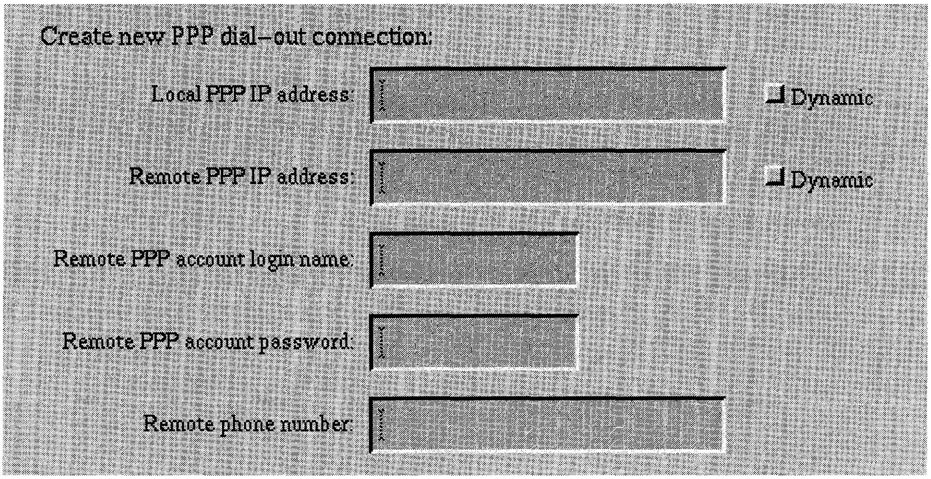
See also:

- "Creating an outbound PPP connection" (this page)
- "Configuring an inbound PPP Connection" (page 459)
- "Troubleshooting your PPP connection" (page 461)

Creating an outbound PPP connection

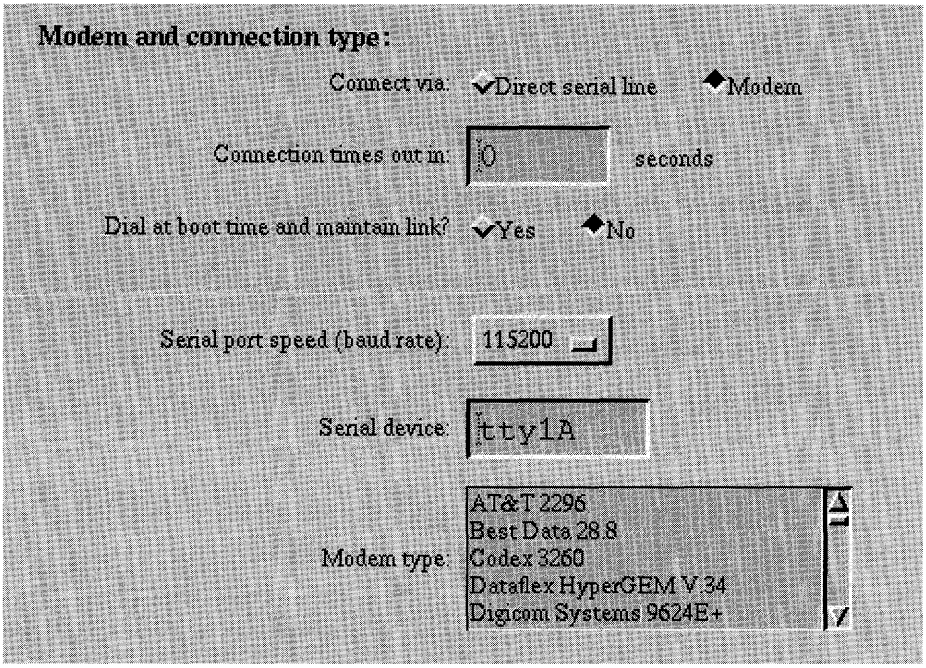
Once you have the information described in "Using a modem to connect to the Internet" (page 456), you are ready to create a PPP connection. The information required is the same whether you are connecting to an ISP or if you simply want to dial in to another system.

The **Internet Manager** page for configuring an outbound PPP connection contains three sections.



Creating a new PPP dial-out connection

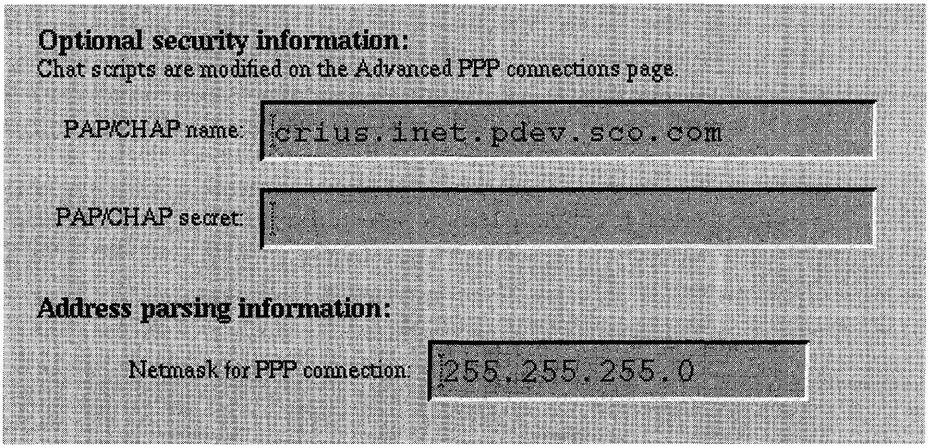
If your ISP or network administrator has given you IP addresses for your system and/or the remote system, enter them here; otherwise, choose default addresses and select **Dynamic** to indicate that IP addresses are to be reassigned dynamically. You must also enter your login name and password. If you are using a modem to make the connection, enter the remote phone number.



Modem and connection type

If you are using a modem to make the connection, select the modem type from the list provided. If your modem does not appear in the list, try one of the generic settings.

You also need to specify whether the line should stay up all the time, or if it should only come up automatically when packets need to be routed across the link. Do this by setting how many seconds the connection needs to be idle before it times out and hangs up. If you are using a part-time connection, the correct timeout value depends on the cost of your phone connection; for many situations, a value of 120 is reasonable. Entering a value of zero (the default) causes the line to stay up continuously. You can also instruct the system to dial the connection every time the system boots.



Optional information

You might also want to specify certain optional parameters. If your ISP or network administrator gives you PAP/CHAP authentication information, enter it here. Finally, you must verify the netmask, which is necessary for the system to properly route packets. A default value of 255.255.255.0 is appropriate for a class C network and is commonly used; you should change it only if your ISP or network administrator instructs you to do so.

Configuring an inbound PPP Connection

The **Internet Manager** does not support the creation of a dial-in Morning Star PPP server unless you have an active Ethernet connection. Without Ethernet, the only choice in the **Internet Manager** for a first connection is dial-out.

In most cases, a LAN connection is desirable for Morning Star PPP servers. If you require a LAN connection for your server, enable it using the **Network Configuration Manager** before configuring PPP with the **Internet Manager**. For more information, see Chapter 28, "Configuring network connections" (page 000).

If you do not need LAN access for your Morning Star PPP server, you can work around the Ethernet requirement by creating a non-functional Ethernet configuration file. To do so, enter:

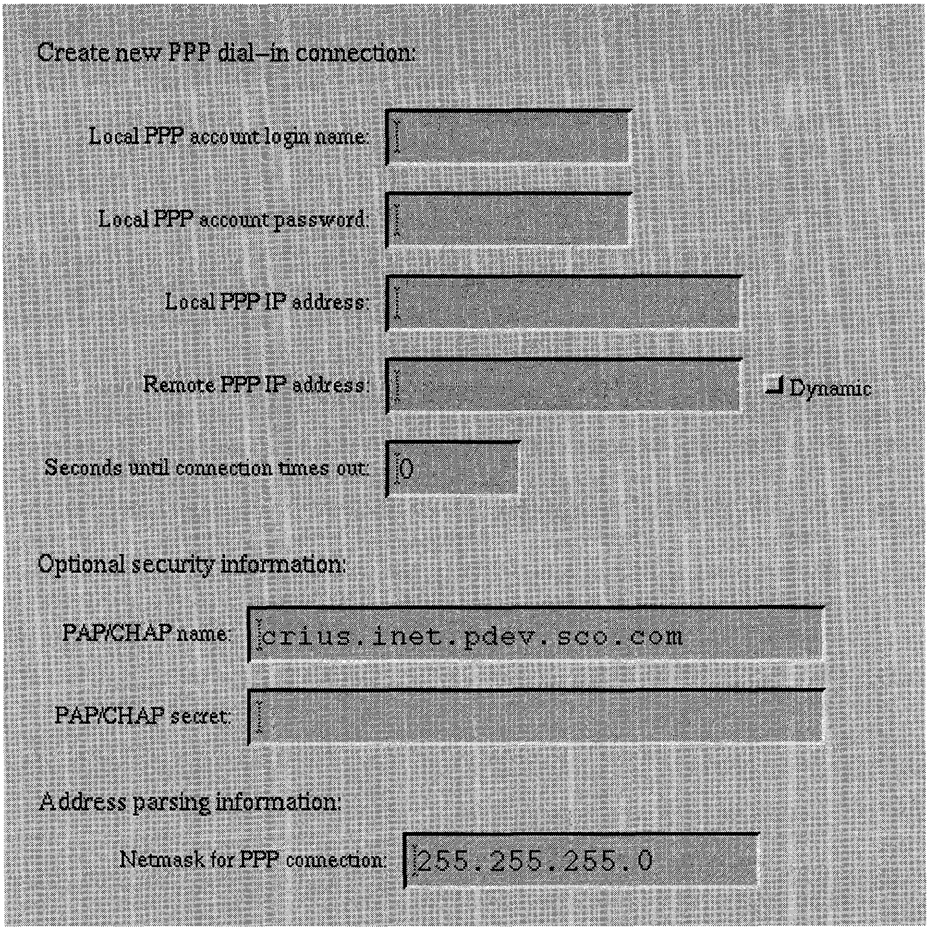
touch /usr/internet/admin/.initdone

Then, restart the **ncsa_httpd** daemon:

/etc/rc2.d/S91mana http stop
/etc/rc2.d/S91mana http start

Finally, configure dial-in Morning Star PPP connections with the **Internet Manager**. The *.initdone* file will be overwritten if you add LAN connections later.

Configuring an inbound PPP connection is similar to creating an outbound connection. You must set the account name and password for each PPP connection, typically one per user. The user account is created for you, using system account defaults (except for the shell, which is specifically for PPP users). You also must specify the IP address used on your system's side of the connection. You can specify that a fixed IP address be used by the remote system each time it connects. If you select the **Dynamic** checkbox, the system uses the IP address given to it by the remote side of the connection during link negotiation. You must specify a default IP address even if you select the **Dynamic** checkbox.



Creating an inbound PPP connection

Enter the number of seconds you want to allow the link to be idle before the system drops the connection. If you enter zero, the system will not drop the connection because it is idle; if you want a part-time connection, enter the timeout period (120 seconds is a reasonable value).

If you require that the remote system authenticate itself using PAP/CHAP, enter the PAP/CHAP name and secret. Finally, enter the appropriate netmask to use for this link; a value of 255.255.255.0 is appropriate for class C networks and is commonly used. If your network uses a different netmask, enter it here.

Once you click on **OK**, the PPP link is ready to use, and a remote system should be able to connect almost immediately.

Troubleshooting your PPP connection

Even though the configuration of a PPP connection appears to be simple, problems often arise. These are most often the result of making the wrong modem selection for the modem you are using, or of the two sides of the connection not agreeing on all the necessary parameters.

Determine that the configurations for both sides of the connection are consistent. For example, they must agree on the account name and password, and the netmask for the connection must agree. Check your IP addresses to make sure they are consistent. If this is an incoming connection, be sure that you do not make the IP address for a system as specified on both sides of the connection dynamic, as neither system will tell the other which IP address to use.

It is often useful to watch what the PPP daemon is doing on your system when it attempts to make the connection:

1. If you are configuring an outgoing connection, edit the */usr/lib/mstppp/Autostart* file. If you are configuring an incoming connection, edit the */usr/lib/mstppp/Accounts* file.
2. Look for the entry corresponding to the connection you are trying to debug. Incoming entries can be identified by account name. Outgoing connections can be identified by the IP addresses of the local and remote systems (dynamic IP addresses are specified by a "~" character).
3. Add `debug` # to the end of the line, where # is a number between 1 and 11 (higher numbers produce more debug information). **debug 5** is a recommended starting point.

4. Save and close the file. If you are debugging an outgoing link, you must kill and restart the PPP daemon:

   - To kill the PPP daemon, enter these commands:

     ps -ef | grep pppd | grep -v grep
     kill ***processID***

     where ***processID*** is the second column of the output from the **grep** command.

   - To restart the PPP daemon, enter these commands:

     cd /usr/lib/mstppp
     ./Autostart

5. Enter these commands at the UNIX prompt:

   touch /usr/adm/pppd.log
   tail -f /usr/adm/pppd.log

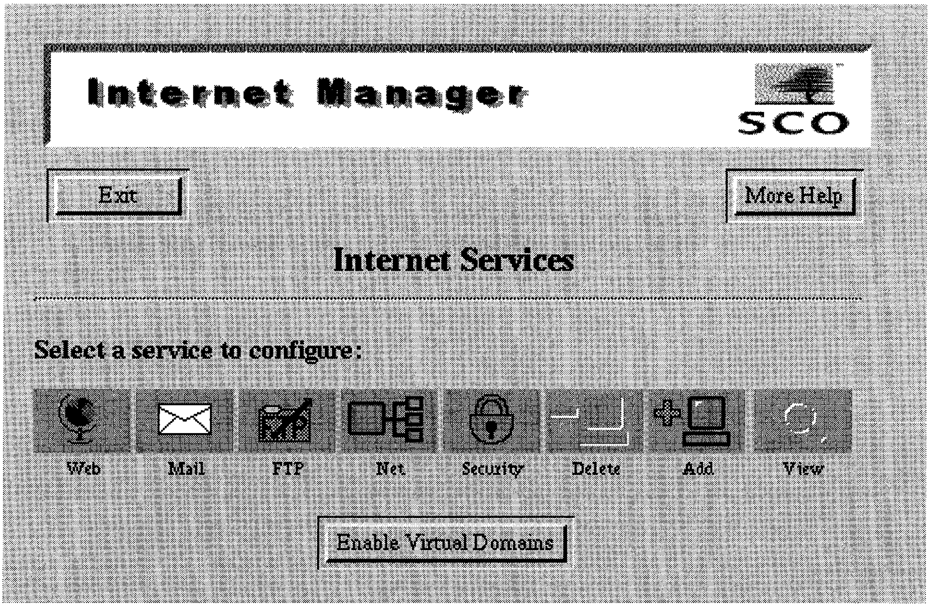
6. Attempt to bring up the connection. To bring up a outgoing connection, use **ping**(ADMN) to contact the remote system's IP address. To bring up an incoming connection, have the remote system dial in.

7. Watch the output of the **tail** command for debug information.

Particular things to watch for are account names and passwords that are incorrect. Also, if one end of the connection is expecting a string to be sent by the other (for example, `login:`) and the other side sends something else (for example, `username:`), this is a problem. If you have such a problem, you can use the **Internet Manager** to modify the chat script by clicking on the **Net** button on the Internet Services page, then clicking on the **PPP Connections** button. If more than one dial-out connection is configured, select the dial-out PPP connection you are debugging, then click on the **Advanced** button. The login chat script can be modified from that page. Alternatively, you can modify the */usr/lib/mstppp/Systems* file, where the chat script is stored. The format of each of the configuration files is described in the corresponding man page: *ppp.Accounts*(MST_PPP), *ppp.Auth*(MST_PPP), *ppp.Devices*(MST_PPP), *ppp.Dialers*(MST_PPP), or *ppp.Systems*(MST_PPP). If you have a complicated chat script, the **Internet Manager** might not be able to configure the connection after the chat script is modified.

Configuring Internet services

Once you have successfully connected to the Internet, the **Internet Manager** displays its main menu, the Internet Services page.



Internet Manager main menu

When you reach the Internet Services page, important Internet services have already been configured for you:

Caching Domain Name Service
: DNS enables your system to act as a name server for your local network, minimizing delay and network traffic.

World Wide Web
: The Netscape FastTrack Server serves a default home page on the Web.

E-mail
: Your system can send and receive e-mail, and any users on your system have POP accounts automatically set up for them.

File transfer
: The system allows password-protected FTP access for users on the system.

These services can be configured by clicking on the appropriate icon:

Web Configure Netscape FastTrack Server, as well as Netscape Proxy Server if it is installed. See "Web" (this page).

Mail Specify e-mail forwarding, the domain used in addresses, and the postmaster and hostmaster. See "Mail" (page 470).

FTP Enable and disable file transfer using the FTP protocol. See "FTP" (page 471).

Net Configure network routing and PPP connections. See "Net" (page 471).

Security Set the **Internet Manager** password and specify which systems can use it remotely. If the optional SCO Internet Security Package is installed, control all network traffic flowing in and out of the system. See "Security" (page 472).

The configuration of each of these subsystems has been simplified to make it easy to configure the system for common uses. When configuring any of these subsystems, you can click on the **More Help** button and the **Internet Manager** will display more information about how to configure it.

See also:

- "Configuring services" (page 475)

Web

When you click on the **Web** button, the **Internet Manager** displays a list of Web servers you have installed.

Clicking on a server enables you to configure it using the Netscape administration utility for that server. This utility prompts you for a user name and password, which are initially set to be the same as that for the **Internet Manager** (the user name is always *admin* and the password is initially set to the first eight characters of the *root* password set during the initial system load).

> **NOTE** If you change the password for the **Internet Manager**, the passwords for the Netscape administration utilities are not changed. To change the passwords for the Netscape administration utilities, you must change them from within those utilities.

The Netscape administration utilities enable you to change many attributes of your servers' behavior. Some attributes, however, should not be changed, or the **Internet Manager** might not work properly. Specifically, these attributes are:

- port
- document root
- bind to address
- server name

See also:

- "Netscape Web server installation defaults" (this page)
- "Starting and restarting Netscape servers" (page 466)
- "Deferring or reconfiguring network configuration" (page 467)
- "Manually configuring Netscape servers" (page 469)

Netscape Web server installation defaults

The installation of the SCO OpenServer Netscape Web servers uses the following default values. You can alter these values once you complete the installation.

Server name	The string returned by **hostname**. Do not change unless you change the system name (or are configuring multiple servers).
Server IP address	The first (non-loopback) returned by **netstat -in**, or 127.0.0.1 if TCP/IP is not configured. Do not change unless you change the system's IP address.
Server port	Netscape FastTrack Server listens on port 80, is administered on port 620. Netscape Proxy Server listens on port 8080, is administered on port 446.
Server home	Netscape FastTrack Server: */usr/internet/ns_httpd* Netscape Proxy Server: */usr/internet/ns_proxy*

Server document root	Netscape FastTrack Server: */usr/internet/ns_httpd/docs*
Server processes	Number of server processes: Minimum 2 Maximum 32 (25 for Netscape Proxy Server)
Home page	Netscape FastTrack Server: */usr/internet/ns_httpd/docs/index.html*
Index files	*index.html* or *home.html* recorded in the server's root (rather than *syslog*).
administration username	Set to *admin*.
administration password	Set to the *root* user's password at installation of server product.

- The servers run as user *nouser*.
- The servers always attempt to resolve IP addresses into host names.
- All accesses to the servers are logged.
- Administration access is limited to the local host.
- The servers use fancy directory indexing.

The Netscape Proxy Server is set to the following additional defaults:

- timeout (maximum time between successive network data packets) set to 2 minutes
- use extended access log format
- by default, HTTP, FTP, and Gopher are proxied (SSL and HTTPS are not)
- no caching

Starting and restarting Netscape servers

Once installed, the Netscape FastTrack and Netscape Proxy Servers start automatically on reboot.

NOTE If you have configured a secure server, starting the server requires a password, and therefore must be done manually.

If you have configured virtual domains (page 473), see "Configuring interfaces" (page 476).

To stop and restart the Netscape servers, use the following commands as *root*:

Netscape FastTrack Server

/usr/internet/ns_httpd/httpd-80/stop and
/usr/internet/ns_httpd/httpd-80/start

If a secure server is configured:

/usr/internet/ns_https/https-443/stop and
/usr/internet/ns_https/https-443/start

Netscape Proxy Server

/usr/internet/ns_proxy/proxy-8080/stop and
/usr/internet/ns_proxy/proxy-8080/start

For more information, see the Netscape FastTrack Server documentation (but note that the server files are installed in */usr/internet/ns-httpd* on SCO OpenServer).

Deferring or reconfiguring network configuration

During SCO OpenServer installation, Netscape servers are configured with settings for Server Name, Hosts, and Addresses by default. If you defer TCP/IP configuration during initial system installation or you reconfigure TCP/IP, any Netscape servers installed on your system might be improperly configured.

To configure your Netscape server after deferring or reconfiguring networking configuration, edit the following files:

Netscape FastTrack Server:

- In */usr/internet/ns_httpd/admserv/ns-admin.conf*, set "ServerName" to the string returned by **hostname**(ADMN). Set "Hosts" and "Addresses" to the hostnames and IP addresses allowed to administer this server. After you set these configuration variables, you can use the Netscape administration server to further configure the server.

  In */usr/internet/ns_httpd/httpd-80/config/magnus.conf*, set "ServerName" to the string returned by **hostname**. Then copy this file to */usr/internet/ns_httpd/admserv/httpd-80/magnus.conf*. The timestamp on the former file must be the same or earlier than that on the latter.

- **If you have enabled virtual domains**, edit */usr/internet/ns_httpd/httpd-80.**ipaddress**/config/magnus.conf*, where ***ipaddress*** is the primary IP address for the system. Set "ServerName" to the string returned by **hostname**. Then copy this file to */usr/internet/ns_httpd/admserv/httpd-80.**ipaddress**/magnus.conf*. The timestamp on the former file must be the same or earlier than that on the latter.

If you changed the system's primary IP address, rename these directories:

mv /usr/internet/ns_httpd/httpd-80.*OldIPaddress* \
/usr/internet/ns_httpd/httpd-80.*NewIPaddress*

mv /usr/internet/ns_httpd/admserv/httpd-80.*OldIPaddress* \
/usr/internet/ns_httpd/admserv/httpd-80.*NewIPaddress*

- **If a secure server is configured, with no virtual domains**, in */usr/internet/ns_https/https-443/config/magnus.conf*, set "ServerName" to the string returned by **hostname**. Then copy this file to */usr/internet/ns_httpd/admserv/https-443/magnus.conf*. The timestamp on the former file must be the same or earlier than that on the latter.
- **If a secure server is configured, with virtual domains enabled**, edit */usr/internet/ns_https/https-443.**ipaddress**/config/magnus.conf*, where ***ipaddress*** is the primary IP address for the system. Set "ServerName" to the string returned by **hostname**. Then copy this file to */usr/internet/ns_httpd/admserv/https-443.**ipaddress**/magnus.conf*. The timestamp on the former file must be the same or earlier than that on the latter.

  If you changed the system's primary IP address, rename these directories:

  mv /usr/internet/ns_https/https-443.*OldIPaddress* \
  /usr/internet/ns_https/https-443.*NewIPaddress*

  mv /usr/internet/ns_httpd/admserv/https-443.*OldIPaddress* \
  /usr/internet/ns_httpd/admserv/https-443.*NewIPaddress*

Netscape Proxy Server:

In */usr/internet/ns_proxy/proxy-8080/config/magnus.conf* set "ServerName" to the string returned by **hostname**. Then copy this file to */usr/internet/ns_proxy/admserv/proxy-8080/magnus.conf*. The timestamp on the former file must be the same or earlier than that on the latter.

Manually configuring Netscape servers

NOTE Configuring new servers directly with the FastTrack Administration Server might cause them not to be seen by the **Internet Manager**.

To configure Netscape servers manually without using the **Internet Manager**:

1. Start the appropriate administration server by entering one of these commands as *root*:

   Netscape FastTrack Server
   /usr/internet/ns_httpd/start-admin

   Netscape Proxy Server
   /usr/internet/ns_proxy/start-admin

2. Access the administration server by opening one of these URLs, on the server being configured, with any forms-capable Web browser:

   Netscape FastTrack Server
   http://localhost:620/

   Netscape Proxy Server
   http://localhost:446/

3. Log into the administration server as user *admin*.

   At installation, the *admin* password was set to the first eight characters of the *root* password.

4. Select the server to administer.

5. When you are finished, stop the administration server by entering:

   Netscape FastTrack Server
   /usr/internet/ns_httpd/stop-admin

   Netscape Proxy Server
   /usr/internet/ns_proxy/stop-admin

Improving Internet server performance

You can improve the performance of your Netscape FastTrack Internet server by increasing the values of:

- **MAXUP**
- **NOFILES**
- **NSTRPAGES**

These variables are tuned with the **Hardware/Kernel Manager** or the **configure**(ADM) command; see the *Performance Guide* for more information.

NSTRPAGES is particularly important if failures are reported by the **netstat -m** command. Increasing **NSTRPAGES** until the failures no longer occur is usually appropriate; see "Tuning STREAMS usage" in the "Tuning networking resources" chapter of the *Performance Guide*. Remember that increasing **NSTRPAGES** also affects memory usage.

If you are running a multi-processor system, it might also be helpful to increase the value of the **str_pool_size** variable by editing the */etc/conf/pack.d/str/space.c* file. Make a back-up copy of this file before making any changes. You must relink the kernel before modifications to *space.c* files take effect. Tuning this variable does not appreciably affect performance on single-processor systems.

> **NOTE** Determining specific values for these parameters depends on your system hardware, configuration, and usage. We recommend that you experiment with these values according to the suggestions in the *Performance Guide*.

Mail

When you install SCO OpenServer, you are given a choice of MMDF or SendMail as your Mail Transport Agent (MTA). To use the **Internet Manager** for configuring electronic mail, you must choose SendMail. SendMail gives you full access to multihoming and other advanced mail features not available from MMDF.

If you installed MMDF, but now want to use SendMail, use the **Software Manager** (page 69) to remove the MMDF package, then add the **sendmail** package.

A Post Office Protocol (POP) server is configured at installation time so that many popular mail programs on PCs and Macintoshes (including Netscape Navigator and other POP clients) can receive mail using your system as the server.

The system is configured so that any incoming mail destined for your system is either delivered locally (if the destination user exists) or is rejected; if the system receives any mail destined for another system, it forwards it on to that system. Any mail addressed to *postmaster* is delivered to the *root* user as well as to those users you have designated *postmaster*.

Outgoing mail is delivered directly to the system to which it is addressed. Mail sent by local users will have the fully qualified domain name of the system shown in the "From:" header (***user@system.subdomain.domain.com***, for example).

By clicking on the **Mail** button on the Internet Services page, you can change the configuration of e-mail forwarding and host hiding (what gets shown on the "From:" header for outgoing mail). If you have a central system that has a full user database for your domain, you can choose to forward "local mail" to that host. In addition, you can specify a system to which all mail outside your domain is delivered. It is intended that this system has good Internet connectivity and is well able to handle large amounts of SMTP traffic.

FTP

By default, your system is configured to allow users who have an account on your system to use the File Transfer Protocol (FTP) to transfer files between your system and other systems. The use of FTP by anonymous users is disabled. (So-called "anonymous FTP" is commonly used to upload and download files from a system by users that are unknown to that system; no authentication is required. If you have ever downloaded a file from the Internet using your Web browser, you probably have used anonymous FTP.)

By clicking on the **FTP** button on the Internet Services page, you can determine whether FTP access is permitted at all, as well as whether anonymous users can download or upload files.

Net

By clicking on the **Net** button on the Internet Services page, you can configure your system's network connections.

By selecting **Network Routing**, you can change which network interface the system uses as your route to the Internet. If you want to make your default route a PPP connection, you must first configure that connection — see "Using a modem to connect to the Internet" (page 456). You can also specify that your system is a gateway. If you configure your system as a gateway, it will forward data packets received on one interface to another interface if appropriate. Otherwise, all received data packets not destined for this system are discarded.

You can configure both inbound and outbound PPP connections by selecting **PPP Connections**. The procedure for adding and configuring PPP connections is described in "Using a modem to connect to the Internet" (page 456).

Security

Because the **Internet Manager** can be used to configure important services on your system, it is important that access to it be restricted to protect your system from unauthorized users. This is accomplished in two ways. First, the **Internet Manager** requires that the user enter a user name and password to gain access. Second, the **Internet Manager** checks that the system from which the user is accessing it is one that you have specifically authorized.

By clicking on the **Security** button on the Internet Services page, you can change the **Internet Manager** password and specify which systems are authorized to use the **Internet Manager**. Initially, the password for the **Internet Manager** is the same as the *root* password. You can change the password by clicking **Set Internet Manager Password** on the Security page.

> **NOTE** Changing the password for the **Internet Manager** does not change the passwords for the Netscape server administration utilities. These must be changed from within those utilities.
>
> The **Internet Manager** uses only the first eight characters of your password.

The system is initially configured to allow access only from the system itself (running the **Internet Manager** on the console display). To allow another system or systems access to the **Internet Manager**, select **Control Access From Remote Sites** on the Security page, then enter the system's IP address.

> **CAUTION** By allowing another system to access the **Internet Manager** remotely, system security is decreased and your system is potentially vulnerable to an "IP spoofing attack". In an IP spoofing attack, a hacker attempts to gain access to your system by making a remote system appear to be one of your trusted systems by using its IP address. It is also possible that someone monitoring data packets on the network could discover your password. The chance of your system actually being attacked in this manner is small, and chances of a successful security breach are even smaller (the attacker must determine both the IP address of one of your trusted systems as well as the **Internet Manager** password). You should weigh the benefits of remote administration against the costs of a potential compromise of system security.

Chapter 28

Managing virtual domains

SCO Internet FastStart supports "virtual domains", allowing a single network interface to respond to multiple IP addresses, so that a single system can be known by multiple names (such as *abc.com* and *def.com*). If system services are configured to bind to specific IP addresses, then a single system can serve the Web sites for both *abc.com* and *def.com*, and anyone accessing either Web site could not tell that these sites are served from a single system. This process of using a single system to respond to multiple IP addresses and system names is called "multihoming". The multiple distinct environments that the system presents to the outside world are called virtual domains. Your SCO Internet FastStart system can support up to 254 virtual domains, each with distinct Web, FTP, and e-mail services.

Use the **SCO Internet Manager** to:

- enable virtual domains (page 474)
- add and delete virtual domains (page 474)
- configure internet services (page 475)
- view properites of virtual domains (page 477)

See also:

- "Remote administration of virtual domains" (page 480)

Enabling virtual domains

To make your system present multiple distinct environments to the outside world, you must enable virtual domains. On the Internet Services page, select **Add** or **Enable Virtual Domains**. Once you enable virtual domains, the Internet services on your system are reconfigured to bind to specific IP addresses. Because of the difficulties involved in reversing this step, the **Internet Manager** will prompt you to verify that this is what you want to do. Once you make your system's Internet services bind to specific IP adresses, you cannot reverse this step using the **Internet Manager**.

When you enable virtual domains, you must choose which network interface to bind the existing Internet services configuration to. You must choose one of your network cards, a PPP connection, or the *localhost* interface. *localhost* always has an IP address of 127.0.0.1 and can only be accessed from the system itself; it is never routed across any network interfaces.

The behavior of the Internet Services page changes after virtual domains are enabled. In addition to the row of buttons used to configure individual services, the **Internet Manager** presents a list of interfaces to configure, as well as a SYSTEM-WIDE option. *localhost* (127.0.0.1), your physical network interface(s) and PPP connection(s) are identified as "physical" interfaces, while any virtual domains you create (additional IP addresses you add to your system) are identified as "virtual" interfaces.

Adding and deleting virtual domains

You can add a virtual domain to your system once you have enabled virtual domains by clicking on the **Add** button on the Internet Services page. You will be prompted for the name and IP address to be used for this virtual domain, as well as an administrative user name and password. You should use IP addresses for the virtual domains that are on the same subnet as your primary physical interface. If you use a separate subnet for your virtual domains, you will have to make manual routing changes on your network's router to enable access to the new subnet.

NOTE It is important to ensure that both the name and IP address for your virtual domain are unique.

You can delete a virtual domain from your system by selecting the virtual domain to delete, and then clicking on the **Delete** button on the Internet Services page. When you delete a virtual domain, the **Internet Manager** reclaims all resources associated with it; this includes removing any Web or FTP content, as well as any mail spool files.

NOTE If you only want to disable a virtual domain and not have the **Internet Manager** reclaim its resources, you should lock it instead: Click on the **View** button on the Internet Services page and select **LOCKED**. For more information, see "Locking and unlocking an interface" (page 480).

Network

Configuring services

You must choose one of the interfaces (or SYSTEM-WIDE) before you click on a service button. Depending on which interface you select, a service may or may not be configurable. For example, PPP configuration (under **Net**) and **Internet Manager** access control (under **Security**) affect the entire system, and are only accessible when SYSTEM-WIDE is selected. Other services are only configurable when a specific interface is selected.

See also:

- "Configuring SYSTEM-WIDE" (this page)
- "Configuring interfaces" (page 476)

Configuring SYSTEM-WIDE

The following services are configurable SYSTEM-WIDE when virtual domains are enabled:

Web The Netscape Proxy Server is only configurable SYSTEM-WIDE (it cannot be bound to specific IP addresses), as its function is to handle requests to and from other sites. (The Netscape FastTrack Server is not configurable SYSTEM-WIDE as it is bound to a specific IP address.)

Mail The system-wide configuration of your mail service is the same as it is when virtual domains are not enabled — see "Configuring e-mail" (page 479) for more information.

FTP You can only determine whether FTP is enabled or disabled SYSTEM-WIDE. Enabling or disabling FTP will affect the operation of all virtual domains (if FTP is disabled SYSTEM-WIDE, FTP to individual virtual domains is also disabled). Anonymous FTP is configured per interface when virtual domains are enabled — see "Configuring interfaces" (this page) for more information.

Net Configuration of network routing and PPP connections is the same as it is when virtual domains are not enabled — see "Configuring network connections" (page 455) for more information.

Security Configuring access to the **Internet Manager** is the same as it is when virtual domains are not enabled — see "Security" (page 472) for more information.

Configuring interfaces

The following internet services are configurable for each interface when virtual domains are enabled:

Web Clicking on the **Web** button allows you to configure the Netscape FastTrack Server associated with the selected interface. You can easily use the Netscape server administration utility to configure web service for each interface. Before enabling virtual domains, the Netscape Web server document root directory is */usr/internet/ip/0.0.0.0/publish/htdocs*. If you configure a Netscape Web server for an interface, the Web server document root directory is */usr/internet/ip/**ipaddress**/publish/htdocs*, where ***ipaddress*** is the IP address of the interface. To start the FastTrack server for a virtual domain, enter this command as *root*:

/usr/internet/ip/*ipaddress*/ns_httpd/start

ipaddress is the IP address of the server to start or **0.0.0.0** for system-wide server(s).

If you have configured a secure server, enter:

/usr/internet/ns_https/https-443.*ipaddress*/start

where ***ipaddress*** is the primary system IP address.

> **NOTE** Do not change the "Bind Address", "Port", "Document Root", or "Server Name" in the Netscape administration utility. Doing so will cause the **Internet Manager** to improperly configure the server. If you need to change IP addresses associated with virtual domains, use the **Add** and **Delete** buttons on the Internet Services page. See "Adding and deleting virtual domains" (page 474) for more information.

Mail Clicking on the **Mail** button allows you to manage mail users associated with the selected interface. Each virtual domain can either use the system-wide set of users, or have a unique set of users associated only with that domain. This means that a single system can have multiple users with the same name that are distinguished by the domain with which they are associated (for example, *joe@abc.com* and *joe@def.com* are distinct users). Before virtual domains are enabled, mail is received wherever system mail is configured: */usr/spool/mail/**name***. For each interface, e-mail spool files for POP mail users are in:

*/usr/internet/ip/**ipaddress**/sco_mail/spool/**user_name***

Where ***ipaddress*** is the interface's IP address and ***user_name*** is the e-mail user's name. Alternatively, if the interfaces use */etc/passwd* instead of private user lists, mail to *joe@abc.com* and *joe@def.com* go to the same system mailbox. *joe* is a real system user, with a full account. When using private user lists for each interface, the users only have POP e-mail access to their mail file. They are not regular users on the system. They cannot use **telnet**(TC) to connect to their accounts to read mail. POP mail is automatically set up for users in the private user lists.

FTP Clicking on the FTP button allows you to control anonymous FTP associated with the selected interface. Before enabling virtual domains, the anonymous FTP directory is */usr/internet/ip/0.0.0.0/sco_ftp*. If you configure FTP, the anonymous FTP directory for an interface is */usr/internet/ip/**ipaddress**/sco_ftp* (***ipaddress*** is the interface's IP address).

Net Configuration of network connections affects the system as a whole, so it cannot be performed separately for each interface.

Security Access to the **Internet Manager** can only be configured SYSTEM-WIDE.

Viewing properties of virtual domains

By clicking on the **View** button on the Internet Services page, you can view and modify properties of the selected virtual domain.

See also:

- "Virtual domain name and DNS" (page 478)
- "Administrative users" (page 479)
- "Configuring e-mail" (page 479)
- "Locking and unlocking an interface" (page 480)

Virtual domain name and DNS

One of the important properties of a virtual domain is its name (for example, *abc.com* or *mywebserver.def.com*). This is the name by which services associated with a virtual domain know themselves — it is the "virtual system name".

To allow other systems to access a virtual domain or physical interface by its name, create entries for it on a DNS server. These entries need to be made on the DNS server that is acting as the primary or authoritative server for the domain within which you have defined the virtual domain's name. Your SCO OpenServer system is configured to run a caching DNS server only because the optimal DNS configuration for many situations is different, and often systems are dedicated to the purpose of running DNS. If you have a small site, your ISP will probably offer you DNS service.

Because of the many installation-dependent issues involved in proper DNS configuration, the **Internet Manager** does not attempt to create the DNS entry for you. You should ask your network administrator or ISP to add a DNS entry corresponding to your system name and IP address. If you are administering DNS yourself, refer to Chapter 6, "Configuring the Domain Name Service" in the *Networking Guide* in your online documentation for more information.

If you are creating a new top-level domain (such as *mycompany.com*), you must also register this domain with the Network Information Center (NIC). The NIC is the worldwide authority responsible for granting the use of top-level domain names. It is necessary for such a centralized authority to grant domain names to guarantee the uniqueness of names throughout the Internet. Information about the NIC and applying for a domain name can be found on the Web at *http://www.nic.org*. The process of registering your domain name can take several weeks due to the number of requests that the NIC receives. If you register a top-level domain (such as *mycompany.com*), either you or your ISP must arrange to provide primary and secondary Domain Name Service for the new domain prior to NIC registration of the new domain.

Administrative users

Each virtual domain has an administrative user associated with it. When a virtual domain is created, the administrative user is given ownership of appropriate files within the virtual domain. This enables the administrative user to update information contained within the virtual domain, such as Web and FTP content. You can have a distinct administrative user for each virtual domain, or one administrative user for several virtual domains. We do not recommend that the administrative user for your virtual domains be the *root* user.

The administrative user is a regular user on the system. If the administrative account does not exist, it is created by the **Internet Manager** using the login name and password supplied. System defaults for shell, authorizations, and the like are used. The home directories for the administrative users are the top of the file hierarchy for the virtual domain administered by that user: (*/usr/internet/ip/**ipaddress**/publish*).

Use the **Account Manager** to modify the attributes of administrative users. For example, you might want to limit system access of an administrative user by changing that user's shell to *rsh, rcsh,* or *rksh*. If a user is administering several virtual domains, you might want to give them a different home directory than the first virtual domain they are assigned. Use the **Account Manager** to remove or retire administrative user accounts.

Configuring e-mail

You can select whether the mail service associated with a virtual domain uses the system-wide password file to determine users within that domain or uses a private user list. If you want user names to be the same throughout your virtual domains, choose "Use system (/etc/passwd) users". If you want users within each virtual domain to be distinct, use a private user list. If you use the system-wide password file to define your user accounts, you must use the **Account Manager** to manage them. See Chapter 1, "Administering user accounts" in the *System Administration Guide* for more information.

If you choose to use a private user list, you can add and delete users as well as change their passwords by clicking on the **Mail** button on the Internet Services page with the appropriate virtual domain selected.

Locking and unlocking an interface

By locking an interface, you can disable access to all services associated with a particular virtual domain. You can re-enable all services by simply unlocking it. When you lock a particular virtual domain, the system will stop responding to the IP address associated with it. This feature might be useful if, for example, you are an ISP and the customer for which you are maintaining the virtual domain stops paying its bill, or if you are trying to resolve possible IP address conflicts with other systems on your network. When a virtual domain is "LOCKED", that word replaces "virtual" in the "Type" column. (Since only virtual domains can be locked, either "virtual" or "LOCKED" in the "Type" column identifies a virtual domain.

NOTE Locking a physical interface has no effect. Only virtual domains can be locked and unlocked.

Remote administration of virtual domains

One of the advantages of having unique administrative users for each virtual domain is that these administrative users can manage their virtual domain remotely using FTP. When administrative users connect to the system using FTP and logs in, their home directories are set to be the top of the file hierarchy associated with their virtual domain. This enables them to upload and download Web content and files to be made accessible using anonymous FTP. If you are an ISP or network administrator, this means that you can create a virtual domain for a user and then step aside and let them administer it themselves using popular FTP programs and Web authoring programs.

The only limitation on the remote administration of a virtual domain is the addition or deletion of POP e-mail users. Since this can only be done by using the **Account Manager** or **Internet Manager**, the system administrator (not the virtual domain administrative user) must make these changes. The administrative user can manage changes to e-mail user passwords by logging into the system using **telnet**(TC) and running the pwfile utility on the e-mail user file (*/usr/internet/ip/**ipaddress**/sco_mail/passwd*).

Chapter 29

Configuring network connections

You can enable networking on your SCO® system by creating "network interfaces" consisting of configured network adapters or serial drivers with protocol stacks and networking applications. The **Network Configuration Manager** (page 482) provides a convenient, interactive way to add, modify, view, and remove network interface configurations.

To configure network interfaces, you must configure:

hardware Set up your adapter to work with your computer's hardware using utilities supplied with your computer, networking adapters, and SCO OpenServer system.

drivers Configure an SCO network driver to work with your adapter.

protocols Configure an SCO protocol stack or serial protocol to enable communication with remote systems.

For information about configuring network interfaces from the command line or in scripts, see the **netconfig**(ADM) manual page.

New and modified network adapter drivers are made available periodically; see "Accessing the SCO Compatible Hardware Web Pages" (page 273). For the new network features and drivers included with this SCO OpenServer release, see *SCO OpenServer Features and Limitations*.

See also:

- "The Network Configuration Manager interface" (page 482)
- "About network configuration" (page 483)
- "Configuring network hardware" (page 489)

- "Configuring protocols" (page 492)
- "Removing a network configuration" (page 494)
- "Troubleshooting network configuration" (page 494)
- "Interpreting ndstat(ADM) output" (page 498)
- "Backward compatibility with LLI drivers" (page 499)

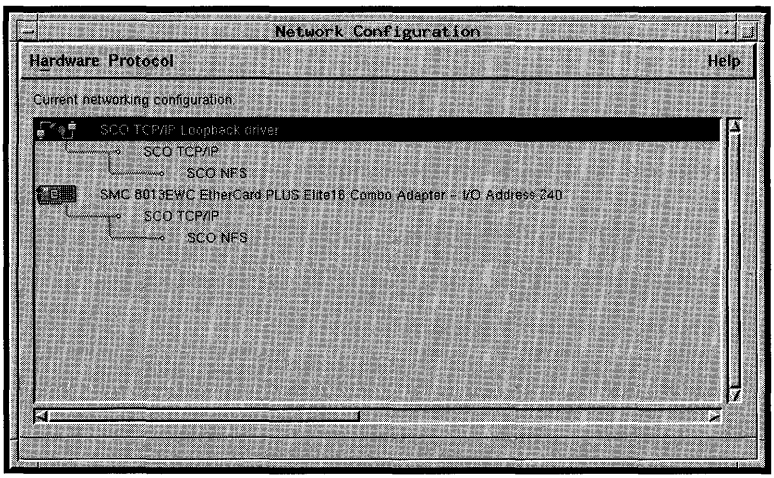
The Network Configuration Manager interface

Use the **Network Configuration Manager** to configure network hardware (page 489), configure network protocols (page 492), and remove a network configuration (page 494).

Start the **Network Configuration Manager** in any of these ways:

- Double-click on the **Network Configuration Manager** icon in the *Networks* directory of the System Administration window on the Desktop.
- Start the SCOadmin launcher by entering **scoadmin** on the command line, selecting **Networks**, then selecting **Network Configuration**.
- Enter **scoadmin network configuration** on the command line (or abbreviate to **scoadmin netwo**).
- Enter **netconfig** on any UNIX command line.

When the **Network Configuration Manager** starts, you see:



For more information on using SCOadmin managers, see "Administering your system with SCOadmin" (page 143).

See also:

- "About network configuration" (this page)
- "Configuring network hardware" (page 489)

About network configuration

SCO network drivers and protocol stacks are central to SCO networking services, which are based on an architecture that affords maximum flexibility, interconnectivity, and standards conformance. Use the **Network Configuration Manager** (page 482) to configure network drivers and protocol stacks.

See also:

- "Network adapter drivers" (this page)
- "Protocol stacks" (page 484)
- "Configuration parameters" (page 485)

Network adapter drivers

Network adapters are hardware devices that connect your system to remote systems using phone lines, specialized data communication cables, or satellite links. Network adapters can be either adapter cards in system slots or chip sets on your system motherboard. They can also be serial communication ports, although these network adapters are not supported in SCO OpenServer Release 5.0.4.

Network adapter drivers provide the software interface between a network adapter and the operating system. A network driver manages data flow and control between the operating system kernel and the various protocol stacks.

The SCO network adapter drivers provide a standard way for many different protocol stacks and networking products to communicate with your computer's networking hardware. Because these drivers conform to a standard set of parameters and interfaces, you can use a single configuration tool, the **Network Configuration Manager** (page 482) to configure them.

Network drivers from other vendors

Many network adapter vendors provide SCO-compatible network adapter drivers. Most of these vendors are listed in the SCO Compatible Hardware Web Pages (page 273). To use an adapter not listed there, contact the vendor.

Protocol stacks

Computers on a network communicate in agreed-upon ways called "protocols". Protocols dictate which signals computers use across cables, how they tell one another that they have received information, and how they exchange information.

Protocols are more accurately termed protocol "stacks" or protocol "suites". These terms reflect the fact that the communications functions are complex and are usually divided into independent layers or levels. A stack is a collection of protocol layers which implement network communication. The protocol associated with each layer communicates only with the layers immediately above and below it, and assumes the support of underlying layers. Lower layers are closer to the hardware; higher layers are closer to the user. The number of layers and tasks that each layer performs depends on which stack you are using.

Although there are many different types of networks, they fall into two general categories:

- A LAN (Local Area Network) connects computers that are in the same office or in adjacent buildings. All the computers on a LAN are connected to a single cable or hub, unless they use a gateway or bridge. A computer on a LAN can communicate directly with any other computer on that LAN.
- A WAN (Wide Area Network) connects computers over long distances using serial lines and sometimes satellite connections. Computers on a WAN can be several hundred feet apart or on the other side of the world from each other. Sometimes messages must go through additional computers (called "gateways", "routers", or "bridges") to reach their destination.

Because the SCO network adapter drivers provide a standard way for networking hardware and software to communicate, you can easily configure different protocol stacks for use on the same machine. The SCO protocol stacks that you can use with the SCO network adapter drivers for LAN communication include:

- SCO TCP/IP (provided with some SCO OpenServer products)
- SCO IPX/SPX® (provided with some SCO OpenServer products)

- Microsoft® NetBEUI (provided with Microsoft LAN Manager for SCO Systems)
- other SCO-compatible transport stacks

The SCO TCP/IP stack can also be used with these WAN communication drivers:

- PPP (Point-to-Point Protocol)
- SLIP (Serial Line Internet Protocol)

For an overview of SCO protocol stack support, see "Networking protocol stacks" in the *Networking Guide.*

Configuration parameters

When configuring network interfaces, you must supply configuration parameters that enable networking hardware to interact with other system hardware and protocol stacks to identify your host system and transmission paths correctly. To configure network interfaces, you must configure:

hardware Set up your adapter to work with your computer's hardware using utilities supplied with your computer, networking adapters, and SCO OpenServer system.

drivers Configure an SCO network driver to work with your adapter.

protocols Configure an SCO protocol stack or serial protocol to enable communication with remote systems.

When configuring network hardware, you must ensure that the networking parameters are not already in use by other system hardware. For more information, see "Determining parameters in use" (page 487).

Hardware configuration

There are several ways to configure your networking hardware depending on the bus type of the adapter you are installing:

PCI PCI hardware setup is usually very simple. In most cases, no user configuration procedures are required, although the specific setup procedures depend on the vendor's implementation. Make sure to run the **Network Configuration Manager** (page 482) after installing PCI adapters into your system.

> **NOTE** Some PCI network drivers have configurable parameters that are available through the Reconfigure window under the Advanced Options window.

EISA and Microchannel™ (MCA)

For EISA and MCA adapters, run your adapter configuration utilities before configuring the driver with the **Network Configuration Manager** (page 482); machines of these types can automatically assign non-conflicting parameters to installed devices. Install EISA network adapters in the machine before running the **Network Configuration Manager**.

ISA, PCMCIA, and Plug-and- Play

Many of these adapters are "software configurable", meaning that you can set hardware parameters from configuration programs. The **Network Configuration Manager** (page 482) can automatically detect many software configurable adapters and assign appropriate configuration parameters to the adapter.

> **NOTE** Many ISA (Industry Standard Architecture) adapters are shipped with DOS setup utilities. However, the **Network Configuration Manager** provides single-point configuration for software-configurable adapters such that many adapters do not require DOS setup. We recommend that you use the **Network Configuration Manager** for basic adapter configuration and resort to the setup utilities only if an adapter cannot be detected or configured by the **Network Configuration Manager**.

Some ISA adapters are "hardware configurable", meaning that you must set jumpers manually on the adapter before installing the adapter in your machine. Make sure that you set the hardware to the same parameters that you assign to the driver with the **Network Configuration Manager**.

Consult your adapter's documentation to determine how to set up your adapter's hardware.

> **CAUTION** Be careful about possible conflicts when installing ISA adapters:
>
> - In non-ISA machines (PCI and EISA), the configuration utilities generally cannot obtain the configuration information for ISA adapters, and therefore cannot check for hardware conflicts.
> - If two or more software-configurable ISA adapters are installed in an ISA machine, they must be set to use different I/O addresses, DMA channels, and shared RAM regions. Otherwise your system may not be able to recognize one of the devices.
> - If two or more ISA cards are installed, be sure to check for all possible hardware conflicts.

Most machines can support one to four networking adapters of a given type (depending on the type of adapter and the capacity of your machine).

Network

Determining parameters in use

To determine many of the settings already in use by drivers installed on your machine, consult your machine's logbook or use the **hwconfig**(C) command:

hwconfig -h

Example 29-1 Sample output from hwconfig

```
device        address     vec  dma  comment
======        =======     ===  ===  =======
serial        0x3f8-0x3ff   4   -   unit=0 type=Standard nports=1
floppy        0x3f2-0x3f7   6   2   unit=0 type=96ds15
console          -          -   -   unit=vga type=0 12 screens=68k
e3B           0x300-0x30f   3   -   type=3c503 addr=02:60:8c:9f:ed:44
disk          0x1f0-0x1f7  14   -   type=W0 unit=0 cyls=967 hds=9 secs=34
```

The fields in the **hwconfig** output shown above are:

device — the name of the device driver

address — the starting and finishing memory address of the driver's working space in hexadecimal; the starting address is often referred to as the "I/O base address" (page 505)

vector — interrupt vector (page 504)

dma — DMA (Direct Memory Access) channel (page 503)

comment — other information relevant to that device using the format *parameter=value*. This example gives the adapter type and MAC (Media Access Control) address.

NOTE If you are configuring an ISA adapter, SCO recommends that you note all network configuration parameters in your machine's logbook.

See also:

- **ndstat**(ADM) manual page
- "Interpreting ndstat(ADM) output" (page 498)

Driver configuration

Use the **Network Configuration Manager** (page 482) to configure a driver.

- You will be prompted for any information that the system cannot detect automatically. You must supply parameters that match those that are defined for the adapter and do not conflict with the settings that are already in use by other hardware installed on your system. See Appendix A, "Configuration parameters" (page 503) for more information.

- The **Network Configuration Manager** checks that network driver parameters do not conflict with those of any other installed driver. If a conflict is found, the **Network Configuration Manager** notes it with an asterisk (*). Some hardware configurations may be prone to conflicts between networking and other components; for more information, see "Checking for conflicts between hardware and drivers" (page 495).
- For some software-configurable ISA adapters, the **Network Configuration Manager** first configures the driver, then writes driver configuration parameters to the adapter.

  See "Supported network adapters by manufacturer" for configuration information specific to your network adapter.

Protocol stack and WAN connection configuration

You can also use the **Network Configuration Manager** (page 482) for protocol configuration. Protocol configuration sets values that uniquely identify your host system in the network and control certain aspects of data transmission.

To configure WAN connections:

PPP Use the **Network Configuration Manager** to add the SCO TCP/IP PPP driver, then use the **PPP Manager** to configure PPP connections; see "Configuring PPP" in the *Networking Guide* for more information.

SLIP Use the **Network Configuration Manager** to configure the SLIP driver and connections.

For information on protocol-specific configuration parameters, see:

- "Serial connection configuration parameters" (page 512)
- "TCP/IP configuration parameters" (page 512)
- "IPX/SPX configuration parameters" (page 518)
- "NetBIOS configuration parameters" (page 523)
- "LAN Manager Client configuration parameters" (page 524)

Network

Configuring network hardware

Configure network hardware using the **Network Configuration Manager** (page 482):

- **To add adapters:**

  From the **Hardware** menu, select **Add New LAN Adapter**. Further configuration will be determined by the bus type of your machine and the ability of the **Network Configuration Manager** to detect your adapter. See:

  - "Configuring adapters in PCI, EISA, and MCA machines" (page 490)
  - "Configuring ISA and PCMCIA adapters" (page 490)
  - "Searching for adapters" (page 491)

  NOTE Configuring a complete network interface includes configuring a protocol with your adapter; see "Configuring protocols" (page 492).

- **To add WAN connections:**

  From the **Hardware menu**, select **Add New WAN Connection**, and select the type of WAN connection to be added. After confirming that TCP/IP will be configured over the selected driver:

  - use the **PPP Manager** to configure PPP connections.
  - continue using the **Network Configuration Manager** to configure SLIP connections.

  For complete information on configuring serial connections, including determining link types and advanced options such as filtering, compression, and debugging, see "Adding a SLIP link" and "Adding a PPP link endpoint" in the *Networking Guide.*

  For general information on the PPP and SLIP protocols, see:

  - Chapter 11, "Configuring the Point-to-Point Protocol (PPP)" in the *Networking Guide*
  - Chapter 12, "Configuring the Serial Line Internet Protocol (SLIP)" in the *Networking Guide*

- **To modify adapter configuration:**

  Select the adapter to modify from the list. From the **Hardware** menu, select **Modify**, then enter new configuration parameters as you did when adding adapters.

  Use the **PPP Manager** to modify your PPP configuration. See protocol stack configuration (page 492).

- **To view adapter configuration:**

  Select the adapter to view from the list, then from the **Hardware** menu, select **Examine**.

- **To remove adapter configuration:**

  Select the adapter to deconfigure from the list, then from the **Hardware** menu select **Remove**. You will be prompted to confirm your choice and informed when the operation is complete.

  NOTE If your network interface includes only one adapter, deconfiguring the adapter will also deconfigure any protocols above it.

Configuring adapters in PCI, EISA, and MCA machines

The **Network Configuration Manager** (page 482) can automatically detect PCI, EISA, and MCA network adapters that are installed in machines with those bus architectures. This means that configuration parameters are read directly from the adapter and the driver is configured automatically. You need only confirm your selection and continue with protocol stack configuration (page 492).

NOTE If you are installing an ISA adapter in a PCI, EISA, or MCA machine, or in a multi-bus machine with PCI, EISA, or MCA network adapters, the ISA adapter will not appear in the list of adapters found in the system. You must select *Configure an adapter not in the list*, then continue configuring the adapter as you would in an ISA machine. See "Configuring ISA and PCMCIA adapters" (page 490).

You must run the **Network Configuration Manager** (page 482) after installing PCI, EISA, or MCA adapters to configure them in your system.

Configuring ISA and PCMCIA adapters

The **Network Configuration Manager** (page 482) presents you with a list of supported adapters arranged by vendor. Select the adapter from the list that most closely corresponds to the one in your machine. If the **Network Configuration Manager** can search for your adapter, it asks if you want to search for it.

Searching for adapters

CAUTION Under certain conditions, such as seaching for an ISA adapter, your system might hang. This is due to limitations in the ISA architecture. If this happens, you must reboot the system and configure the adapter without using the search function.

- **If you search for your adapter:**

1. Click on **Yes**. The **Network Configuration Manager** searchs your system for the selected adapter; this is the recommended option. If you click on **No**, the **Network Configuration Manager** does not attempt to detect an adapter. See If you do not search for your adapter (page 492).

   If the adapter is found, the **Network Configuration Manager** confirms the **key** parameter used to identify the adapter in your system; this is usually the I/O base address (page 505).

2. Click on **Continue**. The **Network Configuration Manager** presents you with a list of configuration parameters that are appropriate to your adapter, with default values for each. If possible, these default values are obtained from the adapter.

3. Select a value for each parameter from the pull-down lists, or click on **Continue** to confirm the set of default selections. Certain adapters also allow you to configure advanced options.

   The **Network Configuration Manager** saves required driver information, and if possible, writes any new settings back to the adapter. If the **Network Configuration Manager** cannot write the settings back to the adapter, it reminds you to make sure that the settings just entered match those on the adapter. For example, this is the case for many adapters with switches or jumpers.

4. When you have completed configuring the network adapter, confirm your selection and continue with protocol stack configuration (page 492).

- **If you do not search for your adapter:**

  You will be presented with reasonable default settings; these are usually the factory-default hardware settings.

  1. Select a value for each parameter from the pull-down lists, or click on **Continue** to confirm the default selection. Certain adapters also allow you to configure advanced options.

     The **Network Configuration Manager** saves required driver information and reminds you to make sure that the settings just entered match those on the adapter.

  2. When you have completed configuring the network adapter, confirm your selection and continue with protocol stack configuration (this page).

> **NOTE** Be sure that the configuration settings you select match the hardware settings; consult your system log for your network configuration parameters.

Configuring protocols

Configure protocols for network adapters using the **Network Configuration Manager** (page 482):

- **To add a protocol:**

  Select the adapter that will use the protocol from the displayed list, then from the **Protocol** menu, select **Add New**.

- **To modify protocol configuration:**

  Select the protocol to modify from the displayed list, then from the **Protocol** menu, select **Modify**. Enter new configuration parameters as you did when adding protocols.

- **To view protocol configuration:**

  Select the protocol to view from the displayed list, then from the **Protocol** menu, select **Examine**.

- **To remove a protocol configuration:**

  Select the protocol to remove from the displayed list, then from the **Protocol** menu, select **Remove**. You will be prompted to confirm your choice and informed when the operation is complete.

  > **NOTE** If your network interface consists of only one adapter and one protocol, deconfiguring the protocol will also remove the adapter.

If your modifications to protocols have altered kernel parameters, the **Network Configuration Manager** will prompt you to relink the kernel when the manager exits. If you do not answer **Yes** at this time, you can do so later by selecting **Rebuild Kernel** in the **Hardware/Kernel Manager**. You must reboot your system before changes to the kernel take effect.

Additional information about protocol configuration is provided in the SCO OpenServer documentation set:

TCP/IP configuration parameters
: See Chapter 3, "Administering TCP/IP" in the *Networking Guide*.

NFS®
: See Chapter 14, "Configuring the Network File System (NFS)" in the *Networking Guide*.

IPX/SPX configuration parameters
: See Chapter 4, "Administering SCO IPX/SPX" in the *Networking Guide*.

SCO Gateway for NetWare®
: See Chapter 3, "Administering SCO Gateway for NetWare" in the *Guide to Gateways for LAN Servers*.

NetBIOS configuration parameters
: See Chapter 5, "Configuring and using NetBIOS" in the *Guide to Gateways for LAN Servers*.

LAN Manager Client configuration parameters
: See Chapter 4, "Administering and using LAN Manager Client" in the *Guide to Gateways for LAN Servers*.

LAN Manager Server services
The **Network Configuration Manager** (page 482) enables you to configure Microsoft LAN Manager for SCO Systems networking transport protocols and applications. See your Microsoft LAN Manager for SCO Systems documentation for more information.

Other network protocols
The **Network Configuration Manager** enables you to configure other SCO-compatible networking transport protocols and applications; see your vendor's documentation for more information.

Removing a network configuration

Remove a complete network adapter configuration using the **Network Configuration Manager** (page 482):

1. Select the network adapter to be removed, then click on **Remove network device**.
2. When the Remove window appears, click **OK** to remove the displayed network system.

NOTE If you are removing protocols that are associated with other network configurations, the network driver you remove is disassociated from that protocol. Other instances of the protocol in network systems are unaffected.

Troubleshooting network configuration

Troubleshooting network interfaces largely consists of identifying whether the problem resides in network hardware, network device drivers, or protocol stacks. Ensure that:

- physical network connections are sound (page 495).
- adapters and drivers are configured correctly (page 495).
- no hardware-specific conflicts are present (page 496).
- the **ndstat**(ADM) command reports no problems (page 498).

You should also use tools appropriate to your network transport to determine whether your local system can reach remote systems. For more information, see:

- "Troubleshooting TCP/IP" in the *Networking Guide*
- "Troubleshooting IPX/SPX" in the *Networking Guide*
- *LAN Manager Troubleshooting and Command Reference*

Checking physical network connections

Ensure that your physical network is sound by checking network connections and conducting regular maintenance. This may include:

- checking cables for loose connections, frayed insulation, or kinks
- using a cable scanner to check the wires and connections

It may also be useful to use your DOS diagnostic utilities to verify that your hardware is functioning correctly.

Checking for conflicts between hardware and drivers

One of the most common network adapter problems arises when adapter hardware configuration parameters do not match those set during driver configuration with the **Network Configuration Manager** (page 482). If such a conflict exists, the network adapter will not work.

To ensure that adapters and drivers are configured together correctly:

1. Verify the hardware settings for parameters such as interrupt vector (page 504), I/O base address (page 505), and RAM base address (page 509).

   To do so, you may need to:

   - Run your DOS setup program.
   - Check jumper settings on your adapter.
   - Run your MCA reference disk.
   - Run your EISA setup program.
   - Run your PCI BIOS configuration program.

2. Verify the SCO system settings for the network drivers. In the **Network Configuration Manager** (page 482), from the **Hardware** menu, select **View**.
3. Correct any conflicts in configuration parameters.

Verifying network media connections

A network interface may be using the wrong network connector on the adapter (many adapters work with more than one cable type). This can happen even if the adapter has been set to valid, non-conflicting settings and the driver is correctly configured to match these settings.

A common symptom of this problem occurs when the number of incoming broadcast frames is the same or less than the number of broadcast frames received, and the incoming/outgoing unicast frames are zero. This is especially common with EISA and Microchannel adapters because the value of the media option can only be set with their setup programs.

To ensure that the correct media connector is being used, verify the adapter's media option by running the hardware configuration. Sometimes, the LEDs on the back of the adapter or on a 10BaseT hub are useful. A network monitor or analyzer can also help verify that the adapter is generating traffic on the desired network media.

If your adapter can detect the correct media automatically, make sure the correct cable is connected to the adapter when the machine boots and that none of the other connectors on the adapter are being used. Ensuring that a single cable is connected to the right media is essential for automatic media detection to work correctly.

If an adapter set to automatically detect the correct media still does not operate correctly, try modifying the settings to the desired media instead of using automatic detection. For EISA and MCA adapters, this may require running the machine's setup program before rebooting your SCO system.

Special considerations concerning hardware conflicts

Hardware conflicts may arise when certain equipment is used together. See:

- "Mixing 16-bit with 8-bit ISA networking adapters" (page 497)
- "Interrupt 2 inconsistencies on ISA computers" (page 497)
- "Graphics and network adapter conflicts" (page 497)

Mixing 16-bit with 8-bit ISA networking adapters

Mixing 16-bit adapters with 8-bit adapters poses special problems on ISA machines. ISA machines reserve the RAM address regions between 640KB and 1MB for devices such as video adapters. This memory area is divided into these 128K regions:

0xA0000 - 0xBFFFF
0xC0000 - 0xDFFFF
0xE0000 - 0xFFFFF

The first region is usually occupied by the video adapter. In the remaining two regions, you must not use 16-bit adapters with 8-bit adapters (or with 16-bit adapters operating in 8-bit mode). You can use a 16-bit adapter with an 8-bit adapter if they are configured to use different memory regions. For example, if you have a 16-bit network adapter configured using the memory region D0000 through D4000, you should not configure any 8-bit adapter to use addresses in the range C0000 through DFFFF.

Interrupt 2 inconsistencies on ISA computers

Interrupt vectors (page 504) on IRQ2 are sometimes lost because of inconsistencies in some ISA computers. If you have verified that your system is correctly installed, but you are losing interrupts on IRQ2, it is probably due to a hardware defect. To work around this problem:

- Choose another available interrupt vector.
- Reconfigure your software using the **Network Configuration Manager** (page 482).
- Reconfigure your hardware by changing jumper settings or using a setup program, if needed.

Graphics and network adapter conflicts

Many video adapters have "vertical graphics retrace", which is associated with IRQ2. If your network board is also configured for IRQ2, this causes a problem when attempting to send or receive data from the network adapter. To work around this, consult the documentation for your video adapter to determine if the "vertical graphics retrace" can be disabled. If it cannot, the network board must be configured for another IRQ that does not conflict with any other configured devices on the system. This has been known to occur with the Genoa SVGA and Orchid Prodesigner VGA adapters.

Some video and network adapters might attempt to use the same shared memory segment. This has been known to occur with network adapter using D0000 and the Paradise and Video 7 1024i video adapters, and it might occur with others as well. Changing the memory I/O address on one of the devices or setting the network adapter to use C0000 might help. Refer to your video adapter documentation for more information.

Interpreting ndstat(ADM) output

Use the **ndstat**(ADM) command to examine the status of the network interface. Here is an example of **ndstat** output:

```
Device       MAC address in use    Factory MAC Address
------       ------------------    -------------------
/dev/net0    00:00:c0:ec:d5:4c     00:00:c0:ec:d5:4c

                Multicast address table
                ------------------------
                01:00:5e:00:00:01

                             FRAMES
      Unicast  Multicast Broadcast  Error    Octets   Queue Length
    ---------- --------- --------- ------ ----------- ------------
In:      33254         0     16133      7     4880475            0
Out:     24785         3        16      9     3029828            0
```

A certain number of errors is normal. It is considered normal if the total number of errors listed in the `Error` column is less than 1% of the total number of `FRAMES` in and out.

- If "In" and "Out" are both zero:

  You cannot reach a remote host and your network interface is probably using a different interrupt vector than its device driver.

- If "In" is non-zero but "Out" equals errors "Out":

  The I/O base address for the network adapter may be incorrect.

- If "In" is zero and "Out" equals errors "Out":

  The network cable may have a faulty connection.

In a TCP/IP environment, the **netstat**(TC) command (particularly the **-i**, **-m**, and **-s** options) is also useful for identifying physical network problems. For more information, see "Troubleshooting TCP/IP" in the *Networking Guide*.

If you are not using TCP/IP, see **crash**(ADM).

Backward compatibility with LLI drivers

SCO network adapter drivers contain a new driver interface called MDI (MAC Driver Interface). The new driver architecture is compatible with the earlier LLI (Link Level Interface) driver architecture. Nonetheless, you should review these sections if you are working in an environment where both architectures are present:

- "MDI functionality not available with LLI drivers" (this page)
- "Using multiple protocol stacks with LLI drivers" (this page)
- "Using an LLI driver with two-protocol stacks" (page 500)
- "Using an LLI driver with three-protocol stacks" (page 500)

MDI functionality not available with LLI drivers

MDI functionality that is not available to LLI drivers includes:

- graphical driver configuration
- automatic detection and one-step configuration of detected drivers
- extended statistics output with **ndstat**(ADM)
- SNMP (Simple Network Management Protocol) support
- automatic driver restart

In addition, LLI drivers are not able to take advantage of new operating system features, such as STREAMS multithreading and access to PCI device configuration information.

Using multiple protocol stacks with LLI drivers

Although all SCO networking stacks can coexist on the same machine, you may need more than one adapter to make them work together. The question of whether a single adapter is adequate to service multiple stacks depends upon the type of framing your stacks use. At present, SCO transport stacks use either 802.3 or Ethernet II framing. NetBEUI and OSI use 802.3 framing and TCP/IP uses Ethernet II framing. IPX/SPX can be set to use either Ethernet II or 802.3 framing.

Two rules determine whether multiple transport stacks can use the same networking adapter. The rules apply to both Ethernet and Token-Ring adapters.

- Only one 802.3 stack can use an LLI at a time. If you intend to use two or more 802.3 stacks and the network adapter uses an LLI driver, you must use one networking adapter per 802.3 stack.
- Any number of Ethernet II stacks can share the same networking adapter with one 802.3 stack.

See also:

- "Framing type" (page 519)

Using an LLI driver with two-protocol stacks

If you intend to use two-protocol stacks on a single adapter, these combinations are possible:

- TCP/IP and NetBEUI
- TCP/IP and OSI
- TCP/IP and IPX/SPX (using either 802.3 or Ethernet II framing)
- OSI and IPX/SPX (using Ethernet II framing)
- NetBEUI and IPX/SPX (using Ethernet II framing)

Any other combination of two-protocol stacks requires multiple network adapters when the network adapter is using an LLI driver.

Using an LLI driver with three-protocol stacks

If you intend to use three-protocol stacks on a single adapter, these combinations are possible:

- TCP/IP and NetBEUI and IPX/SPX (using Ethernet II framing)
- TCP/IP and OSI and IPX/SPX (using Ethernet II framing)

Any other combinations of three-protocol stacks requires multiple network adapters when the network adapter is using an LLI driver.

Reference data appendixes

Appendix A
Configuration parameters

For information on hardware and software configuration parameters required for basic system and network configuration, see:

- "General configuration parameters" (this page)
- "Network driver configuration parameters" (page 505)
- "Serial connection configuration parameters" (page 512)
- "TCP/IP configuration parameters" (page 512)
- "IPX/SPX configuration parameters" (page 518)
- "NetBIOS configuration parameters" (page 523)
- "LAN Manager Client configuration parameters" (page 524)

General configuration parameters

General configuration parameters include:

- "DMA channel" (this page)
- "Interrupt vectors" (page 504)
- "I/O base address" (page 505)

DMA channel

Some devices require that you specify the Direct Memory Access (DMA) channel that you want the adapter to use. Direct memory access permits data to be transferred between memory and a device without the intervention of the system's central processing unit (CPU). Each DMA chip on the system motherboard has eight circuits (or "channels") for conveying data. DMA channel 4 is reserved for use by the system. During configuration, you may choose to use any (or none) of the channels.

Interrupt vectors

Generally, each driver on your system, including those for network adapters and SLIP lines, must have its own interrupt vector (or "IRQ"). An interrupt halts processing momentarily so that input/output or other operations can occur. Processing resumes after the specific operation takes place. Consequently, it is important that each device installed in your system be provided with an interrupt setting that does not conflict with the settings used by the hardware and other peripherals (unless the device in question supports sharing of interrupts).

Unless a device supports sharing of interrupts, its interrupt vector must not be used by any other device on the system. Refer to your networking hardware documentation to determine which vectors the hardware supports. The **hwconfig**(C) and **vectorsinuse**(ADM) commands list the hardware already installed on your system and what vectors are already in use.

Table A-1 Typical interrupt vectors

Hardware	Interrupt Vector (IRQ)
ISA, EISA, or MC machine	
clock	0
console (keyboard)	1
floppy disk controller	6
Hard disk controller	varies
Serial ports	
COM1	4
COM2	3
Parallel ports	
lpt0, lpt1	7
lpt2	5

To install a networking adapter and driver software, you must choose an interrupt vector (IRQ) setting for the adapter. Consult the adapter's documentation for acceptable IRQ settings.

After you determine your hardware's IRQ settings, choose settings for each networking adapter that you plan to install, making sure that the settings do not conflict with each other. The documentation for each networking adapter should indicate whether you need to configure the adapter physically to use the chosen IRQ setting. The operating system reserves interrupt vectors 4 and 7 for *COM1* and *lpt0*, respectively. If you choose any setting that is either a setting reserved for another use or is in use by another device, a conflict occurs. Some SCOadmin managers may be able to detect conflicts.

If yours is an ISA system, your networking hardware might be preconfigured to use a particular vector. If you want to change this vector setting, you might also need to change the physical jumper settings on the adapter or run a setup program provided with the adapter.

NOTE A number of networking adapters are preconfigured to use interrupt vector 3. Your operating system has reserved IRQ3 for the *sio* (serial input-output) device.

I/O base address

Each hardware driver on your system that performs I/O (input/output) must have a unique memory base address so that the system can locate it. This memory address is a three- or four-digit hexadecimal number, must match the settings on the adapter, and must not conflict with any other hardware on your system. Valid base addresses are displayed when you configure your adapter.

The I/O base address is the initial address for a unique area of memory allocated for input/output data control to a specific hardware adapter. For example, 0x300, or 300, is the default I/O base address for the 3Com 3c501 network adapter. The I/O base address must match the hardware configuration on the adapter, and other devices must not use this I/O base address.

WARNING If you enter an I/O base address that is already in use by another device, you might delete that device.

Network driver configuration parameters

In addition to the general configuration parameters, you can set these configuration parameters for network drivers:

- "10BaseT mode enforced" (page 506)
- "Cable (media) type" (page 506)
- "Data rate (Token-Ring)" (page 507)
- "Frame size" (page 507)
- "Full-duplex mode enabled" (page 507)
- "Hardware (MAC) address" (page 507)
- "Interrupt service routine assignment" (page 508)
- "Media speed" (page 508)

Ref data

- "PCI bus, device, and function numbers" (page 508)
- "Primary/Alternate adapter" (page 509)
- "ROM base address" (page 509)
- "Shared RAM address" (page 509)
- "Slot number" (page 510)
- "Source routing" (page 510)
- "Source route optimization" (page 511)
- "tx/rx (transmit/receive) buffers" (page 511)

10BaseT mode enforced

Under normal circumstances, the adapter detects the cable type connected to it. This option turns off auto-detection and enforces a 10BaseT connection. Use this option only if the 10BaseT connector is not detected.

NOTE If you want to use the AUI port, do not plug a cable into the 10BaseT port.

See also:

- "Cable (media) type" (this page)

Cable (media) type

When you configure certain adapters (for example, the 3Com 503 driver), you need to specify whether the adapter connects to "thick," "thin", or "twisted-pair" Ethernet cable. Thick and thin are both coaxial cable. Thick cable is approximately 1/2-inch in diameter, and thin is approximately 1/4-inch in diameter. Twisted pair resembles slightly thicker phone cable.

- Thick cable (also known as "10Base5" and "DIX") uses a 15-pin AUI (Attachment Unit Interface) connector to connect your adapter to a transceiver, which in turn connects to the Ethernet cable.
- Thin cable (also known as "10Base2" and "Cheapernet") uses an on-board transceiver and connects to the Ethernet with a BNC connector.
- Twisted-pair cable (also known as "10BaseT") connects to a hub transceiver using an RJ-45 modular plug connector.

Data rate (Token-Ring)

Some Token-Ring drivers are able to automatically detect the data transmission rate on the ring and configure the adapter accordingly. However, if the adapter is the first active station on the ring, auto-detection will not work and the data rate must be set manually, usually to 4Mbps or 16Mbps. We recommend that you configure servers for a specific ring speed.

NOTE Although it is desirable to set the ring to the highest rate possible, all adapters on the ring should operate at the same rate. Some older Token-Ring adapters can only be set to 4Mbps.

Ref data

Frame size

Frame size is the maximum amount of the data that can be sent out on the network in one packet. The maximum frame size for Ethernet is fixed at approximately 1500 bytes of data. On networks such as Token-Ring, different frame sizes can be used. Larger frame sizes generally increase network performance, although not all systems support larger frame sizes. If you are using a network adapter that supports configurable frame sizes, you may want to experiment with larger sizes in your network.

Full-duplex mode enabled

Full-duplex mode can improve performance for 10BaseT (twisted-pair) connections when using a switched Ethernet hub. It is disabled by default.

NOTE You must be connected to a switched Ethernet network to use full-duplex mode.

See also:

- "Cable (media) type" (page 506)

Hardware (MAC) address

The hardware address — often referred to as the MAC (Media Access Control) address — is assigned by the adapter manufacturer and, under normal circumstances, is not configurable. By default, the **Network Configuration Manager** associates the adapter's hard-coded MAC address with the adapter driver. However, you can supply an alternate MAC address if you want to:

- use a non-SCO protocol stack, such as DEC-Net, that requires configurable hardware addresses

- enable "hot sparing", whereby non-functioning adapters can be replaced by preconfigured spare units without disrupting protocol stacks (this functionality is not currently available)

Configurable hardware addresses do not change the MAC address on the adapter, but the **Network Configuration Manager** can map the physical MAC address to the desired alternate.

A MAC address consists of 6 hexidecimal numbers separated by colons. For example:

```
00:00:c0:34:f1:52
```

See also:

- **ndstat**(ADM) manual page
- "Interpreting ndstat(ADM) output" (page 498)

Interrupt service routine assignment

By default, on multi-processor systems, multi-threaded network drivers are assigned interrupts dynamically. In other words, when the interrupt is received, the system assigns it to a CPU that is available to service the interrupt. To bind network driver interrupt processing to a specific CPU, use this advanced option in the **Network Configuration Manager**.

Media speed

Some Ethernet adapter drivers detect the media speed automatically, although you can manually set it to 10Mbps or 100Mbps. Set the speed manually of hardware incompatibilities cause autodetection to fail.

NOTE You must be connected to a 100Mbps Ethernet network to use the 100Mbps option.

PCI bus, device, and function numbers

PCI machines use unique bus, device, and function numbers to identify each installed device. Bus numbers range from 0-255. Device numbers range from 0-31. Function numbers range from 0-7. PCI bus, device, and function numbers can be displayed using your PCI setup program.

Primary/Alternate adapter

This parameter applies to these adapters:

- IBM Token-Ring Network PC Adapter
- IBM Token-Ring Network PC Adapter II (long and short)
- IBM Token-Ring Network 16/4 Adapter
- IBM Token-Ring Network 16/4 ISA-16 Adapter
- IBM Auto 16/4 Token-Ring Network ISA Adapter
- IBM Token-Ring Network PC Adapter/A
- IBM Token-Ring Network 16/4 Adapter/A

You can install up to two Token-Ring adapters in your system. If you are using two adapters, make sure to use the Primary-Alternate switches on the adapters to set up one as the primary adapter and the other as the alternate adapter. You must also ensure that the adapters are designated as "Primary" or "Alternate" during configuration with the **Network Configuration Manager**. Obtain switch information for these adapters from the documentation supplied by the adapter manufacturer.

ROM base address

Some adapters (for example, IBM Token-Ring adapters) require that you specify a ROM base address. Like the RAM base address, the ROM base address specifies a specific part of ROM memory that is set aside for networking use. If you have more than one adapter requiring that you specify a ROM address, make sure that you do not assign addresses that conflict with another ROM region.

Shared RAM address

The Shared RAM address is the address of a unique area of memory allocated to the host machine and network or graphics adapter for read/write operations; this area is sometimes called the "RAM buffer". Other devices must not use any address in the range from the RAM base address to the end of the allocated memory area (that is, the RAM base address + the RAM buffer size).

The **Network Configuration Manager** notes any conflicting Shared RAM addresses with an asterisk (*).

Slot number

Some adapters (for example, the HP EtherTwist EISA Adapter Card/32) are meant to be used on machines using a EISA, MCA, or PCMCIA bus. If you install one of these adapters and the adapter is not detected in the machine, you may be required to provide its "slot number" during the configuration process. This number refers to the slot in which the adapter is inserted.

Source routing

IBM Token-Ring networking allows you to establish connections from your machine to other machines in these ways:

on a local ring
A local ring is the Token-Ring physically attached to your machine.

to other rings using gateways
A TCP/IP gateway is created when you configure TCP/IP over more than one Token-Ring adapter on the same machine. Those adapters must be connected to different rings and have different IP subnet addresses. TCP/IP gateways connected to Token-Ring networks in this manner will route TCP/IP traffic to the rings without using Token-Ring source routing. Similar gateways can be set up using the OSI and IPX/SPX protocols.

to other networks using a Token-Ring bridge
A Token-Ring bridge is a dedicated piece of computer hardware connected to several Token-Rings. The bridge routes frames between the rings. All Token-Rings connected via bridges will appear as a single ring to each station on the network. Token-Ring source routing allows your adapter to route network traffic across Token-Ring bridges regardless of the protocol stack used by any of the connected networks.

If you intend to connect your machine to a network that includes a bridge, and if you intend to send information from your machine across the bridge, you must use automatic Token-Ring source routing.

The **Network Configuration Manager** offers you two Token-Ring source routing options:

none Source routing is not enabled; frames are not routed beyond the local ring.

auto Source routing is enabled; frames include source routing information and the DLPI module performs source routing on behalf of the protocol stack. This is the default setting.

These options are set for individual adapters; they are not global to all Token-Ring adapters configured in your system.

These options take effect for all protocol stacks using the specified adapter. It is possible for stacks to override default source routing without affecting the source routing mode used by other stacks. In such cases, the source routing is said to be in "stack" mode for the specific protocol stack. For example, SCO TCP/IP and IPX/SPX can be configured to use automatic source routing of a Token-Ring adapter, while a third-party SNA product can provide stack mode routing when using the same adapter.

Protocol stacks provide stack mode routing if the characteristics of the protocol prevent it from working with the general purpose SCO source routing facility, or if a more specialized source routing that is designed to work optimally for a particular protocol is desired. Although no SCO protocol stacks currently provide stack mode source routing, third-party networking products might contain such functionality.

Source route optimization

The **Network Configuration Manager** allows you to find the optimal route between machines on different Token-Ring rings:

yes Use All Routes Explorers (AREs) to discover the optimal route. This is the default.

no Do not try to find the optimal route. Do not use AREs.

It is usually desirable to use ARE explorer frames to discover routes because they find the fastest route between two points and store the information in the Token-Ring source routing table for future transmissions. However, in large networks, using AREs can cause additional network traffic and slow down the network. If minimizing frame traffic is desirable, you may not want to optimize routing.

See also:

- "Source routing" (page 510)

tx/rx (transmit/receive) buffers

Transmit and receive buffers are used to regulate the flow of data frames between adapters and protocol stacks. Although the default settings are usually acceptable, increasing the number may improve performance if network traffic is heavy, but it will also use system memory.

Serial connection configuration parameters

The SCO PPP and SLIP drivers take a variety of configuration parameters, most of which have different possible values and implications dependent upon the type of link configuration you are specifying.

Because of the complexity of these configurations, these parameters are defined by configuration type in the *Networking Guide.* If you are connecting to a service provider, or to another system that is already configured, ask the system administrator of the remote site for the correct values to enter at the configuration prompts. If you are configuring both sides of the connection, refer to this documentation:

- **For a list of configuration types, see:**
  - "PPP endpoint configurations" in the *Networking Guide*
  - "SLIP link configurations" in the *Networking Guide*
- **For a list of parameters associated with each configuration type, and instructions on SLIP and PPP configuration, see:**
  - "Configuring an endpoint for a dedicated link" in the *Networking Guide*
  - "Configuring an endpoint for remote access" in the *Networking Guide*
  - "Configuring an endpoint for automatic or manual dialup" in the *Networking Guide*
  - "Adding a SLIP link" in the *Networking Guide*

TCP/IP configuration parameters

TCP/IP configuration parameters include these basic options:

- "IP address" (page 513)
- "Netmask setting" (page 514)
- "Broadcast address parameters" (page 515)
- "System name" (page 515)
- "Domain name" (page 516)
- "TCP/IP connections" (page 516)

TCP/IP configuration advanced options include:

- "Gateway status" (page 517)

- "Administrator for this system" (page 517)
- "Location of this system" (page 517)
- "Token-Ring Frame format" (page 517)

IP address

The "IP address" identifies and differentiates a given machine from all others on the network. It consists of a 32-bit binary number that is usually displayed as four octets expressed in decimal and separated by periods. You must have a unique IP address for each machine on the network. In addition, if your machine serves as a router to another network (it contains two or more network adapters and belongs to two or more networks), you must assign each adapter a unique IP address on the appropriate network.

NOTE The IP address differs from a MAC (Media Access Control) address in that it is configurable. A MAC address is a 6-byte address that is unique to each physical network adapter. This non-configurable address is assigned by the adapter manufacturer.

The IP address consists of two parts: a network address that identifies the network and a host address that identifies the particular host, or node.

Table A-2 IP address derivation

binary (32-bit)	**10000100100011110000000100000010**			
binary (octets)	**10000100**	**10001111**	**00000010**	**00000010**
decimal octets	**10**	**0**	**2**	**2**

IP address (in standard notation) = 10.0.2.2

Several classes of TCP/IP networks are available, each based on the number of hosts a network needs. Network classes supported by SCO are Class A, B, and C. Use the smallest network class that can accommodate all of your network's hosts. Most TCP/IP installations use Class C, but some larger installations might need to use Class B.

Table A-3 Internet address classes

Class	Available Hosts per Network	Valid Address Ranges
A	16777216	1.0.0.1 through 126.255.255.254
B	65534	128.0.0.1 through 191.255.255.254
C	254	192.0.0.1 through 222.255.255.254
Reserved		224.0.0.0 through 255.255.255.254

If you are connecting your machine to a pre-existing network, the network address (for Class A, the first octet; for Class B, the first two octets; and for Class C, the first three octets) is the same as those of other machines on the network. In this case, you only need to create a unique host address.

If you are creating an entirely new network and you want to connect to the Internet, you need to contact the Network Information Center (NIC) to have a network address assigned; see "Domain name" (page 516) for the Network Information Center address. If you do not want to connect to an outside network, you can choose any network address that conforms to the syntax shown previously. In either case, once you determine the network address, you can then create the unique host address.

When you determine the IP address, remember:

- Each logical network must have its own network address.
- All hosts in a network must have the same network address.
- All hosts in a network must have unique host addresses.
- Do not use these network addresses: 0 or 127 (Class A), 191.255 (Class B), 223.255.255 (Class C), or any of the addresses shown in the Reserved class of Table A-3, "Internet address classes" (this page).

Netmask setting

The "netmask" strips the network ID from the IP address, leaving only the host ID. Each netmask consists of binary ones (decimal 255) to mask the network ID and binary zeroes (decimal 0) to retain the host ID of the IP address. For example, the default netmask setting for a Class B address is 255.255.0.0.

NOTE Always use the default netmask that the installation program prompts you for unless you are creating a subnet (a logical division of a physical network). If you create a subnet, also mask the portion of the address that indicates the subnet. For example, the netmask for a machine on a Class B subnet is 255.255.255.0. For more information, see "Creating subnets" in the *Networking Guide*.

Broadcast address parameters

All datagrams sent by TCP/IP move through all machines in the network path. However, each host adapter ignores any packet that does not include that particular computer's IP address in the datagram header. Occasionally, you might want to send a message to all machines on a particular network. To do so, select a "broadcast address" for your machine. A broadcast address is one in which the host portion of the IP address consists either of all 0's or all 255's. The configuration procedure prompts you to choose between these address schemes:

Table A-4 Broadcast address schemes

Scheme	Example	Purpose
all zeroes (decimal 0)	10.0.0.0	provides compatibility with 4.2BSD systems
all ones (decimal 255)	10.0.255.255	UNIX Operating System Standard (RFC-919)

The addresses shown in the previous table are for a class B network, and are shown as examples only; your values will be different. If you are on a network that does not contain any machines running 4.2BSD systems or earlier BSD versions, choose all ones. If such machines exist on your network, choose all zeroes.

System name

The "system name" ("host name") should be unique on the network. It can consist of lowercase letters and numbers, must begin with a letter, and should be no longer than eight characters. **mail** and other programs use the system name to identify the correct data destination. Some sample valid machine names are *scosysv*, *tcpdev*, and *account1*.

Domain name

The MMDF mail router uses the "domain name" to route messages, such as mail, from machine to machine. The domain name allows your network to fit into a hierarchical network structure. Some common domains at the top of this hierarchy include:

.com	commercial organizations
.edu	educational institutions
.gov	government institutions
.mil	military institutions
.org	miscellaneous organizations

Sample domain names are *sco.com* (the domain name used by SCO) and *berkeley.edu* (the domain name used by the University of California at Berkeley).

Base your domain name choice on:

- If other machines on your network already use a domain name, use the same name for the machine you are installing.
- If you are creating a new domain and want to use BIND to connect to the outside world, you must register the name with the appropriate network (Internet, CSNET, or BITNET). To register a domain name, write to:

  DDN Network Information Center
  Suite 200
  14200 Park Meadow Drive
  Chantilly, VA 22021

- If you are creating a new domain and might or might not eventually connect to an outside network, use the name ***name*.UUCP**, where name is the name of your company or organization.
- If you will never attach to a network outside your company, choose ***company*.com**, replacing ***company*** with your company name.

TCP/IP connections

This TCP/IP configuration parameter sets the maximum number of "TCP/IP connections".

Gateway status

A machine that has interfaces (adapters or serial lines) to more than one network may operate as a "gateway" between networks by forwarding and redirecting packets from one network to another.

When you configure a second adapter under TCP/IP, you are prompted to turn on this gateway behavior or leave your machine in the default, non-gateway mode. If you do not make your machine into a gateway, it will continue to receive packets on each network at the specified IP addresses, but will not forward packets between networks.

See also:

- Chapter 5, "Configuring Internet Protocol (IP) routing" in the *Networking Guide*

Administrator for this system

This optional item lists the name of the network administrator. The information is used by those who need to know who to contact in case of SNMP problems and is stored in the */etc/snmpd.conf* file.

Location of this system

This optional item lists the system location. The information is used by those who need to know who to contact in case of SNMP network problems and is stored in the */etc/snmpd.conf* file.

Token-Ring Frame format

If your network adapter is a token ring card, then the default frame format is 802.n; otherwise it is Ethernet-II. During card reconfiguration, this setting defaults to the previously configured value. The choices for any card are either 802.n framing or Ethernet-II framing.

If you are connecting to any network running LLI Release 3.0 or older, then only Ethernet-II framing can be used. 802.n framing is only allowed for SCO OpenServer network adapters. For more information on frame formats, see "Framing type" (page 519).

IPX/SPX configuration parameters

IPX/SPX configuration parameters include these basic options:

- "NVT logins" (this page)
- "Internal network number" (this page)
- "Network number" (page 519)
- "Framing type" (page 519)

IPX/SPX configuration advanced options include:

- "NVT login banner file" (page 522)
- "SAP reply delay" (page 522)
- "Source routing (Token-Ring framing only)" (page 522)

NVT logins

IPX/SPX allows you to set a maximum number of simultaneous NVT connections. You may want to adjust this parameter if there is an increase or decrease in the number of clients that try to access this server.

The default value is 16 and is reflected by the parameter **nvt_max_logins** in the file */etc/ipx.d/NPSConfig*.

The maximum value is hard-coded at the driver level and can be changed by manually editing the **NVT_MAX_LOGINS** parameter in the file */etc/conf/pack.d/nvt/nvt_tune.h* and relinking the kernel. See "Relinking the kernel" (page 290).

The **nvt_max_logins** parameter must be set to a value less than or equal to **NVT_MAX_LOGINS**. For more information, see *NPSConfig*(SFF) and *nvt_tune.h*(SFF).

Internal network number

The "internal network number" must be unique for every machine on all network segments; it also must not conflict with any network segment's network number. This number is entered in hexadecimal format. You may want to change this parameter if conflicts develop as new servers are added to the network or numbering conventions change.

Network number

The "network number", entered in hexadecimal format, is a unique number identifying a single LAN segment; every node on the same LAN segment must have the same network number. If the SCO system is acting as a router, that is, it is connected to more than one network segment, each connected network segment must be assigned the correct unique network number. You may want to change this parameter if there is a conflict between network numbers or if the numbering conventions change.

Framing type

IPX/SPX allows you to set the type of "framing" performed by the network adapter driver. You may want to change this parameter if you reconfigure a network segment to use a different framing type.

The framing types supported by IPX/SPX are described in:

- "802.3 with 802.2 headers" (this page)
- "802.3" (page 520)
- "Ethernet II" (page 520)
- "Ethernet SNAP" (page 520)
- "Token-Ring" (page 521)
- "Token-Ring SNAP" (page 521)

802.3 with 802.2 headers

The Ethernet 802.3 with 802.2 headers framing type conforms to the IEEE 802.3 and IEEE 802.2 standards. This framing type is the default Ethernet framing type in most Novell® NetWare networks.

The main feature of this framing type is the SAP (Service Advertising Protocol) fields, which indicate the protocol type. For Novell networks, these fields are set to 0xe0, which indicates that the upper layer protocol is IPX. Ethernet 802.3 with 802.2 header frames have this format:

Table A-5 802.3 with 802.2 headers

Header	Field	Size
802.3	destination address	6 octets
802.3	source address	6 octets
802.3	length	2 octets
802.2	destination SAP	1 octet
802.2	source SAP	1 octet
802.2	control	1 octet
	data	...

802.3

The Ethernet 802.3 framing type is commonly used in Novell networks, particularly with native NetWare 2.x and 3.x servers. This framing type was developed by Novell before the IEEE 802.2 standard was complete and is sometimes referred to as "802.3 raw".

The main feature of the Ethernet 802.3 framing type is the use of the hard-coded 0xffff value in the frame header. Ethernet 802.3 frames have this format:

Table A-6 802.3

Header	Field	Size
802.3	destination address	6 octets
802.3	source address 6 octets	
802.3	length	2 octets
802.3	0xffff	2 octets
	data	...

Ethernet II

The Ethernet II framing type is sometimes referred to as the "XEROX PARC version of Ethernet".

The main feature of this framing type is its simple frame structure. Ethernet II frames have this format:

Table A-7 Ethernet II

Header	Field	Size
Ethernet II	address	6 octets
Ethernet II	source address	6 octets
Ethernet II	type	2 octets
	data	...

Ethernet SNAP

Ethernet SNAP framing allows network protocol stacks to use Ethernet II frames on IEEE style networks without modification. SNAP framing is most commonly used for Token-Ring networks.

The main feature of this framing type is the use of three protocol headers: IEEE 802.3, IEEE 802.2, and SNAP. Ethernet SNAP frames have this format:

Table A-8 Ethernet SNAP

Header	Field	Size
802.3	destination address	6 octets
802.3	source address	6 octets
802.3	length	2 octets
802.2	0xaa	1 octet
802.2	0xaa	1 octet
802.2	UI	1 octet
SNAP	protocol ID	1 octet
SNAP	type	1 octet
	data	...

Token-Ring

The Token-Ring framing type conforms to the IEEE 802.5 and IEEE 802.2 standards.

The main feature of this framing type is the SAP (Service Advertising Protocol) fields, which indicate the protocol type. For Novell networks, these fields are set to 0xe0, which indicates that the upper layer protocol is IPX. Token-Ring frames have this format:

Table A-9 Token-Ring

Header	Field	Size
802.5	AC	1 octet
802.5	FC	1 octet
802.5	destination address	6 octets
802.5	source address	6 octets
802.5	routing information	0-18 octets
802.2	destination SAP	1 octet
802.2	source SAP	1 octet
802.2	control	1 octet
	data	...

Token-Ring SNAP

Token-Ring SNAP allows network protocol stacks to use Ethernet II frames.

The main feature of this framing type is the use of three protocol headers: IEEE 802.5, IEEE 802.2, and SNAP. Token-Ring SNAP frames have this format:

Table A-10 Token-Ring SNAP

Header	Field	Size
802.5	AC	1 octet
802.5	FC	1 octet
802.5	destination address	6 octets
802.5	source address	6 octets
802.5	routing information	0-18 octets
802.2	0xaa	1 octet
802.2	0xaa	1 octet
802.2	UI	1 octet
SNAP	protocol ID	1 octet
SNAP	type	1 octet
	data	...

NVT login banner file

IPX/SPX allows you to specify a file from which the NVT daemon prints user login banners. If no banner is desired, simply remove or move the file, or set this field to reference a non-existent file. Do not set this field to null (" ").

SAP reply delay

IPX/SPX allows you to set the delay period that SAPD (Service Advertising Protocol Daemon) should wait before responding to a Nearest Server Request. This allows some control over the order in which servers will respond to Nearest Server Requests. Servers that should be used first for efficiency reasons should be set low. For example, on a network with native NetWare servers, it might be desirable to set the SAP reply delay high on all SCO servers to ensure that the native servers always reply first when there are duplicate services offered on both the SCO host and the native NetWare server. (If there are no duplicate services, a low value should be used on all servers to ensure rapid replies.)

The default value is 1, indicating a minimal delay. The maximum value for this parameter is 300. For more information, see *NPSConfig*(SFF).

Source routing (Token-Ring framing only)

If you selected Token-Ring as your framing type, you can enable IPX/SPX to pass source routing information to your adapter driver. See "Source routing" (page 510) concerning source routing options for your adapter. The **Network Configuration Manager** enables Token-Ring source routing by default.

NetBIOS configuration parameters

TPI (Transport Provider Interface) NetBIOS for TCP/IP configuration is required when running LAN Manager over the TCP/IP protocol stack.

Basic NetBIOS configuration parameters include:

NetBIOS host name
The system name (host name) should be unique on the network. It can consist of lowercase letters and numbers, must begin with a letter, and should be no longer than eight characters. It must be same as the TCP/IP system name (page 515). Here are some sample valid system names: *scosysv*, *srv555b*, and *account1*. The "values" of the other two NetBIOS basic parameters are dependent on the "value" of this parameter. The default is the output of **uname -n**.

NetBIOS IP address
The NetBIOS IP address identifies and differentiates your machine from all others on the network. It consists of a 32-bit binary number that is usually displayed as four octets expressed in decimal and separated by periods (for example, 10.0.65.75). Each machine on your network must have a unique NetBIOS IP address that is the same as the IP address assigned for TCP/IP (page 513).

NetBIOS broadcast address
All datagrams sent by NetBIOS move through all machines in the network path. However, each host adapter ignores any packet that does not include that particular computer's IP address in the datagram header. Occasionally, you might want to send a message to all machines on a particular network. To do so, select a "broadcast address" either of all 0's or all 255's. It must be same as the TCP/IP Broadcast address (page 515).

NetBIOS scope identifier
The NetBIOS scope identifier sets the NetBIOS domain. Only users with equivalent scope identifiers can communicate with each other. It is similar to the TCP/IP domain name (page 516) (for example *sco.com* or *lachman.com*).

Advanced NetBIOS configuration parameters are LAN Manager related "per-user sessions" parameters. If any of the LAN Manager parameters are increased, the corresponding TCP/IP NetBIOS related parameter should also be increased.

Default pending commands per user
The default number of maximum active commands per user.

Default sessions per user
The default number of NetBIOS sessions per user.

Maximum names per user
The maximum number of NetBIOS names (local/remote) per user. A user cannot register more than the maximum number of NetBIOS names on the machine.

Maximum pending commands per user
The maximum number of commands a user can have pending. This is used by **nbstatus** to display the maximum number of active/pending commands a user can set.

Maximum sessions per user
The maximum number of NetBIOS sessions a user may set. This is used by **nbstatus** to display the maximum number of configured sessions a user can set.

Maximum IP datagram size
The maximum IP datagram size before fragmentation can take place. If any datagram is larger than the size set, the packet is fragmented.

LAN Manager Client configuration parameters

The LAN Manager Client configuration parameter is:

Number of transport connections
This sets the maximum number of concurrent sessions that the transport provider will support (default value is 64). The value you enter can be obtained from the documentation for the transport provider.

Appendix B
SCSI host adapters

See *SCO OpenServer Features and Limitations* for information about supported mass storage devices.

Appendix C

Serial adapters

This appendix contains information on serial adapters that have known problems when used with the SCO OpenServer system. Adapters that are specific to a particular architecture are so labelled.

AMI lamb serial adapter

Only continuous mode is supported.

Arnet serial adapter (MCA)

You must use the reference disk to modify the Optional I/O Address Block to be 0180-018F hexadecimal.

AST serial adapter

Only enhanced mode is supported. Do not use the AST driver.

CTC Versanet serial adapter

The correct switch settings for the 8AT and 4AT are:

- As a COM1 (strapped at addr 0x160, using IRQ4) the 8AT has:
  - switches 33, 35, 36, 38, 39 & 40 OFF
  - switches 34, 37 ON (that is, shunted)

  on the DIP switch selection:
  - 5, 6 & 8 should be OFF
  - all the others should be ON

- As a COM2 (strapped at addr 0x218, using IRQ3) the 8AT has:
  - switches 33, 35-40 OFF
  - switch 34 ON (that is, shunted)

  on the DIP switch selection:
  - 1, 2 & 7 should be OFF
  - all the others should be ON

The 4AT is the same as the 8AT in both the above cases, with the following common exception: switches 39 & 40 *must* be ON (shunted). These adapters come in both 8250 and 16450 versions. You must have the 16450 version.

The original CTC Versanet adapters used different addresses. Please ask your hardware vendor for Versanet adapters strapping at the above addresses (0x160 and 0x218).

The CTC "Maomao-4" serial adapter is not supported.

Digiboard serial adapter

Ports for switches DS2 to DS5 (DS9 for 8 port version) must be strapped starting at the adapter's base address as given in the table and incrementing by 8 for each port.

The following example is for COM1 at 110:

DS2	110
DS3	118
DS4	120
DS5	128
DS6	130
DS7	138
DS8	140
DS9	148
DS1	150

If COM1 is used, then all the ports must be strapped as "EVEN" to interrupt request line 4 (see Digiboard documentation). If COM2 is used, then all the ports must be strapped as "ODD" to interrupt request line 3 (same notation). Only revision C and later adapters are supported.

Olivetti RS232C multiport adapter

The factory settings do not function properly. You must alter the existing switch positions to reflect those listed below.

If you are using a single Olivetti adapter, you must configure it as COM2.

If you are using two Olivetti adapters, one must be configured as COM2 and the other configured as COM1, with the COM1 port built into the M380 disabled. To disable the COM1 port built into the M380, refer to the section on "Setting Up the System" in your Olivetti *Installation and Operations Guide.*

The correct switch settings are:

- As a COM1 (strapped at addr 0x2A0):

IRQ2	IRQ3	IRQ4	IRQ5	IRQ6	IRQ7	XA1	XA0	INT	SHR
off	off	on	off	off	off	off	on	on	off

- As a COM2 (strapped at addr 0x1A0):

IRQ2	IRQ3	IRQ4	IRQ5	IRQ6	IRQ7	XA1	XA0	INT	SHR
off	on	off	off	off	off	off	off	on	off

Ref data

Quadram serial adapter

The following Quadram serial expansion adapters can be used in these configurations with the SCO OpenServer system:

COM1	COM2
5-port	-
1-port	-
-	5-port
-	1-port
5-port	1-port

Stargate serial adapters on the Apricot Qi (MCA)

On the Apricot Qi, the Stargate serial adapter card clashes with the Ethernet Controller start address. To resolve the problem, use the reference disk to modify the Ethernet Controller start address. Choose the menu options in the following sequence: **Configuration ⇨ Change ⇨ Internal Ethernet Controller ⇨ Port Address ⇨ Alternate #7**

Tandon serial adapter

Tandon is the only adapter whose I/O addresses are potentially identical to those of other supported adapters, such as the AST and Quadram serial adapters.

Because adapter addresses must not overlap in the same systems, if you have both a Tandon and a Quadram, COM1 and the Quadram must be on COM2.

Appendix D

Mice and bitpads

This appendix contains information on mice and other graphic input devices. You should read the appropriate section if you have one of the devices listed.

NOTE In all cases, except for the Microsoft bus mouse, use interrupt 25 in the software if you have set the interrupt jumper to interrupt 2.

Logitech bus mouse

Set the jumpers as follows:

- Set JMP1 to any interrupt that is not being used.
- Set JMP2 to jumper 1 for 30Hz, as 60Hz is used for DOS.

Microsoft bus mouse

Set the jumpers as follows:

- Set JMP2 and JMP3 to the proper settings listed in your manual.
- Set JMP4 to either interrupt 3, 4, or 5. Do not use the setting for interrupt 2.

Olivetti bus mouse

Set the jumper settings according to your manual.

Logitech serial mice

There are two types of Logitech mouse, those that are Microsoft compatible and those that are proprietary. If the Logitech mouse you are installing is a Microsoft-compatible one, use the Logitech Mouseman driver rather than the Logitech serial mouse driver which supports the proprietary models.

Appendix E

Modems

This appendix contains information on known issues with different makes of modem. You should read the appropriate section if you have one of the modems listed.

Smartmodem 1200 or compatible

If you have a Hayes Smartmodem 1200 or compatible, switches 3 and 8 should be down:

	1	2	3	4	5	6	7	8
up	•	•		•	•	•	•	
down			•					•

When switch 3 is down, the result codes are sent by the modem to the terminal or computer. When switch 8 is down, the modem can interpret the command being issued. This allows both MS-DOS and UNIX system communications systems to work.

Table E-1, "Hayes-compatible switch settings" (page 534) lists the function of each switch setting.

Table E-1 Hayes-compatible switch settings

Switch	Position	Function
1	up*	Modem responds to DTR from computer
	down	Modem forces DTR high, so no signal is required from computer
2	up*	Result codes are in English
	down	Result codes are numeric
3	up	There are no result codes
	down*	Result codes are sent in response to each modem command
4	up*	Commands are echoed
	down	Commands are not echoed
5	up*	Modem answers phone
	down	Modem does not answer phone
6	up*	CD is asserted when carrier is actually present
	down	CD and DSR are forced high
7	up*	Modem is attached to single-line phone
	down	Modem is attached to multi-line phone
8	up	Modem does not recognize dialing commands
	down*	Modem recognizes dialing commands

The asterisks (*) indicate the switch settings required. If you have a different modem, consult your reference manual for the proper switch settings to both send and receive calls.

Smartmodem 2400, V-series 9600 or compatible

The Hayes 2400 and V-series 9600 Smartmodem or compatible modems are supported and are configured automatically when you use the dialer entries or dialer programs supplied with the SCO OpenServer distribution. If you are using an unsupported dialer (one brought from elsewhere or written yourself), and you plan to use it for a dial-in line, be sure that you use the following settings:

AT&f	fetches factory configuration
ATT	is tone dialing
ATl0	is low speaker volume
AT&d2	sets dtr "2": goes on hook when dtr drops
AT&c1	sets dcd "1": dcd tracks remote carrier
ATs0=1	answers phone after one ring (AA light should come on)
ATs2=128	disables modem escape sequence

ATe0 does not echo (modem no longer echoes what is sent to it)

ATq1 is quiet mode (modem does not respond with "OK" after this command or any that follow)

AT&w saves settings in non-volatile memory. If you do not want to save the settings, you do not have to enter this command.

Telebit Trailblazer

If you have a Telebit Trailblazer modem or compatible, log in as *root* and enter the following command:

/usr/lib/uucp/dialTBIT -z /dev/tty*nn* 9600

where ***nn*** is the tty number of the serial line.

Appendix F

Network adapters

See *SCO OpenServer Features and Limitations* for information about supported hardware.

Appendix G

Kernel initialization check letters

Each time the kernel starts, it checks the hardware that it expects to find in the system, initializes various kernel tables, mounts the root filesystem, opens the swap device, and prints configuration information. At each stage of checking, the kernel displays a letter (plus a message if the stage is subdivided). The process normally pauses for a while at certain letters if lengthy checks or initialization are involved. However, if the process stops and does not continue at a particular letter, this usually indicates a problem with the initialization of the corresponding device driver.

The following list describes the meanings of the kernel startup letters:

D Check for 10 bits of I/O decoding by writing to and reading from the direct memory access (DMA) controller channel 0 page table address register (I/O port 0x87).

Perform machine-specific initializations. If the initialization stops here, there is a hardware problem. This may be resolved by running hardware tests available on reference or setup floppy disks from the hardware manufacturer.

E Print configuration information for the numeric coprocessor (80287, 80387, 80487SX, Weitek, or built-in), if any. Also perform machine-specific multiprocessor memory initialization.

If a coprocessor is present but not recognized, confirm that it is properly connected and that your hardware recognizes it. Refer to your floating point processor documentation for available tests.

F Initialize pseudo-devices and I/O devices by calling their corresponding driver initialization functions.

If a failure occurs at this stage, check the relevant devices to see if they are incorrectly configured or non-functioning. Refer to the documentation for the relevant hardware for more information.

The format of the startup "F" messages is:

Message	Description
***driver*init**	Initialize configured ***driver***
BTLD init	Initialize boot-time loadable driver
***driver*init2**	Link SCSI peripheral ***driver*** to SCSI host adapter

G Initialize the Programmable Interrupt Controller (PIC) chips and multiprocessors, configure root disk driver, and reset keyboard.

H Initialize various system resources:

Message	Description
oeminit	OEM-specific features
cinit	character lists (clists)
inoinit	inodes
fsinit	filesystems
fstyp init	filesystem of type ***fstyp***
finit	file table
strinit	STREAMS
ksl init	kernel STREAMS linker (**ksl_start**)
iinit	open root device, load superblock into memory and mount the root filesystem. If the root device is a hard disk, display configuration message. If the system hangs here, suspect a damaged, missing, or incorrectly configured root device. Also reset system clock from hardware clock.
flckinit	file locking
seminit	IPC semaphores
msginit	IPC messages
xsdinit	XENIX shared data
xseminit	XENIX semaphores
cfgmsginit	print configuration error messages if too many groups or open files are defined. Print a warning message if too many memory ranges were specified at boot time.

I Print any machine-specific information, invoke the driver start routine for certain devices, and print total kernel memory and user memory.

The format of the startup "I" messages is:

Message	Description
*driver*start	Start ***driver***
BTLD start	Start boot-time loadable driver

J Initialize floating point emulator.

K Open the swap device, add it to the swap file table, and print information about it.

M Initialize machine-specific memory ECC support.

Print information on root, pipe, dump devices, clock interrupt rate (HZ), kernel I/O buffers, and additional CPUs found.

Ref data

Appendix H

vi command summary

The following tables contain all the basic **vi** commands.

Starting vi

Command	Description
vi *file*	start at line 1 of ***file***
vi +n *file*	start at line ***n*** of ***file***
vi + *file*	start at last line of ***file***
vi +/*pattern* *file*	start at ***pattern*** in ***file***
vi -r *file*	recover ***file*** after a system crash

Saving files and quitting vi

Command	Description
:e *file*	edit ***file*** (save current file with **:w** first)
:w	save (write out) the file being edited
:w *file*	save as ***file***
:w! *file*	save as an existing ***file***
:q	quit vi
:wq	save the file and quit **vi**
:x	save the file if it has changed and quit **vi**
:q!	quit **vi** without saving changes

Moving the cursor

Keys pressed	Effect
h	left one character
l or ⟨Space⟩	right one character
k	up one line
j or ⟨Enter⟩	down one line
b	left one word
w	right one word
(	start of sentence
)	end of sentence
{	start of paragraph
}	end of paragraph
1G	top of file
***n*G**	line ***n***
G	end of file
⟨Ctrl⟩W	first character of insertion
⟨Ctrl⟩U	up ½ screen
⟨Ctrl⟩D	down ½ screen
⟨Ctrl⟩B	up one screen
⟨Ctrl⟩F	down one screen

Inserting text

Keys pressed	Text inserted
a	after the cursor
A	after last character on the line
i	before the cursor
I	before first character on the line
o	open line below current line
O	open line above current line

Changing and replacing text

Keys pressed	Text changed or replaced
cw	word
3cw	three words
cc	current line
5cc	five lines
r	current character only
R	current character and those to its right
s	current character
S	current line
~	switch between lowercase and uppercase

Deleting text

Keys pressed	Text deleted
x	character under cursor
12x	12 characters
X	character to left of cursor
dw	word
3dw	three words
d0	to beginning of line
d$	to end of line
dd	current line
5dd	five lines
d{	to beginning of paragraph
d}	to end of paragraph
:1,. d	to beginning of file
:.,$ d	to end of file
:1,$ d	whole file

Using markers and buffers

Command	Description
mf	set marker named " f "
`f	go to marker " f "
´f	go to start of line containing marker " f "
"s12yy	copy 12 lines into buffer " s "
"ty}	copy text from cursor to end of paragraph into buffer " t "
"ly1G	copy text from cursor to top of file into buffer " l "
"kd`f	cut text from cursor up to marker " f " into buffer " k "
"kp	paste buffer " k " into text

Ref data

Searching for text

Search	Finds
/and	next occurrence of "and", for example, "and", "stand", "grand"
?and	previous occurrence of "and"
/^The	next line that starts with "The", for example, "The", "Then", "There"
/^The\>	next line that starts with the word "The"
/end$	next line that ends with "end"
/[bB]ox	next occurrence of "box" or "Box"
n	repeat the most recent search, in the same direction
N	repeat the most recent search, in the opposite direction

Searching for and replacing text

Command	Description
:s/pear/peach/g	replace all occurrences of "pear" with "peach" on current line
:/orange/s//lemon/g	change all occurrences of "orange" into "lemon" on next line containing "orange"
:.,$/\<file/directory/g	replace all words starting with "file" by "directory" on every line from current line onward, for example, "filename" becomes "directoryname"
:g/one/s//1/g	replace every occurrence of "one" with 1, for example, "oneself" becomes "1self", "someone" becomes "some1"

Matching patterns of text

Expression	Matches
.	any single character
*	zero or more of the previous expression
.*	zero or more arbitrary characters
\<	beginning of a word
\>	end of a word
\	quote a special character
*	the character " * "
^	beginning of a line
$	end of a line
[*set*]	one character from a set of characters
[XYZ]	one of the characters " X ", " Y ", or " Z "
[[:upper:]][[:lower:]]*	one uppercase character followed by any number of lowercase characters
[^*set*]	one character not from a set of characters
[^XYZ[:digit:]]	any character except " X ", " Y ", " Z ", or a numeric digit

Options to the :set command

Option	Effect
all	list settings of all options
ignorecase	ignore case in searches
list	display ⟨Tab⟩ and end-of-line characters
mesg	display messages sent to your terminal
nowrapscan	prevent searches from wrapping round the end or beginning of a file
number	display line numbers
report=5	warn if five or more lines are changed by command
term=ansi	set terminal type to "ansi"
terse	shorten error messages
warn	display "[No write since last change]" on shell escape if file has not been saved

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