Solaris™ 8 Operating Environment System Administration II

SA-288

Student Guide

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Revision A.1, September 2000

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Contents

About This Course

Course Goal

The *Solaris™ 8 Operating Environment System Administrator II* course provides students with the skills necessary to administer Sun™ workstations running the Solaris™ 8 Operating Environment in a network environment.

This course describes how to install and maintain Sun systems, configure and troubleshoot the network file system (NFS) environment, and configure the network information service (NIS) environment.

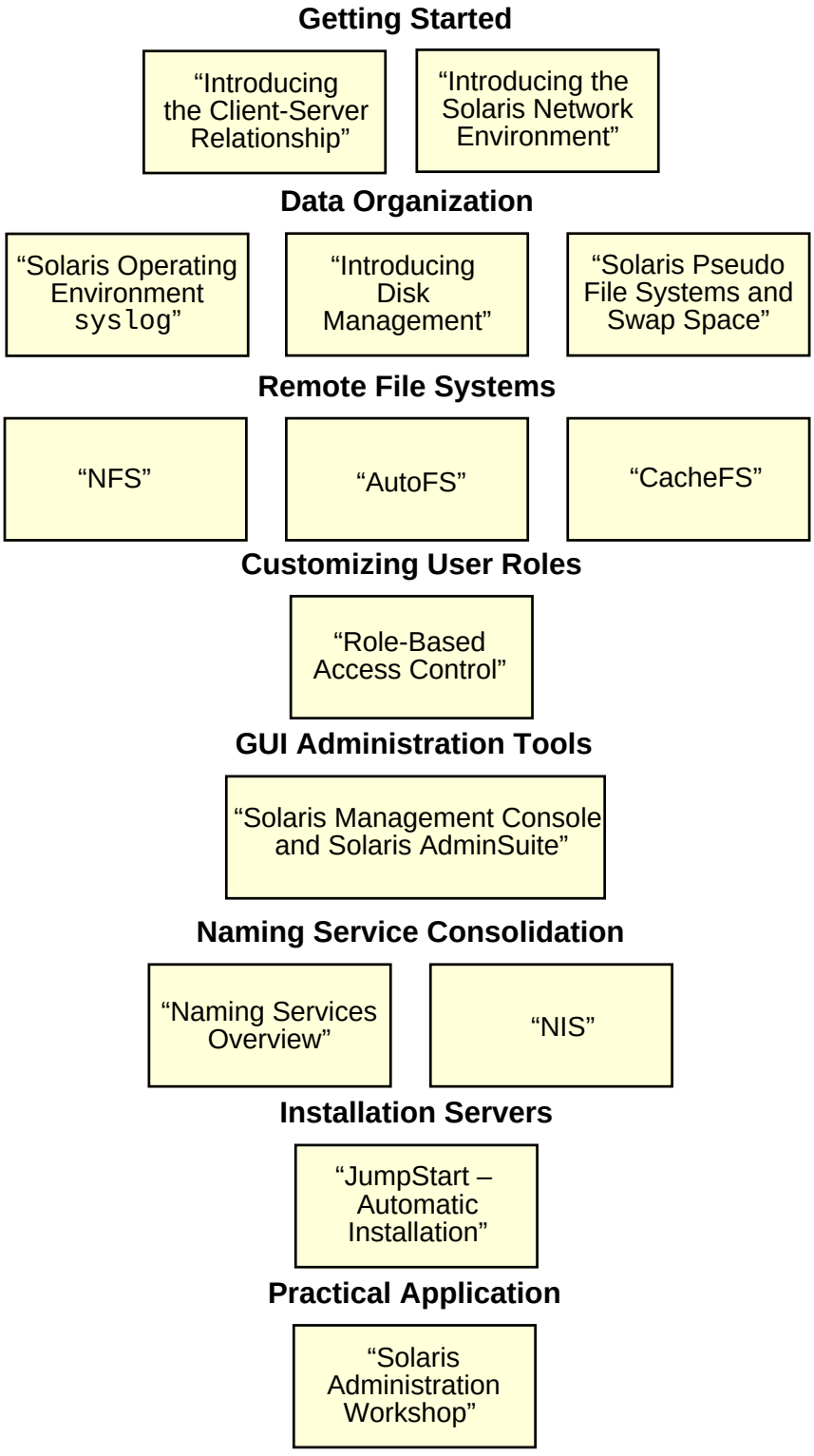
Course Overview

The course is for technical and application support staff who administer a network server running the Solaris Operating Environment. You will learn fundamental network administration skills, including how to:

- Control system logging activity
- Manage virtual disk
- Configure the NFS environment
- Automount file systems on demand
- Administer the NIS
- Create system administrator role-based access permissions
- Use the JumpStart™ program within a subnetwork

Course Map

The following course map enables you to see what you have accomplished and where you are going in reference to the course goal.



Module-by-Module Overview

This course contains the following modules:

- Module 1 – "Introducing the Client-Server Relationship"

  This module introduces the client-server computing model within the Solaris Operating Environment.

  Lab exercise – There is no lab exercise planned for this module.

- Module 2 – "Introducing the Solaris Network Environment"

  This module uses the standard network models to describe the configuration of interfaces and services in the Solaris Operating Environment.

  Lab exercise – There is no lab exercise for this module.

- Module 3 – "Solaris Operating Environment `syslog`"

  This module focuses on the use of the `syslog` utility to manipulate message logs.

  Lab exercise – In this lab, you configure and use the `syslog` utility to better monitor your system

- Module 4 – "Introducing Disk Management"

  This module provides an introduction to disk management, redundant array of inexpensive disks (RAID) concepts, and the Solstice DiskSuite™ graphical user interface (GUI). You use the tools and concepts learned in this module to grow file systems.

  Lab exercise – In this lab, you install the necessary tools and perform a `growfs` operation on a file system that is nearing capacity.

- Module 5 – "Solaris Pseudo File Systems and Swap Space"

  This module describes pseudo file systems and swap space.

  Lab exercise – In this lab, you manipulate swap space, such as adding (and removing) a swap file, adding a swap slice, and adding permanent swap files to the `/etc/vfstab` file.

- Module 6 – "NFS"

  This module addresses networked file systems, the relationship between the NFS server and the NFS client, and the commands that share these file systems.

  Lab exercise – In this lab, you configure an NFS server and client to share and mount `/usr/share/man`.

- Module 7 – "AutoFS"

  This module provides information on the benefits of using `automount`, the purpose of each type of automount map, and describes how and when to start and stop the `automount` daemon.

  Lab exercise – In this lab, you use the automounter processes to automatically mount manual pages and a user's home directory.

- Module 8 – "CacheFS"

  This module describes the need for cached file systems, how to properly configure `cacheFS`, how to set up `cacheFS` logging, and how to dismantle and delete a `cacheFS` file system.

  Lab exercise – In this lab, you mount `/usr/share/man` to a `cacheFS` file system.

- Module 9 – "Role-Based Access Control"

  This module configures a user's execution profile to allow access to a specified subset of system administrator privileges.

  Lab exercise – In this lab, you create an execute attribute, a role-based profile, a role identity, and a login identity that can use the role.

- Module 10 – "Solaris Management Console™ and Solaris AdminSuite"

  This module focuses on the benefits and features of the Solaris Management Console graphical user interface (GUI) and one subordinate GUI, Solaris AdminSuite.

  Lab exercise – In this lab, you use a guided-practice to use the GUI features.

- Module 11 – "Naming Services Overview"

  This module describes the name service concept, lists the name services available, compares name services functionality, describes the name service switch process, and describes how to determine the configuration that is appropriate for your network.

  Lab exercise – There is no lab exercise for this module. Instead, there is a short comprehension check in the form of a question-and-answer exercise.

- Module 12 – "NIS"

  This module describes the NIS components, master server, slave server, and client, and the NIS processes. In addition, this module describes how to configure an NIS master, slave, and client, and the steps necessary to add a new NIS map, update maps, and propagate changes to NIS maps.

  Lab exercise – In this lab, you configure a NIS master server and one NIS client.

- Module 13 – "JumpStart™ Automatic Installation"

  This module describes the JumpStart program. This includes a description, configuration information, and usage of the program. Causes of many common error messages are defined, and possible solutions are offered.

  Lab exercise – In this lab, you configure a JumpStart server to support an installed client.

- Module 14 — "Solaris Administrator Workshop"

  This module offers a comprehensive, hands-on lab workshop reviewing the major course material covered in earlier modules. This module consists only of lab exercises.

Course Objectives

Upon completion of this course, you should be able to:

- Define client-server functionality within the Solaris 8 Operating Environment
- Describe the functional characteristics of each layer in the seven-layer Open Systems Interconnect (OSI) network model and the five-layer Transmission Control Protocol/Internet Protocol (TCP/IP) network model
- Identify and describe the files and commands that control and monitor access to various machines in a network environment
- Set up event logging
- Administer disks using a volume management utility
- Redirect all core dumps to a single `coredump` directory
- Configure NFS to support the client-server environment
- Use the automounter
- Set up and configure `cacheFS` file systems
- Use Solaris AdminSuite to perform user, group, and serial port management duties
- Describe the various naming services: Domain Name System (DNS), Network Information System (NIS), Network Information System Plus (NIS+), and Lightweight Directory Access Protocol (LDAP)
- Configure and administer the NIS environment
- Set up a role-based system administration account
- Install and configure the Solaris Management Console GUI
- Use JumpStart to automate the Solaris Operating Environment installation

Skills Gained by Module

The skills for *Solaris 8 Operating Environment System Administration II* are shown in the first column of the following matrix. The black boxes indicate the main coverage for a topic; the gray boxes indicate the topic is briefly discussed.

Skills Gained	Module 1	2	3	4	5	6	7	8	9	10	11	12	13
Define client-server functionality within the Solaris 8 Operating Environment	■	▒			▒	▒	▒	▒		▒			▒
Describe the functional characteristics between each layer in the seven-layer OSI network model and the five-layer TCP/IP network model		■			▒	▒	▒	▒					
Identify and describe the files and commands that control and monitor access to various machines in a network environment		■			▒	▒	▒	▒	▒	▒	▒		
Set up event logging			■										
Administer disks using a volume-management utility				■									
Redirect all core dumps to a single coredump directory					■								
Configure NFS to support the client-server environment						■	▒	▒	▒				
Use the automounter							■						
Set up and configure CasheFS file systems								■					
Use Solaris AdminSuite to perform user, group, and serial port management duties												■	
Describe the various naming services: DNS, NIS, NIS+, and LDAP									■	▒			
Configure and administer the NIS environment									▒	■			
Set up a role-based system administration account											■		

Skills Gained	Module												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Install and configure the Solaris Management Console GUI												■	
Use JumpStart to automate the Solaris Operating Environment installation													■

Guidelines for Module Pacing

The following table provides a rough estimate of pacing for this course:

Module	Day 1	Day 2	Day 3	Day 4	Day 5
"About This Course"	A.M.				
"Introducing the Client-Server Relationship"	A.M.				
"Introducing the Solaris Network Environment"	A.M. /P.M.				
"Solaris Operating Environment `syslog`"	P.M.				
"Introducing Disk Management"		A.M.			
"Solaris Pseudo File Systems and Swap Space"		A.M. /P.M.			
"NFS"		P.M.			
"AutoFS"			A.M.		
"CacheFS"			A.M.		
"Role-Based Access Control"				P.M.	
"Solaris Management Console and Solaris AdminSuite"				A.M.	
"Naming Services Overview"			A.M.		
"NIS"			A.M. /P.M.		
"JumpStart – Automatic Installation"				A.M. /P.M.	
"Solaris Administration Workshop"				P.M.	A.M. /P.M.

Topics Not Covered

This course does not cover the topics shown below. Many of the topics mentioned here are covered in other courses offered by Sun Educational Services:

- Basic UNIX commands – Covered in SA-118: *Fundamentals of Solaris 8 for System Administrators*
- `vi` editor – Covered in SA-118: *Fundamentals of Solaris 8 for System Administrators*
- Basic UNIX file security – Covered in SA-118: *Fundamentals of Solaris 8 for System Administrators*
- Software package administration – Covered in SA-238: *Solaris 8 Operating Environment System Administration I*
- Patch maintenance – Covered in SA-238: *Solaris 8 Operating Environment System Administration I*
- Addition of users using Admintool – Covered in SA-238: *Solaris 8 Operating Environment System Administration I*
- Basic system security – Covered in SA-238: *Solaris 8 Operating Environment System Administration I*
- Administration of initialization files – Covered in SA-238: *Solaris 8 Operating Environment System Administration I*
- Advanced file permissions – Covered in SA-238: *Solaris 8 Operating Environment System Administration I*
- Backup and recovery – Covered in SA-238: *Solaris 8 Operating Environment System Administration I*
- The `lp` print service and print commands – Covered in SA-238: *Solaris 8 Operating Environment System Administration I*
- Process control – Covered in SA-238: *Solaris 8 Operating Environment System Administration I*
- Hardware or software troubleshooting – Covered in ST-350: *Sun Systems Fault Analysis Workshop*
- System tuning – Covered in SA-400: *Enterprise System Performance Management*

- Detailed Shell Programming – Covered in SA-225: *Advanced UNIX® Utilities and Shell Programming for Administrators*
- Detailed network administration concepts – Covered in SA-389: *Solaris™ TCP/IP Network Administration*

Refer to the Sun Educational Services catalog for specific information on course content and registration.

How Prepared Are You?

To be sure you are prepared to take this course, can you perform the activities that are listed below?

- Install and boot the Solaris 8 Operating Environment on a standalone workstation
- Implement basic system security
- Add users to the system using Admintool
- Use the `pkgadd` command to add software packages
- Set file permissions using access control lists (ACLs)
- Monitor and mount file systems
- Manage disk devices and processes
- Perform backups and restorations

Introductions

Now that you have been introduced to the course, introduce yourself to each other and the instructor, addressing the items shown on the overhead.

How to Use the Course Materials

To enable you to succeed in this course, these course materials employ a learning model including the following components:

- **Course Map** – An overview of the course content appears in the "About This Course" module so you can see how each module fits into the overall course goal.
- **Objectives** – At the beginning of each module is a list of what you should be able to accomplish after completing the module.
- **Lecture** – The instructor presents information specific to the topic of the module. This information helps you learn the knowledge and skills necessary to succeed with the exercises.
- **Exercise** – Lab exercises give you the opportunity to practice your skills and apply the concepts presented in the lecture.
- **Check Your Progress** – Module objectives are restated, sometimes in question format, so you are sure you can accomplish the objectives of the current module before moving on in the course.

Course Icons and Typographical Conventions

The following icons and typographical conventions are used in this course to represent various training elements and alternative learning resources.

Icons

Additional resources – Indicates additional reference materials are available.

Demonstration – Indicates a demonstration of the current topic is recommended at this time.

Discussion – Indicates a small-group or class discussion on the current topic is recommended at this time.

Exercise objective – Indicates the objective for the lab exercises that follow. The exercises are appropriate for the material being discussed.

Note – This contains additional important, reinforcing, interesting, or special information.

Caution – This points out a potential hazard to data or machinery.

Warning – This warns of anything that poses personal danger or irreversible damage to data or the operating system.

Typographical Conventions

`Courier` is used for the names of commands, files, and directories, as well as on-screen computer output; for example:

Use `ls -al` to list all files.
`system% You have mail.`

`Courier bold` is used for characters and numbers you type; for example:

```
system% su
Password:
```

`Courier italic` is used for variables and command-line placeholders that are replaced with a real name or value; for example:

To delete a file, type `rm` *`filename`*.

Palatino italics is used for book titles, new words or terms, or words that are emphasized; for example:

Read Chapter 6 in *User's Guide*.
These are called *class* options.
You *must* be `root` to do this.

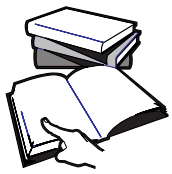
Introducing the Client-Server Relationship 1

Objectives

Upon completion of this module, you should be able to:

- Describe the network capabilities of the Solaris 8 Operating Environment in terms of a client-server relationship
- List and define at least two types of servers used in the Solaris 8 network environment
- Describe the SunRay™ Enterprise Appliance client-server relationship

Additional Resources



Additional resources – The following references provide additional details on the topics discussed in this module:

- *About Solaris 8 Documentation*, Sun Part Number 805-6333-06

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Advanced System Administrator Activities

This course prepares you to perform system administration tasks in a network desktop environment. It includes modules to:

- Introduce the Solaris network environment, which provides a basic overview of how the Open Systems Interconnect (OSI) model and the Transmission Control Protocol/Internet Protocol (TCP/IP) model apply to a network of desktop systems.
- Explain the purpose and the configuration of the `syslog` system logging utility.
- Configure a disk-management utility to create a virtual volume spanning multiple disks.
- Identify pseudo file system types, and configure a file system as a temporary storage device.
- Set up network file systems to reduce network resource requirements.
- Manipulate local cache disk devices to improve system performance.
- Configure file systems to be mounted on demand and unmounted after a predefined period of inactivity.
- Identify the naming services that are available with the Solaris 8 Operating Environment.
- Provide procedures to centrally administer repositories of administrative files.
- Create role-based execution profiles for users.
- Manipulate the Solaris AdminSuite system administrator GUI tool.
- Configure a JumpStart™ server and build boot profiles to use on the server.

The Client-Server Model for Network Workstations

A key advantage to network environments is the ability to configure applications to run using the client-server model. In today's enterprise-oriented computing environment, applications are often distributed across a network of client-server systems.

Servers

A *server* is a host or a *process* that provides services to other systems on the network. These hosts can include:

- Application servers – Provide network access to applications, such as FrameMaker, Photoshop, and Lotus Notes.
- Boot servers – Respond with boot parameters to install clients booting from the network.
- Installation servers – Enable network file system (NFS) access to release software to installing clients.
- Database servers – Offer database access through applications, such as Oracle, Sybase, and Informix.
- Mail servers – Provide inter-networking transfer of email from the local network.
- `home` directory servers – Export `home` directories (typically from `/export/home`) for user access.
- License servers – Run a license daemon that manages the use of licenses on a per-system, per-application basis.
- Print servers – Offer print services to network systems. Printers can either be locally attached or, in the case of printers with Ethernet interfaces, provide spooling services to a printer with an IP address.
- Name services server – Provide a naming service, such as DNS Domain Name System (DNS), Federated Name Service (FNS), Network Information Service (NIS), or Network Information Service Plus (NIS+).

The term *server* infers that the host offers file systems and services to other network hosts referred to as *clients*.

Clients

A *client* is a host or a *process* that uses services provided by servers. An example of a client is a host that makes use of any of the previously-mentioned servers. One example of a client is the JumpStart client. Figure 1-1 illustrates a JumpStart client-server relationship.

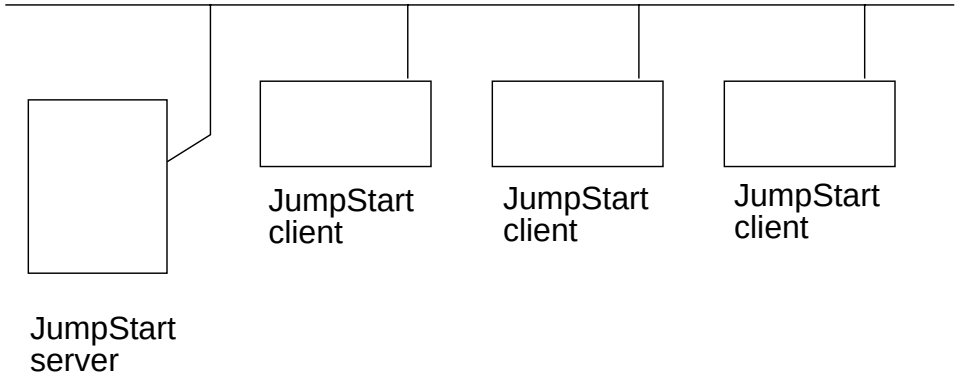


Figure 1-1 JumpStart Client-Server Configuration

You can install a JumpStart client automatically from a preconfigured JumpStart server.

Another approach to client-server architecture is demonstrated with the SunRay Enterprise Appliance. The SunRay architecture uses an approach that removes everything from the desktop except the physical components a user needs: Keyboard, mouse, display, and audio input and output.

All computing is performed on centralized, shared machines, thereby making the SunRay architecture the ultimate in thin-client technology. Everything that previously ran on the user's own desktop, such as a window system, user applications, or mail clients, now runs in a session on the server and is displayed on the SunRay Enterprise Appliance.

Figure 1-2 illustrates the relationship between the enterprise appliances (clients) and the centralized server.

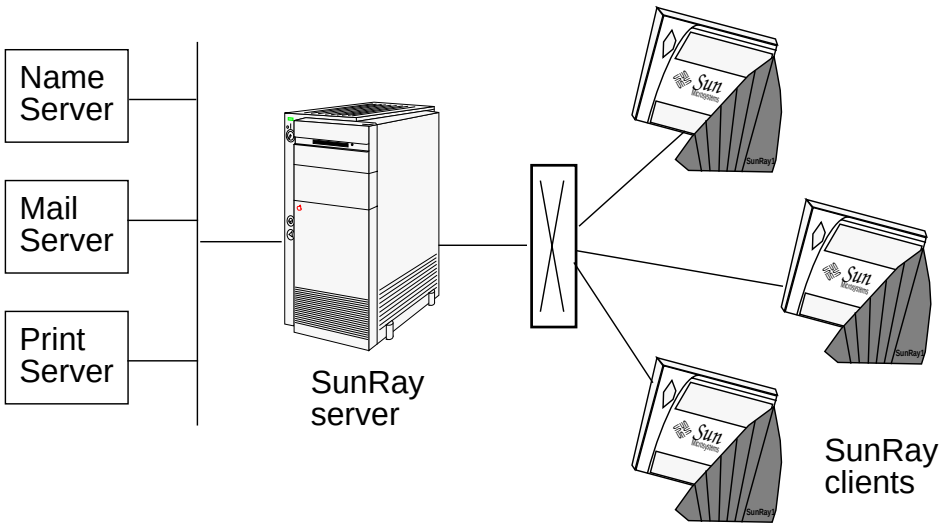


Figure 1-2 SunRay Enterprise Appliance Client-Server

Note – The SunRay Enterprise Appliances can communicate only to the SunRay server; therefore, if any of the previously-mentioned server services are provided by systems other than the SunRay server, it becomes a client system to other server systems on the network.

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- ❑ Describe the network capabilities of the Solaris 8 Operating Environment in terms of a client-server relationship
- ❑ List and define at least two types of servers used in the Solaris 8 network environment.
- ❑ Describe the SunRay Enterprise Appliance client-server relationship

Introducing the Solaris Network Environment 2

Objectives

Upon completion of this module, you should be able to:

- Define the function of each layer within the seven-layer Open Systems Interconnect (OSI) model and the five-layer Transmission Control Protocol (TCP)/Internet Protocol (IP) model
- Describe the contents of various network control files
- Construct command strings to perform basic monitoring operations on an active network
- Start and stop network services using the command line

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- *System Administration Guide, Volume 3*, Part Number 806-0916-10

Overview

The standard Solaris Operating Environment comes with the TCP/IP stack built into it. To understand the protocol stack, you must understand network models.

The most commonly referred to networking models are the seven-layered International Standards Organization (ISO)/ OSI model and the five-layered TCP/IP network model.

Both models provide a framework for describing data communications.

Note – The U.S. Department of Defense created the TCP/IP model.

This module references the TCP/IP model.

The Function of the Layers

Each layer in either of the two network models describes a specific network function. Each function supports the layer above and receives support from the layer below.

The separation of the data-communication process into distinct functions makes it easier for developers to design network components that inter-operate with each other, regardless of the vendor.

Each layer uses separate protocols, such as the IP or the TCP, to complete the required tasks for the particular layer.

The functions of data delivery and connection management are handled by separate protocols. The data delivery protocol is simple and does not deal with connection management. Conversely, the connection management protocol is also simple because it does not concern itself with data delivery.

This separation of the data delivery functions from the connection management functions helps to simplify development using these protocols.

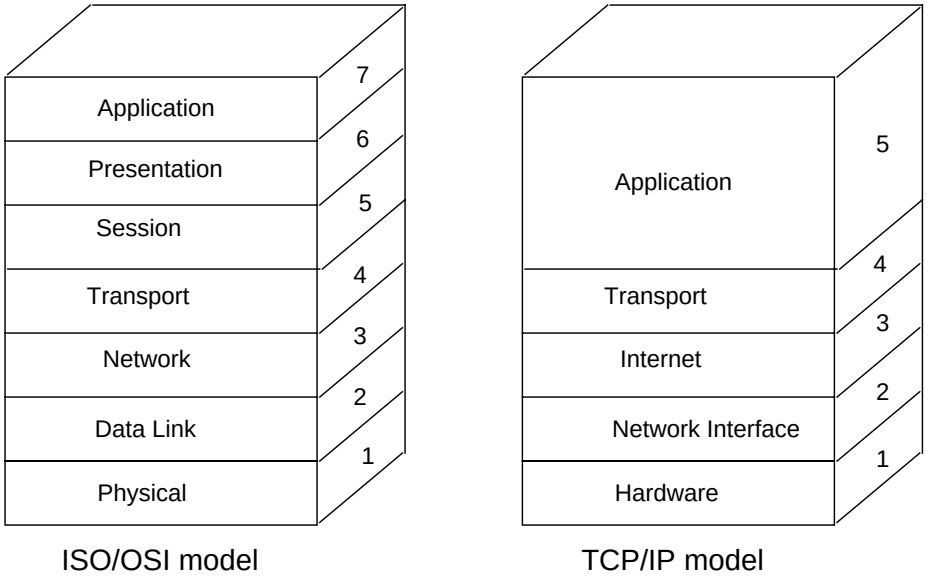


Figure 2-1 ISO/OSI and TCP/IP Model Layers

Protocol layering produces simple protocols, each with a few well-defined tasks. You can then assemble these protocols into a useful whole. You can also remove or replace individual protocols as needed for particular applications.

The function of the individual layers of the ISO/OSI model are described in Table 2-1.

Table 2-1 ISO/OSI Network Model

ISO/OSI Layer	Function
Application	Manages user-accessed application programs and network services (using the underlying layers).
Presentation	Manages the presentation of the data to be independent of the architecture.
Session	Manages communication setup and termination.
Transport	Ensures that messages reach the correct application.
Network	Manages data addressing and delivery between networks, as well as fragmenting data for the Data Link layer. A router functions at this layer by using IP addresses.
Data Link	Manages the delivery of data across the physical network. This layer provides error detection and packet framing. A bridge/switch functions at this layer. Delivery decisions are based on the ethernet address (also known as the Media Access Control [MAC] address).
Physical	Describes the network hardware, including electrical signal characteristics, such as voltage and current. A repeater functions at this layer.

The function of the individual layers of the TCP/IP model are listed in Table 2-2.

Table 2-2 TCP/IP Network Model

TCP/IP Layer	Function
Application	Manages user-accessed application programs and network services (using the underlying layers), manages the presentation of the data to be independent of the architecture, and manages the presentation of the data to be independent of the architecture.
Transport	Ensures that messages reach the correct application.
Internet	Manages data addressing and delivery between networks, as well as fragmenting data for the data link layer. A router functions at this layer by using IP addresses.
Network Interface	Manages the delivery of data across the physical network. This layer provides error detection and packet framing. A bridge/switch functions at this layer. Delivery decisions are based on the ethernet address (also known as the Media Access Control [MAC] address).
Hardware	Describes the network hardware, including electrical signal characteristics, such as voltage and current. A repeater functions at this layer.

Peer-to-Peer Communication

In contrast to the client/server model, the peer-to-peer communication model is one in which each party has the same capabilities and either party can initiate communication.

Encapsulation and De-encapsulation

When systems communicate with each other, data can be thought of as flowing down the model from the application layer to the hardware layer, across the network connection, and then flowing up the model on the target system from the hardware layer to the application layer.

A header is added to each segment received on the way down the model, and a header is removed from each segment on the way up the model, as shown in Figure 2-2.

Each header contains specific address information so that the layers on the remote system know how to forward the communication.

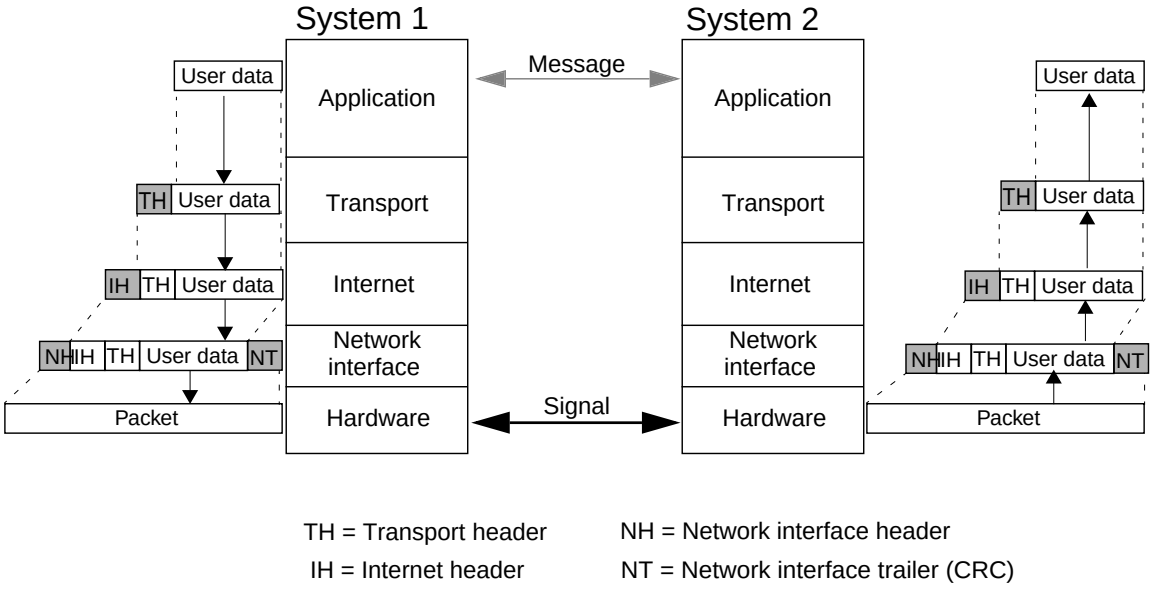


Figure 2-2 Simplified Encapsulation and De-encapsulation Between System 1 and System 2 Using the TCP/IP Model

Common Protocols and Applications in the Solaris Operating Environment

A protocol is a set of rules governing the exchange of data between two entities. Protocols can exist at each layer in a telecommunication session. Both end points must recognize and observe the protocols.

Protocols are described in an industry or international standard. For example, on the Internet, there are the TCP/IP protocols consisting of:

- Transmission Control Protocol (TCP), which uses a set of rules to exchange messages with other Internet points at the information packet level.
- Internet Protocol (IP), which uses a set of rules to send and receive messages at the Internet-address level.

Specific protocols are related with each layer of the network models. Table 2-3 shows some of the protocols associated with each layer of the TCP/IP network model.

Table 2-3 Protocols and Network Model Layers

TCP/IP Layer	TCP/IP Protocol and Applications
Application	NFS, NIS+, DNS, SMTP, DHCP, SNMP, HTTP, RPC, RIP, `rlogin`, `telnet`, and `ftp`,
Transport	TCP and UDP
Internet	IP, ARP, RARP, and ICMP
Network interface	Ethernet, ATM, FDDI, and PPP

TCP/IP Protocol Descriptions

The following sections describe the TCP/IP protocols.

Network Interface Layer Protocols

The network layer protocols consist of the following:

- Ethernet is a type of local area network (LAN) that enables real-time communication between machines connected directly through cables.
- Asynchronous Transfer Mode (ATM) is a dedicated, connection-switching technology that organizes digital data into 53-byte cell units and transmits them over a physical medium using digital signal technology.
- Fiber Distributed Data Interface (FDDI) specifies a 100-Mbytes-per-second, token-passing, dual-ring LAN using a fiber-optic transmission medium. It defines the physical layer and media-access portion of the link layer.
- Point-to-Point Protocol (PPP) transmits IP datagrams over serial point-to-point links.

Internet Layer Protocols

The internet layer protocols consist of the following:

- Internet Protocol (IP) determines the path a packet must take, based on the destination host's IP address. Both IPv4 and IPv6 are supported.
- Address Resolution Protocol (ARP) defines the method that map a 32-bit IP address to a 48-bit Ethernet address.
- Reverse Address Resolution Protocol (RARP) is the reverse of ARP. It maps a 48-bit Ethernet address to a 32-bit IP address.

Note – ARP and RARP are not used in Internet Protocol, version 6 (IPv6).

- Internet Control Message Protocol (ICMP) defines a set of error and diagnostic feedback messages for the IP. ICMP has support for IPv4 (with ICMPv4) and IPv6 (with ICMPv6).

Transport Layer Protocols

The transport layer protocols consist of the following:

- Transmission Control Protocol (TCP) is a connection-oriented protocol that provides the full duplex, reliable service on which many application protocols depend.
- User Datagram Protocol (UDP) provides a half-duplex, non-acknowledged delivery service.

Application Layer Protocols

The application layer protocols consist of the following:

- Network File System (NFS) is a client-server application that enables you to view and, optionally, store and update files on a remote system as though they were on your own system.
- Network Information System (NIS) and Network Information System Plus (NIS+) are network-naming and administration systems.
- Dynamic Host Configuration Protocol (DHCP) automates the assignment of IP addresses in an organization's network.
- Domain Name System (DNS) is a distributed database that maps host names to IP addresses.
- Hypertext Transfer Protocol (HTTP) is used by the world wide web to display text, pictures, sounds, and other multimedia information with a web browser.
- Remote Procedure Call (RPC) is a protocol that one program can use to request service from a on another system in the network without needing to understand network details.
- Routing Information Protocol (RIP) provides for automated distribution of routing information between systems.

- Simple Mail Transport Protocol (SMTP) provides for delivery of mail messages.
- Simple Network Management Protocol (SNMP) is the language that allows for the monitoring and control of network devices.
- `rlogin` is a service, offered primarily by UNIX® systems, which enables users of one system to connect to other systems across the intranet, and to interact as if their terminals were connected to the systems directly.
- `telnet` is a service that enables users of one system to connect to other systems across the Intranet, and to interact as if their terminals were connected to the systems directly.
- File Transfer Protocol (FTP) transfers a file by copying a file from one system to another system.

Network Files and Commands

You must configure network interfaces to allow peer-to-peer communication. You can use many files and commands to manipulate the networking characteristics of a system installed with the Solaris Operating Environment.

This section introduces you to some of the common files and commands, including those used for:

- Identifying a host
- Determining network configuration
- Troubleshooting a network
- Providing network services
- Providing remote procedure calls

Displaying the MAC Address

There are numerous ways to display a system's hardware address, also known as the media access control (MAC) address and as the Ethernet address. The MAC address is usually required by system administrators when configuring a system needing to be jump-started.

The `ifconfig -a` Command

You can use the `ifconfig` command with the `-a` switch to display the system's hardware address. This address is displayed only if the `root` user issues the `ifconfig` command. Only the IP address information is displayed if a non-root user issues the `ifconfig` command.

```
# ifconfig -a
lo0: flags=1000849<UP,LOOPBACK,RUNNING,MULTICAST,IPv4> mtu 8232 index 1
        inet 127.0.0.1 netmask ff000000
hme0: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500 index 2
        inet 192.168.10.25 netmask ffffff00 broadcast 192.168.10.255
        ether 8:0:20:a2:11:de
#
```

The banner Command

You can also retrieve the MAC address from a system that has not yet been booted by typing **banner** at the `ok` prompt.

```
ok banner

Sun Ultra 5/10 UPA/PCI (UltraSPARC-IIi 300MHz), Keyboard Present
OpenBoot 3.1.1 64 MB memory installed, Serial #9361102.
Ethernet address 8:0:20:8e:d6:ce, HostID: 808ed6ce.
```

Configuring Interfaces at Boot Time

System interfaces can be automatically configured at boot time if the supporting files have appropriate entries.

The /etc/rcS.d/S30network.sh File

The /etc/rcS.d/S30network.sh file is one of the startup scripts that is run each time the system is booted. This script uses the ifconfig utility to configure each interface with an IP address and other required network information. The script searches for files called hostname.*xxn* in the /etc directory where *xx* is an interface type and *n* is the instance of the interface. The /etc/hostname.hme0 is an example of a host-name file.

Note – This is a new file in Solaris 8 Operating Environment. It is functionally similar to the file /etc/rcS.S30rootusr in older Solaris releases.

The /etc/hostname.*xxn* File

The /etc/hostname.*xxn* file contains only an entry for the interface. This host name must exist in the /etc/hosts file so that it can resolve to an IP address at system boot time. An example of the file contents is:

```
# cat /etc/hostname.hme0
host1
#
```

Note – Creating an empty /etc/hostname6.*xxn* file causes the Solaris Operating Environment to automatically generate an IP address for the IPv6 interface. This also occurs if the IPv6 is enabled during installation of the Solaris Operating Environment.

The `/etc/hosts` *File*

The `/etc/hosts` file contains at least loop-back and host information. For example:

```
# cat /etc/hosts
# Internet host table
127.0.0.1       localhost       loghost
192.168.10.25 host1
```

The `localhost` and `loghost` are both assigned to the loop-back address and the interface name, `host1`, is assigned to a different IP address.

Important Files and Utilities

The following files and commands play a key role in the administration of the Solaris 8 Operating Environment.

The /etc/nodename File

Each Solaris Operating Environment has a host name, which is used by persons when referring to a system. You can change the host name by editing the /etc/nodename file and rebooting. The following is an example of a system's /etc/nodename file:

```
# cat /etc/nodename
host1
```

A system's host name and the name of its network interfaces do not need to be the same and are often different.

Determining the Current Network Configuration

Use the ifconfig -a command to display the settings of all configured interfaces; for example:

```
# ifconfig -a
lo0: flags=1000849<UP,LOOPBACK,RUNNING,MULTICAST,IPv4> mtu 8232 index 1
        inet 127.0.0.1 netmask ff000000
hme0: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500 index 2
        inet 192.168.10.25 netmask ffffff00 broadcast 192.168.10.255
        ether 8:0:20:a2:11:de
hme1: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500 index 2
        inet 192.9.200.201 netmask ffffff00 broadcast 192.9.200.255
       ether 8:0:20:a2:11:de
#
```

The hme0 interface is up, running, and configured with 192.168.10.25 as its IP address.

You can also use the `ifconfig` utility to manually change the IP address of an interface. For example, to change the IP address to 192.168.10.37, execute the following commands:

```
# ifconfig hme0 down
# ifconfig hme0 192.168.10.37 up
# ifconfig -a
lo0: flags=1000849<UP,LOOPBACK,RUNNING,MULTICAST,IPv4> mtu 8232 index 1
        inet 127.0.0.1 netmask ff000000
hme0: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500 index 2
        inet 192.168.10.37 netmask ffffff00 broadcast 192.168.10.255
        ether 8:0:20:a2:11:de
hme1: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500 index 2
        inet 192.9.200.201 netmask ffffff00 broadcast 192.9.200.255
       ether 8:0:20:a2:11:de
```

Network Troubleshooting Utilities

Two of the most common network troubleshooting utilities are the packet internet groper (`ping`) and the `snoop` utility. Use the `ping` utility to determine if another system can be contacted over the TCP/IP network. For example:

```
# ping host2
host2 is alive
```

A response of `no answer from host2` indicates that `host2` is not available on the network.

Use the `snoop` utility to determine what information is actually traveling between systems. The `snoop` utility can show what actually happens when one system uses the `ping` utility to communication with another system. For example:

```
# snoop host1 host2
host1 -> host2 ICMP Echo request
host2 -> host1 ICMP Echo reply
```

The `snoop` utility can also use audible clicks to notify you of any network traffic by using the `-a` switch. Although noisy, this is especially useful when troubleshooting a JumpStart™ or Dynamic Host Configuration Protocol (DHCP) boot without the help of a second person in a large room.

For example, to hear audible clicks for all network traffic related to a DHCP boot, execute the following:

```
# snoop -a dhcp
```

Some additional snoop options include:

- `snoop -V`

  Provides a summary verbose output

- `snoop -v`

  Provides a detailed verbose output

- `snoop -o filename`

  Redirects the snoop activity output to *filename*

- `snoop -i filename -V |more`

  Displays packets that were previously captured in *filename*

Network Services

Each network service requires a server process to respond to a client request.

The Internet Service Daemon (`inetd`)

A special network process, `inetd`, runs on each system to listen on behalf of many server processes that are not started at boot time. The `inetd` process starts these server processes when the appropriate service is requested.

The `inetd` process is informed of the services to listen for and the corresponding processes to start through the `/etc/inet/inetd.conf` file. For example:

```
# grep ftp /etc/inet/inetd.conf
ftp        stream   tcp   nowait   root  /usr/sbin/in.ftpd    in.ftpd
```

If a change is made to the `/etc/inet/inetd.conf` file, a hang-up signal must be sent to the `inetd` process to force it to reread the configuration file. For example:

```
# pkill -HUP inetd
```

Port Numbers

Each network service uses a port that represents an address space, which is reserved for that service. A client usually communicates with a server through a well-known port. Well-known ports are listed in the `/etc/services` file. For example:

```
# grep telnet /etc/services
telnet          23/tcp
#
```

The example shows that the `telnet` service uses well-known Port 23 and uses the TCP protocol.

Remote Procedure Call (RPC)

Each network service must have a unique port number that is agreed upon by all hosts in the network. This is an increasingly difficult task given the number of systems on any network and the number of network services that the systems are capable of running.

Sun Microsystems™ developed an extension to the client-server model known as a remote procedure call (RPC). When using an RPC service, a client connects to a special server process, `rpcbind`, which is a well-known registered Internet service.

The `rpcbind` process registers port numbers associated with each RPC service listed in the `/etc/rpc` file. The `rpcbind` process receives all RPC-based client application connection requests and sends the client the appropriate server port number. For example, the `sprayd` entry is listed in the `/etc/rpc` file, and looks like the following:

```
# grep spray /etc/rpc
sprayd          100012  spray
#
```

This shows that the `sprayd` daemon has a program number of 100012 and is also known as `spray`.

Checking for Registered Services

Use the `rpcinfo` utility with the `-p` switch to list registered RPC programs. For example, to determine if the `sprayd` daemon is registered, execute the following:

```
# rpcinfo -p host1 | grep sprayd
    100012    1   udp  32805  sprayd
#
```

Stopping a Network Service

Use the `rpcinfo` utility with the `-d` switch to unregister an RPC program, which effectively stops the service. For example, to stop the `spray` service, execute the following:

```
# rpcinfo -d sprayd 1
```

To verify the service has been stopped, execute the following:

```
# rpcinfo -p | grep sprayd
#
```

Starting a Network Service

You can register RPC network services by sending an HUP (Hangup) signal to the `inetd` process. For example, to start the `spray` service again, execute the following:

```
# pkill -HUP inetd
```

To verify the service has been registered again, execute the following:

```
# rpcinfo -p |grep sprayd
    100012    1   udp  42288  sprayd
#
```

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish the following:

- Define the function of each layer within the seven-layer OSI model and the five-layer TCP/IP model
- Describe the contents of various network control files
- Construct command strings to perform basic monitoring operations on an active network
- Start and stop network services using the command line

Solaris Operating Environment
`syslog` 3

Objectives

Upon completion of this module, you should be able to:

- Configure `syslog` message routing
- Modify log message priority and severity
- Determine the effect of the `LOGHOST` variable on the `syslog` process
- Describe the two methods of starting the `syslogd` daemon
- Add entries to a system log using the `logger` utility

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- *System Administration Guide, Volume 2*, Part Number 805-7229-10
- *System Administration Guide, Volume 3*, Part Number 806-0916-10

The syslog *Facility*

The syslog() function sends messages generated by the kernel and system utilities to the syslogd daemon. Depending on the configuration of the /etc/syslog.conf file, this daemon can:

- Write messages to a system log
- Write messages to the system console
- Forward messages to a list of users
- Forward messages to the syslogd on other hosts over the network

The most valuable feature of syslog is that it puts you in control of message logging. This enables you to decide which messages are to be kept and where the messages are to be placed.

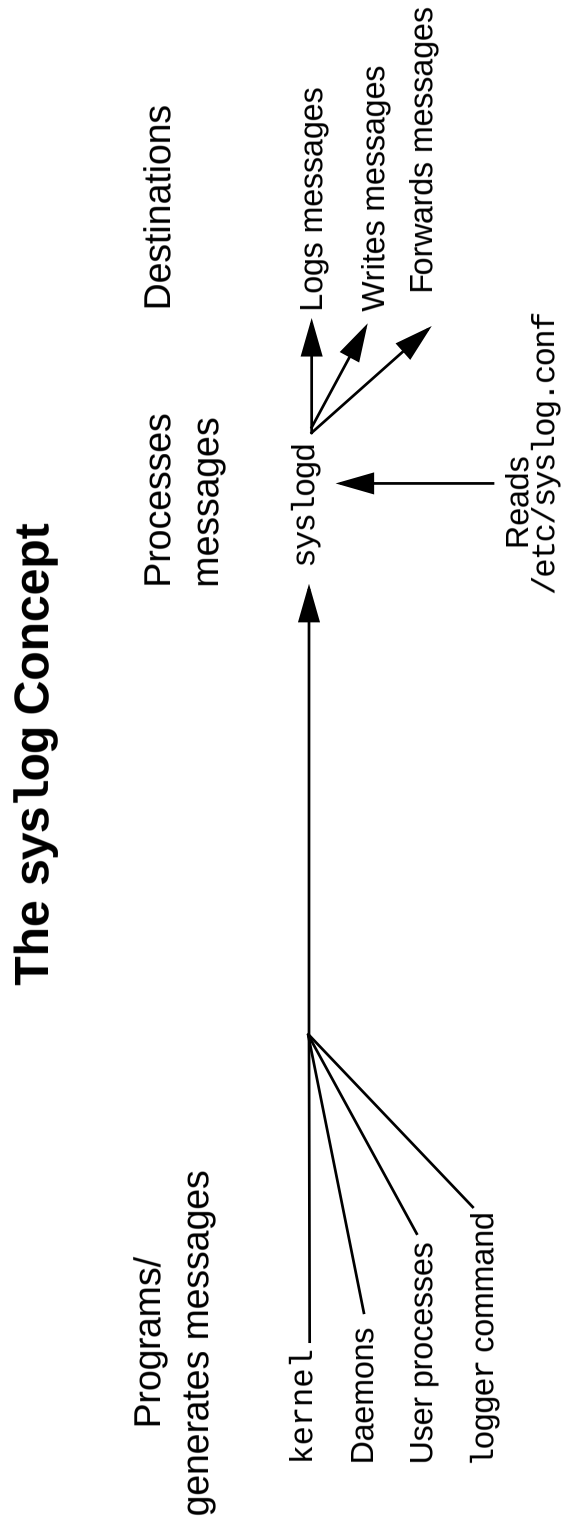


Figure 3-1 The `syslog` Concept

Controlling the Behavior of `syslogd`

Many processes are programmed to generate messages at various levels of importance in response to actions taken, or conditions encountered, during operation.

You can control the manner in which `syslogd` manages these messages by modifying the `/etc/syslog.conf` configuration file. From this configuration file, you can instruct `syslogd` to sort messages by their source or their importance and route them to a specified destination.

Configuring the `/etc/syslog.conf` *File*

A configuration entry in the `/etc/syslog.conf` file consists of two tab-separated fields: *selector* and *action*.

The selector field consists of a facility and a level written as *`facility.level`*. Facilities represent categories of system processes that can generate messages. Levels represent the severity or importance of the message.

The action field determines where to send the message.

For example, placing the following entry in the `/etc/syslog.conf` file causes error messages for all facilities to be sent to the `/var/adm/messages` file:

`*.err`	`/var/adm/messages`
where	
`*.err`	Is the selector field; `*` is the facility, `.` is the delimiter, and `err` is the level of the message
`/var/adm/messages`	Is the action field

Caution – Only use *tabs* as white space in the `/etc/syslog.conf` file.

Selector Field

The selector field is a semicolon-separated list of priority specifications of the form:

`facility.level; facility.level`

Facility is a system facility that is defined by the items shown in Table 3-1.

Table 3-1 Facility

`kern`	Messages generated by the kernel.
`user`	Messages generated by user processes. This is the default priority for messages from programs or facilities not listed in this file.
`mail`	The mail system.
`daemon`	System daemons, such as `in.ftpd` and `telnetd`.
`auth`	The authorization system including `login`, `su`, and `getty`.
`syslog`	Messages generated internally by `syslogd`.
`lpr`	The line printer spooling system – `lpr` and `lpc`.
`news`	Files reserved for the USENET network news system.
`uucp`	The UNIX-to-UNIX copy (UUCP) system; does not use `syslog`.
`cron`	The cron and at facilities, including `crontab`, `at`, and `cron`.
`local0-7`	A field reserved for local use.
`mark`	Time-stamp messages produced internally by `syslogd`.
`*`	All facilities, except the `mark` facility.

Note – You can use the `*` to select all facilities (for example `*.err`); however, you cannot use it to select all levels for a facility (for example, `kern.*`)

Level is the severity of the message. Levels in order of descending order of severity are shown in

Table 3-2 Levels

`emerg`	Panic conditions that are normally to be broadcast to all users.
`alert`	Conditions that should be corrected immediately, such as a corrupted system database.
`crit`	Warnings about critical conditions, such as hard device errors.
`err`	Other errors.
`warning`	Warning messages.
`notice`	For conditions that are not error conditions, but might require special handling.
`info`	Informational messages.
`debug`	Messages that are normally used only when debugging a program.

The `none` message is normally used only when debugging a program. The `none` message appears when messages are not sent from the indicated facility to the selected file; for example, a selector of `*.debug;mail.none` sends all messages except mail messages to the selected file.

Note – Not all levels of severity are implemented for all facilities in the same way. For more information, refer to the online manual pages.

Action Field

The action field defines where the message should be forwarded. It can have any one of the following forms:

- */filename*

  The absolute path for log file is required.

Note – This file must be manually created if it does not exist.

- *@host*

  You must prefix the host name or IP address with an @ sign. Messages are forwarded to the `syslogd` of the remote system.

- *user1,user2*

  `user1` and `user2` receive messages if they are logged in.

- *

  All logged-in users will receive messages.

The /etc/syslog.conf *File*

A sample /etc/syslog.conf configuration file is:

```
#ident  "@(#)syslog.conf   1.5   98/12/14 SMI"   /* SunOS 5.0 */
#
# Copyright (c) 1991-1998, by Sun Microsystems, Inc.
# All rights reserved
#
# syslog configuration file.
#
# This file is processed by m4 so be careful to quote (‘’) names
# that match m4 reserved words.  Also, within ifdef's, arguments
# containing commas must be quoted.
#
*.err;kern.notice;auth.notice                          /dev/sysmsg
*.err;kern.debug;daemon.notice;mail.crit               /var/adm/messages

*.alert;kern.err;daemon.err                            operator
*.alert      root

*.emerg      *

# if a non-loghost machine chooses to have authentication messages
# sent to the loghost machine, un-comment out the following line:
#auth.notice      ifdef(‘LOGHOST’, /var/log/authlog, @loghost)

mail.debug      ifdef(‘LOGHOST’, /var/log/authlog, @loghost)

#
# non-loghost machines will use the following lines to cause "user"
# log messages to be logged locally.
#
ifdef           (‘LOGHOST’, ,
user.err        /dev/sysmsg
user.err        /var/adm/messages
user.alert      ‘root, operator’
user.emerg      *
)
```

Starting and Stopping `syslogd`

The configuration file is read each time `syslogd` starts. The `/etc/rc2.d/S74syslog` file starts `syslogd` during each system boot.

You can manually start or stop `syslogd`, if the configuration file has been modified, with the command:

```
# /etc/init.d/syslog start | stop
```

syslogd *and the* m4 *Macro Processor*

The syslogd daemon, the m4 macro processor, and the /etc/syslog.conf file interact, in conceptual phases, to determine correct message routing. These conceptual phases are described as:

1. syslogd runs m4.
2. m4 processes ifdef statements in /etc/syslog.conf.
3. syslogd uses m4 output to route messages to the appropriate places.

On first evaluation, it appears the syslogd daemon receives message-log routing information from the /etc/syslog.conf file. However, syslogd does not read the /etc/syslog.conf file directly. Instead, syslogd starts m4, which parses the /etc/syslog.conf file for ifdef statements that can be interpreted by m4.

If m4 does not recognize any m4 commands on a line, it passes the output back to syslogd as a two-column output that syslogd then uses to route messages to appropriate destinations. If m4 encounters an ifdef statement within the /etc/syslog.conf file, the ifdef is evaluated for a true or false condition, and message routing occurs relative to the output of the test.

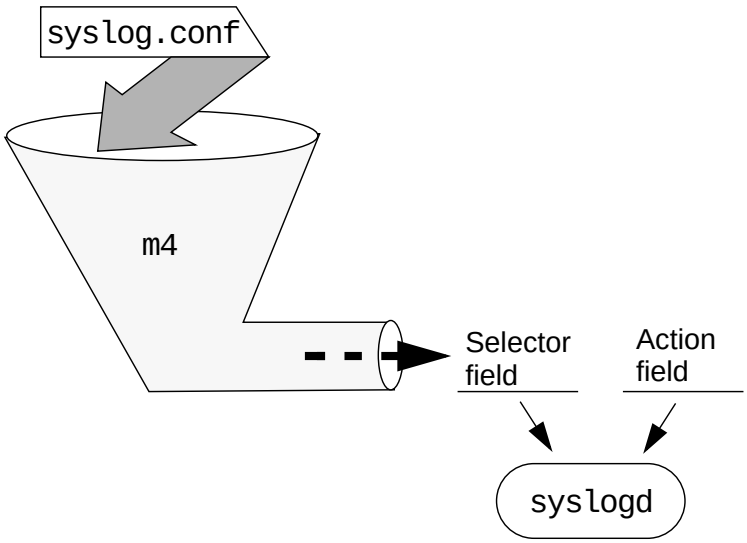


Figure 3-2 The m4 Macro Processor

Detailed Operation

You must first consider two examples of the `host1` system's `/etc/hosts` file.

Note – These `/etc/hosts` file examples have been excerpted for brevity.

Example A

```
192.9.200.1 host1 loghost
192.9.200.2 host2
```

Example B

```
192.9.200.1 host1
192.9.200.2 host2 loghost
```

You must next consider two examples of the m4 command line.

1. `/usr/ccs/bin/m4 /etc/syslog.conf`
2. `/usr/ccs/bin/m4 -D LOGHOST /etc/syslog.conf`

Phase 1

When `syslogd` starts on boot, `syslogd` evaluates the `/etc/hosts` file to check the IP address associated with the *`hostname`* compared to the IP address associated with the `loghost`.

In Example A, `host1` and `loghost` are both associated with IP address `192.9.200.1`; therefore, `syslogd` runs the second command line, `/usr/ccs/bin/m4 -D LOGHOST` that causes the `m4 LOGHOST` variable to be evaluated as `TRUE` during the parsing of the `/etc/sylog.conf` file.

In Example B, `host1` is associated with IP address `192.9.200.1`, while `host2` and `loghost` are both associated with IP address `192.9.200.2`; therefore, `syslogd` runs the first command line, `/usr/ccs/bin/m4` (no `-D LOGHOST`) that causes the `m4 LOGHOST` variable to be evaluated as `FALSE` during the parsing of the `/etc/sylog.conf` file.

Phase 2

In the second phase, the `m4` macro processor parses the `/etc/syslog.conf` file. For each uncommented line that is parsed, `m4` searches the line for an `ifdef` statement. If no `ifdef` is encountered on the line, `m4` passes the line back to `syslogd` daemon.

If the `m4` finds a line with an `ifdef` statement, the line is evaluated for the `TRUE` or `FALSE` condition of the `LOGHOST` variable, and `m4` passes `syslogd` the output, accordingly. For example,

```
mail.debug          ifdef('LOGHOST', /var/log/authlog, @loghost)
```

Consider, if the `LOGHOST` variable was evaluated as `TRUE` in Phase 1, then the `m4` processor returns:

```
mail.debug          /var/log/authlog
```

If the `LOGHOST` variable was evaluated as `FALSE` in Phase 1, then the `m4` processor returns:

```
mail.debug          @loghost
```

In either case, the output has an entry in the selector field and an entry in the action field.

Phase 3

In phase 2, for each line that was parsed in the `/etc/syslog.conf` file, `m4` produced output in a two-column field: A selector field and an action field. This information is returned to `syslogd`, and `syslogd` uses the information to route messages to their appropriate destinations.

Once configured, `syslogd` continues to run with this configuration.

Modifying `inetd` *to Use* `syslog`

The `inetd` is the server process for many network services. The `inetd` process listens for service requests on the TCP (or UDP) ports associated with each of the service listed in its configuration file. When a request arrives, `inetd` executes the server program associated with the service. You can modify the `inetd` to log TCP connections using the `syslogd`.

`inetd` *Manual Page Excerpt*

The following online manual page excerpt for `inetd` shows that only the `daemon` facility and the `notice` message level is supported:

```
% man inetd
Maintenance Commands
inetd(1M)

NAME
     inetd - Internet services daemon
...
...
-t        Instructs inetd to trace the incoming
connections for all of its TCP services. It does this by
logging the client's IP address and TCP port number,
along with the name of the service, using the syslog(3)
facility. UDP services can not be traced. When tracing is
enabled, inetd uses the syslog facility code ``daemon''
and ``notice'' priority level.
...
```

Note – The Internet daemon, `inetd`, provides services for many network protocols including the `telnet` protocol and File Transfer Protocol (FTP).

The inetd *Startup File*

Using the -t option as an argument to the inetd command enables TCP tracing. You must enable the trace option for the inetd daemon for syslog messaging. You add the -t option to the entry, which starts inetd in the inetsvc script in the /etc/init.d directory.

The modified entry looks similar to the following:

```
# grep inetd /etc/init.d/inetsvc
/usr/sbin/inetd -s -t &
#
```

Note – You must restart the inetd process for the new option to take effect.

The /etc/syslog.conf file configures the syslogd to selectively distribute the messages sent to it; in the previous example, from inetd.

```
# grep daemon.notice /etc/syslog.conf
*.err;kern.debug;daemon.notice;mail.crit      /var/adm/messages
```

The notice entry in the /etc/syslog.conf file causes all daemon messages of level notice to be sent to the /var/adm/messages file.

Note – The /var/adm/messages file must exist and you must stop and start the syslog daemon.

Example of `syslog` *Logged Entry*

You can monitor the `syslog` file, `/var/adm/messages`, in real time using the command `tail -f`. This holds the file open so you view messages being routed into this file by `syslog`.

```
# tail -f /var/adm/messages
```

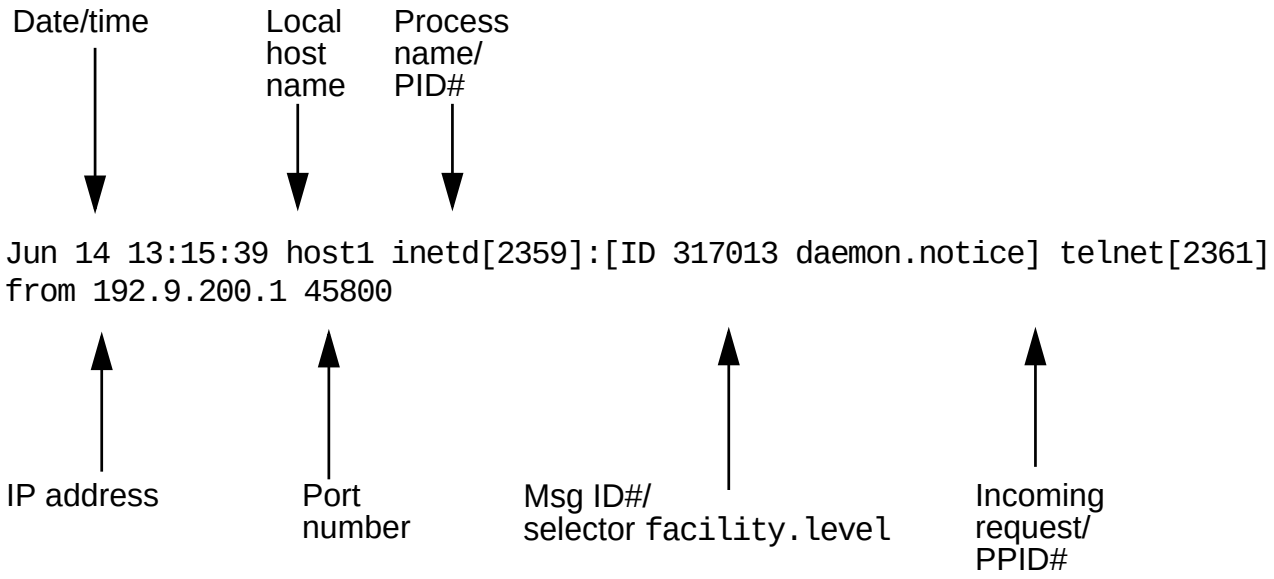


Figure 3-3 Example of `syslog` Logged Entry

The preceding output logs a `telnet` request to system `host1` from IP address `192.9.200.1` on port `45800`.

To exit, press Control-C.

Note – You can use scripts to automatically parse the log files and send notification to support personnel should any unusual activity exist.

The logger *Utility*

With the `logger` command, you can add one-line entries to a system log file. Typically, you can use the `logger` command as part of a script.

Command Format

```
logger [ -i ] [ -f file ] [ -p priority ] [ -t tag ] [ message ]
```

Command Options

- `-f` *`file`*

  Uses the contents of *`file`* as the message to log (*`file`* must exist).

- `-i`

  Logs the process ID of the logger process with each line.

- `-p` *`priority`*

  Enters the message with the specified priority.

- `-t` *`tag`*

  Marks each line added to the log with the specified tag.

- `message`

  Concatenates the string arguments in the message together, in the order specified, separated by single-space characters.

Examples

The following example logs the `System rebooted` message to the default priority level `notice` and the facility `user` for `syslogd`.

```
# logger System rebooted
```

The `System rebooted` message *should* be logged to the file designated for the `user.notice` selector field. However, if you investigate further, you will find that the `user.notice` selector field is not configured (by default) in the `/etc/syslog.conf` file. You can either add the `user.notice` selector field to the `/etc/syslog.conf` file, or you can prioritize the output as follows:

```
# logger -p user.err System rebooted
```

Changing the priority of the message to `user.err` will route the message to the `/var/adm/messages` file as indicated in the `/etc/syslog.conf` file.

Exercise: Using `syslog` *and Auditing Utilities*

Exercise objective – In this lab, you configure and use the `syslog` utility to better monitor your system.

Preparation

Ensure that your system boots without errors and that you can log in as `root`.

Task Summary

In this exercise, you accomplish the following:

- Configure `syslog` logging for the `login` and `telnet` daemons
  - Use the `syslog` utility to write logs to the `/var/adm/messages` file
  - Configure `syslog` to log the `auth` and `daemon` facilities
  - Use the `notice` selector level
- Use the `tail` command to monitor the `syslog` log in real time
- Use the `telnet` command to test logging

Tasks

To configure and use the `syslog` utility to better monitor your system, perform the following steps:

1. Configure `syslog` logging for the `login` and `telnet` daemons.

   a. Make a backup file of the original `/etc/syslog.conf` file.

   # **`cp /etc/syslog.conf /etc/syslog.conf.orig`**

b. Edit the `/etc/syslog.conf` file and add the selector field `auth.notice` to the second entry, which should look like the following:

```
*.err;kern.debug;daemon.notice;mail.crit;auth.notice     /var/adm/messages
```

c. Save your changes, and quit the editor.

d. Edit the `/etc/init.d/inetsvc` file and change the line for the `inetd` command to include the `-t` option.

```
/usr/sbin/inetd -s -t &
```

e. Save your changes, and quit the editor.

f. Stop and start the `syslogd` process.

```
# /etc/init.d/syslog stop
# /etc/init.d/syslog start
```

g. Stop and start the `inetd` process.

```
# /etc/init.d/inetsvc stop
# /etc/init.d/inetsvc start
```

h. Edit `/etc/default/login` and comment out the line starting `'CONSOLE'`.

2. Use the `tail` command in a terminal window to monitor the `syslog` log in real time.

```
# tail -f /var/adm/messages
```

3. In another terminal window, test logging by using the `telnet` command to log in to your own system.

```
# telnet your_hostname
```

Notice how the `syslog` entry is updated as reported by the `tail` command.

4. Exit the `telnet` session, and observe the `syslog` entry.

```
# exit
Connection closed by foreign host.
```

Note – Nothing is logged when you exit the `telnet` session.

5. Press Control-C to stop the output of the `tail` command running in the other window.

Exercise Summary

Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish the following:

- ❑ Configure `syslog` message routing
- ❑ Modify log message priority and severity
- ❑ Determine the effect of the `LOGHOST` variable on the `syslog` process
- ❑ Describe the two methods of starting the `syslogd` daemon
- ❑ Add entries to a system log using the `logger` utility

Introducing Disk Management 4

Objectives

Upon completion of this module, you should be able to:

- List the three utilities used to create, check, and mount file systems
- Identify the physical path name differences between physical disks and virtual disks
- List the potential advantages of any virtual disk management application
- List the basic difference between Solstice DiskSuite™ and Sun StorEdge Volume Manager™
- List the main advantages of using a concatenated virtual file system
- List the main advantage of using a striped virtual file system
- Install the Solstice DiskSuite applications
- Use the Solstice DiskSuite application to dynamically grow a file system

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- *System Administration Guide, Volume I*, Part Number 805-7228
- *System Administration Guide, Volume II*, Part Number 805-7229
- *Solstice DiskSuite 4.2.1 Reference Guide*, Part Number 806-3204-10
- *Solstice DiskSuite 4.2 User's Guide*, Part Number 806-3205-10
- *Sun Enterprise Volume Manager 2.5 Administration Guide*, Part Number 805-1607

Physical Disks

In a standard Solaris 8 Operating Environment installation, memory-resident drivers access all physical disks. Each type of disk device has a unique driver.

Typical Physical Disk Drivers

Typical physical disk drivers include:

- `dad` – IDE disk driver
- `sd` — The SCSI disk drive driver

For efficiency, most drivers are loaded into memory at system boot time.

Access Paths

The access path to all physical disks is through path names defined in the `/dev` directory. For every slice on every physical disk, there are two unique access paths—the block device path and the raw device path.

Block Device Path

The block device path is used by commands, utilities, and processes that refer to the slice as a file system. For example, the following are typical block device path names:

- `/dev/dsk/c0t0d0s0`
- `/dev/dsk/c0t0d0s7`

The following is a typical `mount` command using the block device path name:

```
# mount /dev/dsk/c0t0d0s7 /mnt
```

Raw Device Path

The raw device access path is used by utilities and processes that do not use the device as a file system but transfer data sector by sector. For example, the following are typical raw device path names:

- `/dev/rdsk/c0t0d0s0`
- `/dev/rdsk/c0t0d0s7`

The following are typical commands that can be used with the raw device path name:

```
# newfs /dev/rdsk/c0t0d0s7
# fsck /dev/rdsk/c0t0d0s7
```

Virtual Disk Access Paths

A key feature of all virtual volume management applications is that they transparently provide a virtual partition that can consist of many disk partitions. To the Solaris Operating Environment, a virtual partition appears to be the same as any other. The logical device names associated with the virtual partitions are similar to other special devices in that they have both a raw device path and a block device path.

The following are typical virtual volume raw and block device path names for disks created with Solstice DiskSuite:

- `/dev/md/rdsk/d42`
- `/dev/md/dsk/d42`

The following are typical virtual volume raw and block device path names for disks created with Sun StorEdge Volume Manager:

- `/dev/vx/rdsk/apps/logvol`
- `/dev/vx/dsk/apps/logvol`

You can use virtual volume device paths the same way as any other device path by system utilities; for example:

```
# mount /dev/md/dsk/d42 /mnt
# newfs /dev/md/rdsk/d42
# fsck /dev/vx/rdsk/apps/logvol
```

✓

To eliminate the limitation of one slice per file system, there are virtual volume management applications that can create virtual volume structures in which a single file system can consist of an almost unlimited number of disks or slices.

Two virtual volume managers are available through Sun:

- Solstice DiskSuite
- Sun StorEdge Volume Manager

Virtual Volume Management

Solstice DiskSuite and Sun StorEdge Volume Manager assemble large volumes from multiple disk drives, but they use different approaches.

Solstice DiskSuite

Solstice DiskSuite uses standard partitioned disk slices that have been created using the `format` utility. A typical volume structure is assembled and managed transparently.

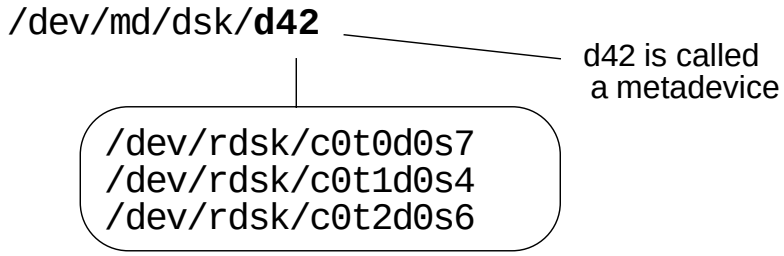


Figure 4-1 Solstice DiskSuite Management of Disk Slices

Sun StorEdge Volume Manager

Sun StorEdge Volume Manager manages disk space by using contiguous sectors. The application formats the disks into only two slices, Slice 3 and Slice 4. Slice 3 is called a private area, and Slice 4 is a public area.

Slice 3 maintains information about the virtual to physical device mappings, while the sectors in Slice 4 provide space to build the virtual devices. Contiguous sector groups can be configured into subdisks; see Figure 4-2.

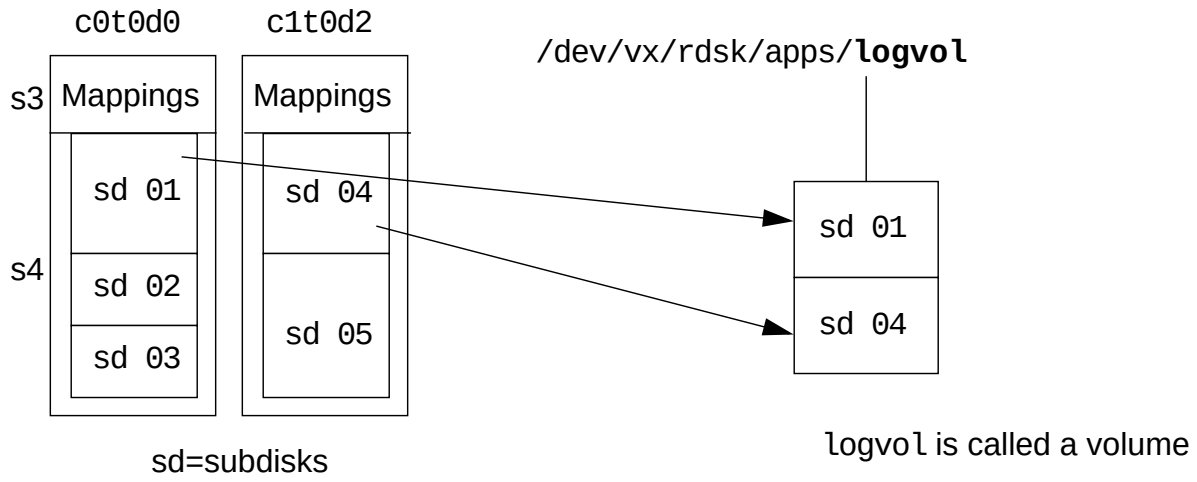


Figure 4-2 Sun StorEdge Volume Management of Disk Slices

An advantage of this approach is there is almost no limit to the number of subdisks you can create on a single disk drive. In a standard Solaris-disk partitioned environment, there is an eight-partition limit per disk.

Concatenated Volumes

A *concatenated volume* combines portions of one or more physical disks into a single virtual structure. The portions are contiguous, and the first portion tends to fill with data before the next portion is used. Figure 4-3 illustrates a sample layout of concatenated volumes.

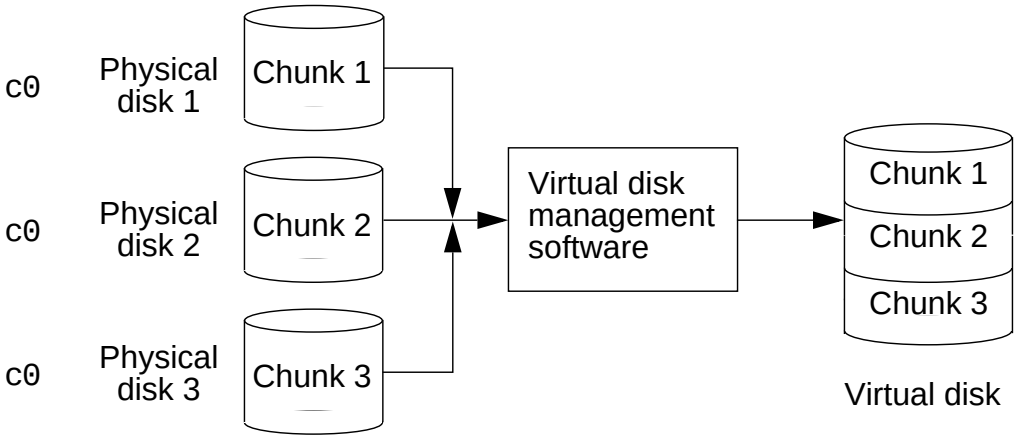


Figure 4-3 Concatenated Volumes

The following describes some of the features of a concatenated volume:

- It can be used to create a virtual volume that is larger than one physical disk.
- You can grow a file system as needed by concatenating additional physical disk space to it. Using this feature, you can increase the size of a file system while it is mounted and in use.

It is not uncommon for file systems to run out of space due to company expansion that was not anticipated during the system planning phase. As a system administrator, you would be required to increase the size of a file system. The Solstice DiskSuite package that is bundled with the Solaris 8 Operating Environment server release can be used to expand (or grow) the size of a file system using concatenation.

Adding a Disk

Before you can use the disk management tools to configure additional disk space, you must first add the additional device and then modify the device configuration directories to make the device visible to the system. The two methods of making the device visible are:

- A reconfiguration boot
- An execution of the `devfsadmd` daemon

Reconfiguration Boot

Traditionally, you would perform a reconfiguration boot operation to recognize new devices on the system. The three basic methods are:

- Execute a `boot -r` from the boot PROM's `ok` prompt
- Execute a `reboot -- -r` from the # (system's superuser shell) prompt; the `--` passes the `-r` to the boot command
- Create a `/reconfigure` file and reboot the system

The disadvantage to these methods is that each requires you to `reboot` the system. In today's computer environments, many systems have a 24 hours a day, seven days a week (24x7) uptime requirement; therefore, rebooting the system to add new devices is not an option.

The `devfsadmd` Daemon

For systems that have a 24x7 uptime requirement, you can add new devices without requiring a reboot.

Before the Solaris 8 Operating Environment, you needed a suite of `devfs` administration tools, including `drvconfig`(1M), `disks`(1M), `tapes`(1M), `ports`(1M), `audlinks`(1M), and `devlinks`(1M) to create the `/dev` and `/devices` entries necessary for the Solaris Operating Environment to access new devices.

These commands still exist in the Solaris 8 Operating Environment; however, each of them is linked to the new `devfsadm` administration command that maintains the name space for `/dev` and `/devices` entries.

Therefore, after adding new hardware (or hot-plugable hardware where permitted), the `devfsadm` command is executed, thereby transparently building the necessary configuration entries The new device is then ready for assignment by the system.

Installing the Solstice DiskSuite Software

The following steps describe how to install the Solstice DiskSuite application software to manage the disk partitions of multiple disks and multiple controllers:

1. Insert the Solaris 8 Software (2 of 2) CD-ROM (Solstice DiskSuite is contained in the Early Access [EA] folder on this CD-ROM), and change to the correct directory.

```
# cd /cdrom/cdrom0/Solaris_8/EA/products/DiskSuite_4.2.1
```

2. Start the `installer` program.

```
#./installer
```

With the exception of the installer's actual GUI windows themselves, feedback generated from the `installer` program is displayed in the terminal window from which the program was started.

The Web Start Additional Information window (Figure 4-4) is displayed.

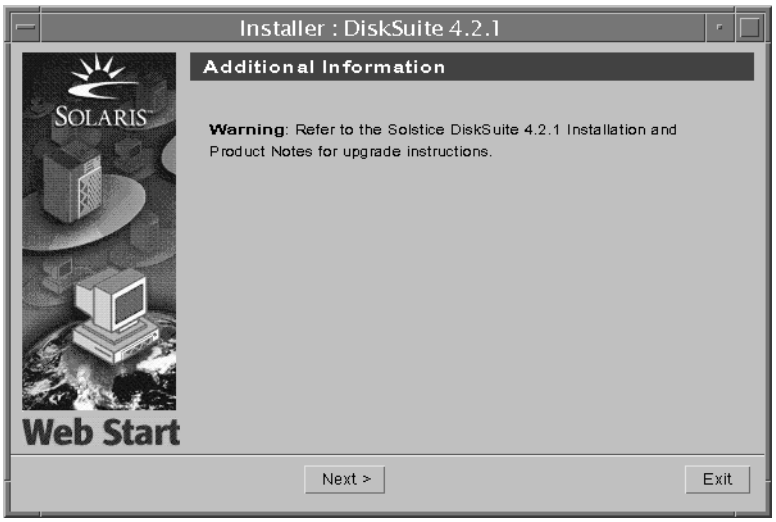


Figure 4-4 Web Start Additional Information Window

3. Click Next.

The Web Start Installer Welcome window (Figure 4-5) is displayed.

Figure 4-5 Web Start Installer Welcome Window

4. Click Next.

The Select Type of Install window (Figure 4-6) is displayed.

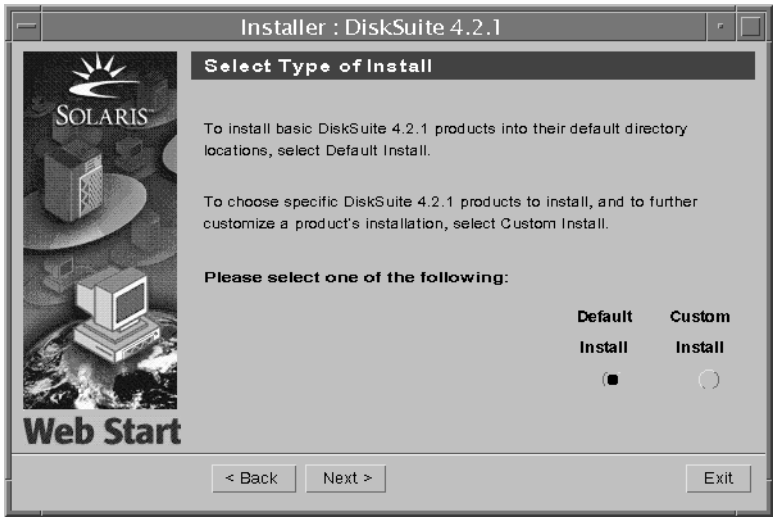


Figure 4-6 Select Type of Install Default Window

To see how the installer processes the Default Install, leave it selected and click Next.

The installer tests for available disk space and displays the Ready to Install window with a scrolling list of all items from the directory on the CD-ROM.

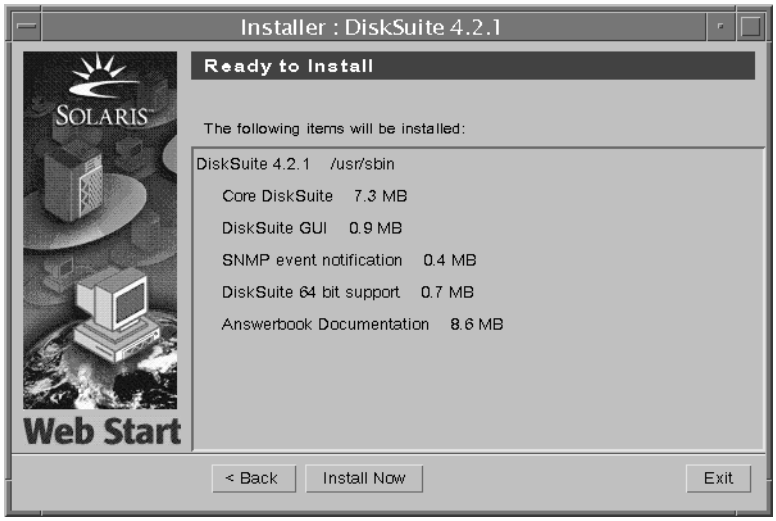


Figure 4-7 Ready to Install Window

5. To enable custom selection of each component listed, click Back to return to the Select Type of Install window.

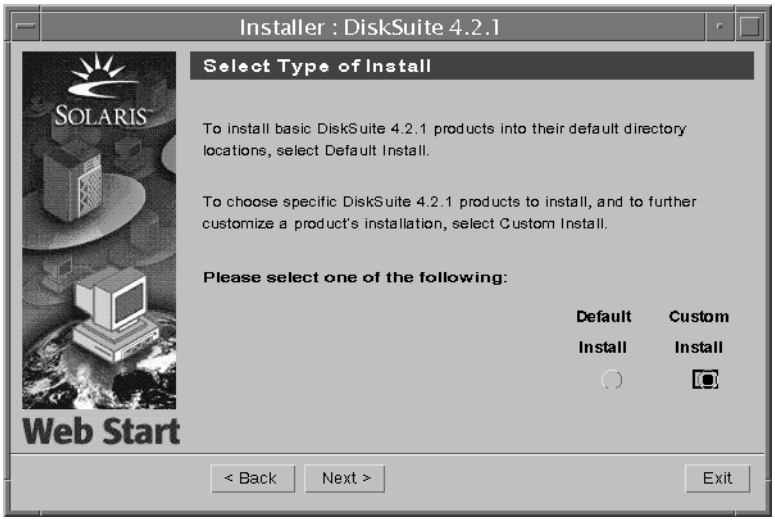


Figure 4-8 Select Type of Install Window

6. Click Custom Install

7. Click Next.

The Component Selection window (Figure 4-9) is displayed. All products available for installation are listed. Typically, you would leave all items selected, however, this window enables selection of each component.

Figure 4-9 Component Selection Window

8. Click Next.

The Ready to Install window (Figure 4-10) is displayed. The Solstice DiskSuite 4.2 products should be the only product listed for installation. If others are displayed, click Back to deselect them.

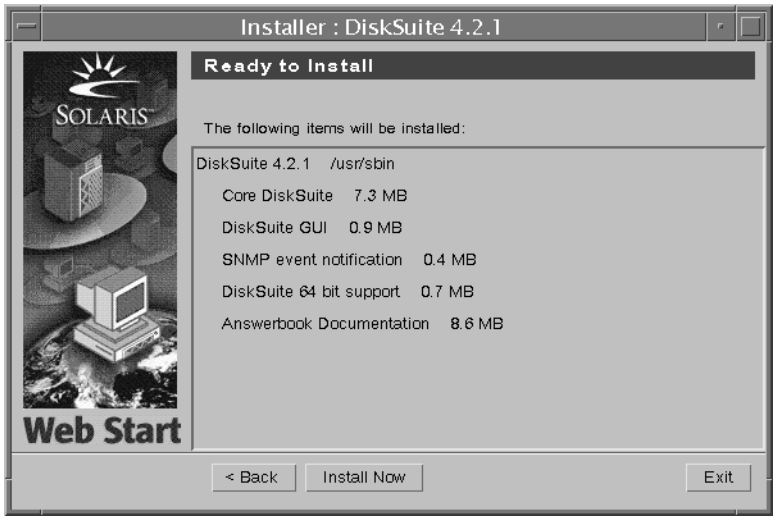


Figure 4-10 Ready to Install Window

9. Click Install Now.

   The Installing window (Figure 4-11) is displayed to enable you to monitor progress. The bar reflects the progress of the current product being installed.

Note – If additional products are being installed, two bars are displayed. The top bar reflects the progress of the current product being installed and the bottom bar monitors the progress of the total set of products being installed.

Figure 4-11 Installing Window

Refer also to the terminal window in which you originally started the `installer` program. It displays the following message:

```
Installing DiskSuite 4.2.1
     Log file:/var/sadm/install/logs/DiskSuite_4.2.1_install.A0555045
```

The final number following "`install.`" is unique to each installation.

When the installation is complete, the Installation Summary window (Figure 4-12) is displayed, confirming success.

Figure 4-12 Installation Summary Window

10. Click Next.

The Additional Information window (Figure 4-13) is displayed, providing you with information on how to add or remove products using the Solaris Product Registry, `/usr/bin/prodreg`, or the Solaris Management Console.

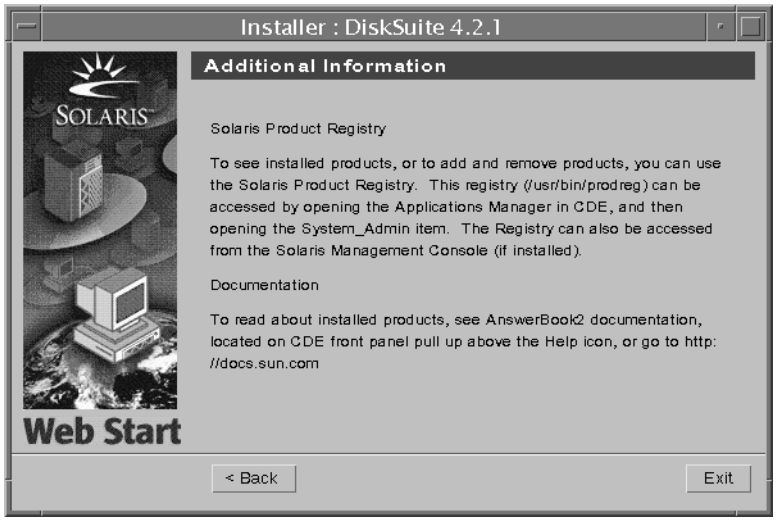


Figure 4-13 Additional Information Window

11. Click Exit.

A dialog box is displayed (Figure 4-14) offering you the selection of Reboot.

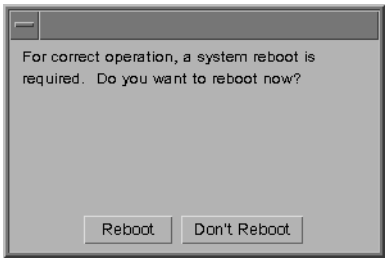


Figure 4-14 Reboot Dialog Box

12. Click Reboot.

Solaris Product Registry

The `prodreg` command (a Java program) referred to previously in Figure 4-13 on page 4-16, is the viewer for the Solaris Product Registry (ProdReg), a system for maintaining records of the software products installed on a given Solaris Operating Environment. You can use it to install and uninstall software packages.

To start the Product Registry program, run the `/usr/bin/prodreg` command:

```
# /usr/bin/prodreg
```

The viewer is shown in Figure 4-15.

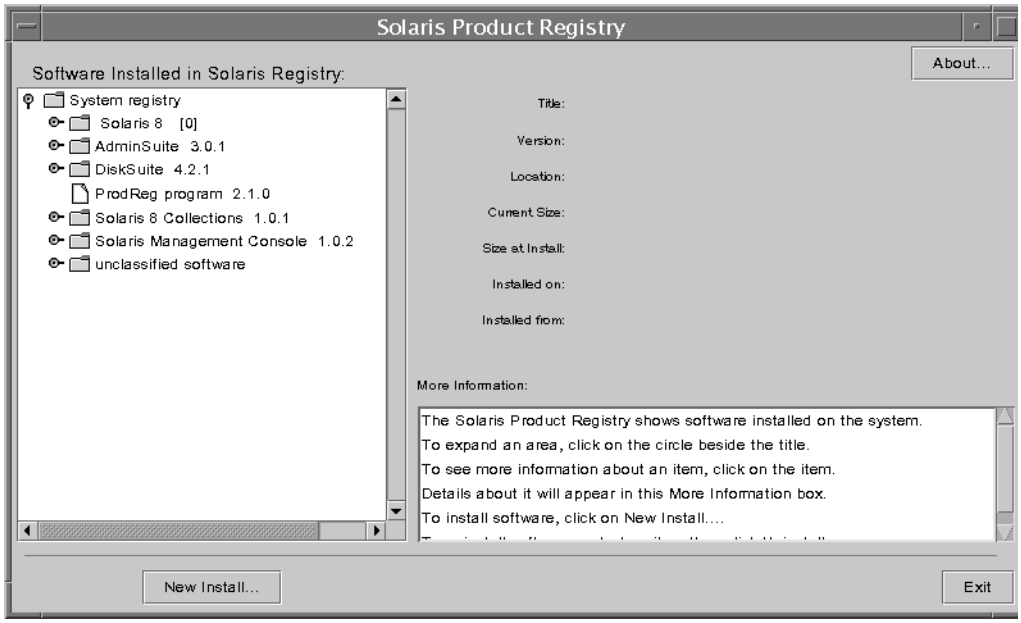


Figure 4-15 Solaris Product Registry Window

Click DiskSuite to view more information about the application.

The DiskSuite application information is displayed in the window (Figure 4-16) and offers an Uninstall DiskSuite button at the bottom. Using that button is the appropriate way to uninstall the DiskSuite software; this method of removal is true of any application installed with the `installer`.

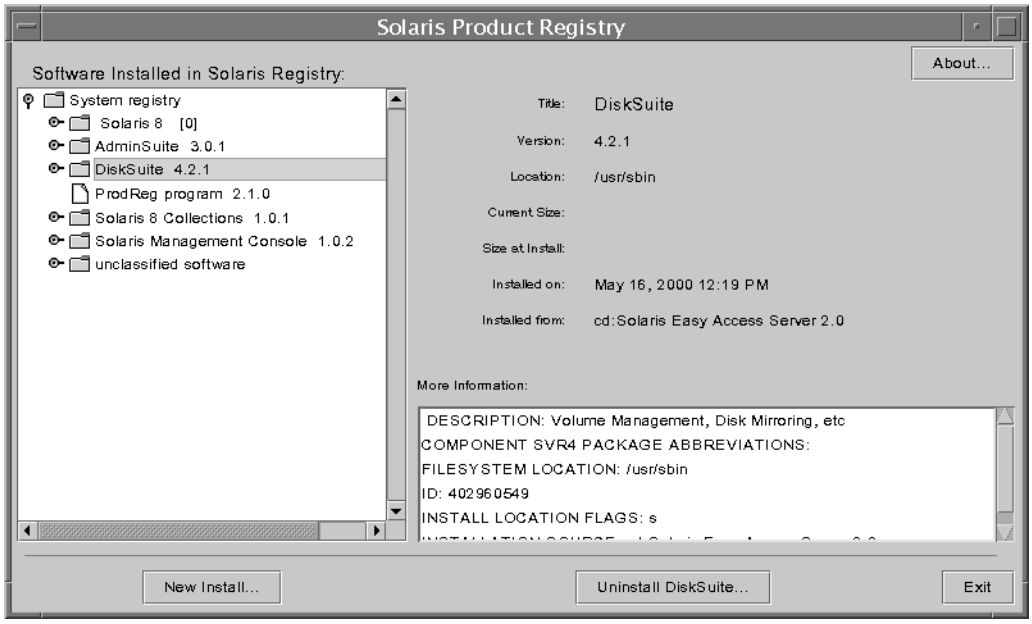


Figure 4-16 Solaris Product Registry Window With DiskSuite Information

If you click Uninstall DiskSuite, the Solaris Product Registry program removes the application and modifies necessary system files to reflect removal.

Starting the DiskSuite Tool

To start and use the DiskSuite tool, perform the following steps:

1. After the system presents the login screen, log in as `root`.
2. Make a backup of the `/etc/vfstab` file.
3. Use the command-line to invoke the Solstice DiskSuite Tool as follows:

```
# /usr/sbin/metatool &
```

Note – Running the DiskSuite Tool in the background frees the window for subsequent commands.

The first time you run the DiskSuite software after installation, the Metastate Database Warning window is displayed, as shown in Figure 4-17.

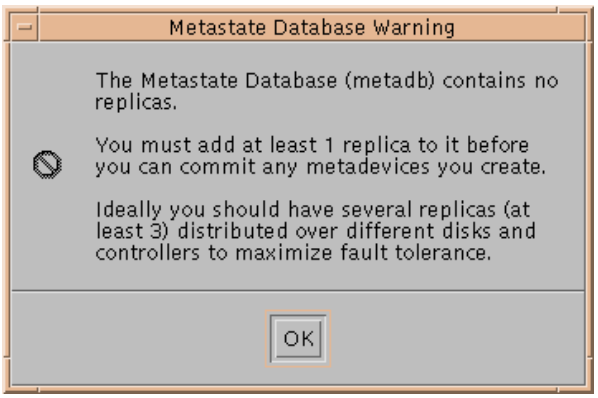


Figure 4-17 Metastate Database Warning Window

You must create the metastate database before you can manage disks.

4. Click OK.

The DiskSuite Tool – Metadevice Editor window (Figure 4-18) is displayed.

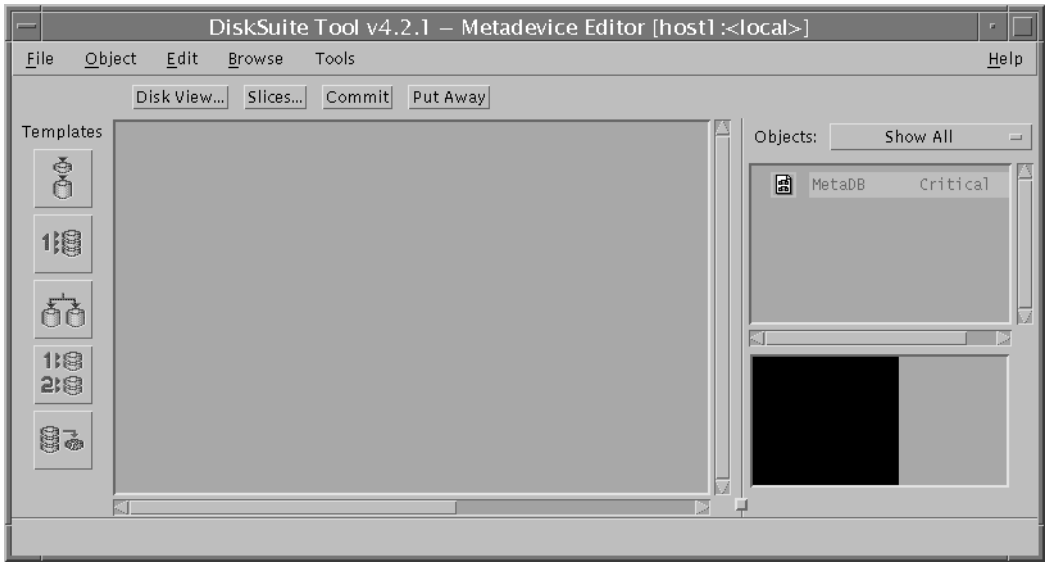


Figure 4-18 DiskSuite Tool – Metadevice Editor Window

5. Click Disk View to display the DiskSuite Tool – Disk View window (Figure 4-19).

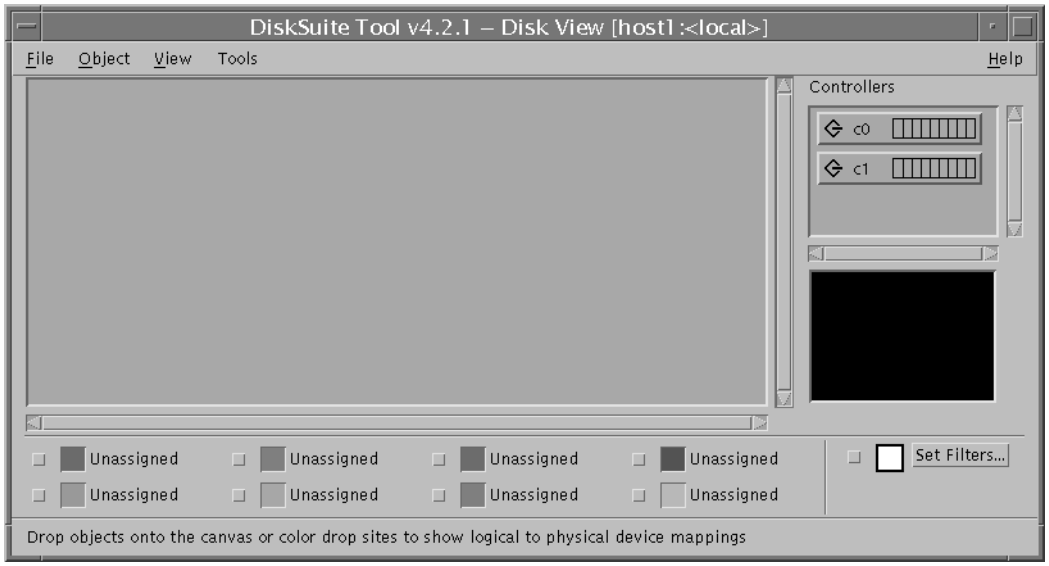


Figure 4-19 DiskSuite Tool – Disk View Window

6. Select View All Controllers from the View menu.

The DiskSuite Tool – Disk View window is displayed, as shown in Figure 4-20. This example indicates there is one disk attached to each of two controllers (`c0` and `c1`) on this system.

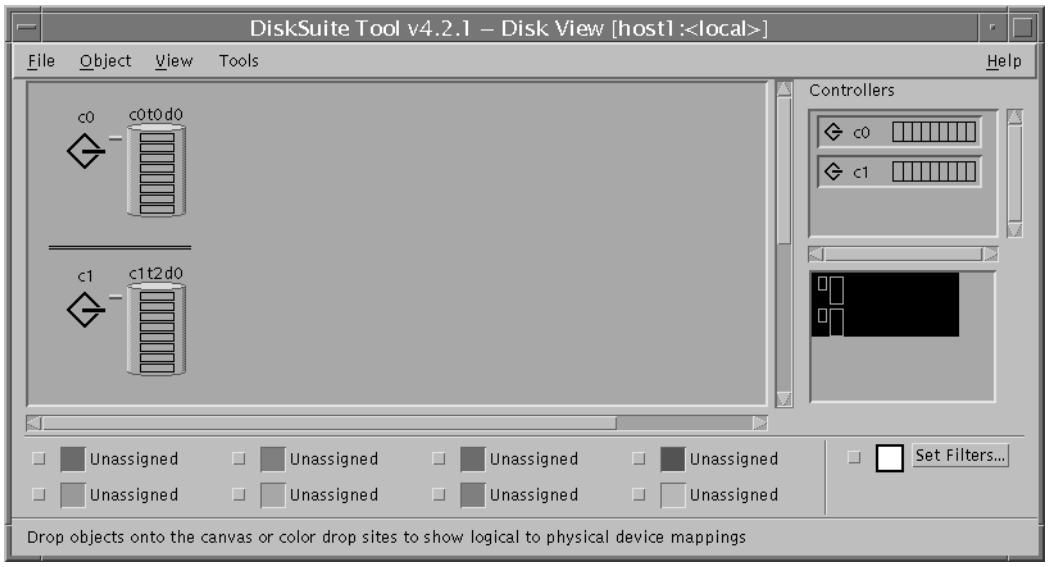


Figure 4-20 DiskSuite Tool – Disk View Window Viewing All Controllers

7. Return to the DiskSuite Tool – Metadevice Editor window and click Slices.

As illustrated in Figure 4-21, the window lists information about each disk partition known to the system. (You might need to enlarge the window to see all of the information about a slice.)

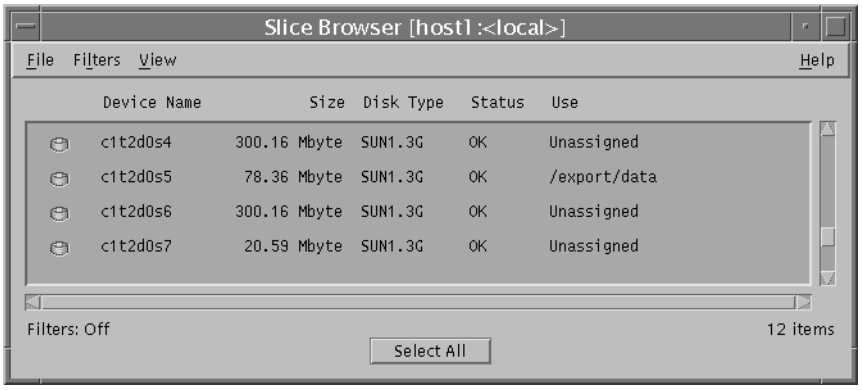


Figure 4-21 Slice Browser Window

Creating the State-Database Replicas

State-database replicas are required by Solstice DiskSuite to maintain disk configuration information. The following steps enable you to create this initial database:

1. Double-click the small MetaDB icon in the Objects area of the DiskSuite Tool to create the initial state-database replica (MetaDB).

   The MetaDB icon moves to the large area of the DiskSuite Tool Metadevice Editor called the canvas. This is the active area of the tool where management of disks takes place.

   The status of this object is Critical.

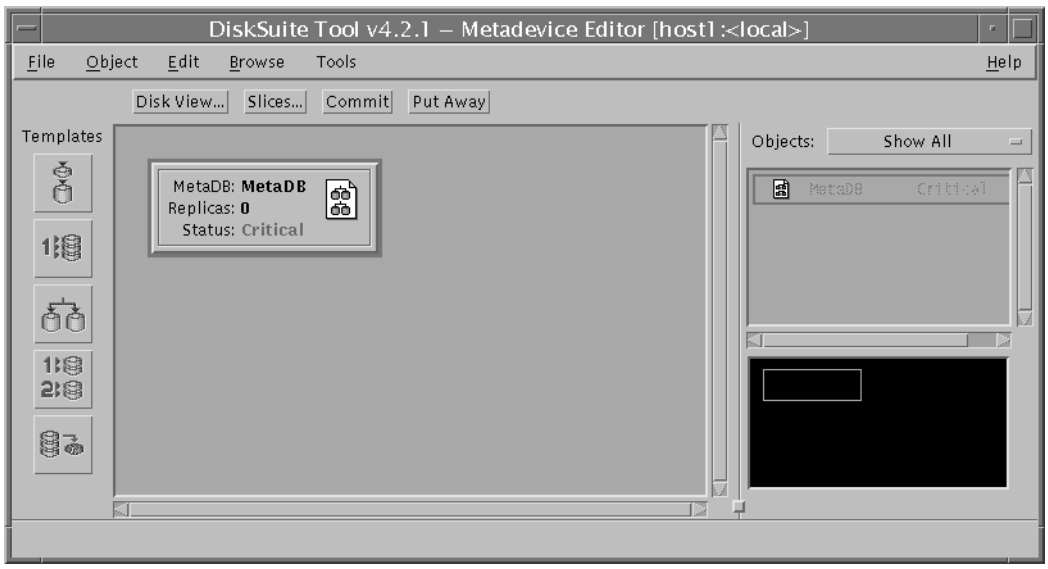


Figure 4-22 DiskSuite Tool – Metadevice Editor Window With MetaDB Icon Information

2. Use the MENU (right) mouse button to click the MetaDB object to display its menu. Select Info item.

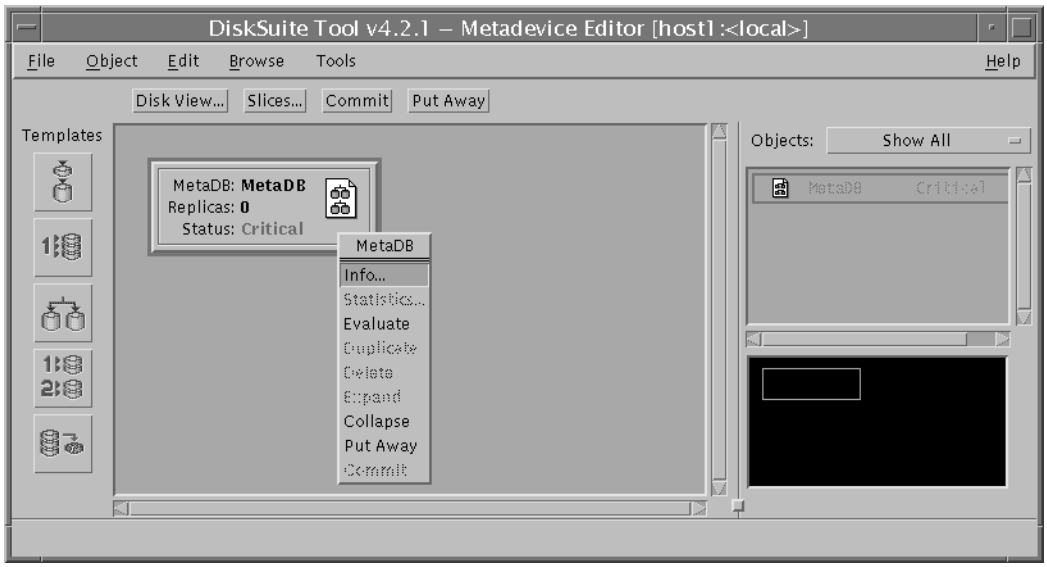


Figure 4-23 DiskSuite Tool – Metadevice Editor Window With MetaDB Information Menu

The Information window (Figure 4-22) is displayed.

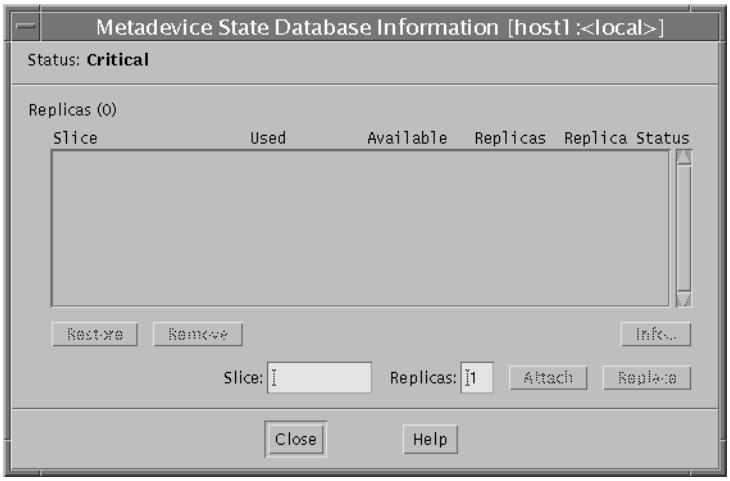


Figure 4-24 Metadevice State Database Information Window

3. In the field labeled Slice, enter the name of a small (approximately 5 Mbytes or more) slice; for example, `c1t2d0s0`.

4. In the field labeled Replicas, replace the initial value of 1 with 3.

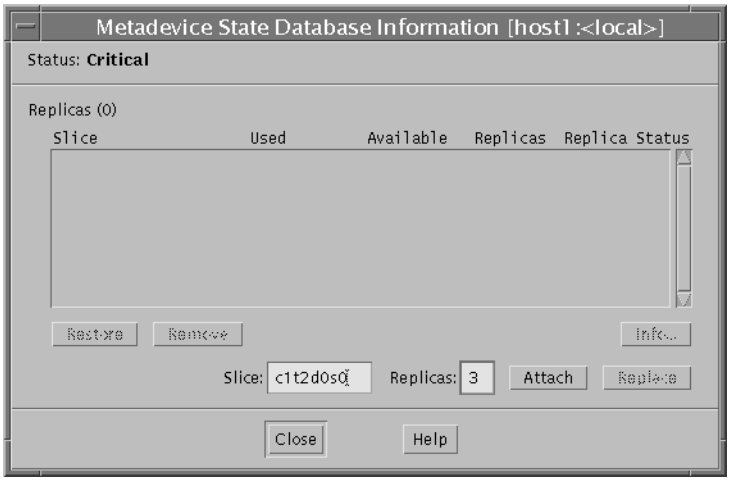


Figure 4-25 Metadevice State Database Information Window

5. Click Attach.

6. Click Close.

   The Information window closes.

7. Return to the DiskSuite Tool Metadevice Editor and verify that the MetaDB object is selected in the canvas area (Figure 4-26), and click Commit.

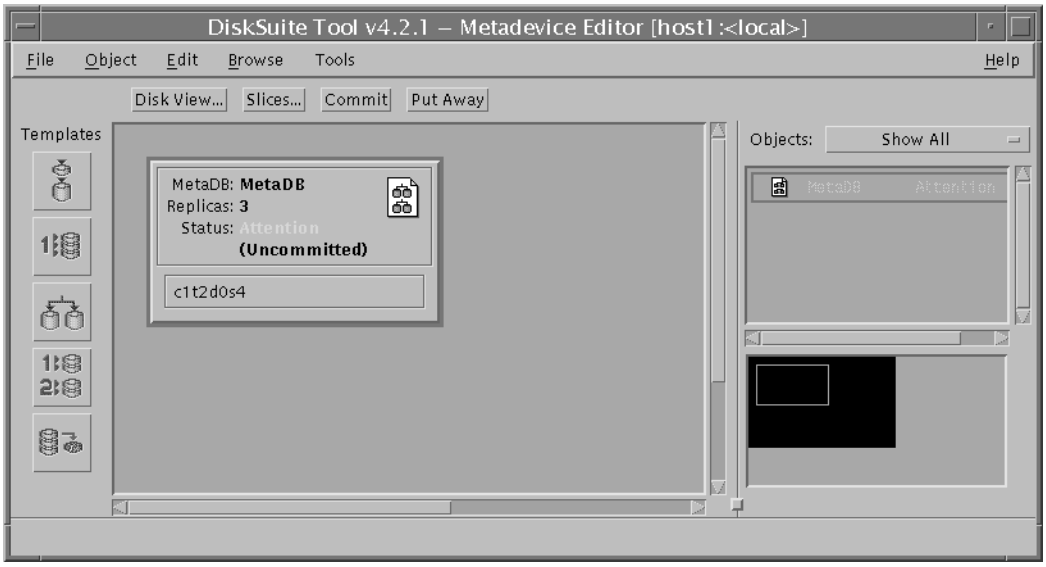


Figure 4-26 DiskSuite Tool – Metadevice Editor Window

A warning message is displayed that indicates that all of the replicas you are making are on the same controller.

Figure 4-27 Metastate Database Commit Warning Window

On a production system you would avoid doing this; however, you can accept this situation for the purposes of this lab.

8. Click Really Commit.

The MetaDB object status now displays Attention in yellow.

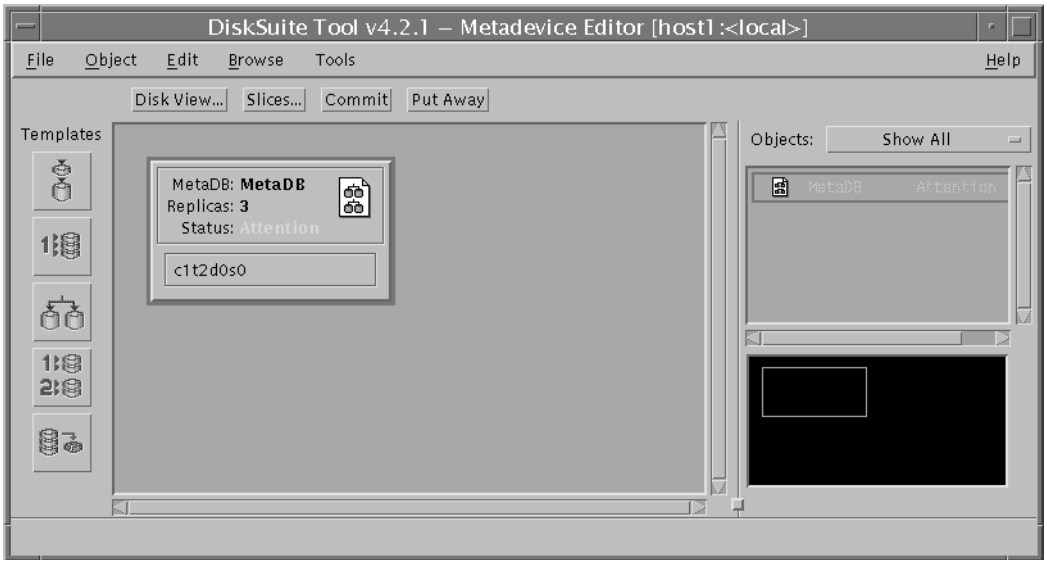


Figure 4-28 DiskSuite Tool – Metadevice Editor Window With Committed Metadevice

9. Click Put Away to remove the MetaDB object from the canvas.

The MetaDB icon moves out of the work area to the Objects list.

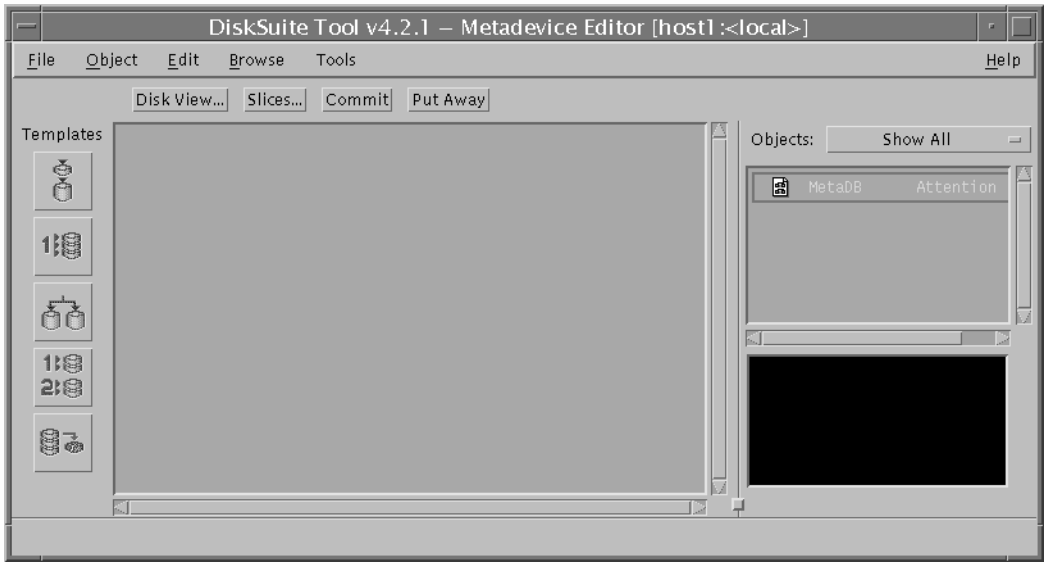


Figure 4-29 DiskSuite Tool – Metadevice Editor Window with Committed Metadevice in Objects Area

Concatenating File Systems

If your /export/data file system is filling up and you cannot afford to move the entire file system, using the Solstice DiskSuite application you can concatenate available space from other disk partitions to increase the available size of the /export/data file system.

To increase the size of the /export/data file system, perform the following steps:

1. Determine the current space available in the /export/data file system.

```
# df -k /export/data
Filesystem            kbytes    used   avail capacity  Mounted on
/dev/dsk/c1t2d0s5      74975   65273    2205    97%    /export/data
```

The output of the preceding command indicates that the /export/data file system, which is approximately 75 Mbytes in size, is almost full.

2. Click the Concatenate/Stripe template.

   A Concatenate/Stripe icon is displayed in the canvas of the DiskSuite Tool Metadevice Editor (Figure 4-30).

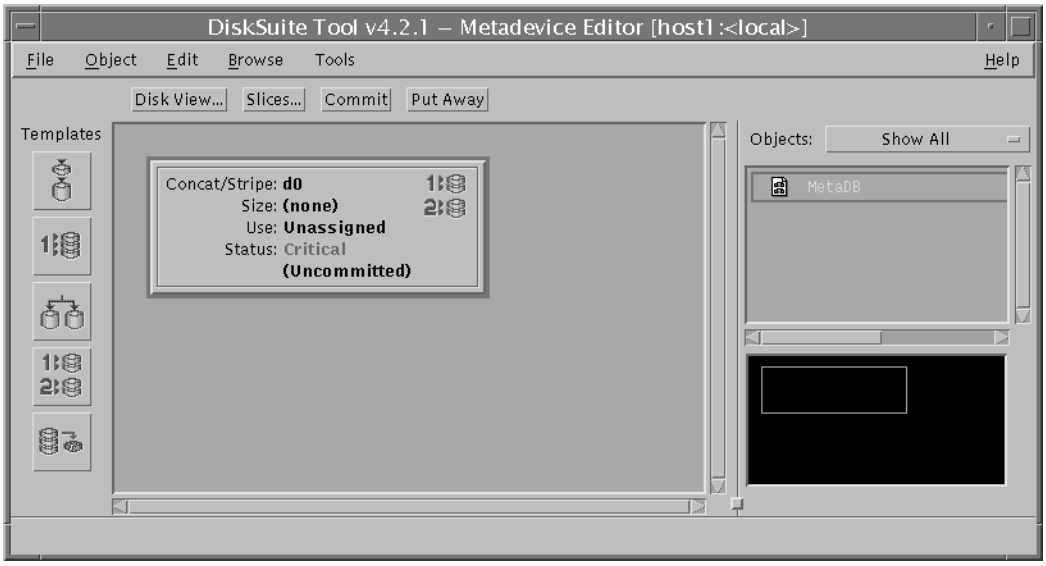


Figure 4-30 DiskSuite Tool – Metadevice Editor Window With Concatenate/Stripe Icon

3. Click Slices to view the disk slices (Figure 4-31) if they are not already displayed.

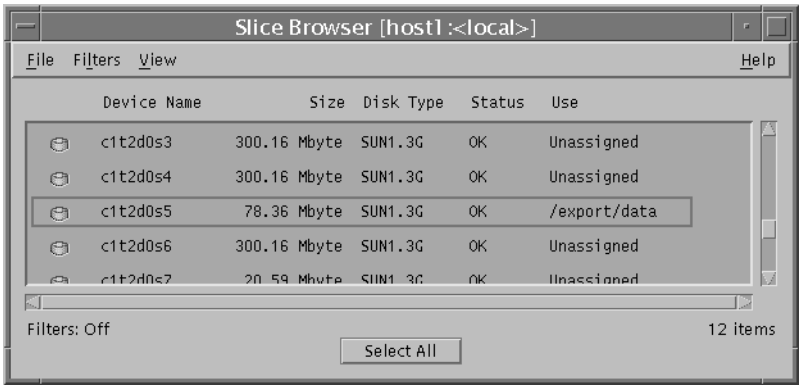


Figure 4-31 Slice Browser Window

4. Drag and drop the `/export/data` file system from the Slices view onto the Concatenate/Stripe template icon.

Note – DiskSuite Tool warns you that you have mounted file systems for the `/export/data` file system. Click Continue in the warning pop-up window (Figure 4-32).

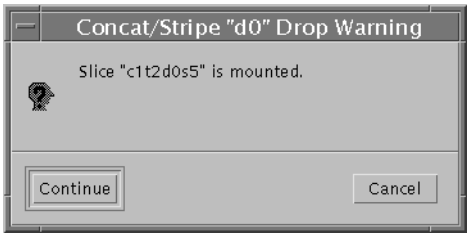


Figure 4-32 Concat/Stripe “d0” Drop Warning Window

The Concat/Stripe icon in the DiskSuite Metadevice Editor work area displays the Status of OK (Uncommitted) for slice `c1t2d0s5` as stripe `0` of `d0`.

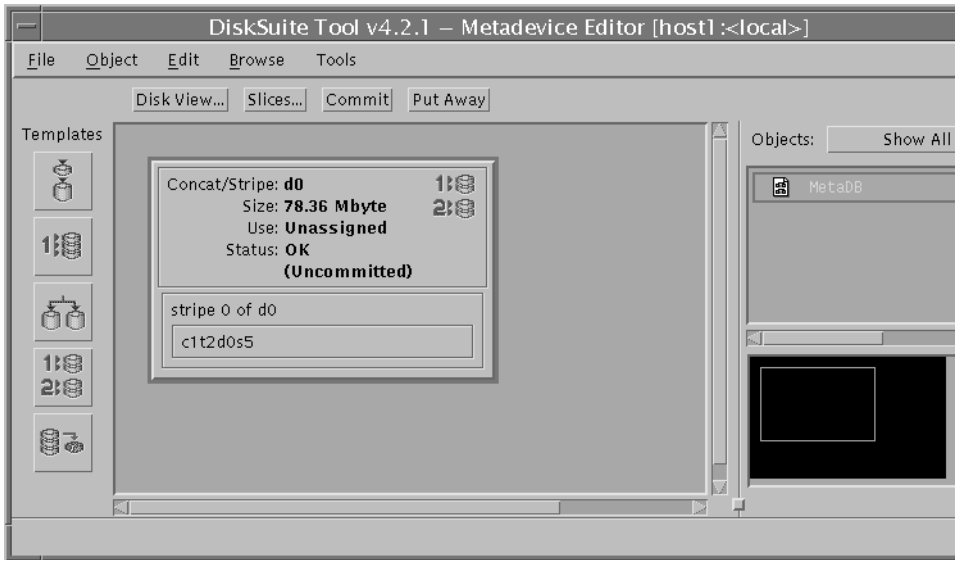


Figure 4-33 DiskSuite Tool – Metadevice Editor Window After Drag and Drop

5. Click Commit to save the change.

   This modifies the `/etc/vfstab` file logical device name entry for `/export/data` from `/dev/dsk/c1t2d0s5` to a new entry for the metadisk information, `/dev/md/dsk/d0`.

6. When the pop-up window labeled Concat/Stripe "d0" Commit Warning appears, click Really Commit.

Figure 4-34 Concat/Stripe "d0" Commit Warning Window

The Metadevice Editor window reflects the Status as OK.

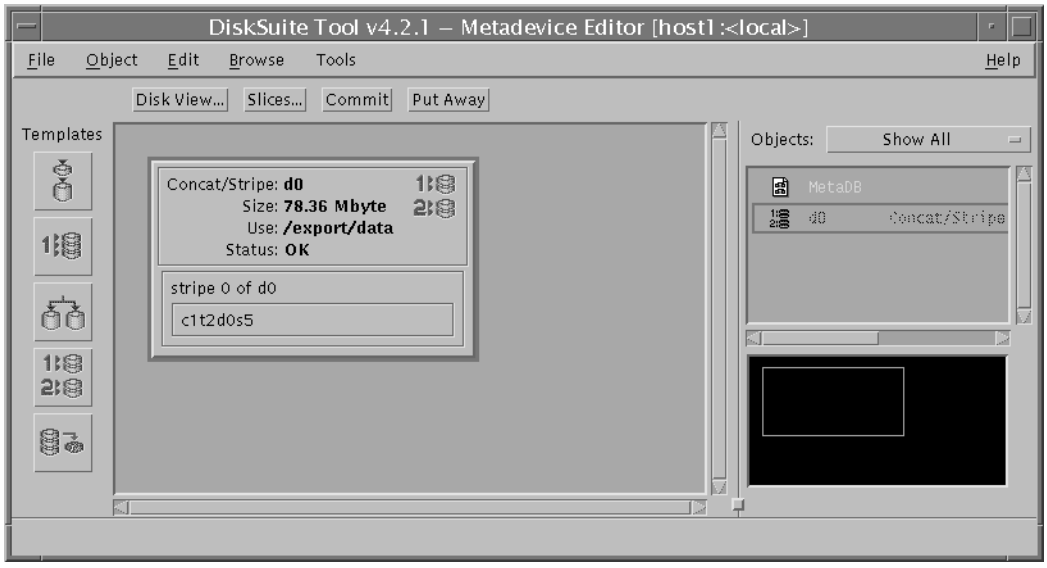


Figure 4-35 DiskSuite Tool – Metadevice Editor Window With d0 Status OK

7. Click Put Away.

The Concat/Stripe object moves from the work area of the Metadevice Editor to the Objects area.

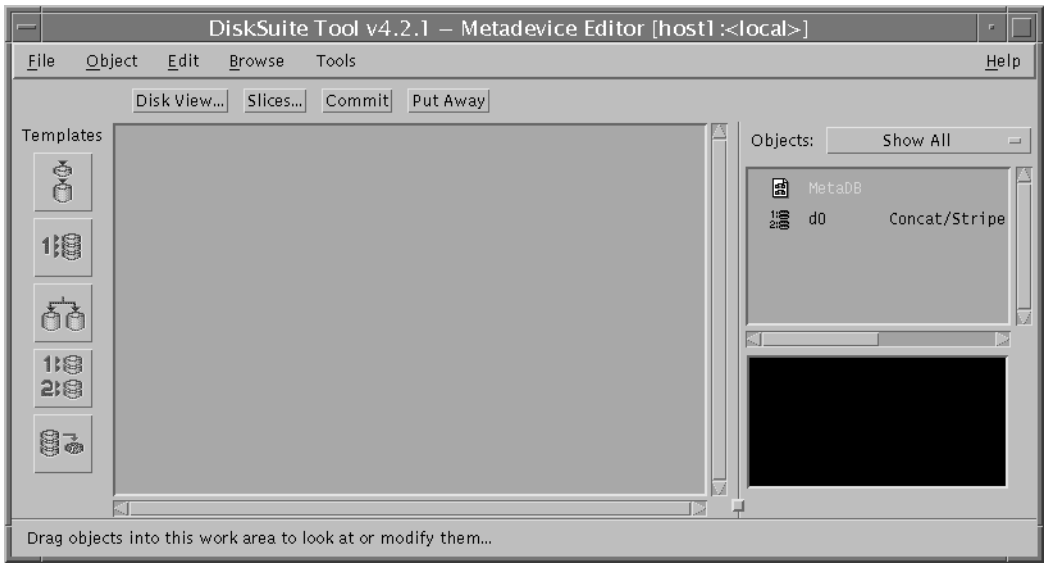


Figure 4-36 DiskSuite Tool – Metadevice Editor Window

8. Exit DiskSuite Tool and reboot the system or simply unmount and remount the `/export/data` file system to see the logical device name change from `/dev/dsk/c1t2d0s5` to `/dev/md/dsk/d0` in the output of the `mount` command.

   Before unmounting `/export/data`:

```
# mount -p | grep data
/dev/dsk/c1t2d0s5 - /export/data ufs - yes
rw,intr,largefiles,onerror=panic,suid,dev=2200000
```

Note – The `-p` option (of the `mount` command) prints the list of mounted file systems in the `/etc/vfstab` format. It must be the only option specified. You can also use the `df -k` command.

After unmounting and remounting `/export/data`:

```
# umount /export/data
# mount /export/data
# mount -p | grep data
/dev/md/dsk/d0 - /export/data ufs - yes
rw,intr,largefiles,onerror=panic,suid,dev=1540000
```

9. If you rebooted, wait for the system to present the Common Desktop Environment Welcome screen, log in as `root` and use a terminal window to start DiskSuite.

   If you unmounted and remounted the `/export/data` file system, start DiskSuite Tool from a terminal window.

```
# /usr/sbin/metatool &
```

   The DiskSuite Tool –Metadevice Editor window is displayed.

10. Double-click the Concat/Stripe object in the Objects area (on the right side of the DiskSuite Tool window) to bring it to the Work Area canvas (Figure 4-37).

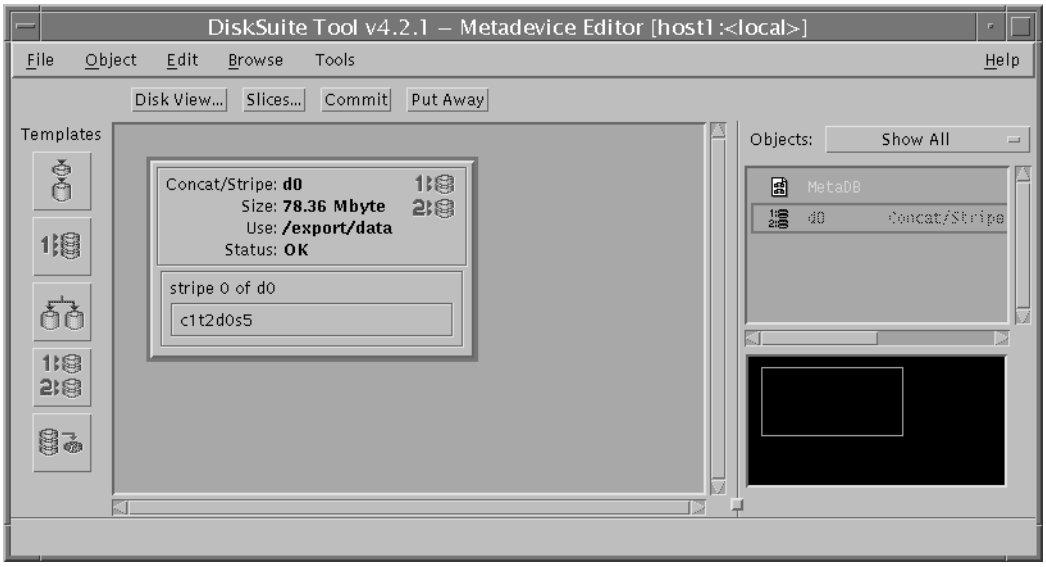


Figure 4-37 DiskSuite Tool – Metadevice Editor Window Displaying Metadevice `d0`

11. Click Slices to display the Slice Browser if it is not already running.

12. Select a slice containing the word “Unassigned” in the Use column from the Slice Browser.

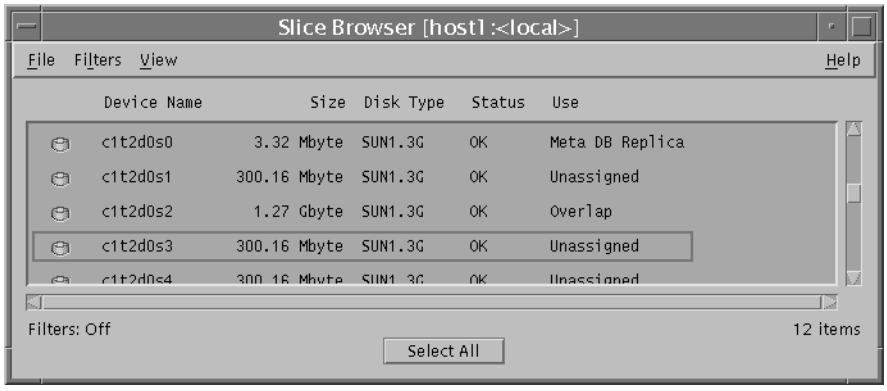


Figure 4-38 Slice Browser Window Displaying Unassigned Slice 3

13. Drag and drop that slice onto the Concat/Stripe icon in the canvas area.

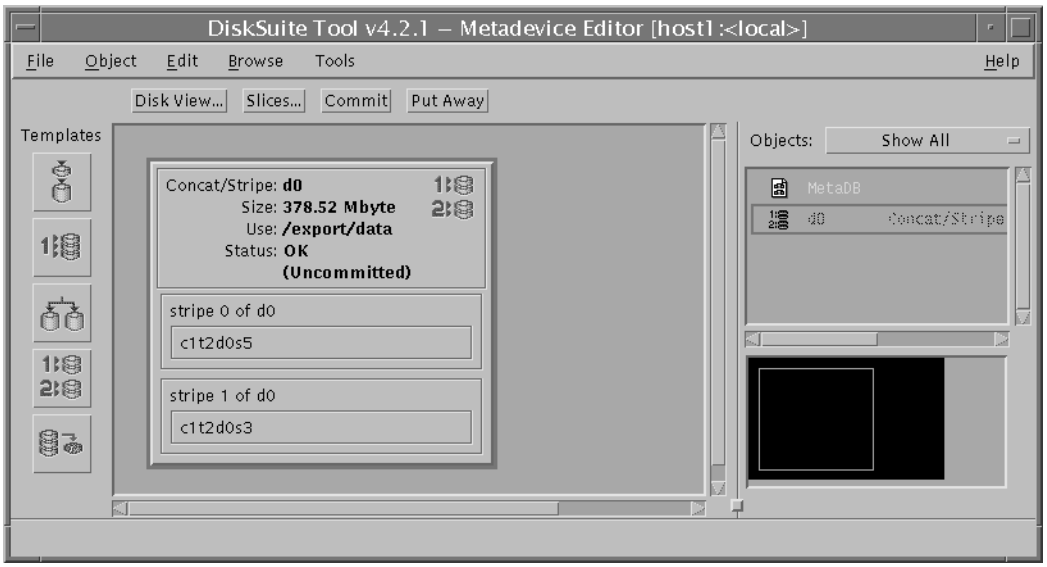


Figure 4-39 DiskSuite Tool – Metadevice Editor Window About to Concatenate Slice 3 and 5

14. Click Commit in the Metadevice Editor to save the change.

The Run GrowFS Command window (Figure 4-40) is displayed.

Figure 4-40 Run GrowFS Command Window

15. Click Grow Now.

    While the change is taking place, a GrowFS Running window is displayed.

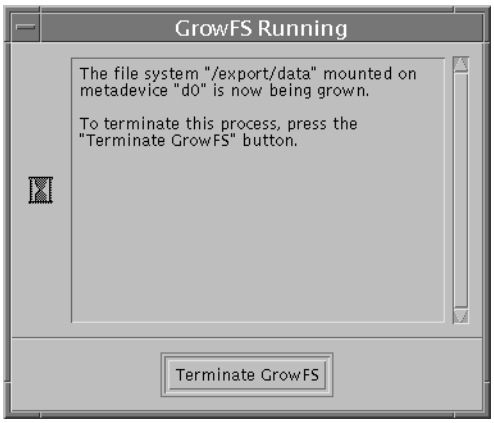


Figure 4-41 GrowFS Running Window

Note – Using the Solstice DiskSuite metadevice instead of the traditional disk device is a *permanent* change.

---

16. Run the `df` command to verify the increase in size of the `/export/data` directory:

```
# df -k /export/data
Filesystem            kbytes    used   avail capacity  Mounted on
/dev/md/dsk/d0        363967   65273  291197    19%    /export/data
```

The output from this command shows the entry in the `Filesystem` column to be `/dev/md/dsk/d0` rather than `/dev/dsk/c1t2d0s5` as previously displayed (*prior* to the creation of the metadevice for that slice). This output verifies that the `/export/data` file system has grown to include the size of Slice 3.

Note – The original data in the `/export/data` directory is preserved.

Exercise: Managing Disks

Exercise objective – In this lab, you install Solstice DiskSuite software, partition a spare disk, and use DiskSuite Tool to grow the `/export/data` file system.

Preparation

Locate the Solstice DiskSuite software on the Solaris 8 software CD-ROM (2 of 2) as described in the ''Installing the Solstice DiskSuite Software'' section on page 4-11. Identify a disk attached to your system that is available for use in this lab. Refer to the lecture notes as necessary to perform the steps listed.

Your instructor will give you any last minute exercise preparation details that might be required.

Task Summary

In this exercise, you accomplish the following:

- Install the Solstice DiskSuite 4.2.1 software from the Solaris 8 software CD-ROM (2 of 2) and reboot the system.
- Use the `format` utility to partition a spare disk to assign 5 Mbytes to Slice 0; 20 Mbytes to Slice 7; 20 percent of the remaining disk space to Slices 1, 3, and 4; and allow Slice 5 to hold all remaining space.
- Use Solstice DiskSuite to create two concatenations. Grow the existing `/export/data` and `/export/home` file systems using Slices 3 and 4 of the spare disk. This task is done in three phases:
  - Modify the MetaDB object to hold three state-database replicas on the 5-Mbyte Slice 0 of the spare disk.
  - Create one Concat/Stripe object (d0) for the `/export/data` file system. Create one Concat/Stripe object (d1) for the `/export/home` file system. Unmount and remount each file system or reboot the system.

- Add Slice 3 from the spare disk to the Concat/Stripe object (`d0`) for `/export/data`. Grow the `/export/data` file system onto the new space. Add Slice 4 from the spare disk to the Concat/Stripe object (`d1`) for `/export/home`. Grow the `/export/home` file system onto the new space. Check the `/etc/vfstab` file for changes. Verify the new disk space exists for both of these file systems.

Tasks

Installing Solstice DiskSuite

To install the Solstice DiskSuite 4.2.1 application software, perform the following steps:

1. Follow the steps described in "Installing the Solstice DiskSuite Software" section on page 4-11.

Partitioning a Spare Disk

2. In a terminal window, start the `format` utility.

   ```
   # format
   ```

3. From the list of disks displayed, select the disk that you did not use during the Solaris installation process, being certain to avoid selecting any disk that is currently in use.

4. From the format menu, select the partition item.

   ```
   format> partition
   partition>
   ```

5. From the partition menu, select `modify`. Use the All Free Hog method to partition your spare disk. Use Partition 5 as the Free Hog. Assign space to partitions according to the following table:

Slice	Size
0	5 Mbytes
1	200 Mbytes
3	200 Mbytes
4	200 Mbytes
6	0 Mbytes
7	0 Mbytes

The following example reflects responses to the format prompts when partitioning a 4-Gbyte external SCSI disk on an Ultra 10 system:

```
(partition table)
partition> modify
Select partitioning base:
0. Current partition table (unnamed)
1. All Free Hog
Choose base (enter number) [0]? 1
Do you wish to continue creating a new partition table based on the above
table [yes]? y
Free Hog partition[6]? 5
Enter size of partition '0' [0b, 0c, 0.00mb, 0.00gb]: 5mb
Enter size of partition '1' [0b, 0c, 0.00mb, 0.00gb]: 800mb
Enter size of partition '3' [0b, 0c, 0.00mb, 0.00gb]: 800mb
Enter size of partition '4' [0b, 0c, 0.00mb, 0.00gb]: 800mb
Enter size of partition '6' [0b, 0c, 0.00mb, 0.00gb]: <Return>
Enter size of partition '7' [0b, 0c, 0.00mb, 0.00gb]: 20mb
Okay to make this the current partition table [yes]? y
Enter table name (remember quotes): "test"
Ready to label disk, continue? y
```

6. Quit the `partition` menu and the `format` utility.

```
partition> q
format> q
```

Creating Concatenations

This section of the exercise is divided into three parts:

1. Creating state database replicas
2. Creating concatenation objects for `/export/data` and `/export/home`
3. Attaching new slices to the `/export/data` and `/export/home` metadisks.

You need to reboot the system between the first and second parts of the lab.

4. Open a terminal window and start DiskSuite Tool.

   # **/usr/sbin/metatool &**

   DiskSuite Tool displays an warning message indicating that no state- database replicas exist.

5. Click OK to dismiss this message.

6. In the object window, double-click the MetaDB object.

   This places the object on the DiskSuite canvas. Note that the status of this object is Critical (see Figure 4-22 on page 4-23).

7. Display the menu on the MetaDB and select the Info item.

   The information window displays (see Figure 4-24 on page 4-24).

8. In the text field labeled Slice, enter the name of the 5-Mbyte slice you created earlier. This should be Slice 0 of the spare disk (for example, `c1t3d0s0`).

9. In the text field labeled Replicas, replace the initial value of `1` with `3`.

10. Click Attach, and then close the information window.

11. Verify that the MetaDB object is selected in the canvas area, and click Commit.

    A warning message indicating that all of the replicas you are making are on the same controller is displayed. Although on a production system you would avoid doing this if possible, accept the situation for the purposes of this lab.

12. Click Really Commit.

    The MetaDB object status should now display Attention in yellow.

13. Click Put Away to remove the MetaDB object from the canvas.

Creating Concatenation Objects for /export/data *and* /export/home

14. Click Slices to display the Slice Browser.

    This should resemble Figure 4-31 on page 4-29.

15. Click the Concat/Stripe icon to the left of the canvas area. (It is the icon with the two disks, labeled 1 and 2.)

    This places a new Concat/Stripe object labeled d0 in the Metadevice Editor canvas area.

16. In the Slice Browser, locate the slice that is currently used to hold the /export/data file system, and use the SELECT button to drag that slice from the Slice Browser onto the new Concat/Stripe object in the canvas area.

    A warning indicating that the slice is mounted is displayed.

17. Click Continue.

18. Verify that the Concat/Stripe object is selected in the canvas area, and click on Commit.

    A warning indicating that changes will be made in /etc/vfstab is displayed.

19. Click Really Commit.

20. Click Put Away to place the d0 Concat/Stripe object back in the Object list area.

21. Repeat step 15 through step 20 to create a second Concat/Stripe object, called d1, and attach the slice used for /export/home.

    At the end of this process you should have three objects in your object list:

    - One MetaDB object, which uses *cxtxdxs0* to hold three state database replicas
    - One Concat/Stripe object for the /export/data directory called d0, where Stripe 0 of the object is *cxtxd0s5*
    - One Concat/Stripe object for the /export/home directory called d1, where Stripe 0 of the object is *cxtxd0s7*

22. Examine the entries in the Slice Browser for the `cxtxd0s5` and `cxtxd0s7` slices. What has changed in their Use column?

23. Exit DiskSuite Tool.

24. Reboot the system or unmount and remount the `/export/data` and `/export/home` file systems to see the change in the logical disk device name.

25. If you rebooted, wait for the system to present the Common Desktop Environment Welcome screen and log in as `root`.

Note – Instead of performing a `reboot`, you can `umount` and `mount` the `/export/data` and `/export/home` file systems.

Attaching New Slices to `/export/data` *and* `/export/home`

26. Open a terminal window and start DiskSuite Tool.

    # **`/usr/sbin/metatool &`**

27. Double-click on the d0 object to move it into the canvas area.

28. Click Slices to display the Slice Browser.

29. In the Slice Browser, locate the unassigned Slice `s3` from your spare disk (check the Use column). Drag this slice onto the `d0` Concat/Stripe object in the canvas area, and be certain to drop it on the main `d0` object, and not on the other slice already in place.

30. Click Commit.

    A dialog box asks if you want to grow the file system now or later. While a file system grows it must be idle. DiskSuite Tool prevents I/O to this device while growing the file system.

31. Click Grow Now.

    The Concat/Stripe object reflects the change in Status of `OK`.

32. Put away the `d0` object.

33. Repeat step 27 through step 32 for the `d1` Concat/Stripe object, but use the unassigned slice `s4`.

At the end of this process you should have three objects in your object list similar to the following:

- One MetaDB object, which uses `cxtxd0s0` to hold three state database replicas
- One Concat/Stripe object called `d0`, where Stripe `0` of the object is `cxtxd0s5`, and Stripe 1 is `cxtxd0s3`
- One Concat/Stripe object called `d1`, where Stripe `0` of the object is `cxtxd0s7`, and Stripe 1 is `cxtxd0s4`

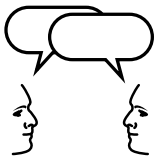
Note – The actual controller (`cx`) and target number (`tx`) can vary, depending on system disk configuration.

---

34. Exit the DiskSuite Tool.
35. Use the `df -k` command to check for the new space on the `/export/data` and `/export/home` file systems.
36. Examine the `/etc/vfstab` file to see the changes that have been made there.

Exercise: Managing Disks

Exercise Summary



Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- ❑ List the three utilities used to create, check, and mount file systems
- ❑ Identify the physical path name differences between physical disks and virtual disks
- ❑ List the potential advantages of any virtual disk management application
- ❑ List the basic difference between Solstice DiskSuite and Sun StorEdge Volume Manager
- ❑ List the main advantages of using a concatenated virtual file system
- ❑ List the main advantage of using a striped virtual file system
- ❑ Install the Solstice DiskSuite applications
- ❑ Use the Solstice DiskSuite application to dynamically grow a file system

Further Study

The Solstice DiskSuite and Sun StorEdge Volume Manager are complex applications. Sun Educational Services has training available for each of these products.

- ES-310: *Volume Manager With SPARCstorage Array*
- ES-220: *Disk Management With DiskSuite*

Solaris Pseudo File Systems and Swap Space 5

Objectives

Upon completion of this module, you should be able to:

- List the Solaris pseudo file system types
- Describe the relationship between system processes and the `/proc` directory
- Describe how the `tmpfs` file system improves performance
- Use the `dumpadm` program to display system dump configuration
- Use the `coreadm` command to display core file configuration
- Create and add a swap file or partition to the swap space

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- *System Administration Guide, Volume I*, Part Number 805-3727-10
- *System Administration Guide, Volume II*, Part Number 805-3728-10

Solaris Pseudo File Systems

Pseudo file systems are sometimes called RAM-based file systems. Their most distinguishing feature is that they do not reside on hard physical media. They reside only in physical memory while the operating system is running.

You use pseudo file systems to increase performance. They enhance performance because they provide access to data in physical memory, instead of disk-based structures. They enable the use of typical file system operation semantics (for example, the use of the standard system calls) for access to the underlying data structures.

The pseudo file systems supported in the Solaris 8 Operating Environment include:

- `procfs` – The Process file system contains a list of active processes, named according to process number, in the `/proc` directory. Information in this directory is used by commands, such as the `ps` command. See the `proc`(4) man page.
- `tmpfs` – The Temporary file system for file storage in memory without the overhead of writing to a disk-based file system. It is created and destroyed every time the system is rebooted.
- `fdfs` – The File Descriptor file system provides explicit names for opening files using file descriptors (for example, `/dev/fd/0`, `/dev/fd/1`, `/dev/fd/2`) in the `/dev/fd` directory.
- `swapfs` – The Swap file system is used by the `kernel` to manage swap space on disk(s).

The /proc *File System*

The /proc directory is a mount point for a pseudo file system that provides access to the state of each process and light-weight process (LWP) in the system. You can write applications to access this state information using the standard system calls.

The process information stored in the /proc file system changes as the process moves through its life cycle.

Beginning with the Solaris 2.6 Operating Environment release, the previously flat /proc file system was restructured into a directory hierarchy that contains additional subdirectories for state information and control functions.

The following are the characteristics of the new directory structure of /proc:

- The name of each entry in the /proc directory is a decimal number corresponding to a process ID.
- Each process ID named directory in /proc has files that contain more detailed information about that process.
- The owner of each file in /proc directory and below is determined by the user ID of the process.

The /proc directory is mounted at system boot time by scripts called from /sbin/rcS. The following example from the /etc/vfstab file shows the mounting of the proc file system on the /proc mount point:

```
#device         device    mount    FS      fsck    mount   mount
#to mount       to fsck   point    type    pass    at boot options

/proc            -        /proc    proc     -       no       -
```

The tmpfs *File System*

The tmpfs file system uses the virtual memory (VM) subsystem. Once this file system is mounted, it supports standard file operations and semantics. Files and directories in this file system are temporary and are released when the tmpfs is unmounted or the system reboots.

This file system supports better performance by maintaining files and directories in RAM. This performance enhancement is most noticeable when a large number of short-lived files are written and accessed on this file system.

The following example from the /etc/vfstab file shows the mounting of tmpfs on the virtual memory subsystem at boot time:

```
#device         device    mount    FS      fsck    mount   mount
#to mount       to fsck   point    type    pass    at boot options
swap              -        /tmp     tmpfs     -       yes      -
```

As a result of using tmpfs, all data written to /tmp is written to RAM if space is available. If RAM space is not available, then any data written to /tmp is written to swap space instead.

The `fdfs` *File System*

The `fdfs` file system is a pseudo file system that maintains a repository of file descriptors for open files. Running programs access files by using these file descriptors.

The following example from the `/etc/vfstab` file shows the mounting of the `fdfs` file system on the `/dev/fd` mount point at system boot time:

```
#device         device    mount    FS      fsck    mount   mount
#to mount       to fsck   point    type    pass    at boot options
fd              -         /dev/fd  fd      -       no      -
```

Table 5-1 describes each file descriptor.

Table 5-1 File Descriptor Usage

File Descriptor	Description
`/dev/fd/0`	`Standard input` (`stdin`)
`/dev/fd/1`	`Standard output` (`stdout`)
`/dev/fd/2`	`Standard error` (`stderr`)
`/dev/fd/3`	Name of file (`file`)

The swapfs *File System*

The Solaris Operating Environment software can use disk partitions for temporary memory storage, in addition to using partitions to store file systems. Partitions used to store memory images are called *swap partitions*.

Swap partitions are used as virtual memory storage areas when the system does not have enough physical memory to handle the needs of the currently running processes. Additionally, swap *files* can be used to augment swap space.

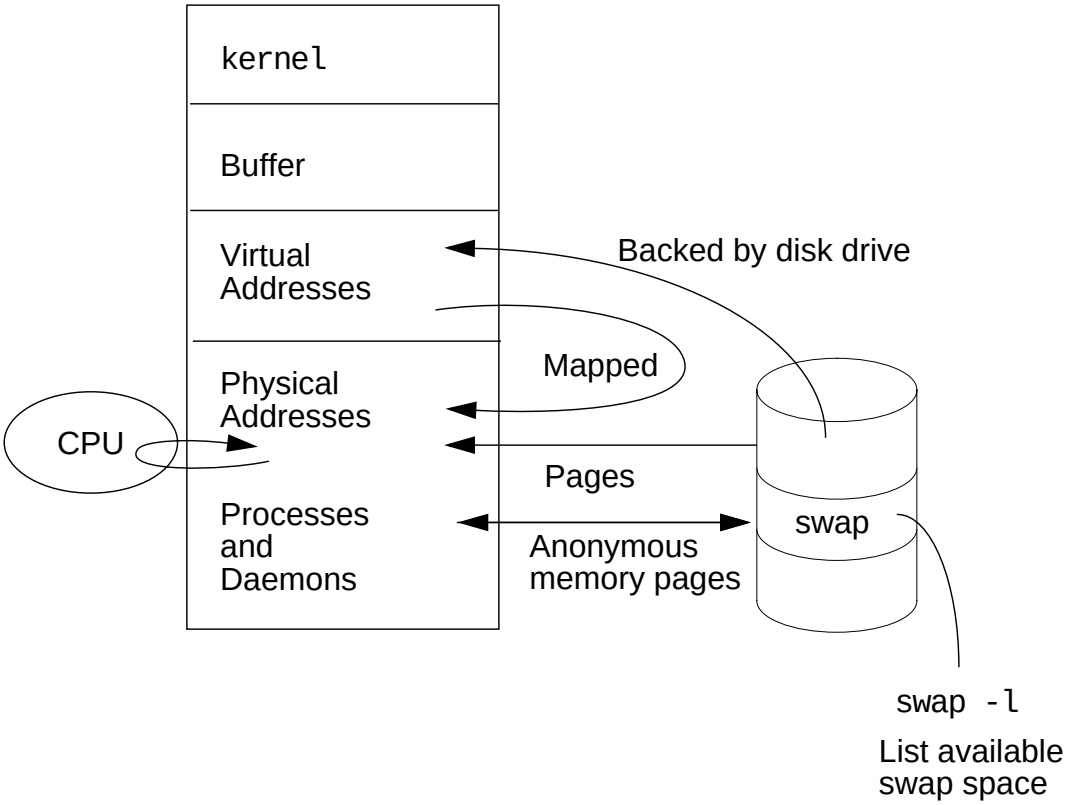


Figure 5-1 Swap Space Definition

Virtual and Physical Addresses

The Solaris virtual memory system maps the files on disk to virtual addresses in memory. As the instructions or static data in those files are needed, the virtual memory system maps the virtual addresses in memory to real physical addresses in memory. The data or instructions

in those files are then paged from the disk into physical memory for use by the CPU. These types of physical pages of memory are always backed by known files on the disk.

Anonymous Memory Pages

In addition to containing program instructions or static data, physical memory pages can contain private data or stack information generated by running processes. The information in these pages of physical memory is not backed by a file in the file system. Therefore, these pages can be backed only by swap space on disk in the event that they must be temporarily paged out of memory. Because these private data or stack pages in physical memory are not backed by an actual file on the disk, but solely by swap space, they are referred to as anonymous memory pages.

Reserving Swap Space

When a process is run by the kernel, swap space for any private data or stack space used by the process must be reserved. This reservation occurs just in case the private data or stack information would have to be paged out of physical memory, due to multiple processes contending for limited memory space.

Without the use of virtual swap, large amounts of physical swap space would have to be configured on systems to accommodate these reservations. Even systems capable of avoiding paging by having large amounts of physical memory available would still need large swap areas configured for these reservations just in case.

However, with the virtual swap space provided in the Solaris Operating Environment by the `swapfs` file system, the need for configuring large amounts of physical swap space can be reduced on systems with large amounts of available memory. This reduced need for physical swap space can occur because `swapfs` provides virtual swap space addresses rather than real physical swap space addresses in response to the requests to reserve swap space.

With `swapfs` providing virtual swap space, real physical swap space is required only with the onset of paging, due to processes contending for memory. In this situation, `swapfs` must convert the virtual swap space addresses to physical swap space addresses for paging to actual swap space to occur.

Criteria for Swap Space

With the addition of `swapfs`, the size of swap space is based entirely on two criteria:

- To save any possible panic dumps resulting from a fatal system failure, there must be sufficient swap space to hold the necessary memory pages in RAM at the time of the failure.
- The amount of RAM + swap memory must be at least equal to the requirements of both the Solaris Operating Environment and any concurrently running processes.

Swap Space

If you use `tmpfs`, you should be aware of some constraints involved in mounting a `tmpfs` file system. The resources used by `tmpfs` are the same as those used when commands are executed. This means that large sized `tmpfs` files can affect the amount of space left over for programs to execute. Likewise, programs requiring large amounts of memory use up the space available to `tmpfs`. Users running into this constraint (for example, running out of space on `tmpfs`) can allocate more swap space by using the `swap` command.

You can add or delete swap space using the `swap` command. When swap files or swap partitions are mounted for access by the kernel memory manager, the file type used is `swap` (observe the contents of the `/etc/vfstab` file).

Using the `swap` *Command*

As the system administrator, you can add swap files or partitions.

Command Format

```
swap [ options ] [ argument ]
```

Options

- `-l`

  Lists swap space

- `-a`

  Adds to swap

- `-d`

  Deletes from swap

- `-s`

  Summarizes swap space

Adding a Swap File

Figure 5-1 illustrates the allocation of swap space.

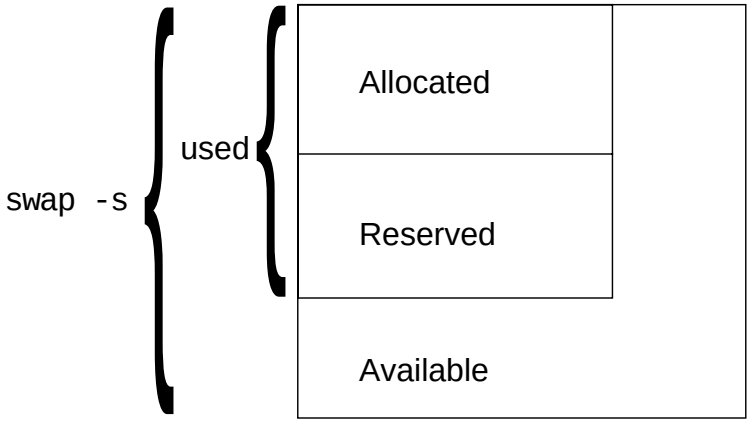


Figure 5-2 Swap Space Allocation

To add a swap file, complete the following steps:

1. List a summary of the system's virtual swap space.

```
# swap -s
total: 25728k bytes allocated + 6140k reserved = 31868k used, 56496k
available
```

2. List the details of the system's physical swap space.

```
# swap -l
swapfile             dev  swaplo blocks   free
/dev/dsk/c0t3d0s1   32,28      8  98792  90384
```

3. Using the `df` command, display the amount of disk space occupied by currently mounted file systems, the amount of used and available space, and how much of the file system's total capacity has been used. From this output, determine which partition has enough space for a swap file of at least 20 Mbytes.

```
# df -k
Filesystem            kbytes    used   avail capacity  Mounted on
/dev/dsk/c0t3d0s0     245455   87061  158149    36%    /
/dev/dsk/c0t3d0s6     480815  375163  105172    79%    /usr
/proc                      0       0       0     0%    /proc
fd                         0       0       0     0%    /dev/fd
/dev/md/dsk/d0        231815      82  231502     1%    /export/data
/dev/md/dsk/d1         67159       9   67083     1%    /export/swap
swap                  103844     204  103640     1%    /tmp
```

The /export/data file system appears to have more than enough space to create an additional swap file. Create a 20-Mbyte swap file named swapfile in the /export/data directory.

```
# mkfile 20m /export/data/swapfile
```

4. Add a swap file to the system's swap space.

```
# swap -a /export/data/swapfile
```

5. List the details of the modified system swap space.

```
# swap -l
swapfile                 dev      swaplo      blocks free
/dev/dsk/c0t3d0s1       32,28       8      98792   90384
/export/data/swapfile      -             8   20472    20472
```

6. List a summary of the modified system swap space.

```
# swap -s
total: 25728k bytes allocated + 6140k reserved = 31868k used, 66708k
available
```

Removing a Swap File

To remove a swap file, complete the following steps:

1. To delete a swap file while online, issue the following command. (Deleting the swap file stops swapping and empties the specified disk space.)

```
# swap -d /export/data/swapfile
```

2. Remove the swap file to free disk space.

```
# rm /export/data/swapfile
```

Adding a Swap Slice

To add a swap slice, complete the following steps:

1. Add information about the swap partition you created to the file system table (the `/etc/vfstab` file).

```
# vi /etc/vfstab
#device          device   mount   FS      fsck   mount     mount
#to mount        to fsck  point   type    pass   at boot   opt
/dev/dsk/c0t2d0s1  -     -       swap    -      no        -
```

2. Reboot the system or use the `swap -a` command to add the additional swap area.

Adding a Permanent Swap File Using the `/etc/vfstab` File

To add a permanent swap file, complete the following steps:

1. Edit the `/etc/vfstab` file and add the entry for the file.

```
# vi /etc/vfstab
#device            device   mount   FS      fsck    mount     mount
#to mount          to fsck  point   type    pass    at boot   opt
/export/data/swapfile -     -       swap     -      no         -
```

2. Reboot the system or use the `swap -a` command to add additional swap space.

The dumpadm *Command*

The dumpadm program is an administrative command that manages the configuration of the operating system crash dump facility.

Note – A panic dump contains a copy of the "interesting portions" of physical memory at the time of a fatal system error.

If a fatal operating system error occurs, a message describing the error is printed to the console. The operating system then generates a crash dump by writing the contents of physical memory to a predetermined dump device, which is typically a local disk partition. The dump device can be configured by using dumpadm. Once the crash dump has been written to the dump device, the system reboots.

Fatal operating system errors can be caused by bugs in the operating system, its associated device drivers and loadable modules, or by faulty hardware. Whatever the cause, the crash dump itself provides invaluable information to your support engineer to aid in diagnosing the problem.

Following an operating system crash, the savecore(1M) utility is executed automatically during a boot up to retrieve the crash dump from the dump device. It then writes the crash dump to a pair of files in your file system named unix.*X* and vmcore.*X*, where *X* is an integer identifying the dump.

The kernel core information placed in the file /var/crash/'uname -n'/vmcore.*X* is accessed from the device /dev/mem. The name list information placed in the file /var/crash/'uname -n'/unix.*X* is accessed from the device /dev/ksyms.

Together, these data files form the saved crash dump. The directory in which the crash dump occurred is saved when you reboot, and you can use the dumpadm command to configure it.

By default, the dump device is configured to be an appropriate swap partition. Swap partitions are disk partitions reserved as virtual memory backing store for the operating system, and thus no permanent information resides there to be overwritten by the dump.

To view the current dump configuration, execute `dumpadm` with no arguments. For example:

```
# dumpadm
Dump content: kernel pages
Dump device: /dev/dsk/c0t0d0s1 (swap)
Savecore directory: /var/crash/host1
Savecore enabled: yes
```

When no options are specified, `dumpadm` prints the current crash dump configuration. The previous example shows the set of default values: the dump content is set to `kernel` memory pages only, the dump device is a swap disk partition, the directory for `savecore` files is set to `/var/crash/`*`hostname`*, and `savecore` is set to run automatically on reboot. The default values are set in the `/etc/dumpadm.conf` file. For example:

```
# cat /etc/dumpadm.conf
# dumpadm.conf
#
# Configuration parameters for system crash dump.
# Do NOT edit this file by hand -- use dumpadm(1m) instead.
#
DUMPADM_DEVICE=/dev/dsk/c0t0d0s1
DUMPADM_SAVDIR=/var/crash/host1
DUMPADM_CONTENT=kernel
DUMPADM_ENABLE=yes
```

Note – All modifications to the `dumpadm` configuration should be done at the command line using the `dumpadm` utility, rather than attempting to edit the `/etc/dumpadm.conf` file. This could result in an inconsistent system dump configuration.

Command Format

```
/usr/sbin/dumpadm [-nuy] [-c content-type] [-d dump-device]
[ -m min k| min m | min%] [-s savecore-dir] [-r root-dir]
```

- `-c` *`content-type`* – Specifies the contents of the crash dump.
  - `kernel` – Indicates `kernel` memory pages only.
  - `all` – Indicates all memory pages.
- `-d` *`dump-device`* – Modifies the dump configuration to use the specified dump device.
  - *`dump-device`* – Specifies a specific dump device specified as an absolute path name, such as `/dev/dsk/c#t#d#s#`.
  - `swap` – Specifies the special token swap. If this swap is specified as the dump device, `dumpadm` examines the active swap entries and selects the most appropriate entry to configure as the dump device. See `swap(1M)`.
- `-m min` *`k`* `|` `min` *`m`* `|` *`min%`* – Creates a `minfree` file in the current `savecore` directory indicating that `savecore` should maintain at least the specified amount of free space in the file system where the `savecore` directory is located.
  - *`k`* – Indicates a positive integer suffixed with the unit *`k`* specifying kilobytes.
  - *`m`* – Indicates a positive integer suffixed with the unit *`m`* specifying megabytes.
  - `%` – Indicates a percent (%) symbol, indicating the `minfree` value should be computed as the specified percentage of the total current size of the file system containing the `savecore` directory.
- `-n` – Modifies the dump configuration so it does not run `savecore` automatically on reboot.
- `-r` *`root-dir`* – Specifies an alternative `root` directory relative to which `dumpadm` should create files. If no `-r` argument is specified, the default root directory "`/`" is used.

- `-s` *`savecore-dir`* – Modifies the dump configuration to use the specified directory to save files written by `savecore`. The default `savecore` directory is `/var/crash/`*`hostname`* where *`hostname`* is the output of the `-n` option to the `uname`(1) command.
- `-y` – Indicates that `savecore` is automatically run on reboot. This is the default for this dump setting.

The coreadm *Command*

Use the coreadm command to specify the name or location of core files produced by abnormally-terminating processes.

The coreadm command provides flexible core file naming conventions and better core file retention. For example, you can use the coreadm command to configure a system so that all process core files are placed in a single system directory. This means it is easier to track problems by examining the core files in a specific directory whenever a Solaris process or daemon terminates abnormally.

Two new configurable core file paths, per-process and global, can be enabled or disabled independent of each other. When a process terminates abnormally, it produces a core file in the current directory, as in previous Solaris Operating Environment releases. But if a global core file path is enabled and set to /corefiles/core, for example, then each process that terminates abnormally produces two core files: one in the current working directory and one in the /corefiles directory.

Note – If the core file path does not exist, you must create it.

Command Format

The following command can be run by regular users and is used to specify the file name pattern to be used by the operating system when generating a per-process core file.

```
coreadm [-p pattern] [pid]...
```

The following command is run by root only and is used to configure system-wide core file options.

```
coreadm [ -g pattern ]  [ -i pattern ]  [ -d option  ...  ]
     [ -e option ... ]
```

Default `coreadm` *Command Without Options*

Using the `coreadm` with no options displays the typical default settings from the `/etc/coreadm.conf` file.

```
# coreadm
     global core file pattern:
       init core file pattern: core
            global core dumps: disabled
      per-process core dumps: enabled
     global setid core dumps: disabled
per-process setid core dumps: disabled
     global core dump logging: disabled
```

The first line of output identifies the name to use for core files placed in a global directory. When generated, a global core file is created with mode 600 and is owned by the superuser. Non-privileged users cannot examine such files.

The second line of output identifies the name to be used if the `init` process generates a core file.

The third line indicates that global core files are disabled.

The fourth line indicates that core files in the current directory are enabled. Ordinary per-process core files are created with mode 600 under the credentials of the process. The owner of the process can examine such files.

In the fifth and sixth lines, if `setid` core files are enabled, they are created with mode 600 and are owned by the superuser.

The seventh line identifies whether the global core dump logging is enabled.

Caution – A process that has a `setuid` mode presents security issues with respect to dumping core files, as it might contain sensitive information in its address space to which the current non-privileged owner of the process should not have access. Normally `setuid` core files are not generated because of this security issue.

Note – Complete all modifications to the `coreadm` configuration at the command line using the `coreadm` utility instead of editing the `/etc/coreadm.conf` file. If you manually edit the `coreadm` configuration file, you must reboot the system or run `coreadm -u`.

Viewing the `/etc/coreadm.conf` file verifies the same configuration parameters that were described on page 5-18:

```
# cat /etc/coreadm.conf
# coreadm.conf
#
# Parameters for system core file configuration.
# Do NOT edit this file by hand -- use coreadm(1) instead.
COREADM_GLOB_PATTERN=
COREADM_INIT_PATTERN=core
COREADM_GLOB_ENABLED=no
COREADM_PROC_ENABLED=yes
COREADM_GLOB_SETID_ENABLED=no
COREADM_PROC_SETID_ENABLED=no
COREADM_GLOB_LOG_ENABLED=no
```

Patterns

A core file name pattern is a normal file system path name with embedded variables, specified with a leading percent (%) character. These variables are expanded from values in effect when a core file is generated by the operating system. The possible variables are:

- `%p` – Process ID
- `%u` – Effective user ID
- `%g` – Effective group ID
- `%f` – Executable file name
- `%n` – System node name (`uname -n`)
- `%m` – Machine hardware name (`uname -m`)
- `%t` – Decimal value of `time`(2)
- `%%` – Literal %

Examples

The following examples show various ways to use the `coreadm` command.

Example 1 – Setting the Core File Name Pattern as a Regular User

When executed from a user's `$HOME/.profile` or `$HOME/.login`, the following command sets the core file name pattern for all processes run during the login session:

```
$ coreadm -p core.%f.%p $$
```

Note – $$ is the process ID of the currently running shell. The per-process core file name pattern is inherited by all child processes.

Example 2 – Dumping a User's Files into a Subdirectory

The following command dumps all of the user's core dumps into the `corefiles` subdirectory of the `home` directory, discriminated by the system node name. This is useful for users who use many different machines but have a shared `home` directory.

```
$ coreadm -p $HOME/corefiles/%n.%f.%p $$
```

Example 3 – Enabling and Setting the Core File Global Name Pattern

The following is an example of setting *system-wide* parameters that add the executable file name and PID to the name of any potential `core` file that might be created:

```
# coreadm -g /var/core/core.%f.%p -e global
```

For example, the core file name pattern: `/var/core/core.%f.%p` causes the `foo` program with process ID 1234, to generate the core file `/var/core/core.foo.1234`.

To verify that this parameter is now part of the `coreadm` configuration, run the `coreadm` command again:

```
# coreadm
       global core file pattern: /var/core/core.%f.%p
         init core file pattern: core
              global core dumps: enabled
         per-process core dumps: enabled
        global setid core dumps: disabled
   per-process setid core dumps: disabled
        global core dump logging: disabled
```

Example 4 – Checking the Core File Configuration for Specific Process IDs

The `coreadm` command with only a list of process IDs reports each process's per-process core file name pattern, for example:

```
$ coreadm 278 5678
278: core.%f.%p
5678: /home/george/cores/%f.%p.%t
```

Only the owner of a process or the superuser can interrogate a process in this manner.

When a core dump occurs, the operating system generates two possible core files, the global core file and the per-process core file. Depending on the system options in effect, one file, both files, or no files can be generated. When generated, a global core file is created in Mode `600` and is owned by the superuser. Non-privileged users cannot examine such files.

Ordinary per-process core files are created in Mode `600` under the credentials of the process. The owner of the process can examine such files.

Options Supported by `coreadm`

The following are some useful options to the `coreadm` command.

- `-i` *`pattern`*

  Sets the per-process core file name pattern for init to *`pattern`*. This is the same as `coreadm -p pattern 1` except that the setting is persistent across `reboot`. Only a superuser can use this option.

- `-e` *`option`*

  Enables the specified core file option. Specifies the option as one of the following:

  - `global`

    Allows core dumps using the global core pattern.

  - `process`

    Allows core dumps using the per-process core pattern.

  - `global-setid`

    Allows `setid` core dumps using the global core pattern.

  - `proc-setid`

    Allows `setid` core dumps using the per-process core pattern.

  - `log`

    Generates a `syslog(3)` message when a user attempts to generate a global core file. Only superuser can use this option.

- `-d` *`option`*

  Disables the specified core file option. See the `-e` option for descriptions of possible options. Multiple `-e` and `-d` options can be specified on the command line. Only `root` can use this option.

- `-u`

  Updates system-wide core file options from the contents of the configuration file `/etc/coreadm.conf`. If the configuration file is missing or contains invalid values, default values are substituted. Following the update, the configuration file is resynchronized with the system core file configuration. Only superuser can use this option.

Exercise: Managing Pseudo File Systems and Swap Space

Exercise objective – In this lab, you understand the pseudo file systems described in the module.

Preparation

Your instructor will give you any last-minute exercise preparation details that might be required.

Task Summary

In this exercise, you accomplish the following:

- Select a process from the process table and verify the process number, ownership, and process name being run with the appropriate entry in the `/proc` directory.
- Determine the amount of disk space being used by the swap file system (`/tmp`).
- Add swap space from a spare slice.
- Create a swap file and add it to the permanent swap space.
- Use the `dumpadm` command to display the location of the dump `Savecore` directory and force a `kernel` panic reboot to create `unix.`*`X`* and `vmcore.`*`X`* files in that directory.
- Use the `coreadm` command to display default initial configuration information and modify this information to change core file name and location.

Tasks

Viewing Processes and the Equivalent entries in the /proc *Directory*

1. Run the `ps -ef` command and select a process from the first 20 processes to investigate this process using the output (this can be done as a user or `root`).

```
# ps -ef | head -20
root     0     0  0   May 23 ?        0:18 sched
root     1     0  0   May 23 ?        0:01 /etc/init -
root     2     0  0   May 23 ?        0:00 pageout
root     3     0  0   May 23 ?        7:25 fsflush
root   398     1  0   May 23 ?        0:00 /usr/lib/saf/sac -t 300
root   241     1  0   May 23 ?        0:00 /usr/lib/utmpd
root   138     1  0   May 23 ?        0:00 /usr/sbin/keyserv
root    53     1  0   May 23 ?        0:00 /usr/lib/devfsadm/devfseventd
root    55     1  0   May 23 ?        0:00 /usr/lib/devfsadm/devfsadmd
root   184     1  0   May 23 ?        0:38 /usr/lib/autofs/automountd
root   135     1  0   May 23 ?        0:01 /usr/sbin/rpcbind
root   121     1  0   May 23 ?        0:00 /usr/lib/inet/in.ndpd
root   176     1  0   May 23 ?        0:00 /usr/sbin/inetd -s
root   219     1  0   May 23 ?        0:00 /usr/lib/lpsched
```

   For the purpose of this exercise, select the process information from the output for `/usr/lib/lpsched` (PID `219` in this output).

2. Verify that there is a matching directory entry for that process in the `/proc` directory:

```
# ls -R /proc/219
dr-x--x--x   5 root     root         736 May 23 17:45 /proc/219
```

3. Run the `man -s4 proc` command and answer the following three questions.

   a. What is contained in the file named `as`?

   _____

   b. What is the `psinfo` file used for?

   _____

c. What is the purpose of the `fd` directory?

_____

Determining the Amount File Disk Space Used by the `swapfs` *File System*

4. Run the `swap -s` command to view the total number of bytes actually allocated (and currently in use), the number of bytes allocated (and not currently in use but reserved by processes for possible future use), the total amount of swap space (both allocated and reserved), and the total swap space currently available for future reservation and allocation. For example:

```
# swap -s
total: 93344k bytes allocated + 12376k reserved = 105720k used, 197552k
available
```

5. Run the command `swap -l` to list the physical swap area configured on your system. The output lists how much total swap space is in each swap device listed, and how much space is available for each of these devices.

```
# swap -l
swapfile             dev  swaplo blocks   free
/dev/dsk/c0t0d0s1   32,1      16 524384 361024
```

6. Run the `df -k /tmp` command.

```
# df -k /tmp
Filesystem            kbytes    used   avail capacity  Mounted on
swap                  196080     608  195472     1%    /tmp
```

7. Using the procedure provided in the "Adding a Swap File" section on page 5-10, create a swap file and add it to the system swap space. Use both `swap -l` and `swap -s` to verify that the new swap space is available.

8. Using the procedure provided in the "Removing a Swap File" section on page 5-11, remove the swap file created in the previous step. Once again use `swap -l` and `swap -s` to verify that the swap space is no longer available.

9. Using the procedure provided in the "Adding a Swap Slice" section on page 5-12, add a disk partition as a swap slice to your existing swap space. Use Slice 1, which was created in Lab 4.

10. Add the new swap partition to the `/etc/vfstab` file to make it permanent. To verify this change, you must reboot the system.

Using `dumpadm` *to Display the* `core` *File Directory Location*

11. Use the `dumpadm` command to view the current dump configuration. Execute `dumpadm` with no arguments. For example,

```
# dumpadm
```

12. Fill in the configuration parameters from the output:

```
Dump content: _____________________________

Dump device: ______________________________

Savecore directory: _______________________

Savecore enabled: _________________________
```

13. Use the command `dumpadm` to change the dump device to be the new swap partition created in step 10.

```
# dumpadm -d /dev/dsk/c#t#d#s#
```

14. Reboot the system using the `-d` flag to `reboot`(1M) command, which forces the `kernel` to panic and save a crash dump.

Warning – This command should not be used on a system in a production environment.

```
# reboot -d
```

15. When the system reboots, make sure the crash dump succeeded by using the following commands to view the content of the `savecore` directory (output shown should be similar):

```
# cd /var/crash/<savecore directory>
# ls
bounds    unix.0    vmcore.0
# file vmcore.0
```

Note – Further investigation of the core files, `unix.0` and `vmcore.0` requires that you use the `mdb(1)`, the modular debugger.

Using `coreadm` *to Display Default Configuration for Potential* `core` *Files*

16. Use the `coreadm` command to display default initial configuration. The command and resulting output should be similar to the following:

```
# coreadm
     global core file pattern:
       init core file pattern: core
            global core dumps: disabled
       per-process core dumps: enabled
      global setid core dumps: disabled
 per-process setid core dumps: disabled
     global core dump logging: disabled
```

17. View the `/etc/coreadm.conf` file:

```
# cat /etc/coreadm.conf
```

18. Enable a global `core` file path and create the core file directory.

```
# coreadm -e global -g /var/core/core.%f.%p
# mkdir /var/core
```

19. Enable global `setid` core dumps.

```
# coreadm -e global-setid
```

20. Turn on logging to generate a message when a global core file is attempted.

```
# coreadm -e log
```

21. Display the configuration information to verify the changes:

```
# coreadm
     global core file pattern: /var/core/core.%f.%p
       init core file pattern: core
            global core dumps: enabled
       per-process core dumps: enabled
      global setid core dumps: enabled
 per-process setid core dumps: disabled
     global core dump logging: enabled
```

22. In another terminal window, run the `ps` command to get the PID of the new shell. Also, run the `pwd` command to set the correct working directory. Send a `SIGFPE` signal (signal 8) to the new shell using the `kill` command. (`SIGFPE` will force a `core` file.)

```
# mkdir /dir
# cd /dir
# ps
# kill -8 PID
```

23. In the original terminal window, check to see if a `core` file exists in the current working directory of the old shell. Use the `file` command to verify the `core` file is from the old shell.

```
# cd /dir
# ls
# file core
```

24. Use the `ls` command to check for a `core` file in `/var/core`.

```
# ls /var/core
```

Exercise Summary

Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Task Solutions

Viewing Processes and the Equivalent entries in the `/proc` *Directory*

25. Run the `man -s4 proc` command and answer the following three questions.

    a. What is contained in the file named `as`?

       This file contains the address-space image of the process, and it can be opened for both reading and writing.

    b. What is the `psinfo` file used for?

       This file contains miscellaneous information about the process and the representative `lwp` needed by the `ps(1)` command. `psinfo` is accessible after a process becomes a zombie.

    c. What is the purpose of the `fd` directory?

       This directory contains references to the open files of a process. Each entry is a decimal number corresponding to an open file descriptor in the process.

Using `dumpadm` *to Display the* `core` *File Directory Location*

26. Fill in the configuration parameters from the output:

    Dump content: `kernel` pages

    Dump device: `/dev/dsk/c0t0d0s1`

    `savecore` directory: `/var/crash/hostname`

    `savecore` enabled: *yes*

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- List the Solaris pseudo file system types
- Describe the relationship between system processes and the `/proc` directory
- Describe how the `tmpfs` file system improves performance
- Use the `dumpadm` program to display system dump configuration
- Use the `coreadm` command to display core file configuration
- Create and add a swap file or partition to the swap space

NFS 6

Objectives

Upon completion of this module, you should be able to:

- Describe the functions of an NFS server and an NFS client
- Make resources available and unavailable for mounting
- Edit the `/etc/dfs/dfstab` file on an NFS server to enable automatic sharing of resources
- Display a server's available resources for mounting
- Mount a resource from another system
- Edit the `/etc/vfstab` file to mount resources on an NFS client
- Describe the function of these commands: `mountall`, `umountall`, `shareall`, and `unshareall`
- Describe and configure NFS logging

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- *System Administration Guide, Volume I*, Part Number 805-7228-10
- *System Administration Guide, Volume II*, Part Number 805-7229-10
- *System Administration Guide, Volume III*, Part Number 806-0916-10

The NFS Distributed File System

The Solaris Operating Environment supports the sharing of remote file system resources and presents them to users as if they were local files and directories.

The sharing of remote file system resources is administered through distributed file systems (DFS) file system types. This file system type provides the architectural support required for mounting resources over the network.

The NFS environment contains the following components:

- *NFS server* – A system that contains the file resources to be shared with other systems on the network.
- *NFS client* – A system that mounts the file resources shared over the network and presents the file resources as if they were local.

Figure 6-1 illustrates an NFS environment.

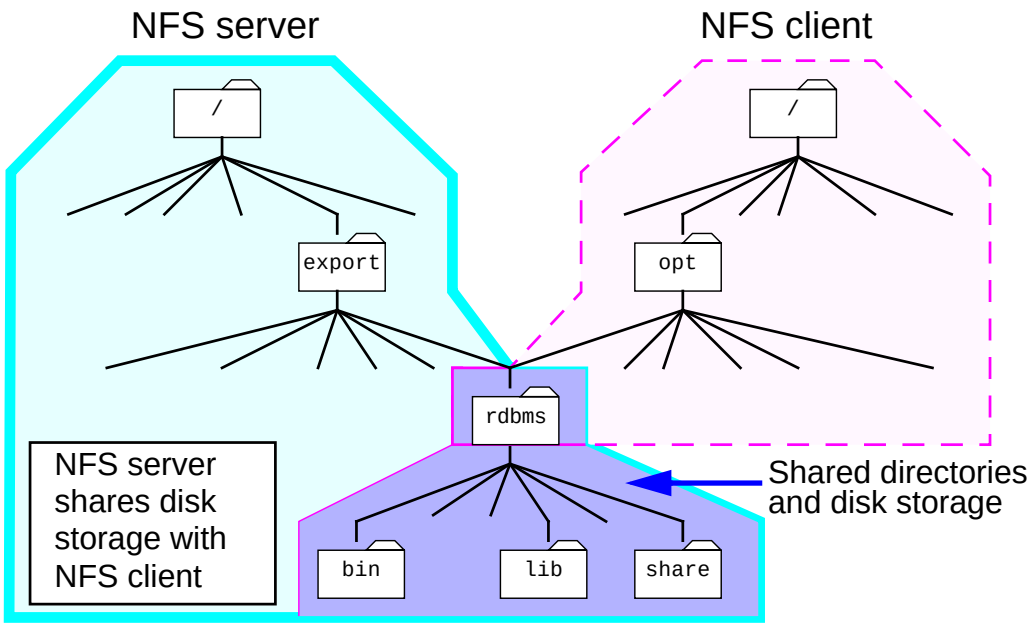


Figure 6-1 NFS Distributed File System

The Benefits of a Network File System

The benefits of an NFS include:

- Centralized file access

  Files are located in centralized locations. You can make a copy of a file accessible to many users or systems simultaneously. This is an especially useful feature with `home` directories or common data files.

- Common software access

  Systems can share one or more software packages that are located in a central location. This reduces the disk space requirements for individual systems.

- Easy to use

  Remote file sharing is transparent to the user and to any applications, because these resources appear as if they were resident on the local system.

The NFS environment provides file sharing in a heterogeneous environment, potentially containing many different operating systems, including UNIX®, MS-DOS, and Virtual Memory System (VMS).

Note – NFS uses remote procedure calls (RPCs) and external data representation (XDR). XDR library routines allow programmers to describe arbitrary data structures in a machine-independent fashion.

NFS Distributed File System Components

The DFS administration files, commands, and daemons necessary for sharing and mounting NFS file resources are illustrated in Figure 6-2, for both an NFS server and an NFS client.

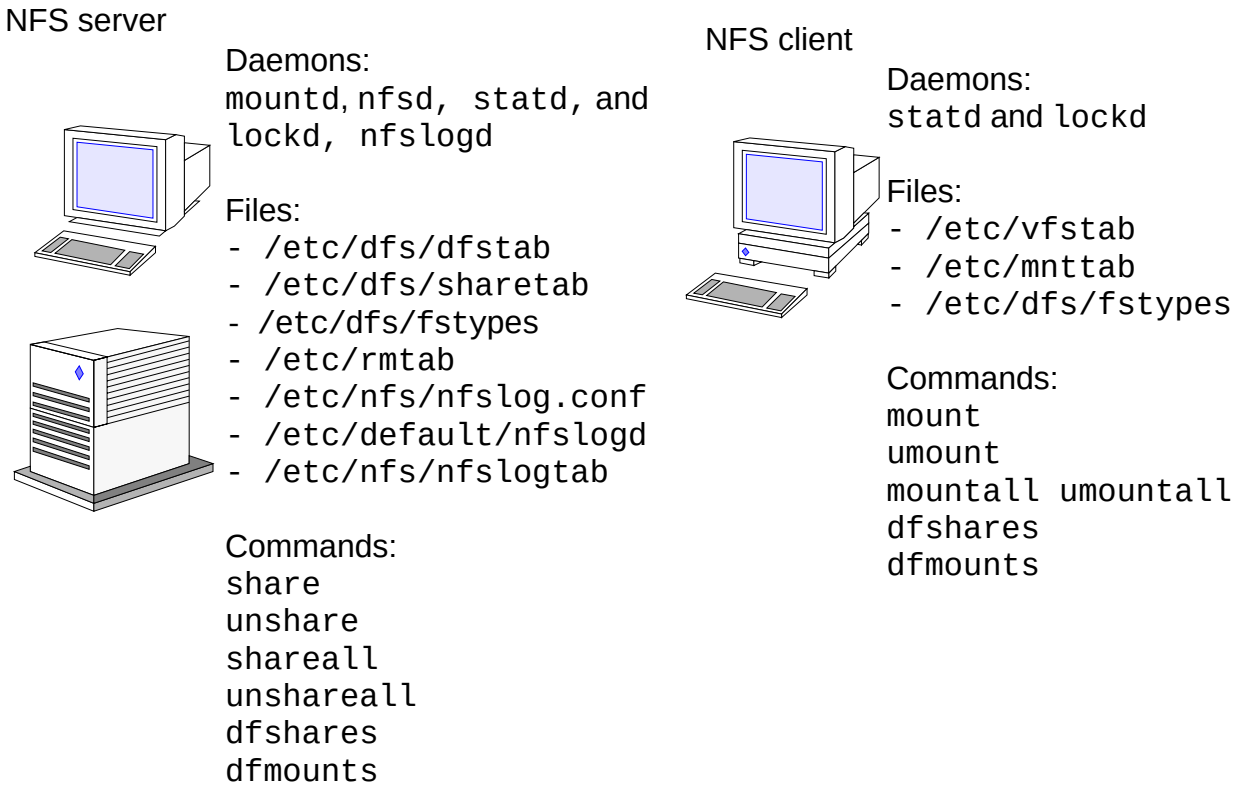


Figure 6-2 NFS Files, Commands, and Daemons

The NFS Daemons

NFS operation requires daemons running on the NFS server and NFS client.

The Mount Daemon

When an NFS client issues an NFS mount request, the mount process contacts the NFS server's mount daemon, `/usr/lib/nfs/mountd`, to get a *file handle* (pointer) for the file resource to be mounted.

The NFS client `mount` process then writes the file handle (along with other information about the mounted resource) to the `/etc/mnttab` file.

NFS Server Daemons

When a process on a client attempts to access a remote file resource, the NFS server daemon, `/usr/lib/nfs/nfsd`, on the server gets the request (along with the resource's file handle) and performs the file operation. It then returns any data to the requesting process on the client.

The server daemons are started from the `/etc/init.d/nfs.server` script. The `nfs.server` script also defines the maximum number of `nfsd` threads that can be started.

If a system has entries in its `/etc/dfs/dfstab` file, these server daemons are started when the system enters run level 3.

NFS Daemons on the Client and Server

Two other NFS daemons, `/usr/lib/nfs/statd` and `/usr/lib/nfs/lockd` run on both the NFS servers and clients. These daemons are started automatically when a system enters run level 2.

The two daemons work together to provide locking services in NFS. If the server crashes, clients can quickly re-establish the connections to files they were using. The server has a record of the clients that were using NFS. It contacts each client to obtain the information about which files were in use to allow continued operation. Both daemons are started from the `/etc/init.d/nfs.client` script, and typically do not require administrative intervention.

NFS File Handles

File handles are client references that identify a unique file or directory on the server. File handles encode the file's inode number, inode generation number, and disk device number.

Once a client successfully completes an NFS mount request, an entry is made in the `/etc/rmtab` file by the `mountd` daemon on the server. The `/etc/rmtab` file contains a table of file systems that are remotely mounted by NFS clients. It also contains a line entry for each remotely mounted file system. For example:

```
hostname:fsname
```

These line entries are removed from this file by the `mountd` command when it is first started.

Stale entries can accumulate in this file for clients that have crashed, and could not send an unmount request. Removing these entries allows the client to remount the resource.

The NFS Server

The following commands and files are used in conjunction with the NFS server.

The share Command

When the mountd daemon is running, use the /usr/sbin/share command to make file resources available for mounting by remote systems.

Command Format

```
share [ -F FSType ] [ -o options ] [ -d description ] pathname
```

Options

The following options can be used with the share command:

- -F *nfs*

  Specifies the file system type. This option is not typically required as nfs is the default remote file system type.

Note – If you do not use the option -F fstypes, the system takes the file system type from the first line of the /etc/dfs/fstypes file.

- -o *options*

  Controls a client's access to an NFS-shared resource.

- -d *description*

  Describes the file resource being shared. This information is displayed by the share command when used with no arguments.

- *pathname*

  Specifies the resource to be shared.

File Resource Sharing

To share a file resource from the command line, execute the following:

```
# share -F nfs -o ro /usr/share/man
```

The `share` command writes information for all shared file resources to the `/etc/dfs/sharetab` file. The file contains a table of the local resources shared.

If no argument is specified, the `share` command displays a list of all file resources currently shared.

```
# share
/usr/share/man
/export/install ro
```

The `/etc/dfs/dfstab` *File*

The `/etc/dfs/dfstab` file gives the system administrator a method for the automatic sharing of local file systems. Each line of the `dfstab` file consists of a `share` command.

```
# cat /etc/dfs/dfstab
#   Place share(1M) commands here for automatic execution
#   on entering init state 3.
#
#   Issue the command '/etc/init.d/nfs.server start' to run the NFS
#   daemon processes and the share commands, after adding the very
#   first entry to this file.
#
#   share [-F fstype] [-o options] [-d "<text>"] <pathname> [resource]
#   e.g,
#   share -F nfs -o rw=engineering -d “home dirs” /export/home2
#
```

The contents of the `/etc/dfs/dfstab` file are executed when:

- The system enters run level 3.
- The superuser runs the `shareall` command. The NFS daemons must be running.

- The superuser runs the `/etc/init.d/nfs.server` script (which contains a `shareall` command) with the `start` argument. This script starts the `nfs` server daemons.

Note – If the `nfs.server` script does not find NFS entries in the `/etc/dfs/dfstab` file, it exits without running the NFS daemons.

NFS Access Management

By default, NFS-mounted resources are available with read and write privileges based on standard Solaris file permissions. Access decisions are based on a comparison of the UID of the client and the owner.

The following `share` command options restrict the read and write capabilities for NFS clients and enable superuser access to a mounted resource.

- `ro`

  Informs clients that the server accepts only read requests.

- `rw`

  Allows the server to accept read and write requests from the client.

- `root=`*`client`*

  Informs clients that the `root` user on the specified client system or systems can perform superuser privileged requests on the shared resource.

- `ro=`*`access-list`*

  Allows read requests from the specified access list.

- `rw=`*`access-list`*

  Allows read and write requests from the specified access list.

  - *`access-list=client:client`*

    Allows access based on a colon-separated list of one or more clients.

- *access-list=@network*

  Allows access based on a network number (for example, @192.168.100) or network name (for example, @mynet.com). The network name must be defined in /etc/networks.

- *access-list=.domain*

  Allows access based on a DNS domain; the dot (.) identifies it as a DNS domain.

- *access-list=netgroup_name*

  Allows access based on a configured net group (NIS or NIS+ only).

- anon=*n*

  Sets *n* to be the effective user ID of unknown users. By default, unknown users are given the effective user ID UID_NOBODY. If *n* is set to -1, access is denied.

You can combine these options by separating each with commas, forming intricate access restrictions.

Examples

```
# share -F nfs -o ro directory
```

This command line restricts access to NFS mounted resources to read-only access.

```
# share -F nfs -o ro,rw=client1 directory
```

This command line restricts access to NFS-mounted resources to read-only access; however, the NFS server accepts both read and write requests from the client named client1.

```
# share -F nfs -o root=client2 directory
```

This command line allows the root user on the client named client2 to have superuser access to the NFS mounted resources.

```
# share -F nfs -o anon=0 directory
```

By setting the option anon=0, the EUID for access to shared resources is set to the UID of the user who is accessing the shared resource.

The unshare *Command*

The /usr/sbin/unshare command makes file resources unavailable for mounting by remote systems. It reads the /etc/dfs/sharetab file.

Command Format

```
unshare [ -F nfs ] pathname
```

Options

The following options can be used with the unshare command:

- `-F nfs`

  Specifies nfs as the file system type. This option is not typically required because nfs is the default remote file system type.

- *pathname*

  Specifies the path name of the file resource to be unshared.

The following example makes the resource unavailable for mounting:

```
# unshare /usr/share/man
```

The shareall *and* unshareall *Commands*

Use the /usr/sbin/shareall and /usr/sbin/unshareall commands to share and unshare all NFS resources.

The shareall *Command*

Without any arguments, the shareall command shares all file resources listed in the /etc/dfs/dfstab file.

```
shareall [ -F nfs ]
```

The unshareall *Command*

Without any arguments, the unshareall command unshares currently shared file resources. It does this by reading the /etc/dfs/sharetab file.

```
unshareall [ -F nfs ]
```

Configuring the NFS File Server

To set up an NFS server, complete the following steps:

1. Edit the `/etc/dfs/dfstab` file and add those file resources to be automatically shared whenever the system enters run level 3. For example:

```
share -F nfs /usr/share/man
```

2. Start the NFS server daemons by invoking the following:

```
# /etc/init.d/nfs.server start
```

This shares the contents of the `/etc/dfs/dfstab` file.

Note – You can use the `dfshares` command to verify that the resources are available.

NFS Informational Commands

Use the following commands to get information about NFS resources.

The `dfshares` Command

The `dfshares` command displays the NFS resources currently being shared.

Command Format

```
dfshares [ -F nfs ] [ host ]
```

Without arguments, the `dfshares` command displays shared resources for the local server.

```
# dfshares
RESOURCE                  SERVER       ACCESS       TRANSPORT
host1:/usr/share/man  host1          -            -
```

It is also used to display shared resources by a specified server name.

```
# dfshares host2
RESOURCE                  SERVER       ACCESS       TRANSPORT
host2:/export         host2          -            -
```

The dfmounts *Command*

This command displays mounted resource information.

Command Format

```
dfmounts [ -F nfs ]
```

Without arguments, the dfmounts command displays the shared resource and clients mounting the resource for the local server.

```
# dfmounts
RESOURCE                SERVER     PATHNAME         CLIENTS
-                       host1      /usr/share/man   host5,host9
```

This command is also used to display mounted resource information for a specified server name.

```
# dfmounts host2
RESOURCE        SERVER      PATHNAME    CLIENTS
-               host2       /export     host5,host9
```

The NFS Client

The following commands and files are used with the NFS client.

The `mount` Command

The `/usr/sbin/mount` command is used to attach either a local or remote file resource to the file system hierarchy.

Command Format

```
mount [ -F nfs ] [ -o options ] server:pathname mount_point
```

Options

The following options can be used with the `mount` command:

- `-F nfs`

  Specifies `nfs` as the file system type. This option is not required because `nfs` is the default remote file system type.

- `-o` *`options`*

  Specifies a comma-separated list of file-system specific options, such as `rw`, to mount the file resource as read, write, and `ro` to mount the file resource read-only. (The default is `rw`.)

- *`server:pathname`*

  Specifies the name of the server and the path name of the remote file resource; these are separated by a colon (`:`).

- *`mount_point`*

  Specifies the path name of the mount point on the local system (which must already exist).

Accessing a Remote File Resource

Use the `mount` command to access a remote file resource. For example:

```
# mount host1:/usr/share/man /usr/share/man
```

To mount a remote read-only file resource from the first-available host in a comma-separated list of hosts, execute the following:

```
# mount -o ro host1,host2,host3:/usr/share/man /usr/share/man
```

For file systems shared as read-only, if multiple hosts are named and the first server in the list is down, the `failover` utility uses an alternative server in the list to access files.

The `/etc/vfstab` *File*

To have remote file resources mounted at boot time, enter the appropriate entries in the client's `/etc/vfstab` file. For example:

```
#device      device        mount      FS       fsck    mount    mount
#to mount    to fsck       point      type     pass    at boot  options
#
host1:/usr/share/man   -    /usr/share/man   nfs    -    yes   soft,bg
```

The fields in the `/etc/vfstab` file include:

- `device to mount`

  The name of the server and the path name of the remote file resource; these are separated by a colon (`:`).

- `device to fsck`

  NFS resources are not checked from the client, because the file system is not owned by the client. This field is always dash (-) for NFS resources.

- `mount point`

  The default mount point for the file resource.

- `FS type`

  Use `nfs` for NFS resources.

- `fsck pass`

  NFS resources are not checked from the client, because the file system is not owned by the client. This field is always dash (-) for NFS resources.

- `mount at boot`

  Either `yes` or `no`, which indicates whether the file resource should be mounted when the system enters run level 2 or when the `mountall` command is issued, respectively.

- `mount options`

  A comma-separated list of `mount` options.

- *`rw`*`|ro`

  Specifies whether the resource is mounted as read write or read only. The default is read write.

- `bg|`*`fg`*

  If the first mount attempt fails, retry in the background or foreground. The default is to retry in the foreground.

- `soft|`*`hard`*

  During an NFS mount request, the `soft` option returns an error if the server does not respond, then it continues boot. The `hard` option continues to retry the mount until the server responds or the retry/timeout values are exceeded. The default is a `hard` mount.

Note – Although `soft` or `bg` are not the default settings, combining these two options usually results in the fastest client boot up when NFS mounting problems arise.

- *`intr`*`|nointr`

  Indicates keyboard interrupts to kill a process that is hung waiting for a response on a hard-mounted file system. The default is `intr`.

- *suid*|nosuid

  Indicates whether to enable `setuid` execution. The default enables `setuid` execution.

- `timeo=`*n*

  Sets `timeout` to *n* tenths of a second. The default `timeout` is 11, measured in one-tenth of a seconds (0.1 second) for User Datagram Protocol (UDP) transports and 600 tenths of a second for TCP.

- `retry=`*n*

  Sets the number of times to retry the mount operation. The default is 10,000 times.

- `retrans=`*n*

  Sets the number of NFS retransmissions to *n*. The default is 5 for UDP. For connection-oriented transports (such as TCP), this option has no effect.

Note – If the file resource is listed in the `/etc/vfstab` file, the superuser can specify either *`server:pathname`* or *`mount_point`* on the command line because the `mount` command checks the `/etc/vfstab` file for more information.

Recommended Mounting Options

Mounting a file system with the `bg` option indicates that if the server's `mountd` does not respond, the system's attempt to remount the file system occurs in the background. This prevents the remount from interruptions of other system services.

When the file system is mounted, an NFS request waits the amount of time indicated by the `timeo` field (tenths of a second) for a response. If no response is received, the value in the `timeo` field is doubled and the request is retried.

When the retransmission times reach the value in the `retrans` field, a file system mounted with the `soft` option returns an error. A file system mounted with the `hard` option prints a warning message and continues to retry.

Table 6-1 lists the recommended mounting options for some commonly shared file resources.

Table 6-1 Mount Options

NFS File Resource	Read-write/ Read-only	System Startup	Server Crash	Interrupt	Security
`/usr`	`ro`	`fg`	hard	`nointr`	`suid`
`/export/home`	`rw`	`bg`	hard	`intr`	`nosuid`
`/opt/frame`	`ro`	`bg`	soft	—	`nosuid`

A Read-Only Directory

The `/usr` file system contains operating system binaries. This essential file system is mounted in the foreground, the booting process does not continue until the mount is completed.

The NFS client hard mounts this directory. This means the client continues to retry the mount request until the server responds.

A Read-Write Directory

The `/export/home` directory is where the users' login directories are commonly placed. A hard mount is recommended for all read-write (`rw`) file systems (for example, users' `home` directories).

The `nosuid` option provides additional network security because the `setuid` permissions on NFS resources are ignored.

A Read-Only Application Directory

Nonessential applications are commonly mounted as read only (`ro`) in the background (`bg`) with a `soft` mount. The system continues to boot if the server does not respond during boot. If the server crashes, the mount times out.

The `umount` *Command*

Use the `/usr/sbin/umount` command to detach either a local or remote file resource from the file system hierarchy.

Command Format

`umount` *`server:pathname | mount_point`*

The command line can specify either *`server:pathname`* or *`mount_point`*.

```
# umount /usr/share/man
```

The `mountall` *and* `umountall` *Commands*

Use the `/usr/sbin/mountall` and `/usr/sbin/umountall` commands to mount and unmount all file resources.

The `mountall` *Command*

Without any arguments, the `/usr/sbin/mountall` command mounts all file resources listed in the `/etc/vfstab` file with a `mount-at-boot` value of `yes`.

To limit the action of this command to remote file resources, use the `-r` option.

Command Format

```
mountall -r [ -F nfs ]
```

The `-F nfs` option restricts the action of this command to NFS resources only.

```
# mountall -r
```

The umountall *Command*

Without any arguments, the /usr/sbin/umountall command unmounts all currently mounted file resources. To limit the action of this command to remote file resources, use the -r option.

Note – root (/), /usr, /var, and all pseudo file systems are not unmounted.

Command Format

```
umountall -r [ -F nfs ]
```

```
# umountall -r
```

Option

The following option can be used with the umountall command:

- -F nfs

  Specifies nfs as the file system type. This option is not required, because nfs is the default remote file system type.

The NFS Client Setup

To set up an NFS client, complete the following steps:

1. Use the `/usr/sbin/dfshares` command to display a server's available resources.

```
# dfshares host1
RESOURCE                  SERVER      ACCES       TRANSPORT
host1:/usr/share/man      host1       -           -
```

2. Use the `/usr/sbin/mount` command to access the remote file resource.

```
# mount host1:/usr/share/man /usr/share/man
```

The `/usr/share/man` directory on the client is the mount point in the local system's file hierarchy. This directory should be empty.

3. Once it has been determined that access to the manual pages located on the remote server is no longer needed, you can unmount the remote file resources from the client by using the `/usr/sbin/umount` command.

```
# umount /usr/share/man
```

Occasionally, an attempt to unmount an NFS file system results in the following error message:

```
nfs mount: /usr/share/man: is busy
```

This usually means that a user or program is accessing the resource.

Mounting Using the `/etc/vfstab` File

Edit the `/etc/vfstab` file to add an entry for the remote resource that is automatically mounted whenever the system enters run level 3.

```
host1:/usr/share/man - /usr/share/man nfs - yes ro,bg
```

NFS Server Logging

A new feature in the Solaris 8 Operating Environment is NFS server logging. This feature records NFS reads and writes on the file system. The daemon, `nfslogd`, provides this operational logging.

When NFS server logging is enabled, records of all NFS operations on the file system are written into a buffer file by the `kernel`. This data includes a timestamp, the client IP address, the UID of the requestor, the file handle of the resource that is being accessed, and the type of operation that occurred.

The `nfslogd` daemon converts this raw data into ASCII records that are stored in ASCII log files. During the conversion, the IP addresses are modified to host names and the UIDs are modified to logins.

Mappings of file handles to path names is also handled by `nfslogd`. It keeps track of these mappings in a `file-handle-to-path` mapping table.

One mapping table exists for each tag identified in the `/etc/nfs/nfslog.conf` file.

The file handles are also converted into path names. The daemon keeps track of the file handles and stores information in a separate file handle to path name table, this way the path does not have to be re-identified each time a file handle is accessed.

Note – It is important to keep the `nfslogd` daemon running, because there is no tracking of changes to the mappings in the `file_handle-to-path` table if `nfslogd` is turned off.

Enabling NFS Server Logging

To enable `nfs` server logging, complete the following steps:

1. Become superuser.

2. Optional: Change the file system configuration settings.

   In `/etc/nfs/nfslog.conf`, either edit the default settings for all file systems by changing the data associated with the `global` tag or add a new tag for the specific file system. If these changes are not needed, do not edit this file.

3. Add entries for each file system to be shared using NFS server logging.

   Edit `/etc/dfs/dfstab` and add one entry to the file for the file system that is to have NFS server logging enabled.

   You must enter the tag used with the `log=tag` option in `/etc/nfs/nfslog.conf`

   The following example uses the default settings in the `global` tag:

```
share -F nfs -o ro,log=global /export/ftp
```

4. Check that the `nfs` service is running on the server.

   If the `nfs` daemons are not running, issue the following commands to kill and restart the `nfs` daemons.

```
# /etc/init.d/nfs.server stop
# /etc/init.d/nfs.server start
```

5. If the NFS daemons are already running, issue a command to share the file system.

   Once you add the entry to `/etc/dfs/dfstab`, the file system can be shared by either rebooting the system or by using the `shareall` command.

```
# shareall
```

   If the NFS daemons were restarted earlier, you do not need to run this command because the script runs the command.

6. Verify that the information is correct.

   Run the `share` command to check that the correct options are listed:

```
# share
       -        /export/share/man   ro   ""
       -        /usr/src     rw=eng   ""
       -        /export/ftp    ro,log=global  ""
```

7. Start the NFS log daemon, `nfslogd`, if it is not running already.

```
# /usr/lib/nfs/nfslogd
```

   This step is not necessary if you restarted the `nfs` daemons using the `nfs.server` script, because this script also starts this daemon if the `/etc/nfs/nfslog.conf` file exists.

The `/etc/nfs/nfslog.conf` *File*

This file defines the path, file names, and type of logging to be used by `nfslogd`. Each definition is associated with a tag.

Starting NFS server logging requires that you identify the tag for each file system. The global tag defines the default values.

The following is an example of an original `nfslog.conf` file:

```
# cat /etc/nfs/nfslog.conf
#ident  "@(#)nfslog.conf        1.5     99/02/21 SMI"
#
   .
   .
 # NFS server log configuration file.
 #
<tag>           [ defaultdir=<dir_path> ] \
                [ log=<logfile_path> ] [ fhtable=<table_path> ] \
[ buffer=<bufferfile_path> ] [ logformat=basic|extended ]
#

global defaultdir=/var/nfs \
log=nfslog fhtable=fhtable buffer=nfslog_workbuffer
```

Use the following parameters with each tag, as needed:

- `defaultdir=path`

  Specifies the default directory path for the logging files.

- `log=path/filename`

  Sets the path and file name for the log files.

- `fhtable=path/filename`

  Selects the path and file name for the `file_handle-to-path` database files.

- `buffer=path/filename`

  Determines the path and file name for the buffer files.

- `logformat=basic|extended`

  Selects the format to be used when creating user-readable log files. The basic format produces a log file similar to some `ftpd` daemons. The extended format gives a more detailed view.

For the parameters that can specify both the path and the file name, if the path is not specified, the path defined by `defaultdir` is used. Also, you can override `defaultdir` by using an absolute path.

To make identifying the files easier, place the files in separate directories. For example,

```
# cat /etc/nfs/nfslog.conf
#ident  "@(#)nfslog.conf        1.5     99/02/21 SMI"
#
   .
   .
# NFS server log configuration file.
#
 global  defaultdir=/var/nfs \
         log=nfslog fhtable=fhtable buffer=nfslog_workbuffer
 publicftp log=logs/nfslog fhtable=fh/fhtables buffer=buffers/workbuffer
```

You must create the directories for `logs`, `fh`, and `buffers` before starting NFS server logging.

In this example, any file system shared with `log=publicftp` uses the following values:

- The default directory is `/var/nfs`.
- The log files are stored in `/var/nfs/logs/nfslog*`.
- The *`file_handle-to-path`* database tables are stored in `/var/nfs/fh/fhtables.`
- The buffer files are stored in `/var/nfs/buffers/workbuffer`.

The `/etc/default/nfslogd` *File*

NFS operations on an NFS server are logged based on the configuration information defined in `/etc/default/nfslogd`.

This file defines some of the parameters used when using NFS server logging. These parameters include:

- `MAX_LOGS_PRESERVE` – Determines the number of log files to be saved. The default value is 10.
- `MIN_PROCESSING_SIZE` – Sets the minimum number of bytes that the buffer file must reach before processing and writing to the log file. The default value for is 524288 bytes. Increasing this number can improve performance by reducing the number of times the buffer file is processed.

  This parameter, along with `IDLE_TIME` determines how often the buffer file is processed.
- `IDLE_TIME` – Sets the number of seconds that `nfslogd` should sleep (wait) before checking for more information in the buffer file. It also determines how often the configuration file is checked. The default value is 300 seconds. Increasing this number can improve performance by reducing the number of checks.
- `CYCLE_FREQUENCY` – Determines the number of hours that must pass before the log files are cycled. The default value is 24 hours. This option is used to prevent the log files from growing too large.
- `UMASK` – Specifies the permissions for the log files that are created by `nfslogd`. The default value is 0137.

Summary of NFS Commands, Files, and Daemons

The main commands and files used on both the server and client systems are summarized in Table 6-2.

Table 6-2 Summary of NFS Commands, Files, and Daemons

	NFS Server	NFS Client

Commands	`share` *`resource`*
	`unshare` *`resource`*
	`shareall`
	`unshareall`
	`dfmounts`
	`/etc/init.d/nfs.server`
		`mount` *`server:directory`* `\`
		`mount-point`
		`umount mount-point`
		`mountall -r`
		`umountall -r`
		`dfshares` *`server`*
		`/etc/init.d/nfs.client`

Files	`/etc/dfs/fstypes`
	`/etc/dfs/dfstab`
	`/etc/dfs/sharetab`
	`/etc/rmtab`
	`/etc/nfs/nfslog.conf`
	`/etc/default/nfslogd`
	`/etc/nfs/nfslogtab`
		`/etc/dfs/fstypes`
		`/etc/vfstab`
		`/etc/mnttab`

Daemons	`/usr/lib/nfs/nfsd`
	`/usr/lib/nfs/mountd`
	`/usr/lib/nfs/statd`
	`/usr/lib/nfs/lockd`
	`/usr/lib/nfs/nfslogd`
		`/usr/lib/nfs/statd`
		`/usr/lib/nfs/lockd`

Troubleshooting NFS Errors

You can discover most NFS problems through console messages or symptoms on a client.

`rpcbind` *Failure Error*

Error Message

```
nfs mount: server1:: RPC: Rpcbind failure
RPC: Timed Out
nfs mount: retrying: /mntpoint
```

This message is displayed on the client during the boot process or in response to an explicit mount request. It indicates a problem accessing the server. This error can occur due to the combination of an incorrect Internet address and a correct host or node name in the `hosts` database file supporting the client node.

This error can also occur whenever the `hosts` database file supporting the client is correctly specifying the server node, but the server node is extremely overloaded, temporarily stopped, or crashed.

Solution

Complete the following step:

1. If the server node is operational, determine if the server is out of critical resources (for example, memory, swap, or disk space).

Note – This example was caused by temporarily shutting down the server node and then attempting (through the command line) to have it service an NFS mount request from a client node.

Server Not Responding Error

Error Message

```
NFS server server2 not responding, still trying
```

This message is displayed during the boot process or in response to an explicit mount request and indicates a known server that is unreachable.

Solution

Complete the following steps:

1. Check to see if the network between the local system and the server is down by using the `ping` command (`ping server2`).
2. Check to see if the server (`server2`) is down.

NFS Client Fails a Reboot Error

Error Condition

An NFS client fails a reboot without producing an error message.

This error condition is encountered whenever an administrator attempts to restart an NFS client node using an `init 6` or `reboot` command. The client node correctly reboots up to the point where the system echoes:

```
Setting default interface for multicast: add net 224.0.0.0: gateway:
client_node_name.
```

The client node does not finish the proper boot sequence and does not generate any error messages.

These symptoms are consistent with a client requesting an NFS mount using an entry in the `/etc/vfstab` file, which specifies a hard mount in the foreground (the default option), to an NFS server that is not operational.

Solution

Complete the following step:

1. If the NFS is available and failing:
   a. Reset the failed client node and boot it in single-user mode.
   b. Once in single-user mode, edit the `/etc/vfstab` file so that you comment out the NFS mounts.
   c. Continue with the boot cycle up to the default run level (normally 3) by pressing `Control-d`.
   d. Using the information in the `/etc/vfstab` file, determine if all the NFS servers are operational and functioning properly.
   e. After you have determined which NFS server(s) have failed, and you have resolved any outstanding problems with them, remove the comments placed in the `/etc/vfstab` file.

Note – An alternative to adding the comments to the `/etc/vfstab` file entries can be altering those entries to use the `soft` mount and `background` activation options.

Stopped Server Error

Error Message

```
nfs mount: dbserver: NFS: Service not responding
nfs mount: retrying: /mntpoint
```

This message is displayed during the boot process or in response to an explicit mount request and indicates a server that is reachable is not running the `nfsd` server daemons.

Solution

Complete the following steps:

1. Use the `who -r` command on the server to see if it is at run level 3. If it is not, change to run level 3 using the `init 3` command.
2. Use the `ps -e` command on the server to check whether the `nfsd` daemon and NFS server daemons are running. If they are not, start them with the `/etc/init.d/nfs.server` script and the `start` keyword.

Program Not Registered Error

Error Message

```
nfs mount: dbserver: RPC: Program not registered
nfs mount: retrying: /mntpoint
```

This message is displayed during the boot process or in response to an explicit mount request and indicates a server that is reachable is not running the `/usr/lib/nfs/mountd` server daemon.

Solution

Complete the following steps:

1. Use the `who -r` command on the server to see if it is at run level 3. If it is not, change to run level 3 using the `init 3` command.

Note – If you used the `shutdown` command to bring the system down to the single-user mode from run level 3, the `who -r` command might be disabled. Rebooting the system re-enables the command.

---

2. Use the `ps -e` command on the server to see if the `mount` daemon is running. If it is not, start it by invoking the `/etc/init.d/nfs.server` script first with a `stop` flag and then with a `start` flag.
3. Check or verify your `/etc/dfstab` entries.

Stale File Handle Error

Error Message

```
stale NFS file handle
```

This message is displayed when a process attempts to access a remote file resource and the file handle is out of date.

Solution

The file resource might have been moved on the server. Complete the following step:

1. Unmount and mount the resource again on the client.

Unknown Host Error

Error Message

```
nfs mount: sserver1:: RPC: Unknown host
```

This message indicates that the host name of the server on the client is missing, or not in the hosts table.

Solution

Complete the following step:

1. Determine if the host name in the `hosts` database supporting the client node is correctly specified.

Note – This example has the node name `server1` misspelled.

Mount Point Error

Error Message

```
mount: mount-point /DS9 does not exist.
```

This message is displayed during the boot process or in response to an explicit mount request and indicates a nonexistent mount point.

Solution

Complete the following step:

1. Check that the mount point exists on the client and is spelled correctly on the command line or in the `/etc/vfstab` file; or comment out the entry and reboot.

No Such File Error

Error Message

```
No such file or directory
```

This message is displayed during the boot process or in response to an explicit mount request and indicates an unknown file resource name on the server.

Solution

Complete the following step:

1. Check that the directory exists on the server and is spelled correctly on the command line or in the `/etc/vfstab` file.

Exercise: Configuring the NFS Environment

Exercise objective – In this lab, you configure an NFS server and client to share and mount `/usr/share/man`.

Preparation

Choose a partner for this lab, and determine which system will be configured as the NFS server and which will serve as the NFS client. Verify that entries for both systems exist in the `/etc/hosts` file of both systems. Refer to the lecture notes as necessary to perform the steps listed.

Task Summary

In this exercise, you accomplish the following:

- Select a system to act as an NFS server, and perform the steps required to share the `/usr/share/man` directory. Use the following commands to verify that the directory is shared and that no NFS mounts are present on the server:
  - `share`
  - `dfshares`
  - `dfmounts`
- On the NFS client system, rename the `/usr/share/man` directory to `/usr/share/man.orig`. Verify that the man pages are not available. Create a mount point called `/usr/share/man`. Mount the `/usr/share/man` directory from the NFS server. Verify that the man pages are now available.
- On the NFS client, record the default options used for this NFS mount. Verify the list of mounts that the server is providing. Unmount `/usr/share/man`, and again verify the list of remote mounts the server is providing.

- On the NFS server, unshare `/usr/share/man`. In `/etc/dfs/dfstab`, change the entry for this directory so that it uses the options `-o rw=bogus`. Share everything listed in the `dfstab` file.
- On the NFS client, attempt to mount `/usr/share/man` from the NFS server. Record what happens.
- On the NFS server, unshare `/usr/share/man` and remove the entry for it from `/etc/dfs/dfstab`.
- On the NFS client, return `/usr/share/man` to its original configuration.

Tasks

Complete the following steps:

On the NFS Server

1. Edit the `/etc/dfs/dfstab` file. Add an entry to share the directory that holds the manual pages.

   ```
   share /usr/share/man
   ```

2. Start the NFS server daemons.

   ```
   # /etc/init.d/nfs.server start
   ```

3. Use the following commands to verify that `/usr/share/man` is shared, and that no NFS mounts are present:

   ```
   # share
   # dfshares
   # dfmounts
   ```

On the NFS Client

4. Rename the `/usr/share/man` directory so that you can no longer access the manual pages installed on the client system. Verify that the man pages are unavailable.

   ```
   # cd /usr/share
   # mv man man.orig
   # man ls
   ```

   What message does the `man` command report?

   _____

5. Create a new `man` directory for use as a mount point.

   ```
   # mkdir man
   ```

6. Mount `/usr/share/man` from the server.

   ```
   # mount server:/usr/share/man /usr/share/man
   ```

7. Verify that the man pages are now available.

   ```
   # man ls
   ```

   Did it work? _____

8. Verify and record the default options used for this mount.

   ```
   # mount
   ```

   _____

9. Verify the list of mounts that the server is providing.

   ```
   # dfmounts server
   ```

10. Unmount `/usr/share/man`, and again verify the list of remote mounts provided by the server.

    ```
    # umountall -r
    # dfmounts server
    ```

On the NFS Server

11. Unshare the /usr/share/man directory.

    # **unshareall**

12. Change the share statement in /etc/dfs/dfstab for /usr/share/man so it reads:

    ```
    share -o rw=bogus /usr/share/man
    ```

13. Share the /usr/share/man directory.

    # **shareall**

On the NFS Client

14. Attempt to mount /usr/share/man again.

    # **mount server:/usr/share/man /usr/share/man**

    What happens?

    _____

On the NFS Server

15. Unshare the /usr/share/man directory.

    # **unshareall**

16. Edit /etc/dfs/dfstab to remove the entry for the /usr/share/man directory.

On the NFS Client

17. Return /usr/share/man to its original configuration. Verify that the man pages are available again.

    # **cd /usr/share**
    # **rmdir man**
    # **mv man.orig man**
    # **man ls**

Exercise Summary

Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Task Solutions

On the NFS Server

1. Edit the `/etc/dfs/dfstab` file. Add an entry to share the directory that holds manual pages.

   ```
   share /usr/share/man
   ```

2. Start the NFS server daemons.

   ```
   # /etc/init.d/nfs.server start
   ```

3. Use the following commands to verify that `/usr/share/man` is shared, and that no NFS mounts are present:

   ```
   # share
   -  /usr/share/man  ro  ""

   # dfshares
   RESOURCE                        SERVER  ACCESS    TRANSPORT
   server:/usr/share/man            server   -           -

   # dfmounts
   #
   ```

   No output for `dfmounts`.

On the NFS Client

4. Rename the `/usr/share/man` directory so that you can no longer access the manual pages installed on the client system. Verify that the man pages are unavailable.

   What message does the `man` command report?

   `No manual entry for ls`.

5. Create a new `man` directory for use as a mount point.

   ```
   # mkdir man
   ```

6. Mount /usr/share/man from the server.

   # **mount** *server*:**/usr/share/man /usr/share/man**

7. Verify that the man pages are now available.

   # **man ls**

   Did it work? *Yes*

8. Verify and record the default options used for this mount.

   Read and write *(rw)*

9. Verify the list of mounts that the server is providing.

```
# dfmounts server
RESOURCE     SERVER   PATHNAME            CLIENTS
-            server  /usr/share/man       client
```

10. Unmount /usr/share/man, and again verify the list of remote mounts provided by the server.

```
# umountall -r
# dfmounts server
#
```

    No output from the dfmounts command indicates that there are no clients mounting file systems from the server.

On the NFS Server

11. Unshare the /usr/share/man directory.

    # **unshareall**

12. Change the share statement in /etc/dfs/dfstab for /usr/share/man so it reads:

```
share -o rw=bogus /usr/share/man
```

13. Share the /usr/share/man directory.

    # **shareall**

On the NFS Client

14. Attempt to mount `/usr/share/man` again.

    What happens?

    The client reports the error message:

    ```
    nfs mount: server:/usr/share/man: Permission denied
    ```

On the NFS Server

15. Unshare the `/usr/share/man` directory.

    ```
    # unshareall
    ```

16. Edit `/etc/dfs/dfstab` to remove the entry for the `/usr/share/man` directory.

On the NFS Client

17. Return `/usr/share/man` to its original configuration. Verify that the man pages are available again.

    ```
    # cd /usr/share
    # rmdir man
    # mv man.orig man
    # man ls
    ```

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- ❑ Describe the functions of an NFS server and an NFS client
- ❑ Make resources available and unavailable for mounting
- ❑ Edit the `/etc/dfs/dfstab` file on an NFS server to enable automatic sharing of resources
- ❑ Display a server's available resources for mounting
- ❑ Mount a resource from another system
- ❑ Edit the `/etc/vfstab` file to mount resources on an NFS client
- ❑ Describe the function of these commands: `mountall`, `umountall`, `shareall`, and `unshareall`
- ❑ Describe and configure NFS logging

AutoFS 7

Objectives

Upon completion of this module, you should be able to:

- List the benefits of using the `automount` utility
- Describe the purpose of each of the types of automount maps
- Configure the `auto_master` map to specify which direct, indirect, and special maps the `automountd` daemon reads
- Create the `auto_direct` map with the full path names and mount options for automatically mounting remote file resources
- Modify the `auto_home` map as an example of an indirect map providing a consistent view of `home` directories across the network, regardless of where the user is logged in

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- *System Administration Guide, Volume I*, Sun Part Number 805-7228-10
- *System Administration Guide, Volume II*, Sun Part Number 805-7229-10
- *System Administration Guide, Volume III*, Sun Part Number 806-0916-10

AutoFS Overview

The AutoFS file system enables you to do the following:

- Mount file systems on demand
- Unmount file systems automatically.

Note – Automounted resources remain mounted for as long as they are being used. If no files or directories within the file system are accessed within a specified time-out period, a file system unmount automatically occurs.

- Centralize the administration of AutoFS mounts through the use of a name service.
- Have multiple mount resources for read-write file systems.

AutoFS Components

AutoFS contains three components that work together on the client to accomplish automatic mounting. These components include an AutoFS file system, the `automount` command, and the `automountd` daemon.

.

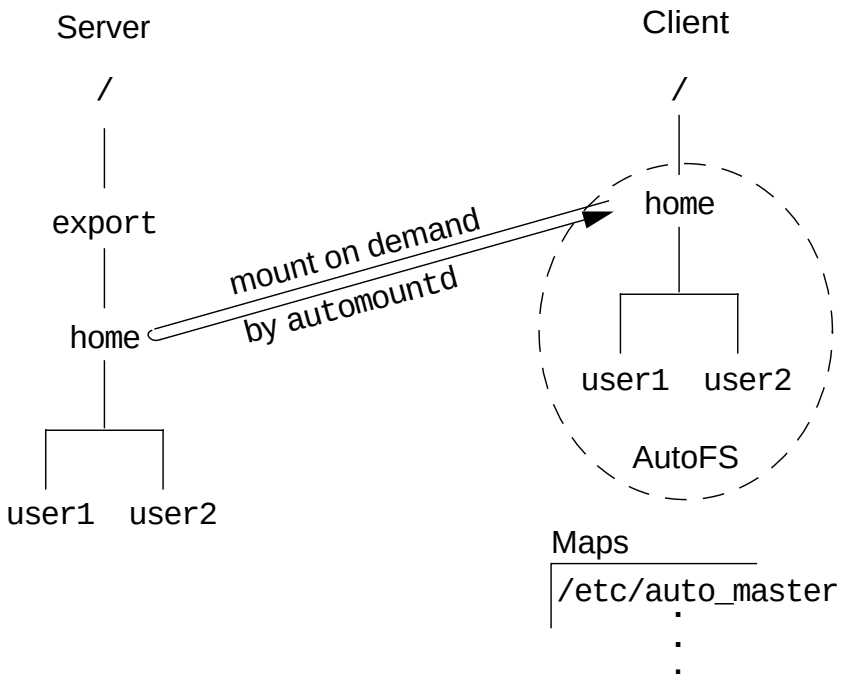


Figure 7-1 AutoFS Components

The following list describes the components:

- The `autofs` file system – An `autofs` file system's mount points are defined in `automount` maps located in the `/etc` directory on the client system. Once the `autofs` mount points are set up, activity under the mount points can trigger file systems to be mounted under them. If automount is configured, the `autofs` file system monitors mount requests made on the client. If a mount request is made for an `autofs` resource not currently mounted, `autofs` calls the `automountd` daemon, which actually mounts the requested resource.

- The `automount` command – The `automount` command, called at system startup time, reads the master map file `/etc/auto_master` to create the initial set of `autofs` mounts. These `autofs` mounts are not automatically mounted at startup time. They are points under which file systems are mounted on demand.
- The `automountd` daemon – The `automountd` daemon is started at boot time from the `/etc/init.d/autofs` script and mounts file systems on demand.

Note – The `automountd` daemon is completely independent from the `automount` command. Because of this separation, you can add, delete, or change map information without having to stop and start the `automountd` daemon process. However, the process might have to reread the maps.

Automount Maps

The `autofs` files, called maps, identify the file system resources to be automatically mounted. These map types include:

- Master map – Read by the `automount` command during boot up. This map lists the other maps used for establishing the `autofs` file system.
- Direct map – Lists the mount points as absolute path names. This map explicitly indicates the mount point on the client.
- Indirect map – Lists the mount points as relative path names. This map uses a relative path to establish the mount point on the client.
- Special – Provides access to entries in `/etc/hosts` or the Federated Naming Service (FNS).

`automount` maps contain ASCII data files or NIS or NIS+ database files. Together, these maps describe information similar to the information specified in the `/etc/vfstab` file for remote file resources.

Master Maps

The `auto_master` file associates a mount point with a map. It is a master list specifying all of the maps that `autofs` should check. Names of direct and indirect maps listed here refer to files in `/etc`. The following example shows what an `auto_master` file can contain:

```
# cat /etc/auto_master
# Master map for automounter
#
+auto_master
/net            -hosts          -nosuid,nobrowse
/-              auto_direct
/home           auto_home       -nobrowse
/xfn            -xfn
```

The following describes the fields in this example of a master map file:

`mount_point` The full path name of a directory. If the directory does not exist, `autofs` creates one if possible.

`map_name` The name of a direct or indirect map. These maps are directions to mounting information.

`mount-options` The general options for the map. The mount options are the same as those for standard NFS mounts.

Note – The plus (+) symbol at the beginning of the `+auto_master` line in this file directs the automounter program to look at the NIS or NIS+ databases. If this line is commented out, only the local files are used.

Special Maps

There are two mount points for special maps listed in this `/etc/auto_master` file. They identify the following:

- The `-hosts` map

  This special map provides access to all resources shared by each NFS server listed in the `hosts` database. You can obtain this information from `/etc/inet/hosts`, NIS, NIS+, or DNS. This is a default entry. Shared resources associated with this map are mounted below `/net/`*`hostname`*.

- The `-xfn` map

  This special map provides access to resources available through the X/Open Federated Naming Service. Resources associated with this service mount below `/xfn`.

Direct Map Entries

The `/-` entry in the example master map defines a mount point for direct maps. This mount point is a pointer that informs the automounter program that the full path names are defined in the file specified by *`map_name`* (`/etc/auto_direct` in this example).

Note – This is not an entry in the default master map. It has been added here as an example. The other entries in this example already exist in the `auto_master` file.

Note – A NIS or NIS+ `auto_master` map can have only one direct map entry. An `auto_master` map that is a local file can have any number of entries.

Indirect Map Entries

The `/net`, `/home`, and `/xfn` entries define mount points for indirect maps. The maps `-hosts`, `auto_home`, and `-xfn` list relative path names only. Indirect maps get the initial path of the mount point from the master map.

The Solaris 2.6 Operating Environment through Solaris 8 Operating Environment releases support browsing of indirect maps (and special maps) with the `-browse` option. This allows all of the potential mount points to be visible, regardless of whether they are mounted. The `-nobrowse` option disables the browsing of indirect maps. Therefore, in this example, the `/home` automount point provides no browser functions for any directory other than those that are currently mounted. The default for this option is `-browse`.

Direct Maps

Direct maps specify the absolute path name of the mount point, the specific options for this mount, and the shared resource to mount. For example:

```
# cat /etc/auto_direct
# Superuser-created direct map for automounter
#
/apps/frame     -ro,soft   server1:/export/framemaker,v4.0
/opt/local      -ro,soft   server2:/export/unbundled
/usr/share/man  -ro,soft   server3,server4,server5:/usr/share/man
```

The following describes the syntax for direct maps:

key [*mount-options*] *location*

- *key* – The full path name of the mount point for direct maps.
- *options* – The specific options for a given entry.
- *location* – The location of the file resource specified in *server:pathname* notation.

The following direct map entry specifies that the client mounts the `/usr/share/man` directory as read only from the servers `server3`, `server4`, or `server5`, as available:

```
/usr/share/man   -ro        server3,server4,server5:/usr/share/man
```

This entry uses a special notation, a comma-separated list of servers, to specify a powerful automounter feature—multiple locations for a file resource.

Note – The comma-separated list of servers automount feature works *only* with servers that are sharing files as read-only.

The `automountd` command automatically mounts `/usr/share/man` as needed, from `server3`, `server4`, or `server5`, with server proximity being the factor on server selection. If the nearest server fails to respond within the prescribed time-out period, the server with the next nearest proximity is selected.

Indirect Maps

Indirect maps have relative paths in the key field. The first part of the path name is specified in the master map. Indirect maps are useful when you want to mount many remote file resources below a common directory.

The auto_home *Indirect Map*

The auto_home indirect map provides a consistent view of home directories across the network, regardless of which system a user is currently logged in to. For example,

```
# cat /etc/auto_home
# Home directory map for automounter
#
+auto_home
stevenu       host5:/export/home/stevenu
johnnyd       host6:/export/home/johnnyd
wkd           server1:/export/home/wkd
```

Note – The plus (+) symbol at the beginning of the +auto_home line in this file directs the automounter to look at the NIS or NIS+ databases. If this line is commented out, only the local files are used.

The following describes the syntax for indirect maps:

key [*mount-options*] *location*

- *key* – The path name of the mount point relative to the beginning of the path name specified in the /etc/auto_master file.
- *options* – The specific options for a given entry.
- *location* – The location of the file resource specified in *server:pathname* notation.

The Substitution String for an Indirect Map

The following entry reduces the `auto_home` file to a single line. The use of substitution characters specifies that for every login ID, the client remotely mounts the `/export/home/loginID` directory from the NFS server `server1` onto the local mount point `/home/loginID`.

```
*       server1:/export/home/&
```

This entry uses the wildcard character `(*)` to match any key; the substitution character `(&)` at the end of the location specification is replaced with the matched key field. This works only when all home directories are on a single server (in this example, `server1`).

The automount *Command*

When making changes to the master map or creating a direct map, make the change effective by running the automount command.

Command Format

automount [-t *duration*] [-v]

The following describes the automount command options.

- -t *duration*

  Specifies a time, in seconds, that the file system remains mounted when not in use. The default is 600 seconds (10 minutes).

- -v

  Displays output as the automount command executes

You do not have to stop and restart the automountd daemon after making changes to existing entries in either a direct or indirect map because it is stateless. You can modify existing entries in both direct and indirect maps at any time. The new information is used when the automountd daemon next uses the map entry to perform a mount.

You can modify the master map entries or add entries for new maps. However, you must run the automount command to make these changes take effect.

A modification is a change to options or resources. A change to the key (the mount point) or a completely new line is considered to be an added or deleted entry or both.

Use Table 7-1 to determine whether you should run (or re-run) the `automount` command.

Table 7-1 Using Automount Maps

Automount	Run if Entry is Added or Deleted	Run if Entry is Modified
`auto_master`	Yes	Yes
direct map	Yes	No
indirect map	No	No

Note – There is no harm in running the `automount` command to rescan the maps, even if it is not required.

The Client autofs *File System*

The autofs file system is a kernel file system that supports automatic mounting and unmounting. When you make a request to access a file system at an autofs mount point, the following occurs:

1. The autofs file system intercepts the request.
2. The autofs file system sends a message to the automountd daemon for the requested file system to be mounted.
3. The automountd daemon locates the file system information in a map and performs the mount.
4. The autofs file system allows the intercepted request to proceed.
5. The automountd daemon will unmount the file system after a period of inactivity.

Note – Mounts managed through the autofs service should not be manually mounted or unmounted. Even if the operation is successful, the autofs file system does not check that the object has been unmounted, resulting in possible inconsistency. A reboot clears all of the autofs mount points.

Multi-threaded autofs

The new autofs automount daemon is now fully multi-threaded. This enables concurrent servicing of multiple mount requests and increases reliability.

Automount Administration

The following procedure describes how to set up remote access to a resource in the Solaris Operating Environment that is located on an NFS server, using the `automountd` daemon.

Setting up a Direct Map

This example demonstrates how to set up remote access to the man pages located on an NFS server.

1. Edit the `/etc/auto_master` file to add a direct map entry.

```
# Master map for automounter
#
+auto_master
/net          -hosts              -nosuid,nobrowse
/home         auto_home           -nobrowse
/-            auto_direct
/xfn          -xfn
```

2. Create a new file called `/etc/auto_direct` and add the following entry for the directory you want to automount. Replace *server* with the host name of your server.

```
/usr/share/man      -ro         server:/usr/share/man
```

3. Make the changes effective.

```
# automount -v
automount: /usr/share/man mounted
automount: no unmounts
```

Setting up an Indirect Map

Complete the following steps to set up an indirect map:

1. Edit the `/etc/auto_master` file. Add the `patch` directory and map.

```
# Master map for automounter
#
+auto_master
/net          -hosts           -nosuid,nobrowse
/home         auto_home        -nobrowse
/services     auto_patch
/xfn          -xfn
```

2. Create an `/etc/auto_patch` map. Enter the patch directory name on the client and the *`server:pathname`*. The following example illustrates the indirect map content:

```
# Patch directory map for automounter
#
patch      server1:/export/patch
```

3. Make the changes effective.

```
# automount -v
```

Exercise: Using the Automounter

Exercise objective – In this lab, you use the automounter processes to automatically mount manual pages and a user's home directory.

Preparation

Choose a partner for this lab, and determine which system will be configured as the NFS server and which will serve as the NFS client. Verify that entries for both systems exist in the `/etc/hosts` file of each systems. Refer to the lecture notes as necessary to perform the steps listed.

Task Summary

In this exercise, you accomplish the following:

- On the server, perform the steps required to share `/usr/share/man`.
- On the client, rename `/usr/share/man` to `/usr/share/man.orig`, and create a new mount point for the `/usr/share/man` directory. Edit the master map so it calls for a direct map. Edit the direct map to mount `/usr/share/man` from the server. Use `automount` to update the automounter. Test that the man pages work and verify the mount that occurs.
- Create a new identical user on both the server and client that uses `/export/home/`*`username`* for the user's home directory. On both systems, make the changes required in `/etc/passwd` to set the home directory for this new user to the `/home/`*`username`* directory.
- On the server, perform the steps required to share the `/export/home` directory.

- On both systems, make the changes required in the `/etc/auto_home` to allow both systems to automatically mount `/export/home/`*`username`* when the new user calls for the `/home/`*`username`* directory. Test the new user login on both systems and verify the mounts that happen. Log in as `root` when finished.
- On the server, unshare `/export/home` and `/usr/share/man` and remove entries for these directories from the `/etc/dfs/dfstab` file. Stop the NFS server daemons.
- On the client, remove the direct map entry from `/etc/auto_master` and update the automounter with the change. Return `/usr/share/man` to its original configuration.

Tasks

Complete the following steps:

On the Server Host

1. Edit the `/etc/dfs/dfstab` file and add the following line to share the manual pages:

   ```
   share /usr/share/man
   ```

2. Use `pgrep` to check if the `mountd` daemon is running.

   ```
   # pgrep -xl mountd
   ```

   If the `mountd` daemon is not running, start it.

   ```
   # /etc/init.d/nfs.server start
   ```

   If the `mountd` daemon was already running, share the new directory by using the following command:

   ```
   # shareall
   ```

On the Client Host

3. Rename the `/usr/share/man` directory so you can no longer access the manual pages installed on the client system.

   ```
   # cd /usr/share/
   # mv man man.orig
   ```

4. Make a new `man` directory for use as a mount point.

   ```
   # mkdir man
   ```

5. Change to the `/etc` directory.

   ```
   # cd /etc
   ```

6. Edit `/etc/auto_master` to add the following line for a direct map:

   ```
   /-    auto_direct
   ```

7. Use `vi` to create a new file called `/etc/auto_direct` and add the following line to it:

   ```
   /usr/share/man          server:/usr/share/man
   ```

8. Run the `automount` command to update the list of directories managed by the automounter.

   # **automount -v**

9. Test the configuration and verify that a mount for `/usr/share/man` exists after accessing the manual pages.

   # **man ls**
   # **mount | grep man**

   Did it work? _____

On the Server Host

10. Verify that the `/export/home` directory exists. If it does not, create it.

    # **ls /export/home**
    # **mkdir /export/home**

11. Run Admintool.

    # **admintool &**

12. From the Edit menu, select Add. In the Add User form, complete the following information:

    a. User Name: Your choice.

    b. User Id: 3001.

    c. Primary Group: Leave as 10.

    d. Secondary Groups: Leave blank.

    e. Comment: Your choice.

    f. Login Shell: Your choice.

    g. Password: Select Normal Password: Set the password to **cangetin**.

    Skip the password aging lines.

    h. Create Home directory: Leave as selected (do not click on the box).

    i. Path: **/export/home/***username*.

13. Click OK.

    This creates a user on this system along with a home directory for the user (physically on this system).

14. Quit Admintool.

On the Client Host

15. Verify that the `/export/home` directory exists. If it does not, create it.

    ```
    # ls /export/home
    # mkdir /export/home
    ```

16. Run Admintool.

    ```
    # admintool&
    ```

17. From the Edit menu, select Add. In the Add User form, complete the following information:

    a. User Name: Same user.

    b. User Id: Same UID as the server.

    c. Primary Group: Same GID as the server.

    d. Secondary Groups: Leave blank.

    e. Comment: Your choice.

    f. Login Shell: Same shell.

    Password: Select Normal Password: Set the password to **`cangetin`**.

    Skip the password aging lines.

    g. Create Home directory: Deselect it (click on the box).

    h. Path: **`/export/home/`***`username`*.

18. Click OK.

    You are warned that the home directory does not exist.

19. Click OK.

    This adds a user to this system but does not create a home directory. This is correct. Eventually you will use the `automount` command to mount the home directory from the server system.

20. Quit Admintool.

On Both Systems

21. Edit the `/etc/passwd` file and change the home directory for the new user from `/export/home/`*`username`* to `/home/`*`username`*. Replace *`username`* with the name of your new user.

22. Edit the `/etc/auto_home` file. Add the following line and replace *`username`* with the name of your new user:

    username *server*`:/export/home/`*username*

On the Server Host

23. Edit the `/etc/dfs/dfstab` file and add the following line to share the `/export/home` directory:

    `share /export/home`

24. Use the `pgrep` command to check if the `mountd` daemon is running.

    # **`pgrep -xl mountd`**

    If the `mountd` daemon is not running, start it.

    # **`/etc/init.d/nfs.server start`**

    If the `mountd` daemon is running, share the new directory.

    # **`share /export/home`**

On Both Systems

25. Log in as the new user.

    Do both systems automatically mount the new user's home directory? _____

    What directory is mounted, and what is the mount point:

    - On the server?

      _____

    - On the client?

      _____

26. If the user's home directory is not mounted automatically, as `root`, stop and restart the `automountd` daemon.

    ```
    # /etc/init.d/autofs stop
    # /etc/init.d/autofs start
    ```

27. On both systems, log out from the current user session and log back in as `root`.

On the Server Host

28. Unshare all shared directories. Edit the `dfstab` file and remove the lines for the `/export/home` and `/usr/share/man` directories.

    ```
    # unshareall
    ```

29. In preparation for subsequent labs, stop the NFS server daemons.

    ```
    # /etc/init.d/nfs.server stop
    ```

On the Client Host

30. Edit the `/etc/auto_master` file and remove the line that reads:

    ```
    /-    auto_direct
    ```

31. Delete the `/etc/auto_direct` file.

    ```
    # rm /etc/auto_direct
    ```

32. Run the `automount` command to update the list of directories managed by the automounter.

    # **automount -v**

33. Remove the `/usr/share/man` mount point.

    # **cd /usr/share**
    # **rmdir man**

34. Rename the `/usr/share/man` directory so you again have access to the manual pages installed on the client system.

    # **mv man.orig man**

Exercise Summary

Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Task Solutions

On the Server Host

1. Edit the `/etc/dfs/dfstab` file and add the following line in order to share the manual pages:

   `share /usr/share/man`

2. Use `pgrep` to check if `mountd` is running.

   # **`pgrep -xl mountd`**

   If `mountd` is not running, start it.

   # **`/etc/init.d/nfs.server start`**

   If `mountd` was already running, share the new directory by using the following command:

   # **`shareall`**

On the Client Host

3. Rename the `/usr/share/man` directory so you can no longer access the manual pages installed on the client system.

   # **`cd /usr/share/`**
   # **`mv man man.orig`**

4. Make a new `man` directory for use as a mount point.

   # **`mkdir man`**

5. Change to the `/etc` directory.

   # **`cd /etc`**

6. Edit `/etc/auto_master` to add the following line for a direct map:

   `/-    auto_direct`

7. Use `vi` to create a new file called `/etc/auto_direct` and add the following line to it:

   `/usr/share/man` *`server`***`:/usr/share/man`**

8. Run the automount command to update the list of directories managed by the automounter.

   # **automount -v**

9. Test the configuration and verify that a mount for /usr/share/man exists after accessing the manual pages.

```
# man ls
<-- output from man command -- >
# mount | grep man
/usr/share/man on server:/usr/share/man read/write/remote on Fri Aug 13
16:56:14 1999
```

   Did it work?

   This should automatically mount the directory where the manuals are stored. The man *command should work.*

On the Server Host

10. Verify that the /export/home directory exists. If it does not, create it.

    # **ls /export/home**
    # **mkdir /export/home**

    The /export/home *directory should have been created during installation of the operating system. If not, the second command applies.*

11. Run Admintool.

    # **admintool &**

    The admintool *window is displayed.*

12. From the Edit menu, select Add. In the Add User form, complete the following information:

    a. User Name: Your choice.

    b. User Id: 3001.

    c. Primary Group: Leave as 10.

    d. Secondary Groups: Leave blank.

    e. Comment: Your choice.

    f. Login Shell: Your choice.

    g. Password: Select Normal Password: Set the password to **`cangetin`**.

    Skip the password aging lines.

    h. Create Home directory: Leave as selected (do not click on the box).

    i. Path: **`/export/home/`***`username`*.

13. Click OK.

    This creates a user on this system along with a home directory for the user (physically on this system).

14. Quit Admintool.

On the Client Host

15. Verify that the `/export/home` directory exists. If it does not, create it.

    ```
    # ls /export/home
    # mkdir /export/home
    ```

    The `/export/home` *directory should have been created during installation of the operating system. If not, the second command applies.*

16. Run Admintool.

    ```
    # admintool &
    ```

17. From the Edit menu, select Add. In the Add User form, complete the following information:

    a. User Name: Same user.

    b. User Id: Same UID as the server.

    c. Primary Group: Same GID as the server.

    d. Secondary Groups: Leave blank.

    e. Comment: Your choice.

    f. Login Shell: Same shell.

    g. Password: Select Normal Password: Set the password to **`cangetin`**.

    Skip the password aging lines.

    h. Create Home directory: Deselect it (click on the box).

    i. Path: **`/export/home/`***`username`*.

On the Client Host

18. Click OK.

    You are warned that the home directory does not exist.

19. Click OK.

    This adds a user to this system but does not create a home directory. This is correct. Eventually you will use the `automount` command to mount the home directory from the server system.

20. Quit Admintool.

On Both Systems

21. Edit the `/etc/passwd` file and change the home directory for the new user from `/export/home/`*`username`* to `/home/`*`username`*. Replace *`username`* with the name of your new user.

22. Edit the `/etc/auto_home` file. Add the following line and replace *`username`* with the name of your new user:

    `username` *`server`***`:/export/home/`***`username`**

On the Server Host

23. Edit the `/etc/dfs/dfstab` file and add the following line to share the `/export/home` directory:

    ```
    share /export/home
    ```

24. Use the `pgrep` command to check if the `mountd` daemon is running.

    ```
    # pgrep -xl mountd
        391 mountd
    ```

    If the `mountd` daemon is not running, start it.

    ```
    # /etc/init.d/nfs.server start
    ```

    Once the `mountd` daemon is running, share the new directory.

    ```
    # share /export/home
    #
    ```

On Both Systems

25. Try to log in as the new user.

    Do both systems automatically mount the new user's home directory?

    Yes, this should work.

    What directory is mounted, and what is the mount point:

    - On the server?

      /home/*username* on /export/home/*username*

    - On the client?

      /home/*username* on *server*:/export/home/*username*

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- List the benefits of using the `automount` utility
- Describe the purpose of each of the types of automount maps
- Configure the `auto_master` map to specify which direct, indirect, and special maps the `automountd` daemon reads.
- Create the `auto_direct` map with the full path names and mount options for automatically mounting remote file resources.
- Modify the `auto_home` map as an example of an indirect map providing a consistent view of `home` directories across the network, regardless of where the user is logged in.

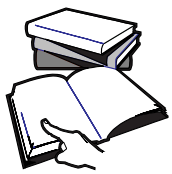
CacheFS 8

Objectives

Upon completion of this module, you should be able to:

- Describe the CacheFS file system
- Use the appropriate commands to configure the CacheFS file system
- Use the appropriate commands to check the status and consistency of the CacheFS file system
- Set up CacheFS file system logging
- Describe the steps necessary to perform a check of the CacheFS file system
- List the steps to dismantle and delete a CacheFS file system

Additional Resources



Additional resources – The following references provide additional details on the topics discussed in this module:

- *System Administration Guide, Volume I*, Sun Part Number 805-7228-10
- *System Administration Guide, Volume II*, Sun Part Number 805-7229-10
- System Administration *Guide, Volume III*, Sun Part Number 806-0916-10

CacheFS File System

You can use the CacheFS file system to improve the performance of remote file systems (such as NFS), or slow devices, such as CD-ROM drives.

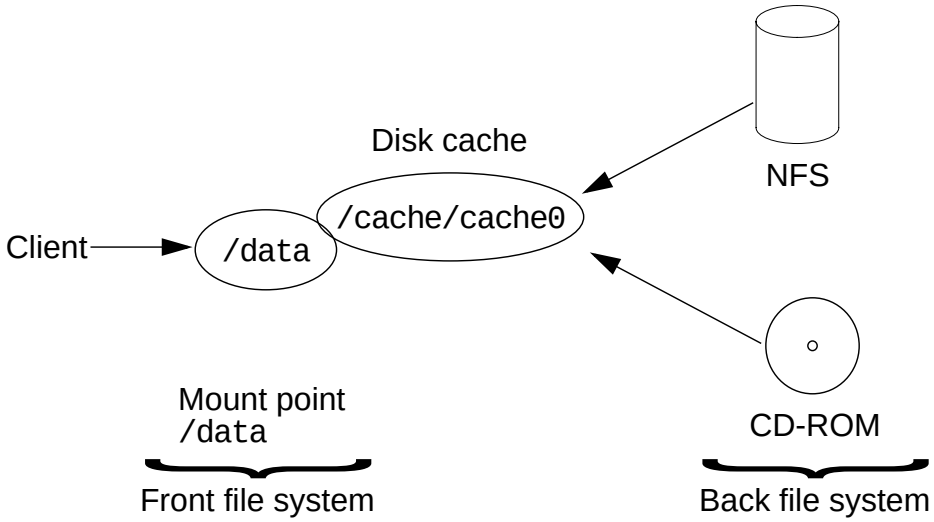


Figure 8-1 CacheFS Diagram

When you enable the CacheFS file system, the data read from the remote file system or CD-ROM is stored in a disk-based cache on the local system. Subsequent read requests to the same data are fulfilled by the local cache, which improves read performance.

Note – This has no effect on the NFS server; it affects only the client.

Using CacheFS Terminology

The following terms are used when discussing the CacheFS file system:

- Back file system – The original disk-based, network-based, or CD-ROM-based file system that is mounted as a CacheFS file system and cached.
- Front file system – The mounted file system that is cached and accessed by the user through the local mount point.
- Consistency – Refers to the state of synchronization between the back and front file systems.

Using CacheFS File System Commands

You have the following commands available for administering a CacheFS file system:

- `cfsadmin` – This command administers the disk space for the cached file system. This includes creating, deleting, and listing the contents of the cache.
- `cachefsstat` – This command provides statistics on cache usage.
- `cachefslog` – This command establishes a login procedure for the cache.
- `cachefswssize` – This command helps determine the working set sizes for CacheFS file systems so that the cache area can be properly sized. This functions only if CacheFS logging is enabled.

Creating a CacheFS File System

Setting up a CacheFS file system is basically a three-step procedure, illustrated in Figure 8-2.

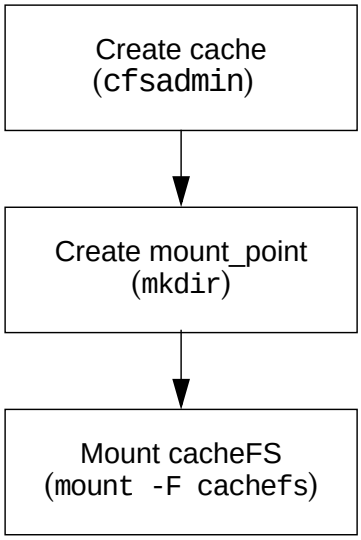


Figure 8-2 Setting up a CacheFS File System

This example procedure assumes that a file system (`/export/data`) on a remote system (`host1`) IS available to the local system. The local system mounts the resource and caches it.

Note – All commands are executed on the local system.

To set up a CacheFS file system, perform the following steps:

1. Create a cache using the following command:

```
# cfsadmin -c /cache/cache0
```

2. If one does not already exist, create a local mount point in preparation for mounting the remote file system.

```
# mkdir /data
```

3. Mount the remote file system and implement a CacheFS file system.

```
# mount -F cachefs -o backfstype=nfs,cachedir=/cache/cache0,\
cacheid=data_cache host1:/export/data /data
```

- The remote resource is mounted as a CacheFS file system.
- The source file system type (backfstype) is nfs.
- You must specify the cachedir.
- The cacheid is optional, but it can provide a convenient user-defined label to identify this CacheFS mount for subsequent administration commands.
- The remote resource is host1:/export/data and local users access it through the /data mount point.

4. Use the mount command to verify the mount.

```
# mount
/ on /dev/dsk/c0t0d0s0 read/write/setuid/largefiles on Thu May 11
15:55:34 2000
/proc on /proc read/write/setuid on Thu May 11 15:55:34 2000
/dev/fd on fd read/write/setuid on Thu May 11 15:55:34 2000
/tmp on swap read/write on Thu May 11 15:55:35 2000

/data on /cache/cache0/.cfs_mnt_points/host1:_export_data
backfstype=nfs/cachedir=/cache/cache0/cacheid=data_cache on Thu May 11
06:38:43 2000
```

You could automate this mount by adding a line similar to the following to the /etc/vfstab file:

```
host1:/export/data - /data cachefs - yes
backfstype=nfs,cachedir=/cache/cache0,cacheid=data_cache
```

The cache is now used when local users access the resource through the local /data mount point.

CacheFS Cache Directory Details

Figure 8-3 illustrates areas of the underlying cache directory hierarchy:

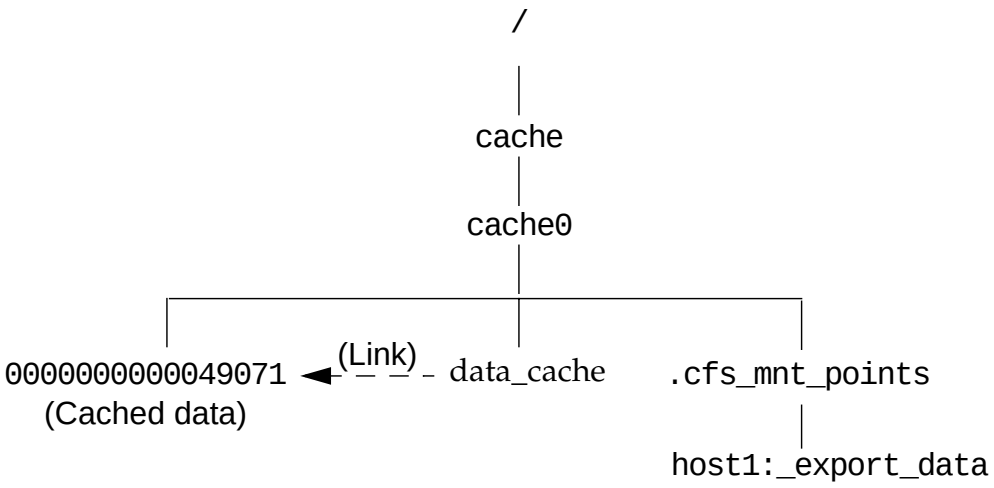


Figure 8-3 CacheFS Cache Directory Structure

The following describes the cache directory hierarchy:

- For each CacheFS file system being cached in the cache directory, an entry is made in the `.cfs_mnt_points` directory.
- If you specify a cache ID string when the CacheFS file system is mounted, this string becomes a symbolic link to the cache data for that file system.
- Local users access the cached data through the local `/data` mount point.

CacheFS Statistics and Consistency Checking

To view CacheFS file system statistics you can use the `cachefsstat` command. To check consistency, use the `cfsadmin` command.

The `cachefsstat` Command

You use `cachefsstat` command to display cache statistics. It displays information that describes the effectiveness of your cache.

The following output shows statistics for a newly created cache:

```
# cachefsstat /data

/data
cache hit rate:        100% ( 8 hits, 0 misses)
consistency checks:      24 (24 pass, 0 fail)
modifies:                 0
garbage collection:       0
```

By default, automatic cache consistency is enabled. The files in the cache are checked against the originals in the back file system (on the server) and updates are performed on the client's front file system. The `pass` value (24 in this example) indicates the number of consistency checks performed. The `fail` value (0 here) indicates the number of updates that have been performed.

The value in the `hit` rate indicates the efficiency of the cache. The hits indicate the instances when the cached file was used and access to the original file avoided. The `miss` value indicates when there was not a cached copy of the file and the back file system copy was accessed.

To collect status over a specific period of time, you can first zero the `cachefs` counters. To zero all `cachefs` counters, use the following command:

```
# cachefsstat -z
```

The demandconst *Option*

You can disable the automatic consistency checks by using the `demandconst` option for the `mount` command (see the `mount_cachefs`(1) man page for more information). This should be done only when the back file system is static or the back and front file systems do not need to be synchronized. For example, if the back file system is a read-only file system on a CD-ROM, there is no need to enable consistency checking.

The cfsadmin *Command*

If automatic consistency checking is disabled by using the `demandconst` option, the following `cfsadmin` command manually invokes a consistency check and performs any necessary updates:

```
# cfsadmin -s /data
```

Enhancing CacheFS File System Caching

You can have additional control of the caching mechanism for CacheFS file systems by doing the following:

- Set the number of data blocks used by the cache as a percentage of the front file system. Refer to the `cfsadmin`(1M) man page for details.

Note – These percentages can be enforced only if the CacheFS file subsystem is given exclusive access to the front file system.

- Set the minimum and maximum number of files that the CacheFS file system can use as a percentage of the files in the front file system.

  The following display of cache statistics shows the default values:

```
# cfsadmin -l /cache/cache0
cfsadmin: list cache FS information
   maxblocks     90%
   minblocks      0%
   threshblocks  85%
   maxfiles      90%
   minfiles       0%
   threshfiles   85%
   maxfilesize    3MB
  data_cache
```

  where:

  - `maxblocks` – Maximum amount of storage space that CacheFS can use, expressed as a percentage of the total number of blocks in the front file system.
  - `minblocks` – Minimum amount of storage space (expressed as a percentage of the total number of blocks in the front file system) that CacheFS is always allowed to use without limitation by its internal control mechanisms.
  - `threshblocks` – A percentage of the total blocks in the front file system beyond which CacheFS cannot claim resources once its block usage has reached the level specified by `minblocks`.

- `maxfiles` – Maximum number of files that CacheFS can use, expressed as a percentage of the total number of inodes in the front file system.
- `minfiles` – Minimum number of files (expressed as a percentage of the total number of inodes in the front file system) that CacheFS is always allowed to use without limitation by its internal control mechanisms.
- `threshfiles` – A percentage of the total inodes in the front file system beyond which CacheFS cannot claim inodes once its usage has reached the level specified by `minfiles`.
- `maxfilesize` – Largest file size (expressed in Mbytes) that CacheFS is allowed to cache.

These parameters are specified with the `-o` option, with multiple parameters separated by commas. Refer to the `cfsadmin`(1M) man page for more details.

You can change these parameters only when you create the cache.

Sizing the Cache

You use the `cachefswssize` command to determine the current size of the data in the cache. This includes the amount of cache space needed for each file system that was mounted under the cache, as well as a total. Before using the `cachefswssize` command, you must enable `cachefs` logging. Before you enable the `cachefs` logging, you must create the directory for the log files.

```
# mkdir /var/cachelogs
```

The following command creates and begins a `cachefs` log:

```
# cachefslog -f /var/cachelogs/data.log /data
/var/cachelogs/data.log: /data
```

In the previous command, a cache log called `/var/cachelogs/data.log` was created for the CacheFS file system mounted locally as `/data`.

You can change the cache log at any time. The following command is an example of changing the log file to: `/var/cachelogs/data_new.log:`

```
# cachefslog -f /var/cachelogs/data_new_062100.log /data
/var/cachelogs/data_new_062100.log: /data
```

At any time, you can determine the current log file. The following is a sample command that describes how to do this:

```
# cachefslog /data
/var/cachelogs/data_new_062100.log: /data
```

You can stop and verify logging using the following commands:

```
# cachefslog -h /data
not logged: /data
# cachefslog /data
not logged: /data
```

Once you enable logging, you can check the size of the cache.

```
# cachefswssize /var/cachelogs/data.log

    total for cache
   initial size:             4256k
       end size:              511k
high water size:              511k
```

CacheFS File System Integrity

You use the `fsck`(1M) command to check and repair the integrity of file systems.

To check the integrity of the CacheFS file system, perform the following steps:

1. Unmount the CacheFS file system before invoking the `fsck` command.

```
# umount /data
```

2. Use the following command to check and repair the CacheFS file system:

```
# fsck -F cachefs -o noclean /cache/cache0
```

The `-F` option informs the `fsck` command that the type of file system to check is the CacheFS file system type. The `-o noclean` option is used to force `fsck` to perform a check even if it determines that a check is not necessary.

3. Use the `mount` command to enable access to the repaired CacheFS file system.

```
# mount -F cachefs -o backfstype=nfs,cachedir=/cache/cache0,\
cacheid=data_cache host1:/export/data /data
```

Dismantling a CacheFS File System

Implementing a CacheFS file system can be an interim measure for enhancing performance. You can delete a CacheFS file system and recreate it at a later time.

Note – Deleting a CacheFS file system (that is, deleting its cached copy) has no effect on the original back file system.

You can mount more than one back file system as a CacheFS file system and cache it in the same caching directory. You can dismantle one CacheFS file system, leaving others intact. You can also dismantle all the CacheFS file systems in the caching directory.

To dismantle a CacheFS file system, perform the following steps:

1. If necessary, warn users that their access to the CacheFS file system will be interrupted.

2. Determine the cache ID for the CacheFS file system you intend to delete. The ID string is located in the last line of the output of the following command. The remainder of the output is covered later in this module.

```
# cfsadmin -l /cache/cache0
cfsadmin: list cache FS information
   maxblocks     90%
   minblocks      0%
   threshblocks  85%
   maxfiles      90%
   minfiles       0%
   threshfiles   85%
   maxfilesize    3MB
  data_cache
```

3. Unmount all CacheFS file systems that share the same cache directory with the one you intend to delete. The examples in this module use only one cache directory, so the command is:

```
# umount /data
```

4. Delete the CacheFS file system.

```
# cfsadmin -d data_cache /cache/cache0
```

Note – To delete all CacheFS file systems in the cache directory, use the `cfsadmin -d all` command.

5. If some CacheFS file systems remain after others are deleted, use the `fsck` command to correct the resource counts in the cache directory.

```
# fsck -F cachefs -o noclean /cache/cache0
```

6. Remount the remaining CacheFS file systems.

Exercise: Configuring the CacheFS File System

Exercise objective – In this lab, you mount `/usr/share/man` to a CacheFS file system.

Preparation

Designate a machine in the lab that will store the man pages for clients to mount on the CacheFS file system.

Task Summary

In this exercise, you accomplish the following:

- Make a backup copy of `/usr/share/man` and then remove the original directory.
- Create a cache directory.
- Mount the `/usr/share/man` NFS file system to your CacheFS file system and list the files created in your cache directory.
- Check the status of the CacheFS file system and look at the size of the cache directory using the `df` command.
- Execute the `snoop` command from a terminal window to capture traffic between the server and the CacheFS system and then run the command `man ls` and note the network traffic.
- Perform a consistency check and note the hit rate and other information.
- Find the size of the cache directory using the `df` command and note the differences from the previous output.
- Remove the CacheFS file system and reinstall the original man pages from the backup copy or CD-ROM.

Tasks

Complete the following steps:

1. Move the man pages to another directory.

   # **mv /usr/share/man /usr/share/man.save**

2. Create a cache directory.

   # **cfsadmin -c /export/cache_dir**

3. Create a mount point for your CacheFS mount.

   # **mkdir /usr/share/man**

4. Mount the `/usr/share/man` NFS file system from the designated server to your CacheFS file system.

```
# mount -F cachefs -o \
backfstype=nfs,cachedir=/export/cache_dir,cacheid=007man,demandconst \
servername:/usr/share/man /usr/share/man
```

Note – You use the `demandconst` option to disable the consistency check features.

---

5. Use the `mount` command to identify the mount that succeeded.

   # **mount | grep man**

6. List the files created in the cache directory and note the cache ID number.

   # **cd /export/cache_dir**
   # **ls -al**

7. List the contents of the `.cfs_mnt_points` directory and note the mount points created.

   # **ls -al .cfs_mnt_points**

8. Check the status of the CacheFS file system.

   # **cachefsstat /usr/share/man**

9. Display file system size of the cache directory using the `df` command.

   # **`df -k /export/cache_dir`**

10. Open another terminal window and run the following `snoop` command:

    # **`snoop`** *`servername clientname`*

11. Access the `/usr/share/man` directory using the following command:

    # **`man ls`**

Note – In the `snoop` window, take note of the network traffic that is generated.

---

12. Use the same `man` command again and note the network traffic generated. Why is there a difference?

    _____

    _____

13. Use the following commands to perform a manual consistency check. Note the hit rate and consistency checks.

    # **`cfsadmin -s /usr/share/man`**
    # **`cachefsstat /usr/share/man`**

    How have the numbers changed from the output of the previous (step 8) `cachefsstat` command?

    _____

    _____

14. Display the file system size of the cache directory again using the `df` command.

    # **`df -k /export/cache_dir`**

Note – Compare the size to that output in step 9.

---

15. Run the `cfsadmin` command to determine the maximum amount of space in the `/export` directory that the cache can use.

```
# cfsadmin -l /export/cache_dir
```

16. Unmount the `/usr/share/man` directory and remove the CacheFS file system.

```
# umount /usr/share/man
# cfsadmin -d 007man /export/cache_dir
#
```

17. Remove the directory you created for the CacheFS file system.

```
# rmdir /usr/share/man
```

18. If the system is still running the `snoop` command from step 10, press Control-C to terminate it.

19. Reinstall the original man pages

```
# mv /usr/share/man.save /usr/share/man
```

Exercise Summary

Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Task Solutions

1. Move the man pages to another directory.

   # **mv /usr/share/man /usr/share/man.save**

2. Create a cache directory.

   # **cfsadmin -c /export/cache_dir**

3. Create a mount point for your CacheFS mount.

   # **mkdir /usr/share/man**

4. Mount the /usr/share/man NFS file system from the designated server to your CacheFS file system.

```
# mount -F cachefs -o \
backfstype=nfs,cachedir=/export/cache_dir,cacheid=007man,demandconst \
servername:/usr/share/man /usr/share/man
```

   The demandconst option is used to disable the consistency check features.

5. Use the mount command to identify the mount that succeeded.

```
# mount | grep man
/usr/share/man on
/export/cache_dir/.cfs_mnt_points/servername:_usr_share_man
backfstype=nfs/cachedir=/export/cache_dir/cacheid=007man/demandconst on
Fri Aug 13 10:27:20 1999
```

6. List the files created in the cache directory and note the cache ID number.

```
# cd /export/cache_dir
# ls -al
total 33924
d---------   5 root     other        512 Aug 13 10:27 .
drwxr-xr-x   8 root     root         512 Aug 13 10:24 ..
-rw-------   1 root     other         48 Aug 13 10:24 .cfs_label
-rw-------   1 root     other         48 Aug 13 10:24 .cfs_label.dup
-rwx------   1 root     other          0 Aug 13 10:24 .cfs_lock
drwx------   3 root     other        512 Aug 13 10:27 .cfs_mnt_points
-rw-------   1 root     other    17334272 Aug 13 10:27 .cfs_resource
-rw-r--r--   1 root     other          4 Aug 13 10:24 .cfs_unmnt
-rw-r--r--   1 root     other         41 Aug 13 10:24 .nsr
drwxrwxrwx  10 root     root         512 Aug 13 10:27 000000000004e000
lrwxrwxrwx   1 root     root          16 Aug 13 10:27 007man ->
000000000004e000
drwx------   2 root     other        512 Aug 13 10:24 lost+found
```

7. List the contents of the `.cfs_mnt_points` directory and note the mount points created.

```
# ls -al .cfs_mnt_points
drwx------   3 root     other        512 Aug 13 10:27 .
d---------   5 root     other        512 Aug 13 10:27 ..
drwxr-xr-x  81 bin      bin         1536 Feb  8  1999
server:_usr_share_man
```

8. Check the status of the CacheFS file system.

```
# cachefsstat /usr/share/man

    /usr/share/man
                cache hit rate:    100% (0 hits, 0 misses)
            consistency checks:      0 (0 pass, 0 fail)
                      modifies:      0
            garbage collection:      0
```

9. Display file system size of the cache directory using the `df` command.

```
# df -k /export/cache_dir
Filesystem            kbytes    used   avail capacity  Mounted on
/dev/dsk/c0t0d0s3    2828824  326557 2445691    12%    /usr/share/man
```

10. Open another terminal window and run the following `snoop` command, and leave it running.

```
# snoop servername clientname
Using device /dev/hme (promiscuous mode)
```

11. Access the `/usr/share/man` directory using the following command:

```
# man ls
```

Note – In the `snoop` window, take note of the network traffic that is generated.

```
clientname -> servername NFS C GETATTR3 FH=0082
servername -> clientname NFS R GETATTR3 OK
clientname -> servername NFS C ACCESS3 FH=0082lookup (lookup)
servername -> clientname NFS R ACCESS3 OK (lookup)
clientname -> servername NFS C GETATTR3 FH=40EE
servername -> clientname NFS R GETATTR3 OK
clientname -> servername NFS C ACCESS3 FH=40EEread (read)
servername -> clientname NFS R ACCESS3 OK (read)
clientname -> servername TCP D=2049 S=677     Ack=13938960
Seq=2251034193 Len=0 Win=8760
clientname -> servername NFS C GETATTR3 FH=5331
servername -> clientname NFS R GETATTR3 OK
clientname -> servername NFS C ACCESS3 FH=5331read (read)
servername -> clientname NFS R ACCESS3 OK (read)
clientname -> servername NFS C GETATTR3 FH=5331
< output deleted >
```

12. Use the same `man` command again and note the network traffic generated. Why is there a difference?

The output from the previous command is now accessed from the cache.

13. Use the following commands to perform a manual consistency check. Note the hit rate and consistency checks.

```
# cfsadmin -s /usr/share/man
# cachefsstat /usr/share/man

    /usr/share/man
                cache hit rate:   75% (12 hits, 3 misses)
            consistency checks:      2 (2 pass, 0 fail)
                      modifies:      0
            garbage collection:      0
```

How have the numbers changed from the output of the previous (step 8) `cachefsstat` command?

The cache hit rate should be less than 100 percent.

14. Display the file system size of the cache directory again using the `df` command.

```
# df -k /export/cache_dir
Filesystem            kbytes    used   avail capacity  Mounted on
/dev/dsk/c0t0d0s3    2828824  327456 2444792    12%    /export
```

Compare the size to that output in step 9.

The `used` *column shows almost a 1 Mbyte increase (*327456 - 326557*=899 Kbytes).*

15. Run the `cfsadmin` command to determine the maximum amount of space in the `/export` directory that the cache can use.

```
# cfsadmin -l /export/cache_dir
cfsadmin: list cache FS information
   maxblocks     90%
   minblocks      0%
   threshblocks  85%
   maxfiles      90%
   minfiles       0%
   threshfiles   85%
   maxfilesize    3MB
  007man
```

16. Unmount the `/usr/share/man` directory and remove the CacheFS file system.

    # **umount /usr/share/man**
    # **cfsadmin -d 007man /export/cache_dir**

17. Remove the directory you created for the CacheFS file system.

    # **rmdir /usr/share/man**

18. If the system is still running the `snoop` command from step 10, press Control-C to terminate it.

19. Reinstall the original man pages.

    # **mv /usr/share/man.save /usr/share/man**

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- ❑ Describe the CacheFS file system
- ❑ Use the appropriate commands to configure the CacheFS file system
- ❑ Use the appropriate commands to check the status and consistency of the CacheFS file system
- ❑ Set up CacheFS file system logging
- ❑ Describe the steps necessary to perform a check of the CacheFS file system
- ❑ List the steps to dismantle and delete a CacheFS file system

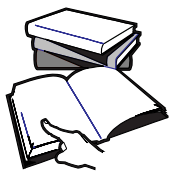
Role-Based Access Control 9

Objectives

Upon completion of this module, you should be able to:

- Build an association between users and roles with authorizations and execution profiles
- Define authorizations and their attributes
- List a profile's assigned authorizations
- Define the privileged operations that are assigned to a profile
- Identify help files that are associated with profiles and authorizations
- Configure a user's execution profile to allow access to a specified subset of system administrator privileges

Additional Resources



Additional resources – The following references provide additional details on the topics discussed in this module:

- *System Administration Guide, Volume I*, Sun Part Number 805-7228-10
- *System Administration Guide, Volume II*, Sun Part Number 805-7229-10

Role-Based Access Control

Role-based access control (RBAC) provides an alternative to the all-or-nothing security model of traditional superuser-based systems. The problem with the traditional model is not just that the superuser is so powerful, but that other users are not powerful enough to fix their own problems. RBAC enables you to assign subsets of superuser privileges to user accounts. This enables users to solve some of their own problems.

You can still control the capabilities of the superuser by dividing those capabilities into several packages and assigning them separately to individuals sharing administrative responsibilities.

RBAC includes the following features:

- Authorization – A right that is used to grant access to a restricted function
- Execution profile (or simply profile) – A bundling mechanism for grouping authorizations and commands with special attributes; for example, user and group IDs
- Role – A special type of user account intended for performing a specific set of administrative tasks

Warning – You can use RBAC to provide superuser access to administrative roles within the system. However, you must exercise caution to avoid creating security lapses when providing access to administrative accounts using these features.

Components

RBAC relies on four databases to provide users access to privileged operations:

- /etc/`user_attr` (extended user attributes database) – In addition to the `/etc/passwd`, `/etc/group`, and `/etc/shadow` files, this database associates users and roles with authorizations and execution profiles.
- `/etc/security/auth_attr` (authorization attributes database) – This database defines authorizations and their attributes and identifies the associated help file.
- /etc/security/`prof_attr` (execution profile attributes database) – This database defines profiles, lists the profile's assigned authorizations, and identifies the associated help file. Profiles can be logically named based on what the profile is designed to do.
- /etc/security/`exec_attr` (profile execution attributes database) – This database defines the privileged operations assigned to a profile.

Delimiters

Understanding the RBAC databases is simplified with the use of a common set of delimiters. These delimiters function as follows:

- Colon (:) – Used as a field separator within each database; for example,

```
name:qualifier:res1:res2:attribute
```

- Semicolon (;) – Used to separate key-value pairs within attribute fields; for example,

```
...:attribute_type=value;attribute_profile=value;attribute_auth=value
```

- Comma (,) – Used to separate an ordered list within a specific attribute key; for example,

```
...;attribute_profile=profile_access1,profile_access2,profile_access3;...
```

- period (.) – Used to separate the prefix from suffixes within authorization names to define execution profiles with finer granularity; for example,

```
solaris.system.date:::Set Date & Time::help=SysDate.html
```

Figure 9-1 illustrates the interdependencies between the RBAC components. Databases are shown in boxes while the arrows indicate relationships between databases. The entities assigned in the relationships appear next to the arrows.

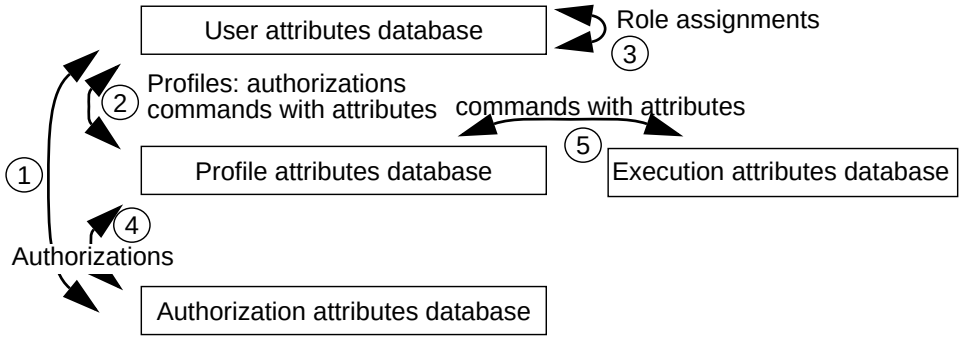


Figure 9-1 Component Interaction within RBAC

You can assign authorizations (1) and profiles (2) to users in the `user_attr` database; this is a direct assignment of privileged operations. You can also assign the user to a role (3), which gives the user access to any privileged operations associated with that role. Profiles are defined in the `prof_attr` database and can include authorizations (4) defined in `auth_attr` and `commands` with attributes (5) defined for that profile in `exec_attr`.

Note – illustrates that dependencies exist; the remainder of this module expands on these dependencies.

Commands that are assigned to profiles are run in special shells called *profile* shells. The profile shells are `pfsh`, `pfcsh`, and `pfksh`, and they correspond to the Bourne shell (`sh`), C shell (`csh`), and Korn shell (`ksh`) respectively.

*Extended User Attributes Database (*user_attr*)*

The /etc/user_attr database supplements the passwd and shadow databases. It contains extended user attributes, such as authorizations and execution profiles. It also allows you to assign roles to a user.

A *role* is a special type of user account that is intended for performing a set of administrative tasks. It is similar to a normal user account in most respects except that users gain access to it only through the su command. Users cannot access it using their normal procedures; for example, through the CDE login window. From a role account, a user can access commands with special attributes, typically root user ID, which are not available to users in normal accounts.

The fields in the user_attr database are separated by colons, as follows:

```
user:qualifier:res1:res2:attr
```

Table 9-1 describes the fields in the `user_attr` database.

Table 9-1 `user_attr` Database

Field Name	Description
`user`	The name of the user, as specified in the `passwd`(4) database.
`qualifier`	Reserved for future use.
`res1`	Reserved for future use.
`res2`	Reserved for future use.
`attr`	An optional list of semicolon-separated (`;`) key-value pairs that describe the security attributes to be applied when the user runs commands. There are four valid keys: `auths`, `profiles`, `roles`, and `type`. • `auths` specifies a comma-separated list of authorization names chosen from names defined in the `auth_attr`(4) database. Authorization names might include the asterisk (*) character as a wildcard. For example, `solaris.device.*` means all of the Solaris Operating Environment device authorizations. • `profiles` contains an ordered, comma-separated list of profile names chosen from `prof_attr`(4). A profile determines which commands a user can execute and with which command attributes. At minimum, each user in `user_attr` should have the `All` profile, which makes all commands available but without any attributes. The order of profiles is important; it works similarly to UNIX search paths. The first profile in the list that contains the command to be executed defines which (if any) attributes are to be applied to the command. • `roles` can be assigned to the user using a comma-separated list of role names. Roles are defined in the same `user_attr` database. They are indicated by setting the `type` value to `role`. You cannot assign roles to other roles. • `type` can be set to `normal`, if this account is for a normal user, or to `role`, if this account is for a role. A role is assumed by a normal user after the user has logged in.

The following is an example of a `user_attr` database, with typical values:

```
root::::type=normal;auth=solaris.*,solaris.grant;profiles=All
sysadmin::::type=role;profiles=Device Management,Filesystem
Management,All
johndoe::::type=normal;auths=solaris.system.date;roles=sysadmin;profiles=
All
```

Repeating this typical role assignment (and emphasizing the details) you can see that the `sysadmin` *role* has been assigned to the user `johndoe`. When assuming the `sysadmin` role, johndoe has access to specific profiles, such as `Device Management`, `Filesystem Management`, and the `All` profile.

```
root::::type=normal;auth=solaris.*,solaris.grant;profiles=All
sysadmin::::type=role;profiles=Device Management,Filesystem
Management,All
johndoe::::type=normal;auths=solaris.system.date;roles=sysadmin;profiles=
All
```

Authorizations

An authorization is a user right that grants access to a restricted function. It is a unique string that identifies what is being authorized as well as who created the authorization.

Authorizations are checked by certain privileged programs to determine whether users can execute restricted functionality. For example, `the solaris.jobs.admin` authorization is required for one user to edit another user's `crontab` file.

All authorizations are stored in the `auth_attr` database. You can assign authorizations directly to users (or roles) in which case they are entered in the `user_attr` database. You can also assign authorizations to execution profiles, which in turn are assigned to users.

The fields in the `auth_attr` database are separated by colons:

```
authname:res1:res2:short_desc:long_desc:attr
```

Table 9-2 describes the fields in the auth_attr database.

Table 9-2 `auth_attr` Database

Field Name	Description
`authname`	A unique character string used to identify the authorization in the format `prefix.[suffix]`. Authorizations for the Solaris Operating Environment use `solaris` as a prefix. All other authorizations should use a prefix that begins with the reverse-order Internet domain name of the organization that creates the authorization (for example, `com.xyzcompany`). The suffix indicates what is being authorized, typically the functional area and operation. When there is no suffix (that is, the `authname` consists of a prefix and functional area and ends with a period), the `authname` serves as a heading for use by applications in their GUIs rather than as an authorization. The `authname` `solaris.printmgr` is an example of a heading. When `authname` ends with the word `grant`, the `authname` serves as a grant authorization and lets the user delegate related authorizations (that is, authorizations with the same prefix and functional area) to other users. The `authname` `solaris.printmgr.grant` is an example of a grant authorization; it gives the user the right to delegate authorizations, such as `solaris.printmgr.admin` and `solaris.printmgr.nobanner` to other users.
`res1`	Reserved for future use.
`res2`	Reserved for future use.
`short_desc`	A terse name for the authorization suitable for displaying in user interfaces, such as a GUI.
`long_desc`	A long description. This field identifies the purpose of the authorization, the applications in which it is used, and the type of user interested in using it. You can display the long description in the help text of an application.
`attr`	An optional list of semicolon-separated (`;`) key-value pairs that describe the attributes of an authorization. You can specify zero or more keys. The help keyword identifies a help file in HTML. You can access help files from the `index.html` file in the `/usr/lib/help/auths/locale/C` directory.

The following is an example of an auth_attr database, with some typical values:

```
solaris.*:::Primary Administrator::help=PriAdmin.html
solaris..grant:::Grant All Rights::help=PriAdmin.html
...
solaris.device.:::Device Allocation::help=DevAllocHeader.html
solaris.device.allocate:::Allocate Device::help=DevAllocate.html
solaris.device.config:::Configure Device Attributes::help=DevConfig.html
solaris.device.grant:::Delegate Device Administration::help=DevGrant.html
solaris.device.revoke:::Revoke or Reclaim Device::help=DevRevoke.html
```

The relationship between the auth_attr and the user_attr databases is illustrated in the following example. The solaris.system.date authorization, which is defined in the auth_attr database, is assigned to the user johndoe in the user_attr database.

```
root::::type=normal;auths=solaris.*,solaris.grant;profiles=All
...
johndoe::::type=normal;auths=solaris.system.date;roles=sysadmin;profiles=
All
...
```

```
solaris.*:::Primary Administrator::help=PriAdmin.html
...
solaris.system.date:::Set Date & Time::help=SysDate.html
...
```

Execution Profiles

An execution profile is a bundling mechanism for grouping authorizations and commands with special attributes, and assigning them to users or roles. The special attributes include real and effective UIDs and GIDs. The most common attribute is setting the real or effective UID to `root`. The definitions of execution profiles are stored in the `prof_attr` database.

The fields in the `prof_attr` database are separated by colons:

```
profname:res1:res2:desc:attr
```

Table 9-3 describes the fields in the `prof_attr` database.

Table 9-3 `prof_attr` Database

Field Name	Description
`profname`	The name of the profile. Profile names are case-sensitive.
`res1`	Reserved for future use.
`res2`	Reserved for future use.
`desc`	A long description. This field should explain the purpose of the profile, including what type of user would be interested in using it. The long description should be suitable for displaying in the help text of an application.
`attr`	An optional list of key-value pairs separated by semicolons (`;`) that describe the security attributes to apply to the object upon execution. You can specify zero or more keys. There are two valid keys, `help` and `auths`. • The keyword `help` identifies a help file in HTML. You can access help files from the index.html file in the `/usr/lib/help/auths/locale/C` directory. • The `auths` keyword specifies a comma-separated list of authorization names chosen from those names defined in the `auth_attr`(4) database. You can specify authorization names using the asterisk (`*`) character as a wildcard.

The following is an example of a prof_attr database, with some typical values:

```
All:::Standard Solaris user:help=All.html
...
Printer Management:::Manage print jobs:help=Printer.html
Device Management:::Control Access to Removable Media:
auths=solaris.device.*;help=DevMgmt.html
...
```

The following example illustrates the relationship between the prof_attr and the user_attr databases. The Device Management profile, which is defined in the prof_attr database, is assigned to the sysadmin role in the user_attr database.

```
root::::type=normal;auth=solaris.*,solaris.grant;profiles=All
sysadmin::::type=role;profile=Device Management,Printer Management
```

```
All:::Standard Solaris user:help=All.html
...
Printer Management:::Manage print jobs:help=Printer.html
Device Management:::Control Access to Removable Media:
auths=solaris.device.*;help=DevMgmt.html
```

The following example illustrates the relationship between the `prof_attr` and the `auth_attr` databases. The `Device Management` profile is defined in the `prof_attr` database as having all authorizations beginning with the `solaris.device.string` assigned to it. These authorizations are defined in the `auth_attr` database.

```
All::::Standard Solaris user;help=All.html
...
Device Management::::Control access to Removable Media:
auths=solaris.device.*;help=DevMgmt.html


solaris.*:::Primary Administrator::help=PriAdmin.html
solaris.grant::Grant All Rights::help=PriAdmin.html
...
solaris.device:::Device Allocation::help=DevAllocHeader.html
solaris.device.allocate:::Allocate Device::help=DEvAllocate.html
solaris.device.config:::Configure Device Attributes::help=Dev Config.html
solaris.device.grant:::Delegate Device Administration::help=DevGrant.html
solaris.device.revoke:::Revoke or Reclaim Device::help=DevRovoke.html
...
```

Execution Attributes

An execution attribute associated with a profile is a command (with special security attributes) that can be run by those users or roles to whom the profile is assigned. Special security attributes refer to attributes, such as UID, EUID, GID, EGID that can be added to a process when the command is run.

The definitions of the execution attributes are stored in the `exec_attr` database.

The fields in the `exec_attr` database are separated by colons:

```
name:policy:type:res1:res2:id:attr
```

Table 9-4 describes the fields in the `exec_attr` database.

Table 9-4 `exec_attr` Database

Field Name	Description
`name`	The name of the profile. Profile names are case-sensitive.
`policy`	The security policy associated with this entry. Currently, `suser` (the superuser policy model) is the only valid policy entry.
`type`	The type of entity whose attributes are specified. Currently, the only valid type is `cmd` (command).
`res1`	Reserved for future use.
`res2`	Reserved for future use.
`id`	A string identifying the entity. You can use the asterisk wild card. Commands should have the full path or a path with a wild card. To specify arguments, write a script with the arguments and point the `id` to the script.
`attr`	An optional list of semicolon (`;`) separated key-value pairs that describe the security attributes to apply to the entity upon execution. You can specify zero or more keys. The list of valid key words depends on the policy being enforced. There are four valid keys: `euid`, `uid`, `egid`, and `gid`. • `euid` and `uid` contain a single user name or a numeric user ID. Commands designated with `euid` run with the effective UID indicated, which is similar to setting the `setuid` bit on an executable file. Commands designated with `uid` run with both the real and effective UIDs. • `egid` and `gid` contain a single group name or numeric group ID. Commands designated with `egid` run with the effective GID indicated, which is similar to setting the `setgid` bit on an executable file. Commands designated with `gid` run with both the real and effective GIDs.

The following is an example of an `exec_attr` database, with some typical values:

```
All:suser:cmd:::*:
...
Printer Management:suser:cmd:::/usr/lib/lp/lpsched:euid=0
Printer Management:suser:cmd:::/usr/lib/lp/lpshut:euid=0
Printer Management:suser:cmd:::/usr/lib/lp/lpmove:euid=0
Printer Management:suser:cmd:::/bin/lp:euid=0
Printer Management:suser:cmd:::/binlpadmin:euid=0
Printer Management:suser:cmd:::/usr/sbin/lpadmin:euid=0
Printer Management:suser:cmd:::/usr/bin/enable:euid=0
Printer Management:suser:cmd:::/usr/bin/disable:euid=0
Printer Management:suser:cmd:::/usr/sbin/accept:euid=0
Printer Management:suser:cmd:::/usr/sbin/reject:euid=0
Printer Management:suser:cmd:::/usr/sbin/lpsystem:euid=0
...
```

The following example illustrates the relationship between the `exec_attr` and the `prof_attr` databases. The Printer Management profile is defined in the `prof_attr` database. It has 13 execution attributes with the appropriate security attributes assigned in the `exec_attr` database.

```
All::::Standard Solaris user:help=Al.html
...
Printer Management:::Manage print jobs:help=Printmgt.html
...
```

```
All:suser:cmd:::*:
...
Printer Management:suser:cmd:::/etc/init.d/lp:euid=0
Printer Management:suser:cmd:::/usr/bin/cancel:euid=0
Printer Management:suser:cmd:::/usr/bin/lpset:egid=14
Printer Management:suser:cmd:::/usr/bin/enable:euid=lp
Printer Management:suser:cmd:::/usr/bin/disable:euid=lp
Printer Management:suser:cmd:::/usr/sbin/accept:euid=lp
Printer Management:suser:cmd:::/usr/sbin/reject:euid=lp
Printer Management:suser:cmd:::/usr/sbin/lpadmin:egid=14
Printer Management:suser:cmd:::/usr/sbin/lpfilter:euid=lp
Printer Management:suser:cmd:::/usr/sbin/lpforms:euid=lp
Printer Management:suser:cmd:::/usr/sbin/lpmove:euid=lp
Printer Management:suser:cmd:::/usr/sbin/lpshut:euid=lp
Printer Management:suser:cmd:::/usr/sbin/lpusers:euid=lp
...
```

Figure 9-2 Role-based Access Control

Assuming Role-Based Access Control

To assume a `role`, you must use the `su` command. You cannot log in to a role. For example:

```
% su my-role
Password: my-role-password
#
```

To use commands in the profile, type into a shell. For example:

```
# lpadmin -p myprinter options
```

The `lpadmin` command is executed with any process attributes, such as special UIDs or GIDs. You must have assigned these attributes to the `lpadmin` command in the profiles.

Tools for Managing Role-Based Access Control

In addition to editing the databases directly, a number of tools are available for managing role-based access control. The tools include:

- `roleadd` – Adds a role account on the system.
- `rolemod` – Modifies a role's login information.
- `useradd` – Adds a user account on the system.

The `roleadd` Command

The `roleadd` command adds a role entry to the `/etc/passwd`, `/etc/shadow`, and `/etc/user_attr` files. Some common options include:

- `-c comment`

  Any text string. It is generally a short description of the role.

- `-d dir`

  The home directory of the new role.

- `-m`

  Create the new role's home directory if it does not already exist.

- The `-A authorization` and `-P profile`

  These options respectively assign authorizations and profiles to the role.

```
roleadd -m -d /export/home/tarback -c "Privileged tar Backup Role" \
-P "Backup and Restore" tarback
```

The `roleadd` command creates a new role called `tarback`, builds the required directory structures (including the `home` directory), and assigns the role with a profile of `Backup` and `Restore`.

Note – `Backup` and `Restore` should have been previously edited into the `exec_attr` file and the `prof_attr` file.

The `rolemod` *Command*

The `rolemod` command modifies a role's login information on the system. It changes the definition of the specified login and makes the appropriate login-related system file and file system changes.

- `-A authorization`

  One or more comma separated authorizations, as defined in `/etc/security/auth_attr`.

- `-e expire`

  Specifies the expiration date for a role.

- `-l new_logname`

  Specifies the new login name for the role.

- `-P profile`

  One or more comma separated authorizations, as defined in `/etc/security/auth_attr`.

- `-s shell`

  Specifies the full pathname of the program that is used as the role's shell when logging in.

These options respectively modify authorizations and profiles to the role.

```
# rolemod -P auth1,auth2 role1
```

This is a generic example of the `rolemod` command that assigns authorizations `auth1` and `auth2` to the role named `role1`. These named authorizations must be previously defined in the `/etc/security/auth_attr` database.

The useradd *Command*

The useradd command adds a new user to the /etc/passwd, /etc/shadow, and /etc/user_attr files. Some common options include:

- -c comment

  Any text string. It is generally a short description of the login command and is currently used as the field for the user's full name.

- -d dir

  The home directory of the new user.

- -m

  Creates the new user's home directory if it does not already exist.

- -s shell

  Full pathname of the program used as the user's shell on login

- -R role

  One or more comma-separated execution profiles defined in user_attr(4).

```
# useradd -m -d /export/home/usera -c "User Account usera" -s
/usr/bin/ksh -R datuser usera
```

The useradd command creates a new user account for a user named usera. The user has access to the role datuser, and the user's shell has been changed from the default Bourne shell to the Korn shell.

Additional Commands

Table 9-5 describes some additional commands that you can use with RBAC operations.

Table 9-5 RBAC Commands

Command	Description
`auths`(1)	Displays authorizations for a user.
`makedbm`(1M)	Makes a `dbm` file.
`nscd`(1M)	Identifies the name service cache daemon, which is useful for caching the `user_attr`, `prof_attr`, and `exec_attr` databases.
`pam_roles`(5)	Identifies the role account management module for the Password Authentication Module (PAM). Checks for authorization to assume role.
`pfexec`(1)	Identifies profile shells, used by profile shells to execute commands with attributes specified in the `exec_attr` database
`policy.conf`(4)	Identifies the configuration file for security policy. Lists granted authorizations.
`profiles`(1)	Displays profiles for a specified user.
`roles`(1)	Displays roles granted to a user.
`roleadd`(1M)	Adds a role account on the system.
`roledel`(1M)	Deletes a role's account from the system.
`rolemod`(1M)	Modifies a role's account information on the system.
`useradd`(1M)	Adds a user account on the system. The `-R` option assigns a role to a user's account.
`userdel`(1M)	Deletes a user's login from the system.
`usermod`(1M)	Modifies a user's account information on the system.

Note – Reference `http://docs.sun.com` for further information on these commands.

Creating a User and a Role

To create a user and a role, perform the following steps:

1. Create the role.

```
# roleadd -u 1000 -g 10 -d /export/home/minime -m username
# passwd minime
```

2. Create the profile.

```
# vi /etc/security/prof_attr
Shut:::Able to shutdown the system:
```

3. Add the profile to the role.

```
# rolemod -P Shut,All username
```

4. Verify that the changes have been made in the `/etc/user_attr` file.

```
# more /etc/user_attr
```

5. Create the user.

```
# useradd -u 1001 -g 10 -d /export/home/user1 -m -s /bin/ksh -R username
user1
# passwd user1
# more /etc/passwd /etc/user_attr
```

6. Assign commands to the profile:

```
# vi /etc/security/exec_attr
Shut:suser:cmd:::/usr/sbin/shutdown:uid=0
```

Testing the Configuration

To test the configuration, complete the following steps.

1. Log in as `user1`.
2. Use the `su` command to assume the `role` *`username`*.
3. Issue the following command:

```
# /usr/sbin/shutdown -i 6 -g 0
```

Exercise: Implementing System Security

Exercise objective – In this lab, you:

- Create an execute attribute
- Create a role-based profile
- Create a role identity
- Create a login identity that can make use of the role

Preparation

During the lab, you are directed to carry out commands that do not work in order to demonstrate how the RBAC facility must be used by login users.

Task Summary

In this exercise, you configure and test role-based access control.

Tasks

Creating a Role

You need to create an entry in the `/etc/security/exec_attr` file. This entry allows a user to execute the `date` command with an effective ID of 0 (the `root` user). This allows the user to set the system date and time even though that user did not log in as `root`.

1. Add the following line to the end of the `/etc/security/exec_attr` file:

   `Date Management:suser:cmd:::/usr/bin/date:euid=0`

   - The first field of data is a descriptive field name. This field's contents become the official name by which this attribute is known. Because this example includes a Space character, the field name must always be enclosed in quotes when used with either the `useradd` or `roleadd` (or user/role associated) commands.

   - The second field value, `suser`, is required. This value is the only value currently supported by the Solaris 8 Operating Environment, although other values might be added in the future.

   - The third field contains the word `cmd`. This is a required value that denotes that this attribute relates to a command.

   - Two empty fields follow. These are currently not in use and should be left empty.

   - The sixth field contains the absolute pathname of the command that is to be executed. In this instance, the command to be executed is the `/usr/bin/date` command.

   - The final field states which effective user ID value will be assigned to the user when the command (`/usr/bin/date`) is executed. Entering a value of `0` gives the user the effective identity of the `root` user.

2. Save and exit from that file.

3. You must enter a profile attribute entry in the `/etc/security/prof_attr` file, as follows:

`Date Management:::Date Setting:`

- As with the `exec_attr` file, the first data field contains the official name for the attribute. This must exactly match the first field as used in the `/etc/security/exec_attr` file.
- The second, third and fourth fields are currently not used.
- The fifth field is a comment field and can contain any descriptive text that might be required.

4. Using the `roleadd` command, create a role entry:

```
# roleadd -m -d /export/home/datuser -c “RBAC Lab example” \
-s /usr/bin/pfksh -P “Date Management”,All datuser
# passwd datuser
```

- The words `Date` and `Management` must be enclosed in quotes to be treated as a one-name entry.
- The word `All` does not require the quotes because it consists of just one word. The word *All* relates to a predefined profile that should exist in the files at the time of installation of the Solaris 8 Operating Environment. This profile allows a user to execute any valid UNIX command while functioning in a role-based capacity.

Note – One of the lab exercises that follows asks you to remove this from the appropriate file and then test whether the role-based user can execute commands, such as the `ls` command.

- The shell that is being used by the user is `/usr/bin/pfksh`. This is a special version of the Korn shell that allows you to use the RBAC profiles. If the user had been created to use a standard shell (such as `/usr/bin/ksh`), then that user would not be able to be assigned a role.

5. Two profiles have been used for the `role` called `datuser`. You can view these profiles by viewing the contents of the `/etc/user_attr` file, as shown in the following example:

```
# cat /etc/user_attr
# Copyright (c) 1999 by Sun Microsystems, Inc. All rights reserved.::::
#::::
# /etc/user_attr::::
#::::
# user attributes. see user_attr(4)::::
#::::
#pragma ident   "@(#)user_attr  1.2     99/07/14 SMI"::::
#::::
root::::type=normal;auths=solaris.*,solaris.grant;profiles=All
datuser::::type=role;profiles=Date Management,All
```

The `type` field contains the value `role`. This designates that the name `datuser` can be used only for role-assignment and cannot be used as a valid login name.

You must create a user that can make use of the `datuser` attribute.

You create this user by issuing the following command:

```
# useradd -m -d /export/home/userb -c "Role user (userb)" -s /usr/bin/ksh
-R datuser userb
# passwd userb
```

Note – Provide an appropriate password for the role user (`userb`).

After you have added the user, the following line should appear in the `/etc/user_attr` file:

```
userb::::type=normal;roles=datuser
```

Note – The type field contains the value normal instead of `role`. This indicates that the name `userb` is a valid login name.

You have created the profile and execute attributes, and you have created a user who can make use of these attributes. You should test that the user called `userb` can now set the system's date and time.

Test Role

Complete the following steps:

1. Log in to the system as `userb`. Attempt to execute the following commands.

   The output of the commands, listed below, is shown for example only. Your output will be different for some of the commands issued.

```
$ who
userb console      May  4 15:23
$ ls
local.cshrc    local.login    local.profile
$ id
uid=102(userb) gid=1(other)
$ pwd
/export/home/userb
$
```

2. Check the current date and time using the `date` command.

```
$ date
Thu May  4 15:23:39 BST 2000
```

3. Add two minutes to the current time, and attempt to update the system time with that new value.

   In this example, as the date format is `MMDDhhmm` and the current values are `05041523`, the new date and time value that will be used is `05041525`.

```
$ date -u 05041525
```

You should receive the following error message:

```
date: Not owner
usage:  date [-u] mmddHHMM[[cc]yy][.SS]
        date [-u] [+format]
        date -a [-]sss[.fff]
```

This is because you do not have the appropriate authority to change the system date and time.

If you assume the role of `datuser`, you are granted that authority.

4. Use the su command to assume the datuser role, by issuing the following command:

```
$ su datuser
Password: <enter the password for datuser here>
```

5. Validate the current login and session identities, using the following commands:

```
$ who
userb console      May  4 15:23
$ id
uid=103(datuser) gid=1(other)
```

6. Attempt to execute some of the standard UNIX commands:

```
$ ls
local.cshrc    local.login    local.profile
$ pwd
/export/home/userb
```

7. Run the date command to assess the current date and time details; for example:

```
$ date
Thu May  4 15:24:43 BST 2000
```

8. As before, try to add two minutes to the current time and see if you can reset the system's date and time details.

```
$ date -u 05041527
Thu May  4 15:27:00 GMT 2000
```

You should be successful because you have assumed the role of datuser.

9. Exit from the su session, using the exit command, and then log off as the user (userb).

10. Log in to the system as the root user.

11. Edit the /etc/user_attr file and modify the datuser line, as follows:

The line currently reads:

```
datuser::::type=role;profiles=Date Management,All
```

Remove the comma and the word `All` from the end of the line so that the line now reads:

`datuser::::type=role;profiles=Date Management`

12. Save and exit from the file and then log out as the `root` user.

13. Log in as the user called `userb`.

14. Issue the following commands (output might differ on your system):

```
$ id
uid=102(userb) gid=1(other)
$ who
userb console      May  4 16:43
$ pwd
/export/home/userb
$ ls
local.cshrc    local.login    local.profile
$ date
Thu May  4 16:43:27 BST 2000
```

15. Switch to the `datuser` role, using the `su` command.

```
$ su datuser
Password: <enter the appropriate password>
```

16. Execute a range of standard UNIX commands:

```
$ date
Thu May  4 16:43:38 BST 2000
$ who
pfksh: who:  not found
$ ls
pfksh: ls:  not found
$ id
pfksh: id:  not found
```

Only the `date` command is currently valid, because it is the only `exec` authority that applies to the `datuser` role

17. Exit from the `datuser` session and then log off as the user (`userb`).

Modify Roles

Complete the following steps:

1. Log in to the system as the `root` user.

2. Make the following amendments to the files:

   a. Add the following line to the end of the `/etc/security/auth_attr` file:

```
solaris.backup.:::Backup and Restore::help=index.html
```

   b. Add the following line to the end of the `/etc/security/exec_attr` file:

```
Backup and Restore:suser:cmd:::/usr/sbin/tar:uid=0
```

   c. Add the following line to the end of the /etc/security/prof_attr file:

```
Backup and Restore:::Control Backup and restore using tar:
```

3. Create the role, using the `roleadd` command.

```
# roleadd -m -d /export/home/tarback -c “Privileged tar Backup Role” \
-P “Backup and Restore,All” tarback
```

4. Assign a password to the `tarback` role.

```
# passwd tarback
New password: tarback
Re-enter new password: tarback
passwd (SYSTEM): passwd successfully changed for tarback
```

5. Edit the `/etc/user_attr` file and modify the entry for `userb` as follows. The line should currently read:

```
userb::::type=normal;roles=datuser
```

   Edit the entry so that it reads:

```
userb::::type=normal;roles=datuser,tarback
```

   This adds the role of a privileged `tar` user to the user called `userb`.

6. Save and exit from the file.

7. Log out as the `root` user.

8. Log in as `userb`, and issue the following commands.

Note – The output of these commands will differ depending on your system.

```
$ id
uid=102(userb) gid=1(other)
$ cd /etc
$ cat /etc/shadow
cat: cannot open /etc/shadow
$
$ tar cvf /tmp/shadowfile.backup ./shadow
tar: ./shadow: Permission denied
$
```

Note – Even though the `tar` command is unsuccessful here, you have created the file `/tmp/shadowfile.backup` with `userb` as the owner.

Caution – Subsequent successful writes to this file, by any user, create a security hole in that `userb` will own the data. You can circumvent this security hole by ensuring that this file is removed before continuing.

9. Switch to the `tarback` role, using the `su` command, as shown below:

```
$ su tarback
Password: <...enter the appropriate password>
```

10. You should still be situated in the `/etc` directory but will not be able to use most UNIX commands because of the earlier stage of the exercise where the `All` profile was removed. Test to see that you are in the `/etc` directory using the following command:

```
$ pwd
/etc
```

11. Test to see if the role, tarback, has access to the contents of the shadow file, using the following commands:

```
$ tar cvf /tmp/shadowfile.backup ./shadow
a ./shadow 1K
$
$ tar tvf /tmp/shadowfile.backup
tar: blocksize = 4
-r--------   0/3      375 May  4 17:11 2000 ./shadow
$
```

12. Exit from the tarback role by issuing the exit command.

```
$ exit
```

13. Because the backup file was effectively created by the userb, working in the tarback role, the resultant backup file is owned by the userb. To validate this, issue the following command:

```
$ ls -l /tmp/shadowfile.backup
-rw-r--r--   1 userb other       2048 May  4 17:16
/tmp/shadowfile.backup
```

Note – As noted in step 8, userb owns the /etc/shadowfile.backup file. Therefore userb has access to this data, even if this was not your intent.

14. Change the directory back to the userb $HOME directory.

```
$ cd
$ pwd
/export/home/userb
```

15. Because userb owns the backup file, userb should be able to extract from that file into a file in the userb $HOME directory.

```
$ tar xvf /tmp/shadowfile.backup
tar: blocksize = 4
x ./shadow, 375 bytes, 1 tape blocks
```

Note – This was achieved only because the original backup was made using a relative pathname for the /etc/shadow file. If an absolute pathname had been used, the only way the file could be restored from a backup would be to restore it to its absolute-pathname position.

16. Ensure the file that has been restored.

```
$ cat shadow
root:X2ApPcp5SERlg:6445::::::
daemon:NP:6445::::::
bin:NP:6445::::::
sys:NP:6445::::::
adm:NP:6445::::::
lp:NP:6445::::::
uucp:NP:6445::::::
nuucp:NP:6445::::::
listen:*LK*:::::::
nobody:NP:6445::::::
noaccess:NP:6445::::::
nobody4:NP:6445::::::
liz:a0PJDaxoxpGbM:11081::::::
userb:KTW978x91tLNc:11081::::::
datuser:1zSiCkDZmkejw:11081::::::
tarback:.dRSpVHAqXNnU:11081::::::
```

17. Validate that your personal copy of the `shadow` file is identical in size to the original version of the file, as stored in the `/etc` directory, using the following commands:

```
$ ls -l shadow
-r--------   1 userb other        375 May  4 17:11
shadow
$ ls -l /etc/shadow
-r--------   1 root     sys          375 May  4 17:11
/etc/shadow
$ pwd
/export/home/userb
```

18. Log out as the user (`userb`).

Exercise Summary

Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- ❑ Build an association between users and roles with authorizations and execution profiles
- ❑ Define authorizations and their attributes
- ❑ List a profile's assigned authorizations
- ❑ Define the privileged operations that are assigned to a profile
- ❑ Identify help files that are associated with profiles and authorizations
- ❑ Configure a user's execution profile to allow access to a specified subset of system administrator privileges

Solaris Management Console™ and Solaris AdminSuite 10

Objectives

Upon completion of this module, you should be able to:

- List the benefits of the Solaris Management Console™
- Install the Solaris Management Console software
- Add an application to the Solaris Management Console
- List the features of Solaris AdminSuite
- Install the Solaris AdminSuite software
- Create and modify user accounts using the Users feature of Solaris AdminSuite
- Add hosts to the server using the Computers/Networks feature of Solaris AdminSuite
- Manipulate mount states on existing file systems using the Mounts/Shares feature of Solaris AdminSuite
- Configure serial ports using the Serial Ports feature of Solaris AdminSuite

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- Solaris Management Console Help
- Solaris AdminSuite 3.0.1 Help

The Solaris Management Console

The Solaris Management Console (SMC), also called the Console, is a Java™ technology-based tool for administration of the servers. It provides a central integration point for important applications and services.

SMC software simplifies the job of configuring and administering servers. With point-and-click GUI tools, SMC makes the Solaris Operating Environment easy to administer, especially for administrators not familiar with the UNIX environment.

The Console enables users and administrators to register other SMC servers and applications on the network they wish to administer. When you access the Console, it dynamically configures tree views of those registered hosts and services. By pointing and clicking, you can remotely invoke an application on a selected SMC server and view the application's GUI on the local display.

The Benefits of Using the Console

The benefits of using the Console include:

- The network features of the SMC reduce the number of remote logins required to do administration, including rebooting systems, performing backups, and so on.
- The SMC simplifies user administration by bringing all the tools together in one location.
- You can manage all SMC servers from one location.
- Once a new application is added to an SMC server, anyone can run that application from that server.
- The SMC gives the user a graphical representation of the administration components available and the level of user privilege required to run them.

Installation Requirements

The SMC client is an application written entirely in Java programming language. The client package does not include a Java runtime environment, like the Solaris 2.6 and Solaris 7 Operating Environments. The supported Java environments are JDK™ 1.1.5 and JDK 1.1.6. The distribution CD-ROM (SEAS 2.0) has JDK1.1.6 on it if you need to upgrade your system. You can also download the JDK for the Solaris Operating Environment from SUN's web site, `http://www.sun.com/solaris/java`.

Download Procedure

Installing the Solaris Operating Environment requires `root` privilege on the destination machine. It involves adding the SMC client software package and providing system-wide usage of the client for all users.

Use the `ftp` command to download the `Solaris_Management_Console.shar` and `AdminSuite.shar` files from the classroom server. The following is an example of the `ftp` exchange that takes place:

```
# ftp classroom_server
Connected to classroom_server.
220 classroom_server FTP server (SunOS 5.8) ready.
Name (classroom_server:root):
331 Password required for root.
Password:
230 User root logged in.
ftp> cd pub
250 CWD command successful.
ftp> bin
200 Type set to I.
ftp> get Solaris_Management_Console.shar
200 PORT command successful.
150 Binary data connection for Solaris_Management_Console.shar
(129.147.11.62,34935) (20065485 bytes).
226 Binary Transfer complete.
ftp> get AdminSuite.shar
150 Binary data connection for AdminSuite.shar (192.9.200.9,33727)
(10254380 bytes).
226 Binary Transfer complete.
ftp> bye
```

Installing SMC

To install the SMC on your system (installation steps for Solaris AdminSuite start on page 10-15), perform the following steps:

1. Log in to the CDE desktop environment as `root`, and, with your shell located in the download directory, begin the installation the SMC client with this command:

```
# sh Solaris_management_Console.shar
```

This starts an installation wizard as shown in Figure 10-1.

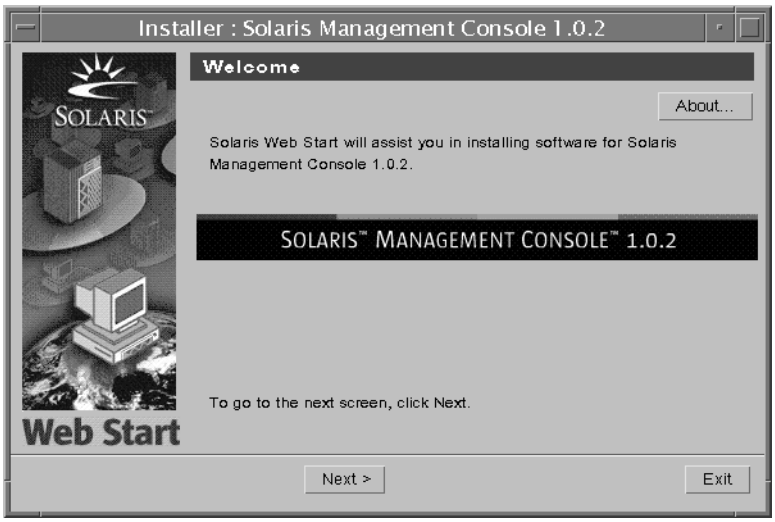


Figure 10-1 Solaris Management Console Install Wizard Window

2. Click Next to continue the installation.

A screen enabling the selection of either the Default or Custom Install is displayed.

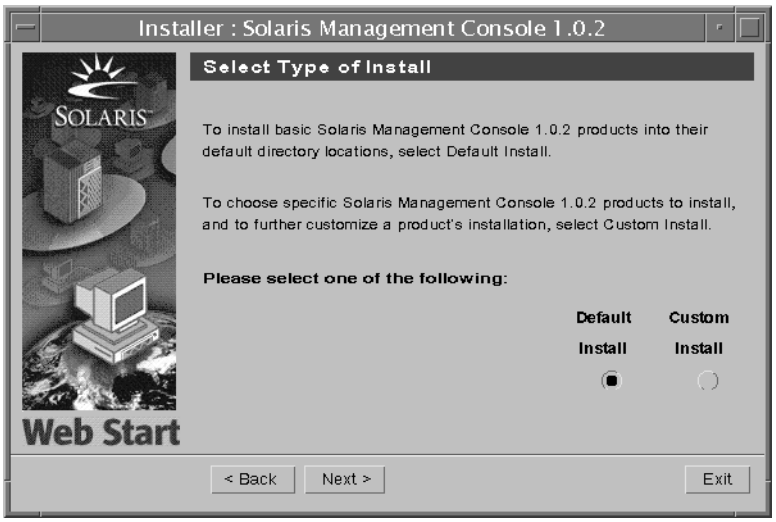


Figure 10-2 SMC Install Wizard - Select Type of Install Window

3. For the purpose of this module, select Custom Install to see all installation choices possible.

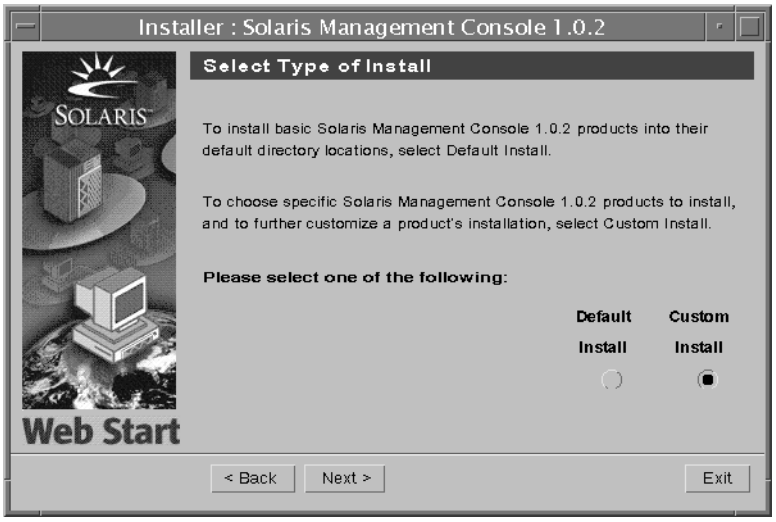


Figure 10-3 SMC Install Wizard - Select Type of Install Window

The Locale Selection window is displayed to enable the selection of other languages, in addition to the default English:

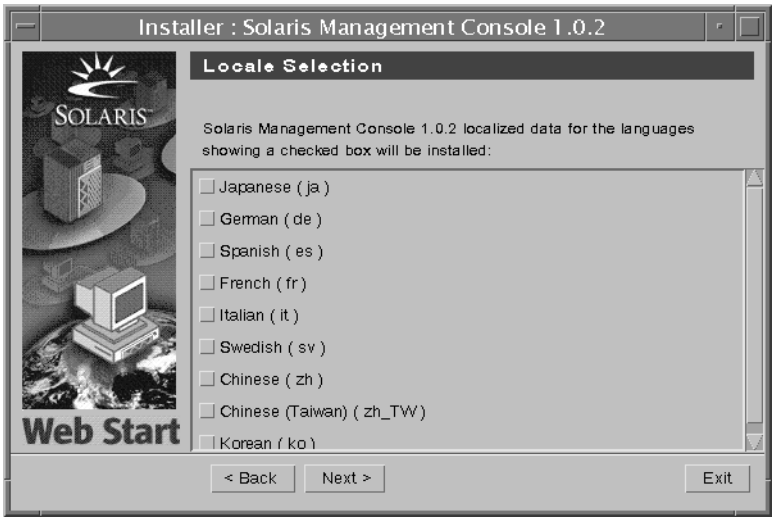


Figure 10-4 SMC Install Wizard – Locale Selection Window

4. Select the appropriate language(s) for your locale.
5. Click Next.

   The Select Install Directory window is displayed.

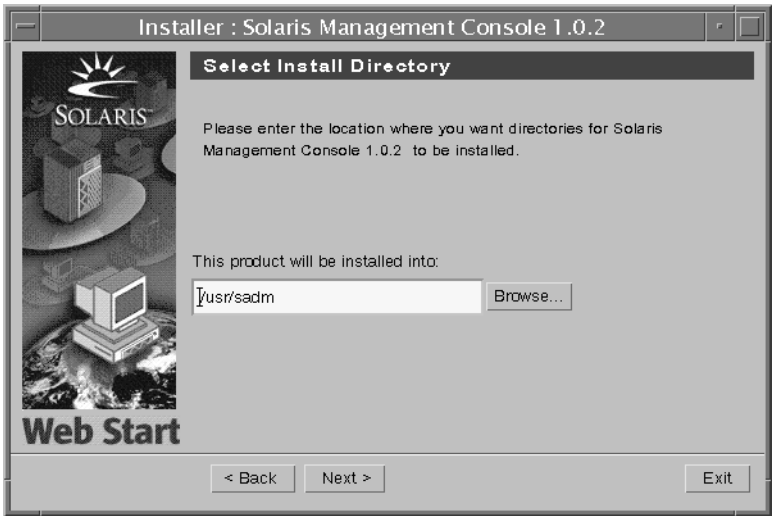


Figure 10-5 SMC Install Wizard – Select Install Directory Window

6. Accept the default install directory location of `/usr/sadm`.
7. Click Next.

This displays the Component Selection screen.

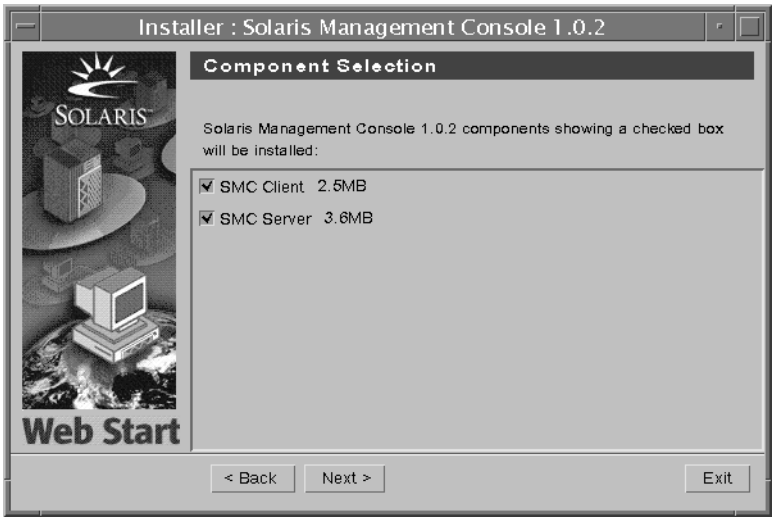


Figure 10-6 SMC Install Wizard – Component Selection Window

8. Accept the default selections of both the SMC client and server.
9. Click Next.

   This displays the Ready to Install screen.

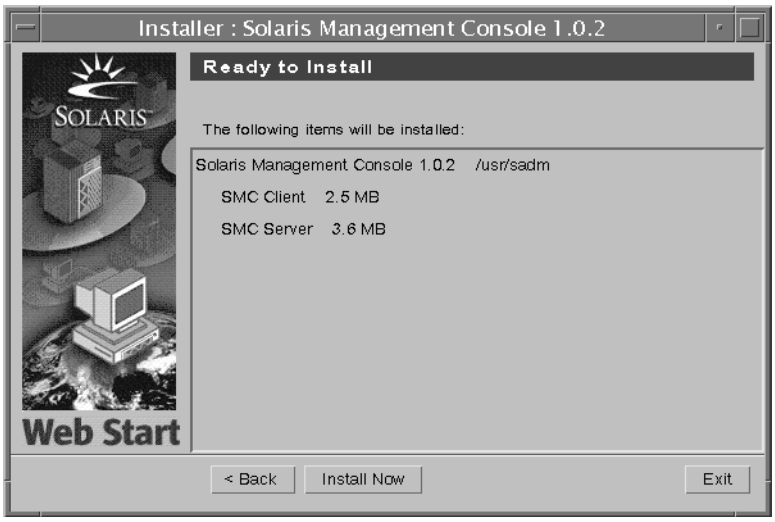


Figure 10-7 SMC Install Wizard – Ready to Install Window

10. Ensure that both the SMC Client and Server items are selected for installation.
11. Click Install Now.

The Installing window is displayed, and it shows the install progress as it takes place.

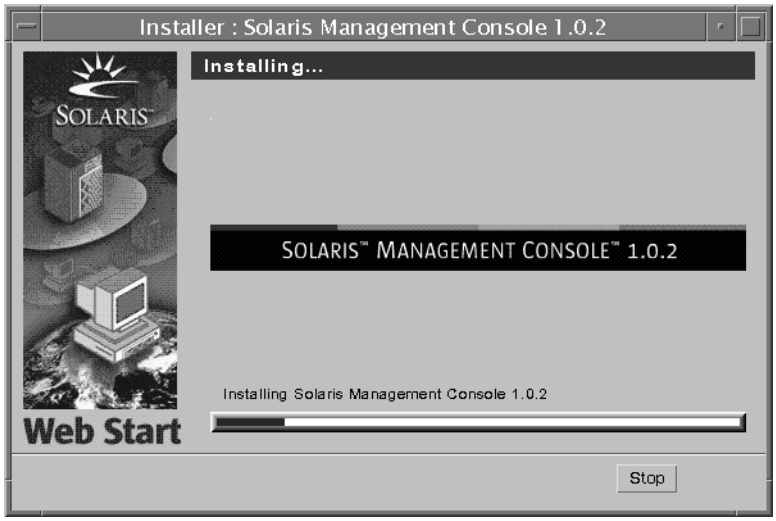


Figure 10-8 SMC Install Wizard – Installing Window

Once installation is complete, the install wizard displays the Installation Summary window, which confirms the success of the installation.

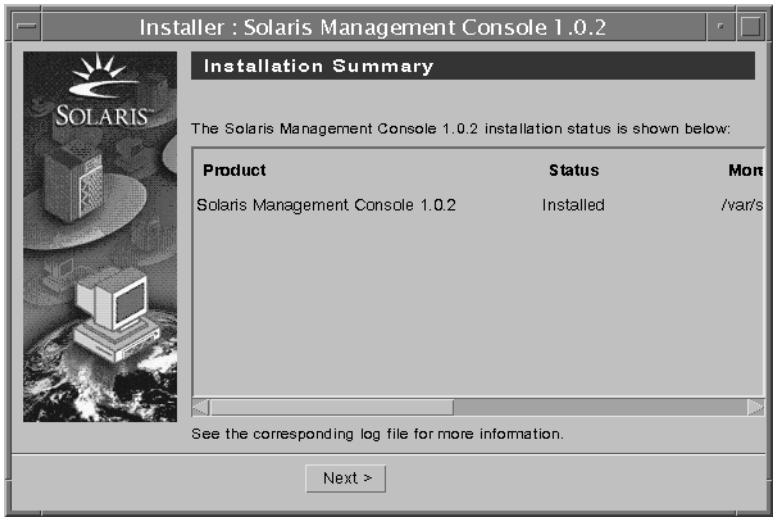


Figure 10-9 SMC Install Wizard – Installation Summary Window

12. Click Next to continue.

The Additional Information screen is displayed and provides a brief explanation of the Solaris Product Registry and the `/usr/bin/prodreg` command, which enables installation and removal of installed products.

Warning – Use the `/usr/bin/prodreg` command to remove any products (such as the SMC) that are added to the Solaris Operating Environment using installation wizards. Using this command ensures a complete removal. You can use this same command to install additional software.

Note – This window also references the URL location for AnswerBook2™ documentation, `http://docs.sun.com`.

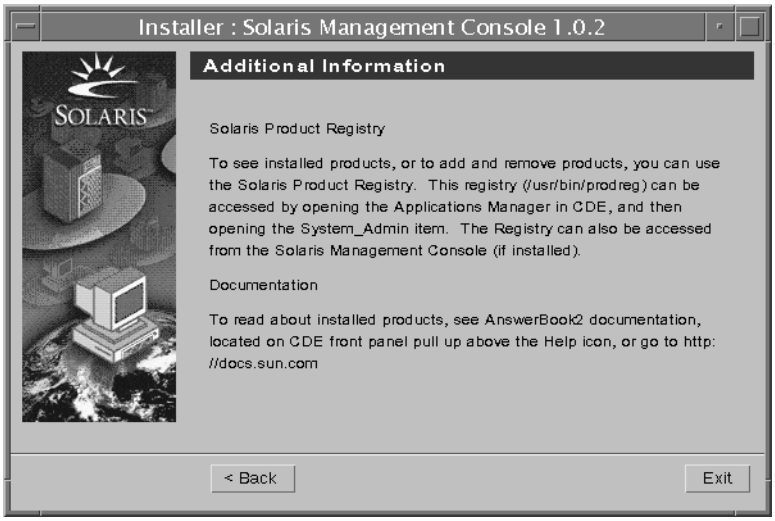


Figure 10-10 SMC Install Wizard – Additional Information Window

13. Click Exit to complete the install process.

14. Create a new user account.

    This account is used for access to the SMC application and in the Solaris AdminSuite exercise.

Running the SMC Application

After you have installed SMC client software on a machine, perform the following steps to start the Console:

1. Type `smc` from the command line.

   $ **`smc &`**

   After a few moments, the initial SMC window is displayed with the name of the current SMC server in the Server field.

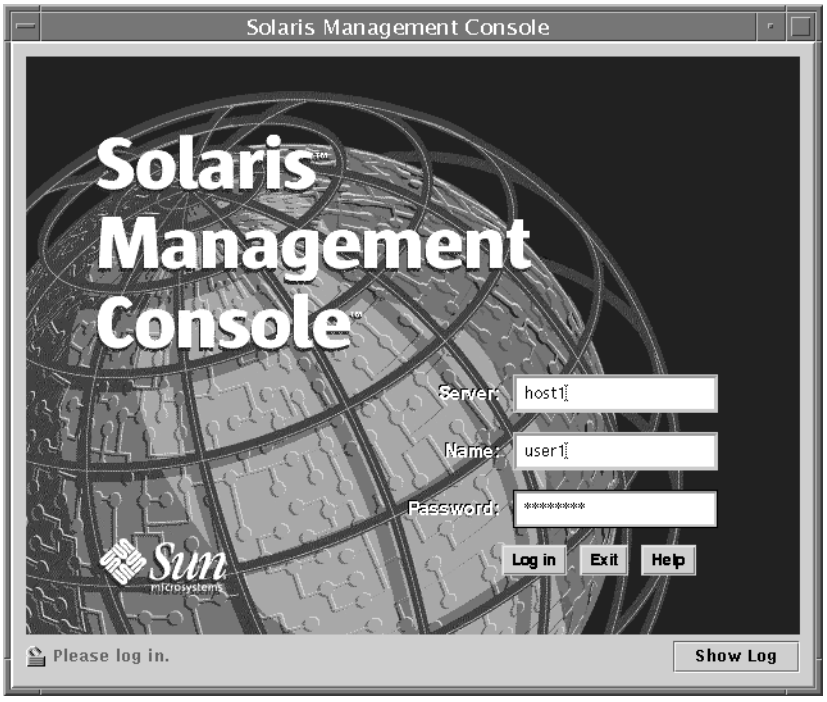


Figure 10-11 SMC Initial Console Window

2. Enter the server name if it is not already displayed.

   To log in to a machine other than the current SMC server, replace the name in the Server field. The server name is limited to 40 characters.

3. Log in as a user (*not* `root`).

   Once you are running the Console, if root or another user ID is necessary for the application you want to run, the Authorization Required dialog box is displayed.

4. Enter the password for the logged in user.

5. Click the Log in button.

6. After a short delay, the Console is displayed, in Applications View, listing a number of categories within which software applications are available on the current server.

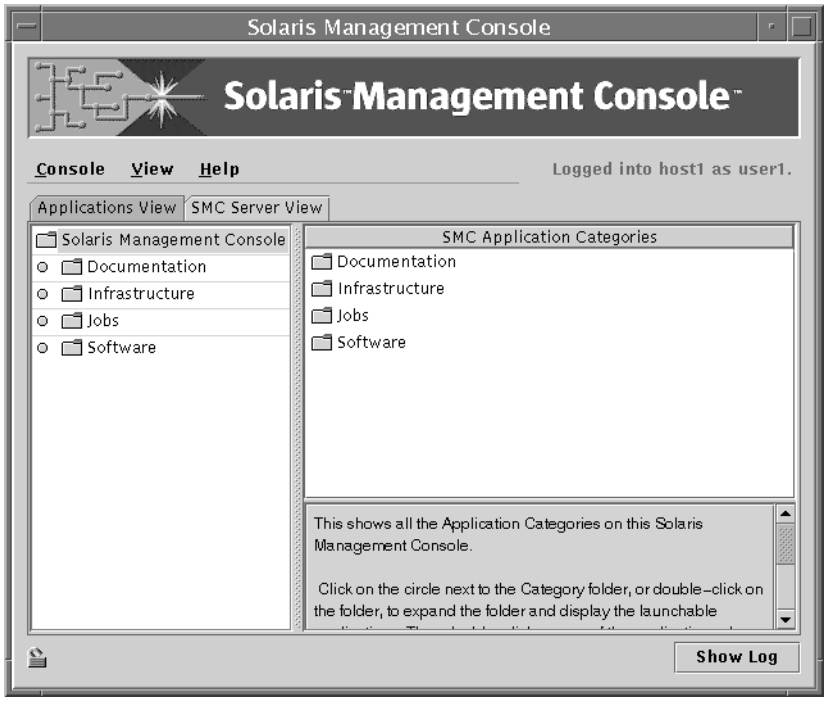


Figure 10-12 SMC Applications View Console Window

When you start the Console for the first time on a particular host, it is displayed in Applications View, with a number of service categories listed. The applications available to be managed by the Console are those applications that have been registered as SMC applications for the current host. In Applications View, a number of SMC application categories (4 in the example in Figure 10-12 are listed: Documentation, Infrastructure, Jobs, and Software).

To expand the application folders shown on the left-most frame, click the small circle just to the left of the category. In the following example, with the Documentation folder circle selected, the display opens to show the AnswerBook application:

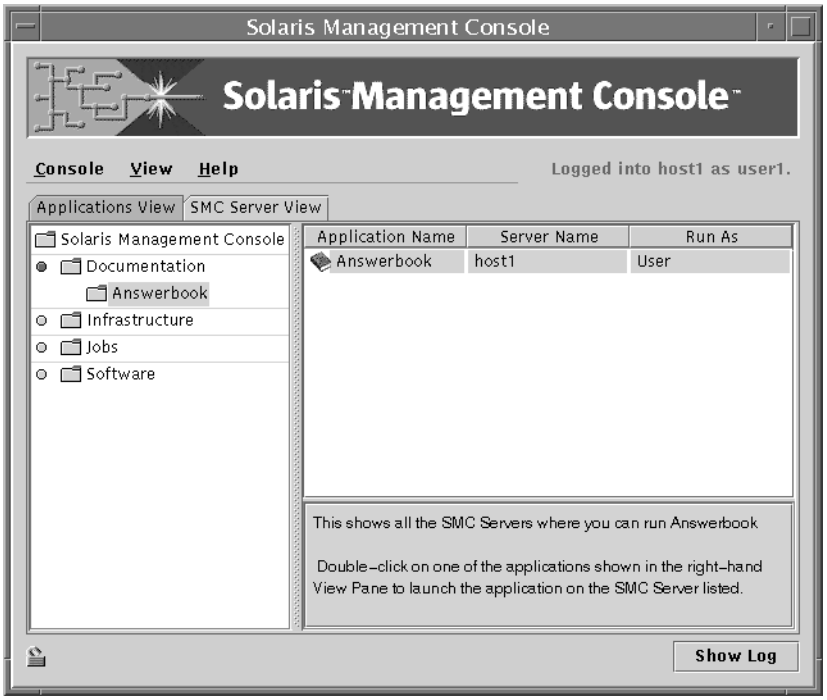


Figure 10-13 SMC View of the AnswerBook Application

You can start the AnswerBook application by double-clicking on the icon by that name in the right-most frame. Any of the other folders can be expanded and their respective applications started in the same way.

Solaris AdminSuite

Solaris AdminSuite contains GUI features that automate:

- User administration
- Group management
- Host administration
- File system manipulation
- Serial ports configuration

Each of the previously mentioned features is launched from the Solaris Operating Environment AdminSuite graphical user interface (GUI).

User Manager

The User Manager enables easy setup and maintenance of user accounts. This includes adding new users, removing users, and updating user information. Some of the defaults that you can set up include:

- Login shell
- Password policy
- The user's mail server

Group Manager

You can use the Group Manager to add, display, modify, and delete groups in the NIS or NIS+ name service environment or on a local or remote system (`/etc` files).

Host Manager

The Host Manager is used for connecting client systems to the network as well as modifying and deleting them. Supported client types include standalone, diskless, AutoClient, and JavaStation. The Host Manager also enables you to add operating environment services and set up remote installation services.

Mount/Share Manager

There are three components of the Mount/Share Manager: a File System Manager, Mounted File System Monitor, and Shared File System Monitor. The File System Manager manages mounted file systems on a server.

Serial Port Manager

The Serial Port Manager is used for adding and maintaining port services for terminals and modems. It can display serial port information and facilitate port set up, modification, and deletion. It also provides templates for common terminal and modem configurations.

Installation Procedure

To install the AdminSuite application on your system, perform the following steps:

1. Log in to the CDE desktop environment as `root`, (with your shell located in the download directory).

2. Run the following commands to stop NIS daemons on the NIS master only, and then install the SMC client.

```
# /usr/lib/netsvc/yp/ypstop
# sh AdminSuite.shar
```

This starts an install wizard as shown in Figure 10-14.

Figure 10-14 AdminSuite Application Install Wizard

3. Click Next to continue the installation.

This displays a screen enabling the selection of either the Default or Custom Install.

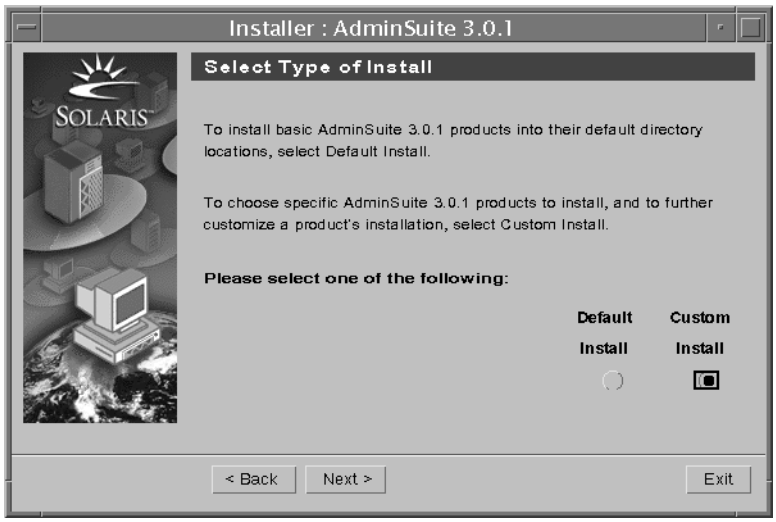


Figure 10-15 AdminSuite Install Wizard – Select Type of Install Window

4. For the purpose of this module, select Custom Install to see all installation choices possible.

5. Click Next.

The Locale Selection window is displayed to enable the selection of other languages, in addition to the default English:

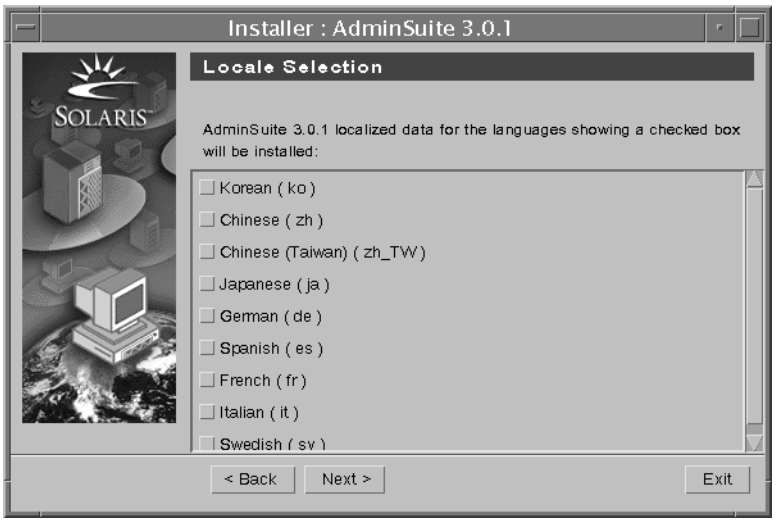


Figure 10-16 AdminSuite Install Wizard – Locale Selection Window

6. Select the appropriate languages for your locale.
7. Click Next.

The Select Install Directory window is displayed.

Figure 10-17 AdminSuite Install Wizard – Install Directory Selection Window

8. Accept the default install directory location of `/opt`.
9. Click Next.

The Component Selection window is displayed.

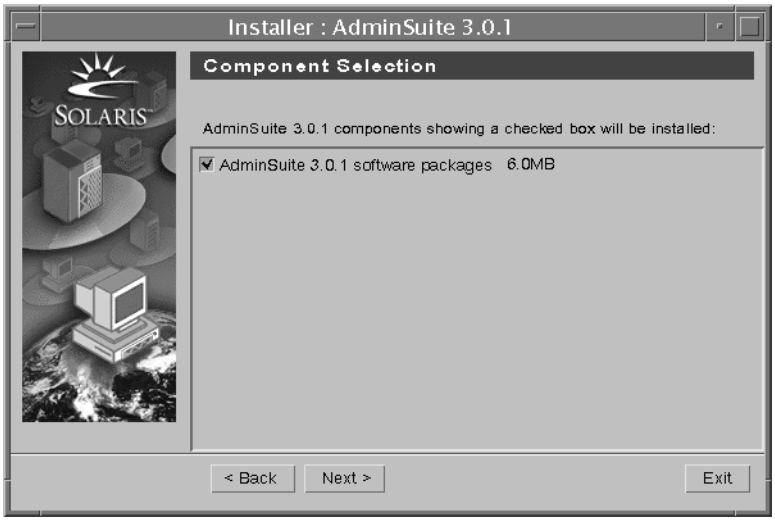


Figure 10-18 AdminSuite Install Wizard – Component Selection Window

10. Accept the default selections of AdminSuite 3.0.1 software packages.

11. Click Next.

    The Primary Administrator window is displayed:.

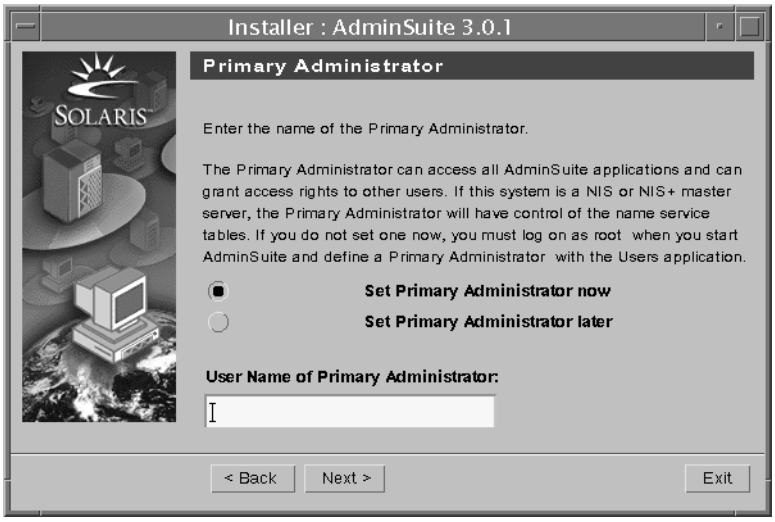


Figure 10-19 AdminSuite Install Wizard – Primary Administrator Window

12. Select Set Primary Administrator now.

13. Type your user name in the empty field; the example that follows indicates `user1` set to be the primary administrator:

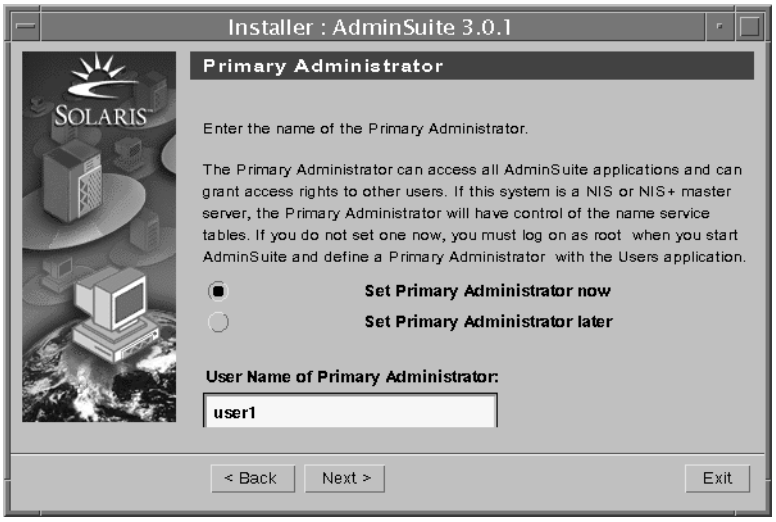


Figure 10-20 AdminSuite Install Wizard – Primary Administrator Window

14. Click Next.

    The Ready to Install window is displayed.

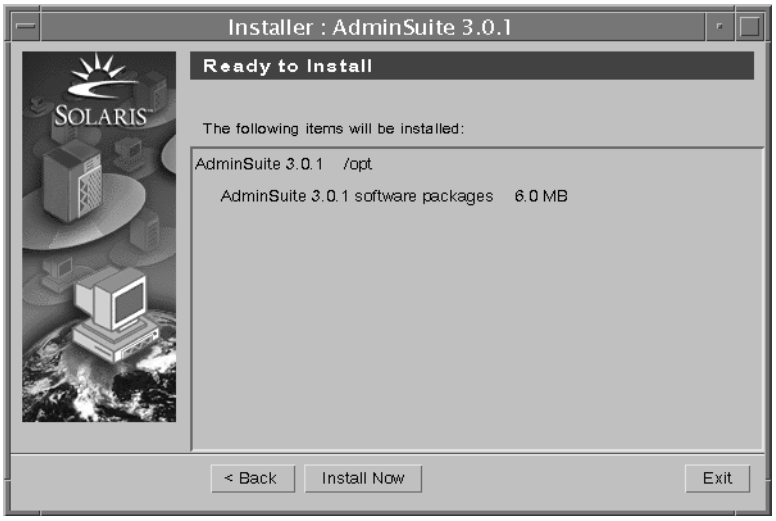


Figure 10-21 AdminSuite Install Wizard – Ready to Install Window

15. Ensure that the AdminSuite 3.0.1 item is shown.

16. Click Install Now.

The Installing window is displayed, and it shows the install progress as it takes place.

Figure 10-22 AdminSuite Install Wizard – Installing Window

After the installation is complete, the install wizard displays the Installation Summary window confirming installation success.:

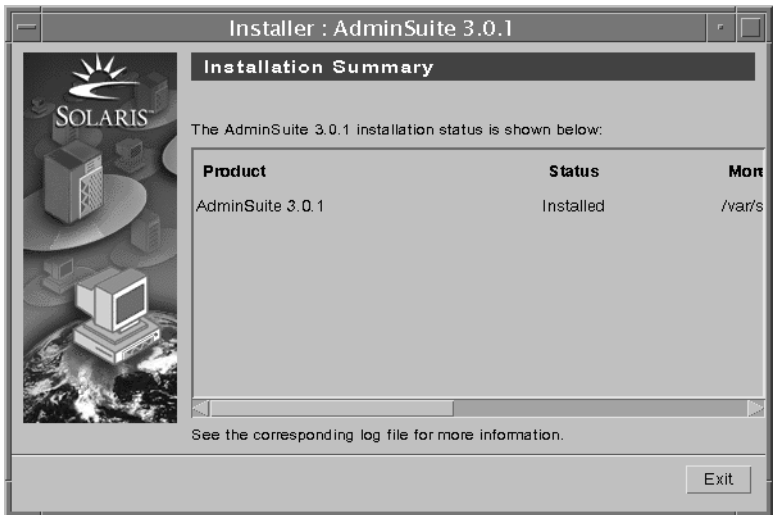


Figure 10-23 AdminSuite Install Wizard – Installation Summary Window

17. Click Exit to complete the install process.

The Solaris AdminSuite GUI can be used by either the superuser or a user that belongs to Group 14, the administrative group.

Note – Unless privileges have been modified using RBAC, the `root` identity has privileges (to access and update data) only on the local system. Solaris AdminSuite permissions are granted to users who are members of the `sysadmin` group (group 14). This means that a user modifying administration data must be a member of the `sysadmin` group on the system where the task is being executed.

Before running the Solaris AdminSuite program, execute the following commands:

```
# /opt/SUNWseam/3_0/sbin/dirtbl_setup initial
# init 6
```

To run the Solaris AdminSuite tools, log in as `root` and type the command `/opt/SUNWseam/3_0/bin/admapp` at the command-line prompt. The Solaris AdminSuite window is displayed.

```
# /opt/SUNWseam/3_0/bin/admapp &
```

Starting Solaris AdminSuite

When you launch the Solaris AdminSuite application, the AdminSuite banner is displayed (see Figure 10-24).

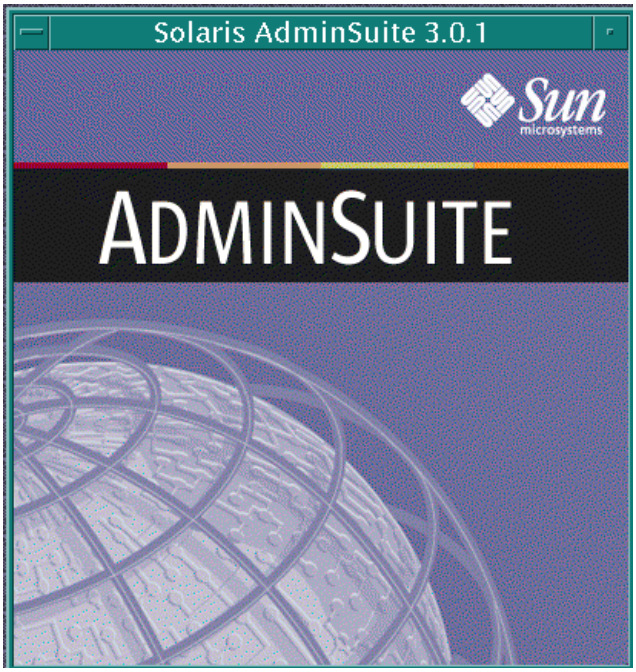


Figure 10-24 Solaris AdminSuite Banner Window

You must enter a login and password before using the Solaris AdminSuite application (see Figure 10-25).

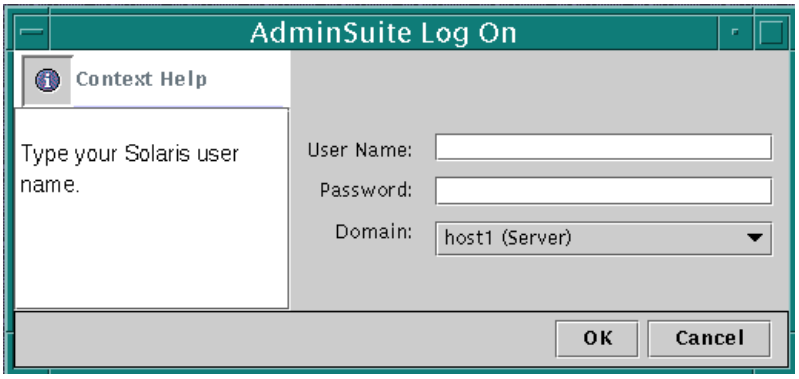


Figure 10-25 AdminSuite Log On Window

Selecting a Name Service

In earlier releases of the Solaris AdminSuite software, you had to select a name service when you launched the individual tools that comprised the Solaris AdminSuite package. In this release of the Solaris AdminSuite application, you select name service configuration using the Domain menu, as shown in Figure 10-26 on page 10-26:

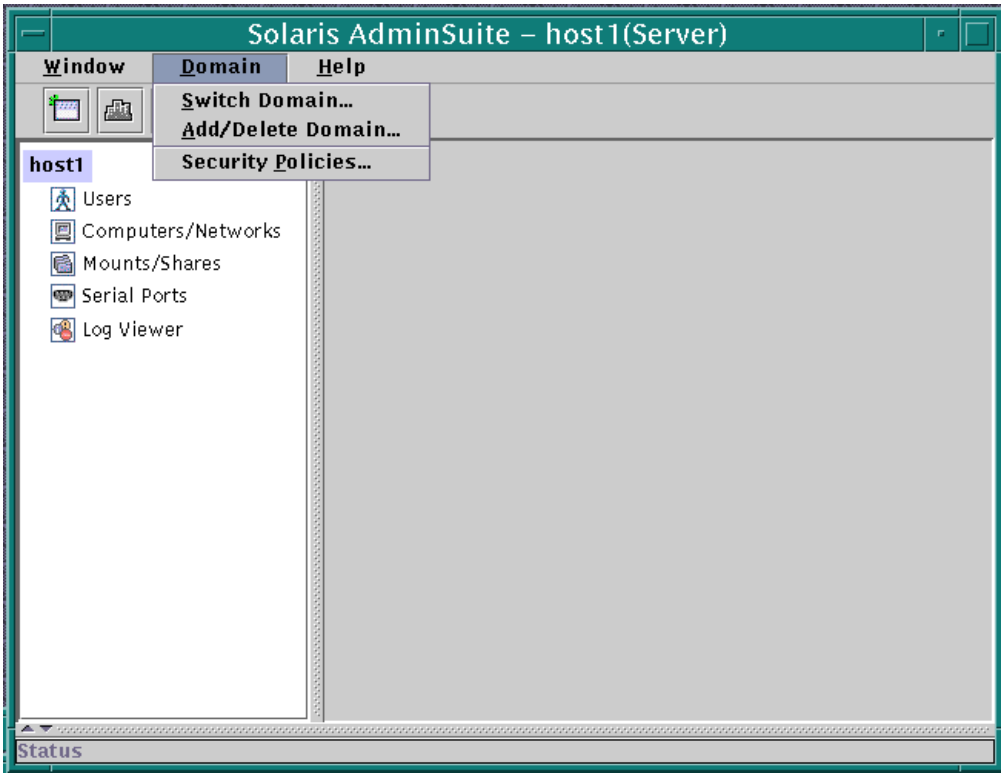


Figure 10-26 Solaris AdminSuite – Domain Menu

1. Click Domain➤Security Policies (see Figure 10-26).

   You are presented with the Name Service Selection display (see Figure 10-27 on page 10-27).

   You must be a primary administrator for the server shown in the title bar, before you can set security policies for the server.

2. Select your desired name service configuration by clicking on the appropriate selections.

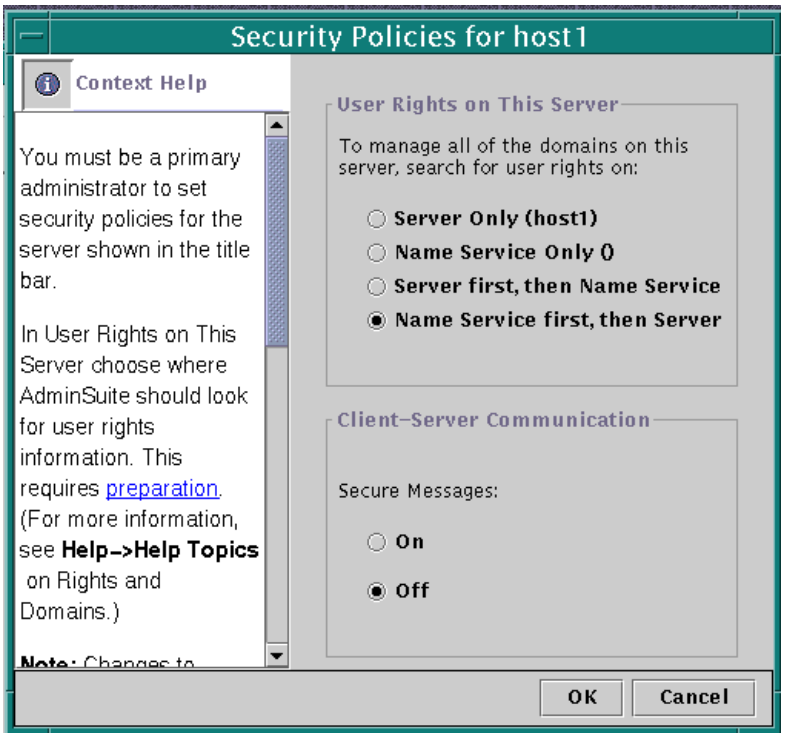


Figure 10-27 Security Policies for Host Window

3. Click OK.

Note – You must configure the selected name services before selecting them, or you will receive an error message alerting you to potential problems.

Solaris AdminSuite Components

The initial Solaris AdminSuite window is shown in Figure 10-28. The display can be divided into three segments, as follows:

- The menu segment in the upper left corner
- The Context Help segment across the bottom
- The current context workspace occupies the upper right segment

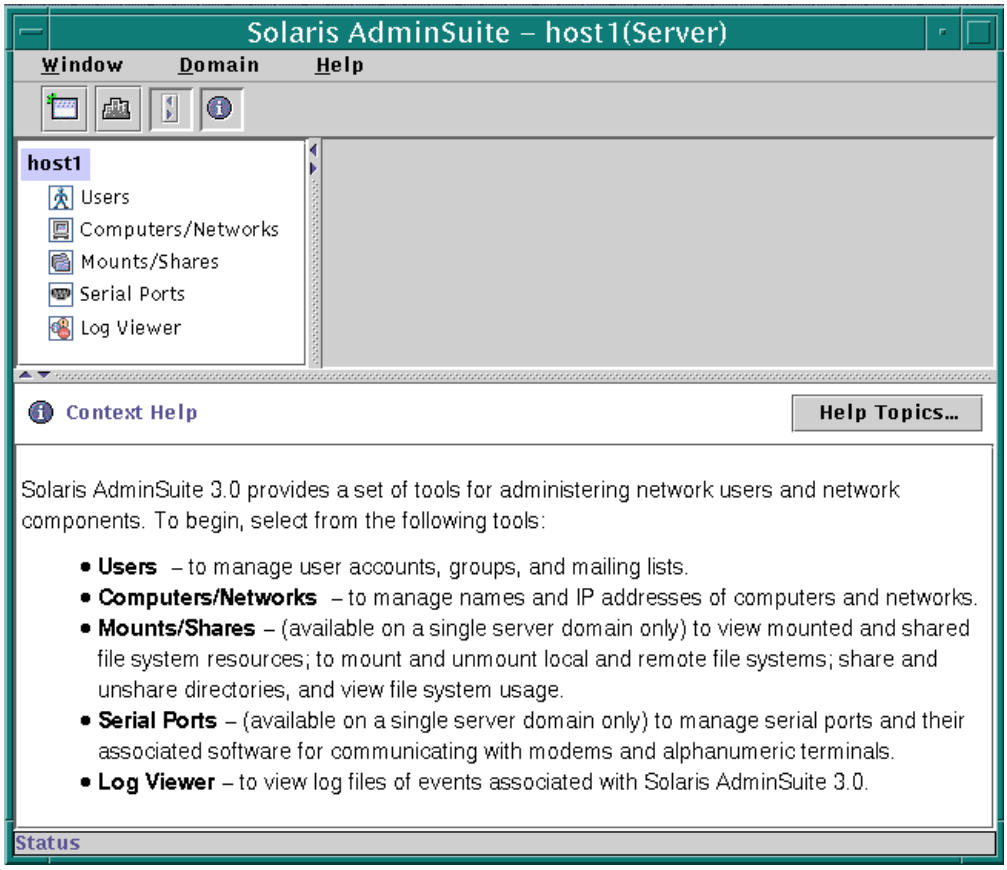


Figure 10-28 Solaris AdminSuite – Host Window

The current context workspace contains displays for the feature of Solaris AdminSuite that you are currently using. You can expand this workspace to absorb the menu segment space by clicking on the left arrow or right arrow on the slider bar or by sliding the slider bar itself. Similarly, the workspace can absorb the Context Help segment with its arrows or slider bar.

Users Feature

You can access the Users feature through the Users Menu, which expands this feature to configure users, configure groups, or configure mailing lists. Click the Users icon in the upper left segment (on Figure 10-29 on page 10-30) to display the desktop segment (or upper right segment).

Note – In Figure 10-29 on page 10-30, the (bottom) Context Help segment has been absorbed to provide a larger desktop (workspace) segment in the upper right.

Viewing Users

Double-clicking Users in the menu expands the menu selection to include its sub-menu selections, then double-click the User Accounts icon.

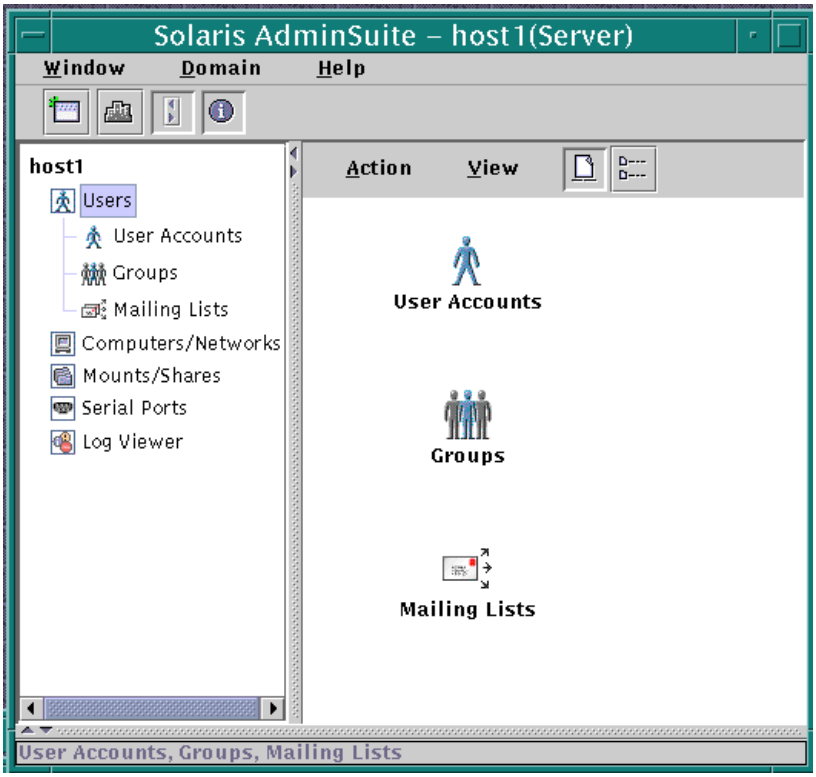


Figure 10-29 Solaris AdminSuite – Users Window

You are prompted to set the initial view for displaying the available user accounts.

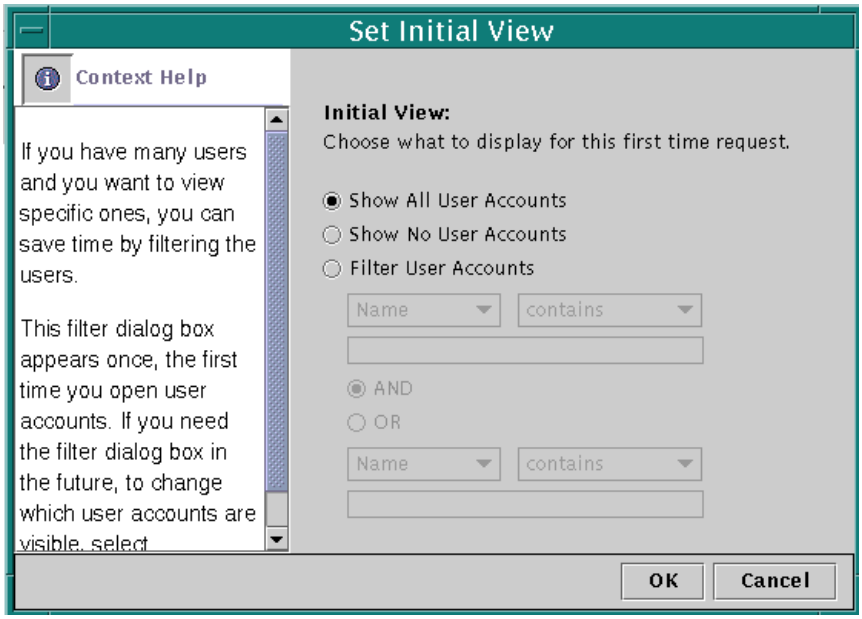


Figure 10-30 Solaris AdminSuite – Set Initial View Window

To manipulate user accounts, perform the following steps:

1. Click your desired view.
2. Click OK.

If you select the option to show all user accounts, you are presented with the icons for each account, as illustrated in Figure 10-31.

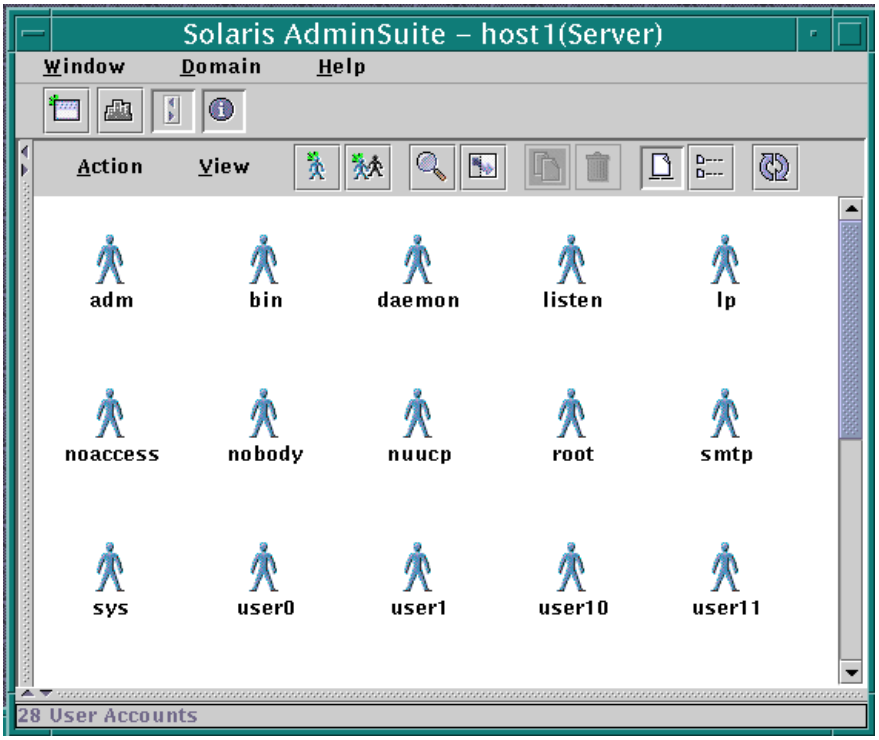


Figure 10-31 Solaris AdminSuite – All Users Window

The Menu/Icon bar changes to support the current desktop workspace environment. The View menu on this display shows the current configuration of the desktop. The icons show the user names, but you can display more information about each user by selecting a detailed view, as follows:

1. Click View➤Details.

   The new display contains a text-oriented listing of all current users that are visible to `host1`.

   You can alter this display using the sort selection under the View menu, as follows:

2. Click View➤Sort by➤*`sort_characteristic`*.

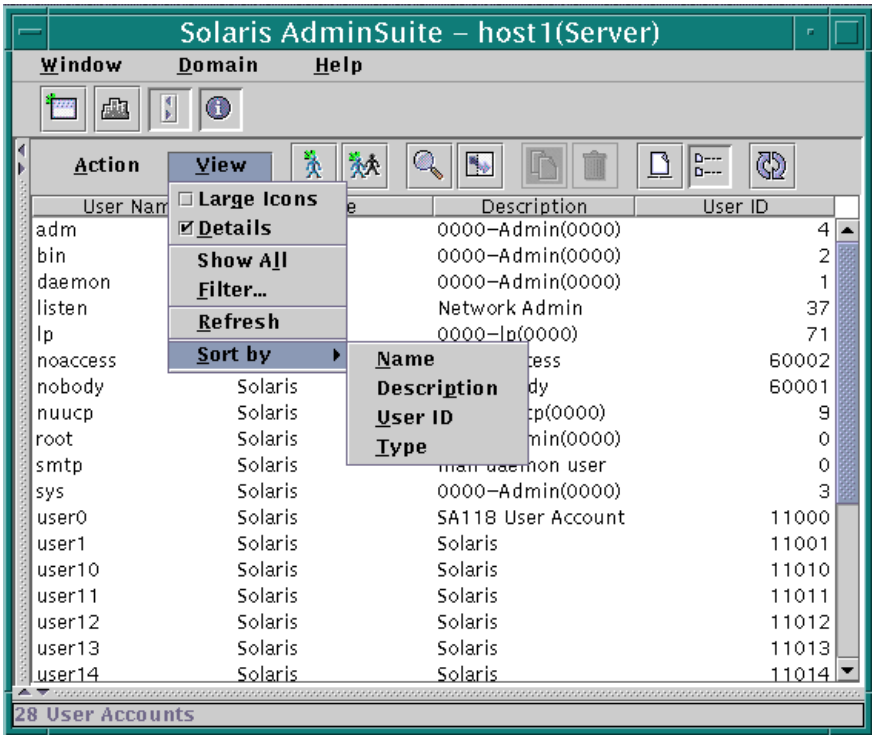


Figure 10-32 Solaris AdminSuite – Users Sort By Menu

Adding Users

Just as the View menu provides the ability to alter how the current users are displayed, an Action menu provides various methods of manipulating the User accounts feature.

To add a new user, perform the following steps:

1. Click Action➤Add User.

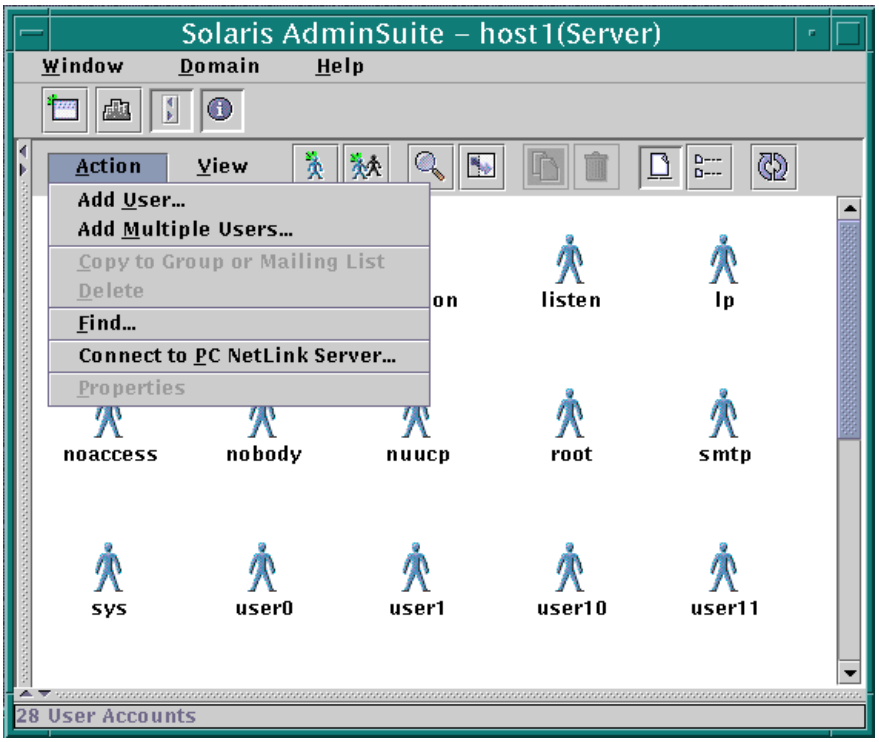


Figure 10-33 Solaris AdminSuite – Users Action Menu

A series of input windows are displayed that prompt for the information describing the new user account.

The left side of the display lists the steps that are required to accomplish the selected operation. Each step in the process displays an additional display, with the corresponding process step highlighted on that display.

2. Enter the new user name.

Note – The naming conventions for users differ according to organizational rules.

3. Enter a brief description of the user account.

Note – Descriptions are optional, but they are usually recommended.

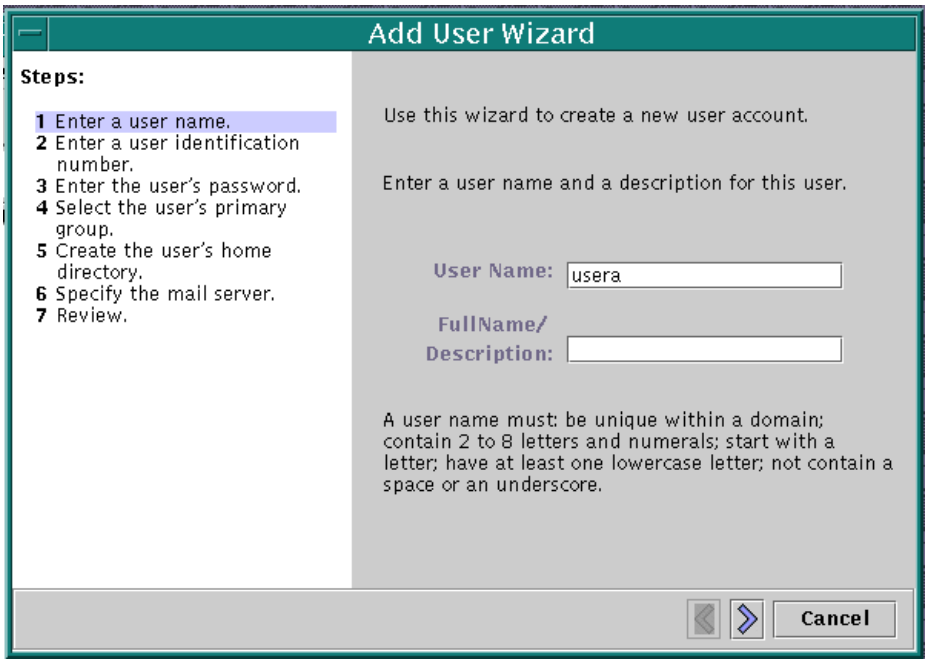


Figure 10-34 Add User Wizard

4. Click the **>** symbol.

   The user ID (UID) number is the identifier by which this user will be known to the system.

5. Add a unique user identification number to the account.

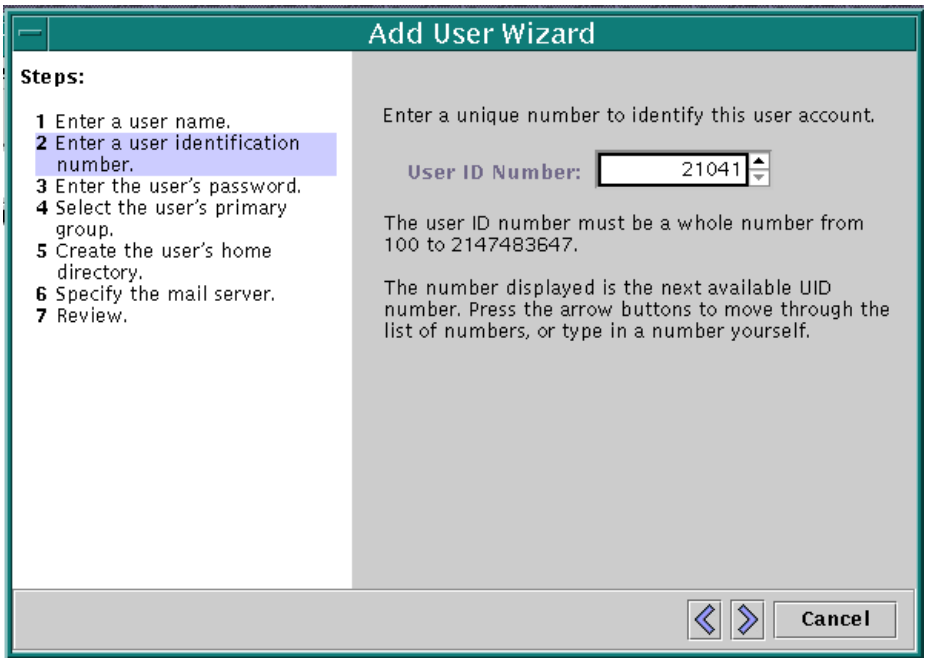


Figure 10-35 Add User Wizard – Add User ID

6. Click the **>** symbol.

You can set the user's initial password within this display, or you can require the user to set their own password during their first login session.

7. Click User Must Use This Password At First Logon:
8. Enter a password in the Password field
9. Re-enter the password in the Confirm Password field

Note – The password displays as a series of asterisks for security purposes.

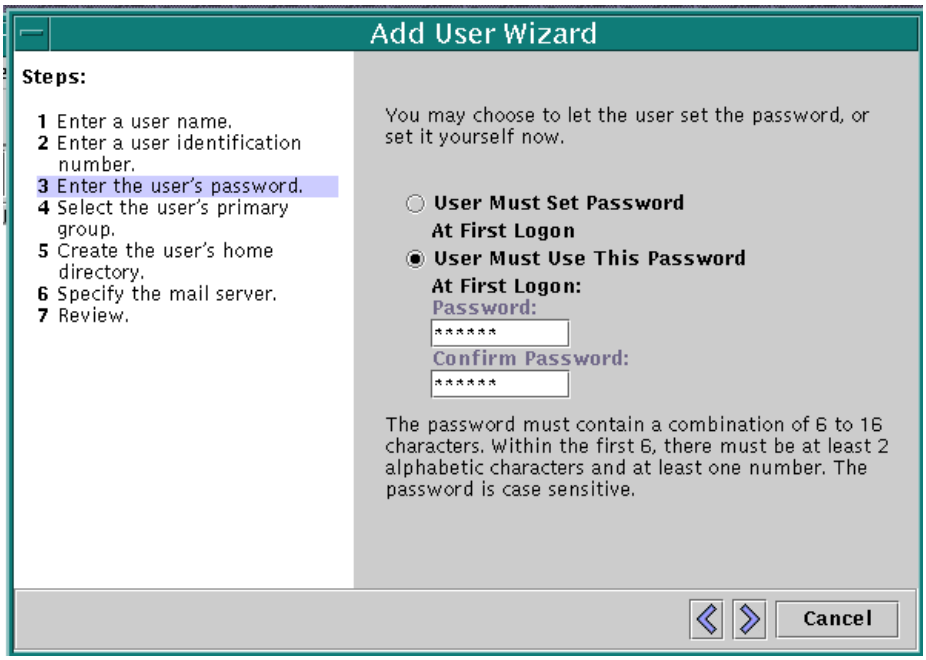


Figure 10-36 Add User Wizard – Add User Password

10. Click the **>** symbol.

Select the primary group to which this user is to belongs.

11. Click Primary Group.

12. Select the user's group from the drop-down list.

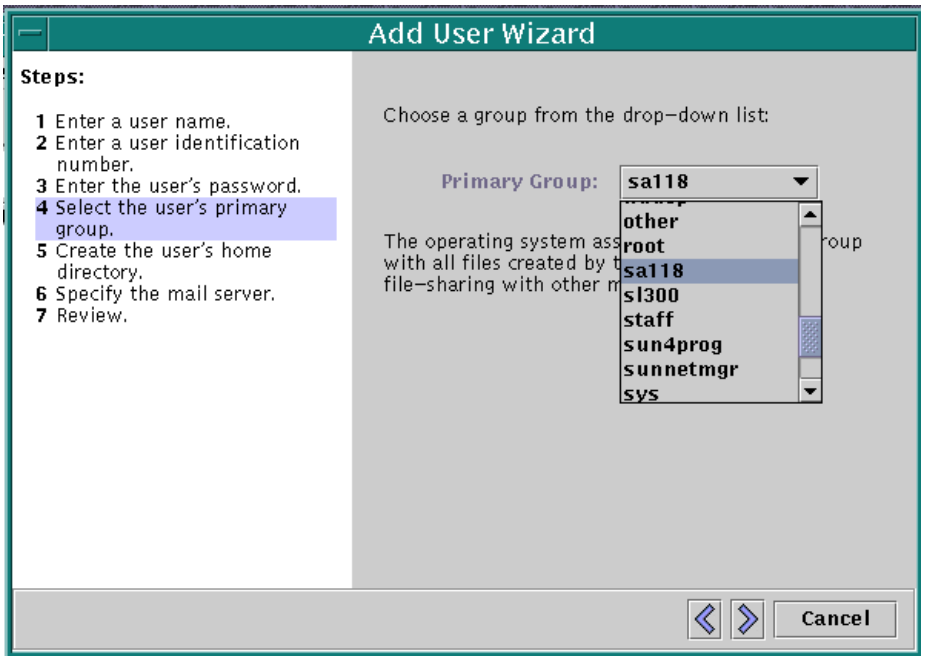


Figure 10-37 Add User Wizard – Add User Group Selection

13. Click the **>** symbol.

Each user requires a home directory where the user is placed upon login. If the home directory server is other than this server, you must ensure Solaris AdminSuite 3.*x* is running on the home directory server.

14. Enter the home directory path minus the user name.

Note – The user name is appended to the end of the path before the directory is created.

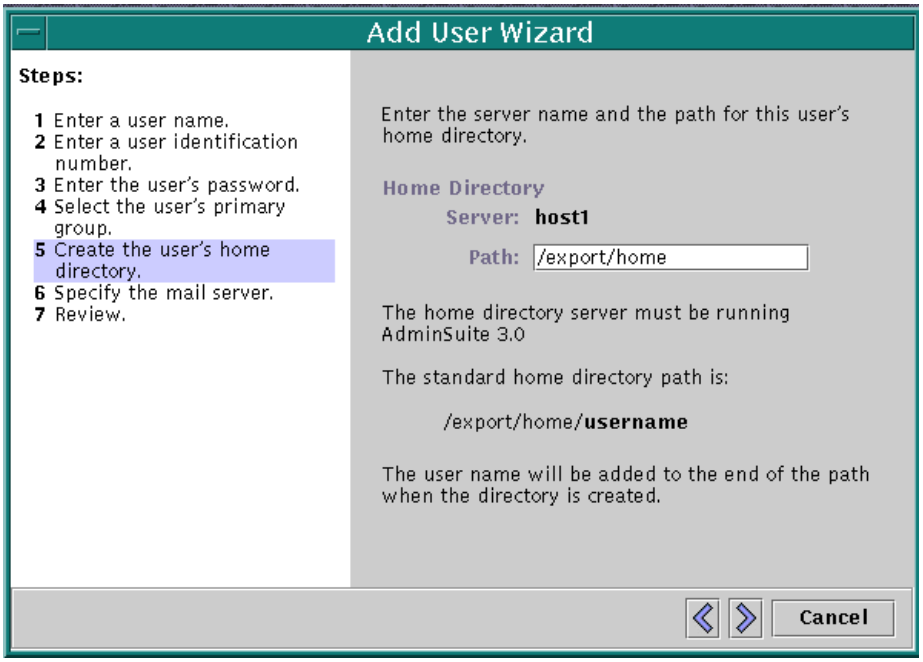


Figure 10-38 Add User Wizard – Add User Home Directory

15. Click the **>** symbol.

This window is for informational purposes only.

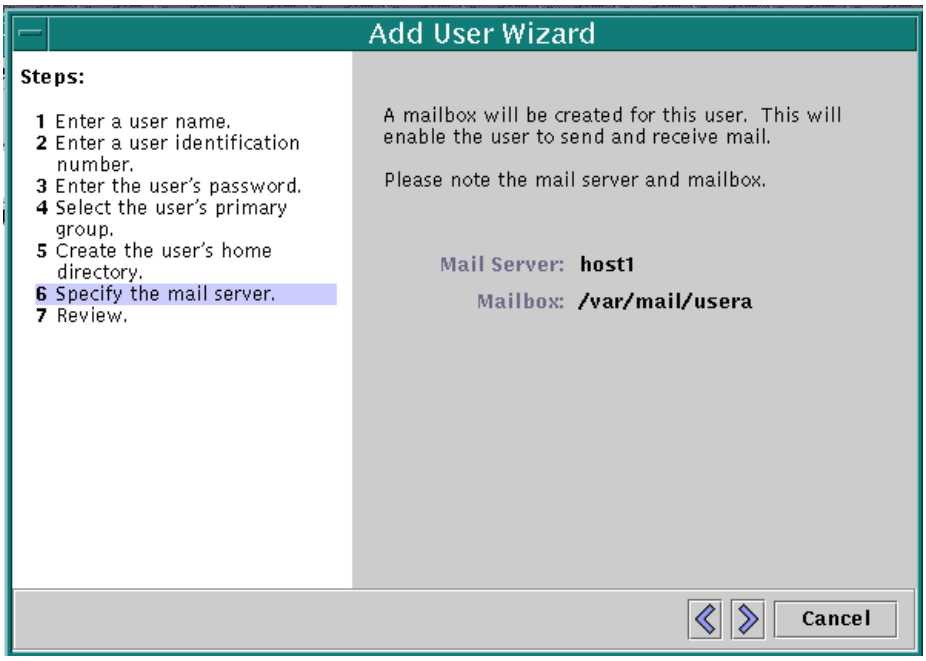


Figure 10-39 Add User Wizard – Add User Mail Server

16. Click the **>** symbol.

Before to actually creating the user account, Solaris AdminSuite re-displays your sections, and provides an opportunity to correct the errors.

17. If there are errors, return to the appropriate display to correct them.

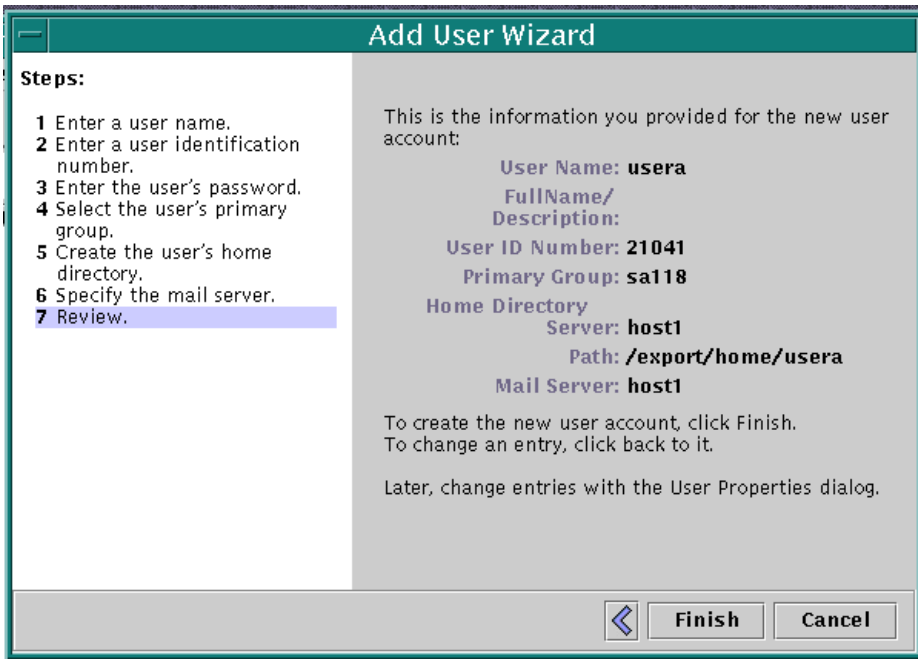


Figure 10-40 Add User Wizard – Add User Attributes Confirmation

18. If there are no errors, click Finish.

After you create the new user, you can confirm the operation was successful by listing the users.

Note – If your view option is set for Large Icons, your display might differ from this screen capture; however, the icon for `usera` should still be present.

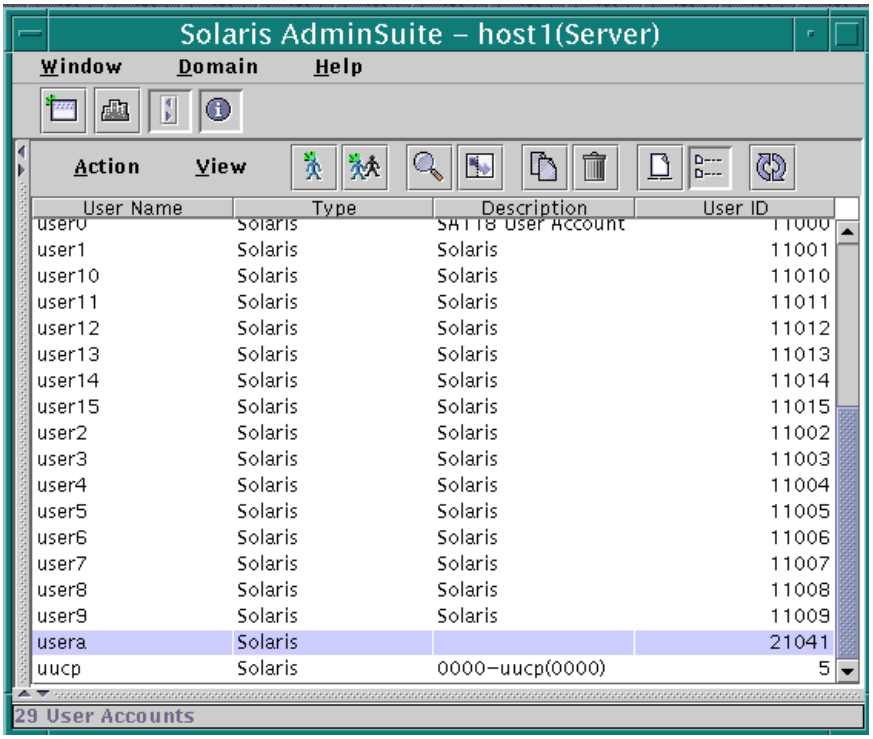


Figure 10-41 Solaris AdminSuite – New User Listing

You can now use the new `usera` login.

Viewing Groups

Viewing groups begins by either clicking the Groups icons on the desktop in the upper right segment, or by clicking on the Groups icon in the Users menu on the upper left segment of the Solaris AdminSuite display.

In this example, you would click the Groups icon in the Users menu on the upper left segment of the Solaris AdminSuite display, because the list of users (from the previous example) is displayed on the right.

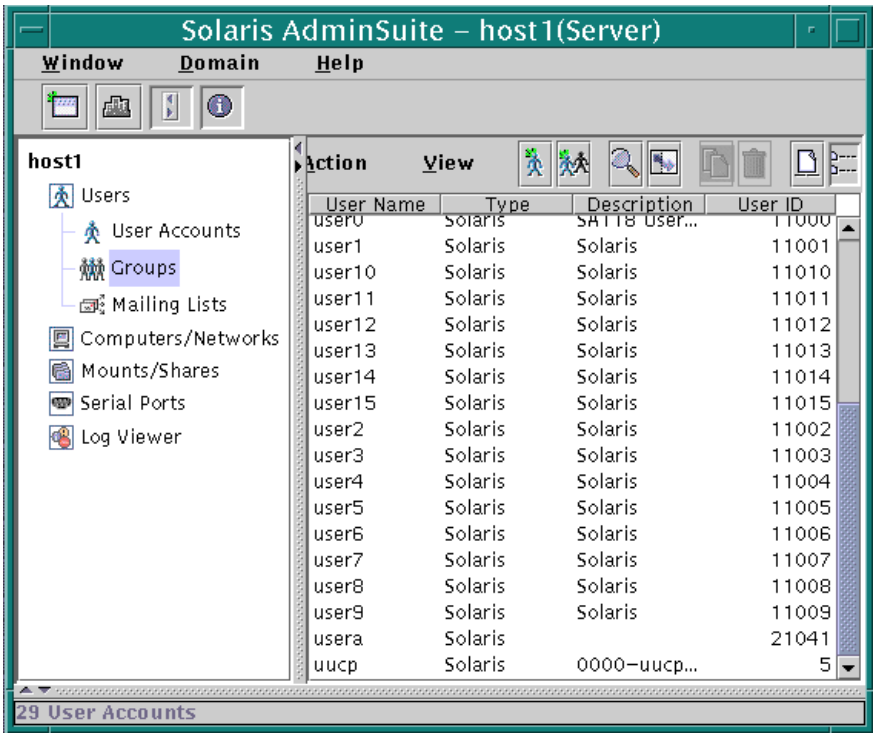


Figure 10-42 Solaris AdminSuite – Users Group Selection

To set the initial view for group accounts, perform the following steps:

1. Double-click the Groups Accounts icon.

You are prompted to set the initial view for displaying the available groups.

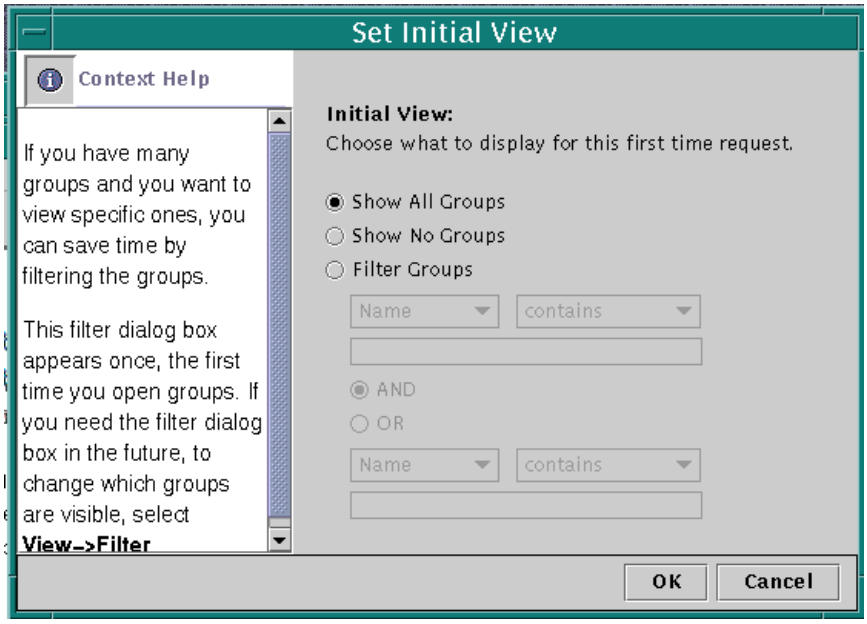


Figure 10-43 Set Initial View Window

2. Click your desired view.
3. Click OK.

The initial view of the available groups is displayed alphabetically by name.

Note – You must remember that your earlier selection of Domain➤Security Policies affects whether you search though local sever files first or use the naming services.

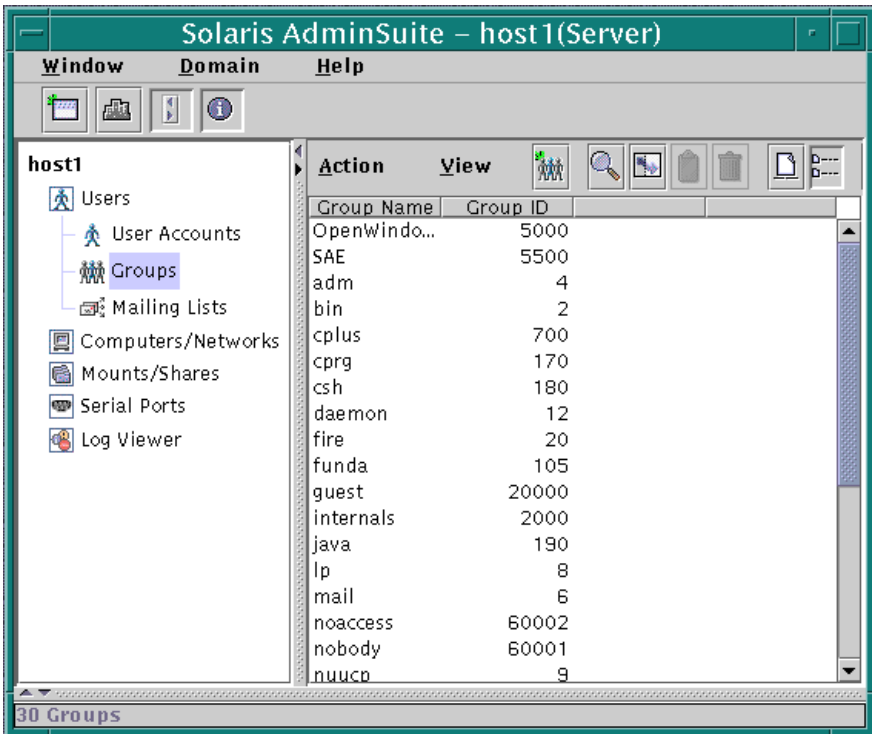


Figure 10-44 Solaris AdminSuite – Groups Window

Many administrators find a numerically sorted group file easier to read. You can sort the displayed groups by group number, as follows:

4. Click View➤Sort by➤Group ID.

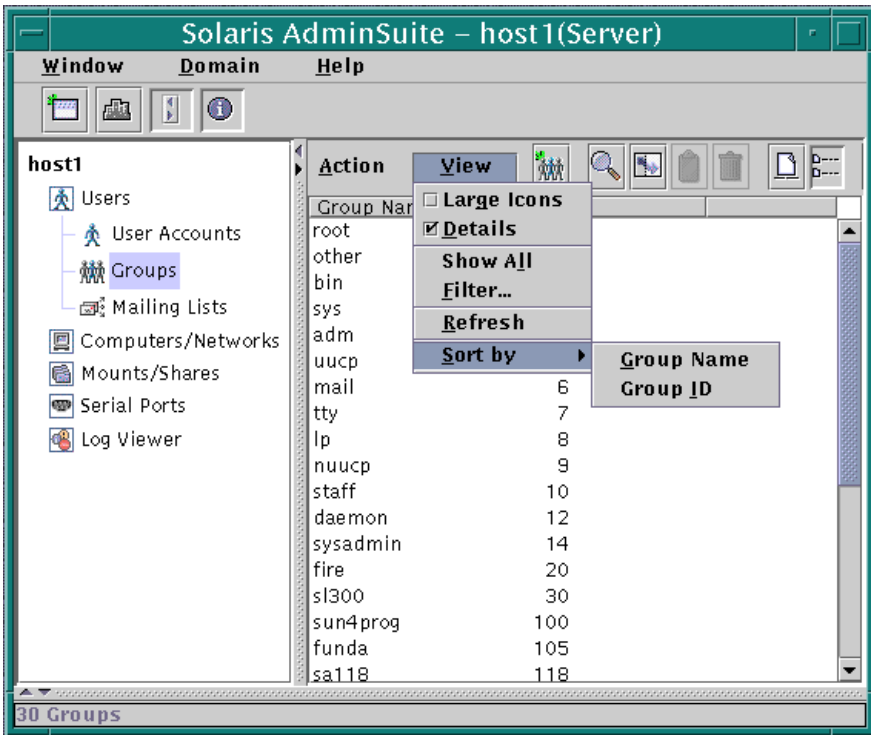


Figure 10-45 Solaris AdminSuite – Groups View Sort By Menu

The group display also contains an action menu. To make the menu item active, you must first select an existing group; otherwise, the only active menu item is the Add Group selection.

Adding Groups

To add a new group, perform the following steps:

1. Click Action➤Add Group.

   The Group Action menu is displayed.

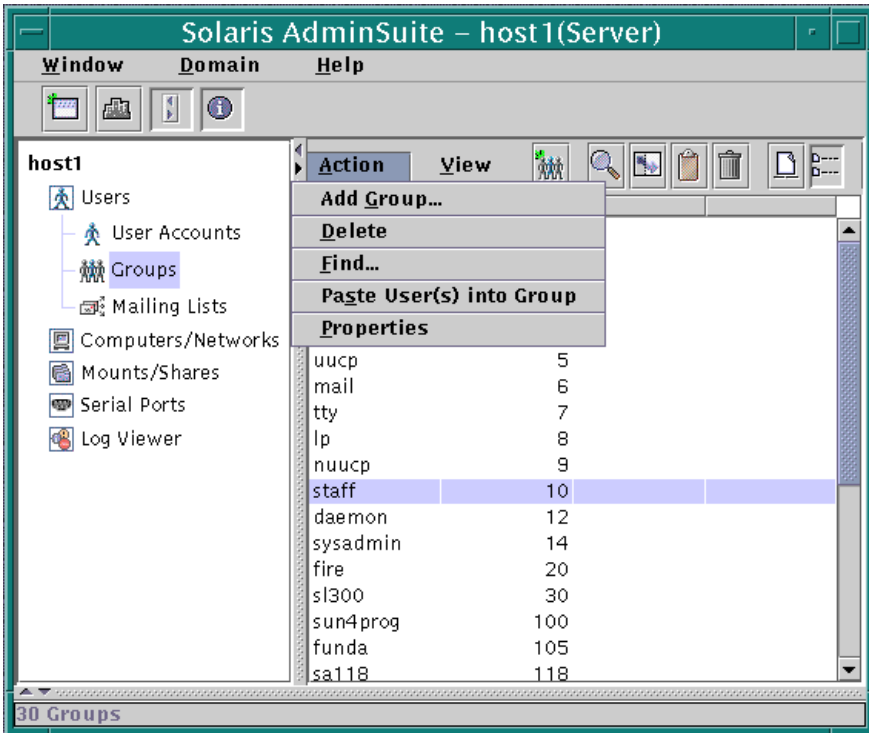


Figure 10-46 Solaris AdminSuite – Groups Action Menu

2. Enter the new group name.

You are presented with an available (unused) group ID number.

3. You can accept this group ID number or choose another.

Note – This group name and group ID number must be unique.

---

4. Enter the user names of the group members in the appropriate space.

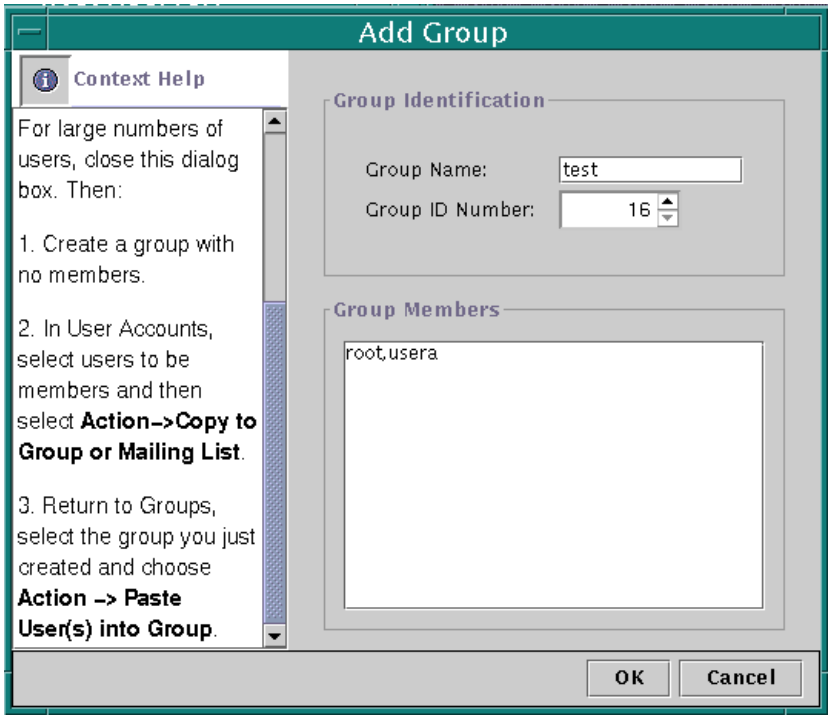


Figure 10-47 Add Group Window

5. Click OK.

6. To confirm the creation of the group, click the Groups icon in the upper-left window.

Note – When you reference the groups file using the menu icon, the display's view format returns to alphabetical.

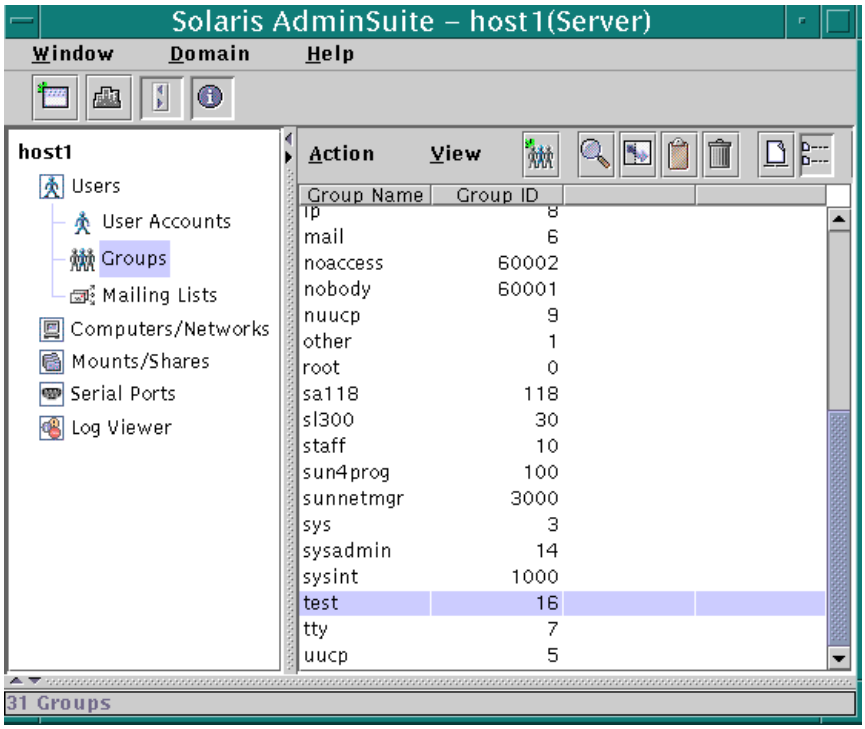


Figure 10-48 Solaris AdminSuite – New Group Listing

Modifying Groups

To add users to an existing group, perform the following steps:

1. Highlight the group in the groups display (select `sysadmin`).
2. Click Action➤Properties.

   The Group Properties window that corresponds to the highlighted group is displayed.

3. Enter the additional group members into the appropriate location.

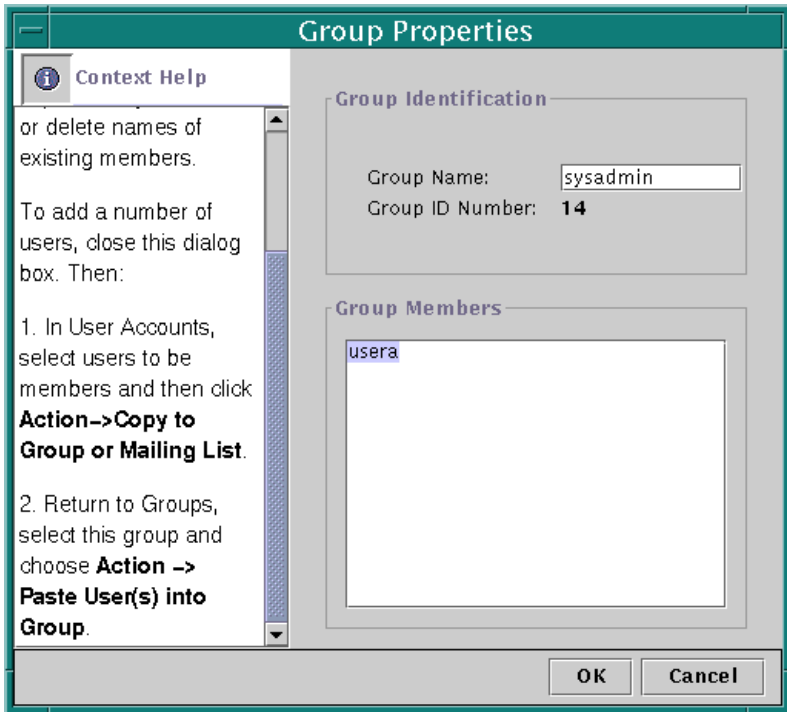


Figure 10-49 Group Properties Window

4. Click OK.

Computers/Networks Feature

Solaris AdminSuite has a feature for manipulating the Computers/Networks information. Local hosts are selected using the Computers selection on the sub-menu.

1. Click Computers/Networks to display the menu selections.

2. Click the Computers selection, and answer the prompts for the initial view.

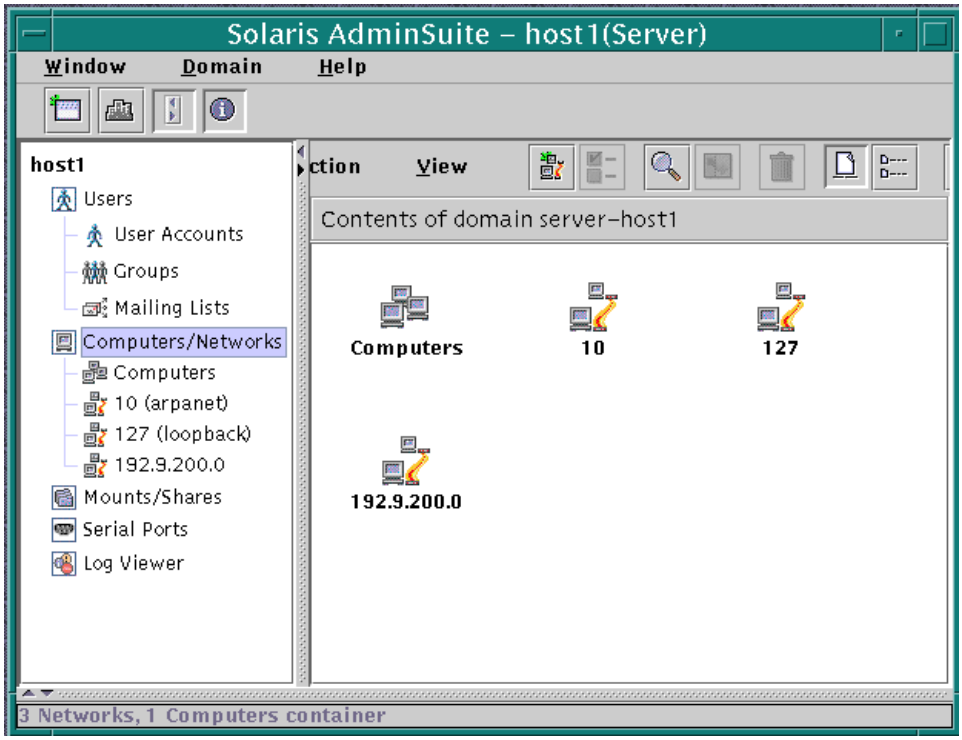


Figure 10-50 Solaris AdminSuite – Computers/Networks Selections

Depending on the size of your subnet, you can select to Show All Computers or some subset of the available computers on the subnet

3. To choose a subset of the net, click Filter Computers.

4. Enter the desired filter.

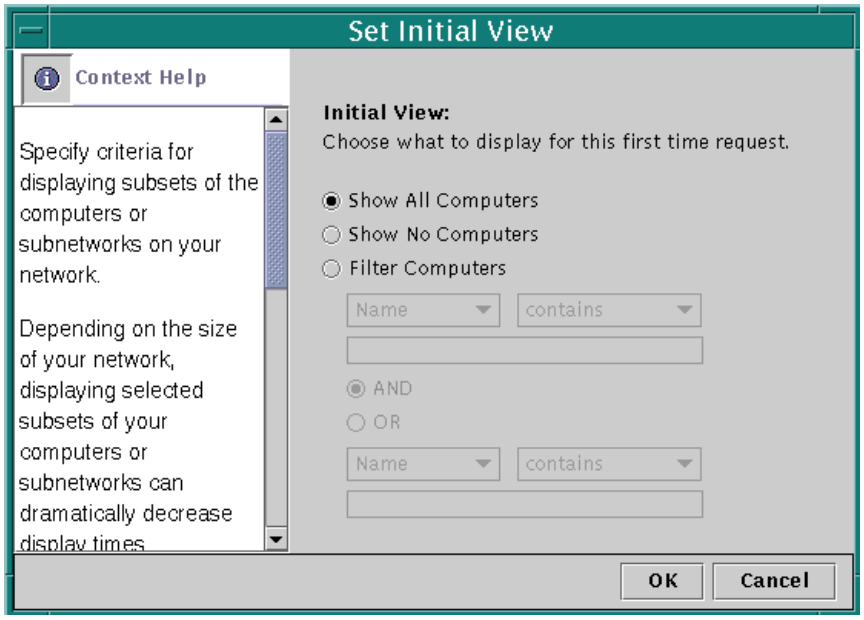


Figure 10-51 Set Initial View Window

5. Click OK.

The following display was generated from a complete listing of a small network.

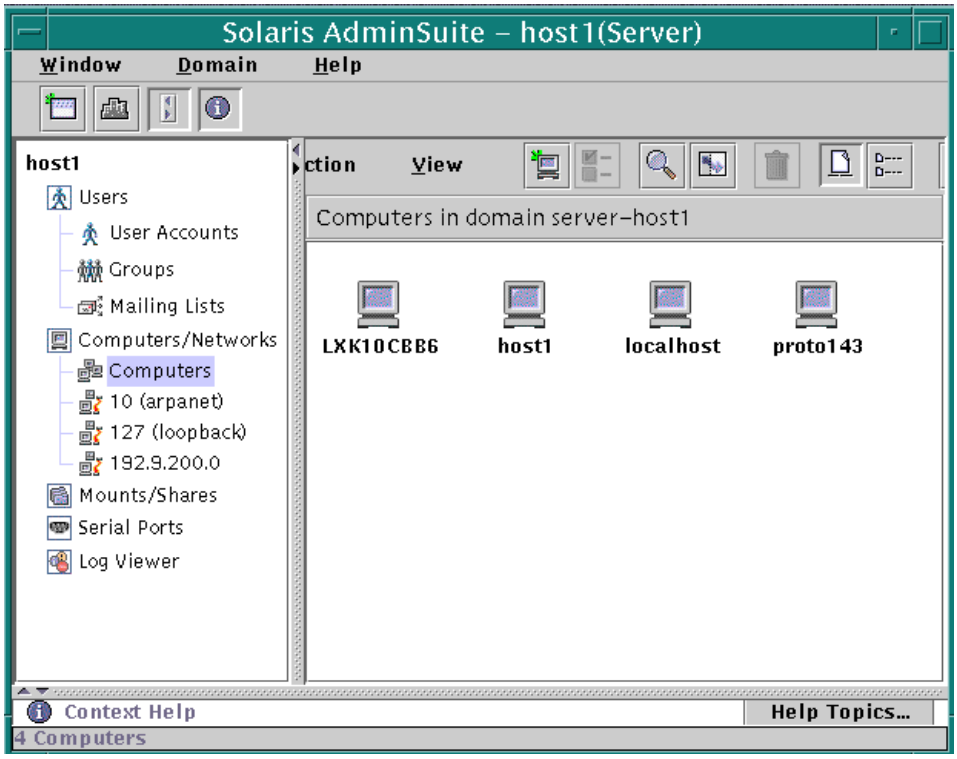


Figure 10-52 Solaris AdminSuite – Computers (Local Host) Window

6. Click View to Open the View menu.

   The view menu for hosts shows this subnet is sorted by the name of the computer. Other possible sort categories include:

   - IP addresses
   - Descriptions
   - Aliases
   - Ethernet addresses

You can sort the members either in ascending or descending order.

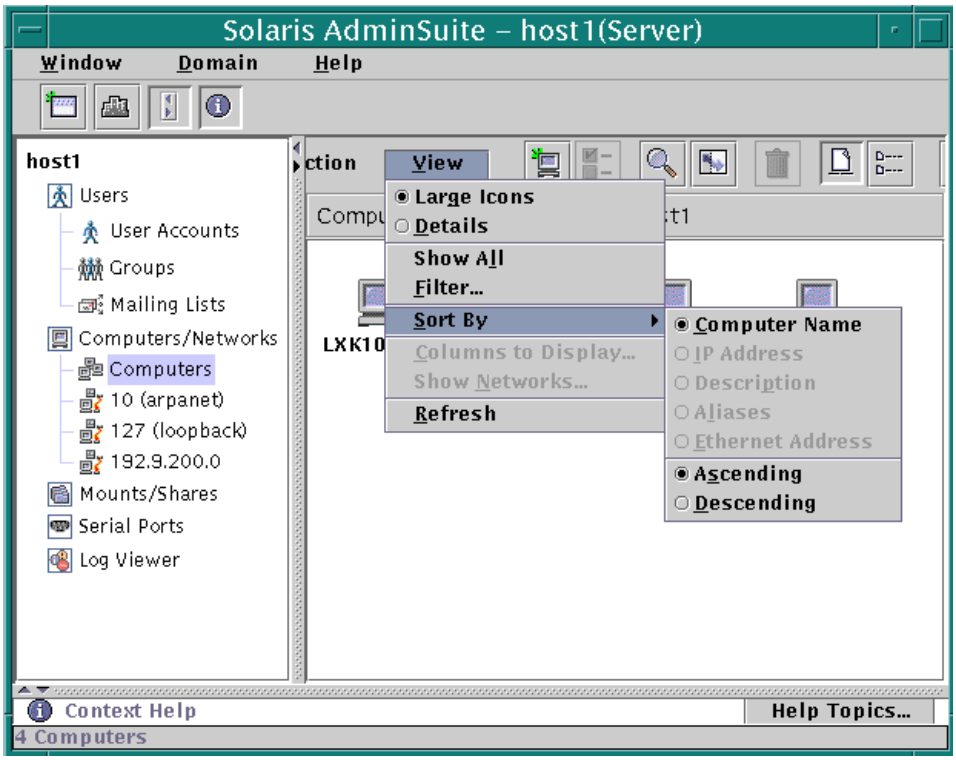


Figure 10-53 Solaris AdminSuite – Computers View Sort By Menu

Adding a Host

Similar to the other Solaris AdminSuite features, to add another host to the subnet, you need to use the Action menu. Perform the following steps:

1. Click Action➤Add Computer.

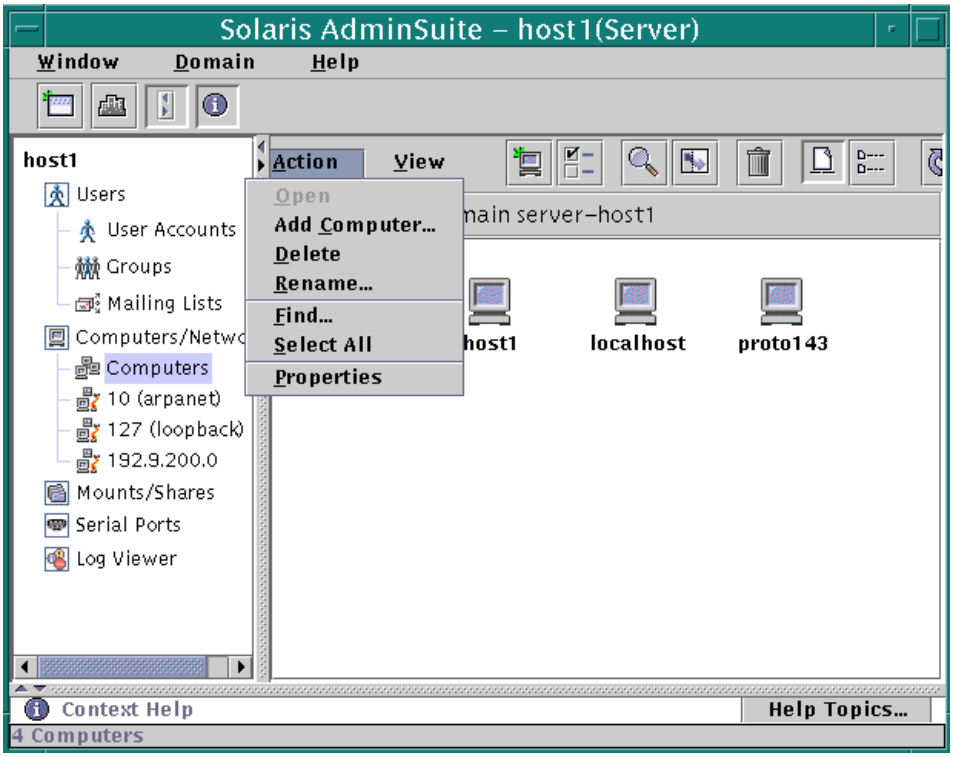


Figure 10-54 Solaris AdminSuite – Computers Action Menu

2. In the Name field, enter the new host name.

3. In the IP Address field, enter the Internet Protocol address.

Note – The additional information fields are optional. You can add aliases, descriptions, and Ethernet addresses. This information can make future administration exercises easier; however, the added information is not required.

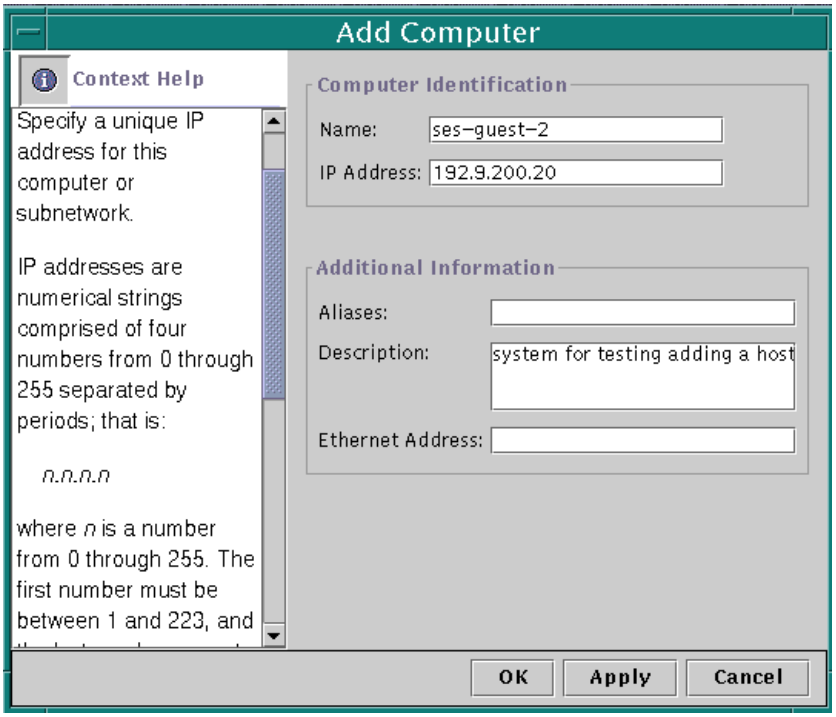


Figure 10-55 Add Computer Window

4. Click OK.

5. Verify that the new host was added by re-displaying the list of subnet hosts.

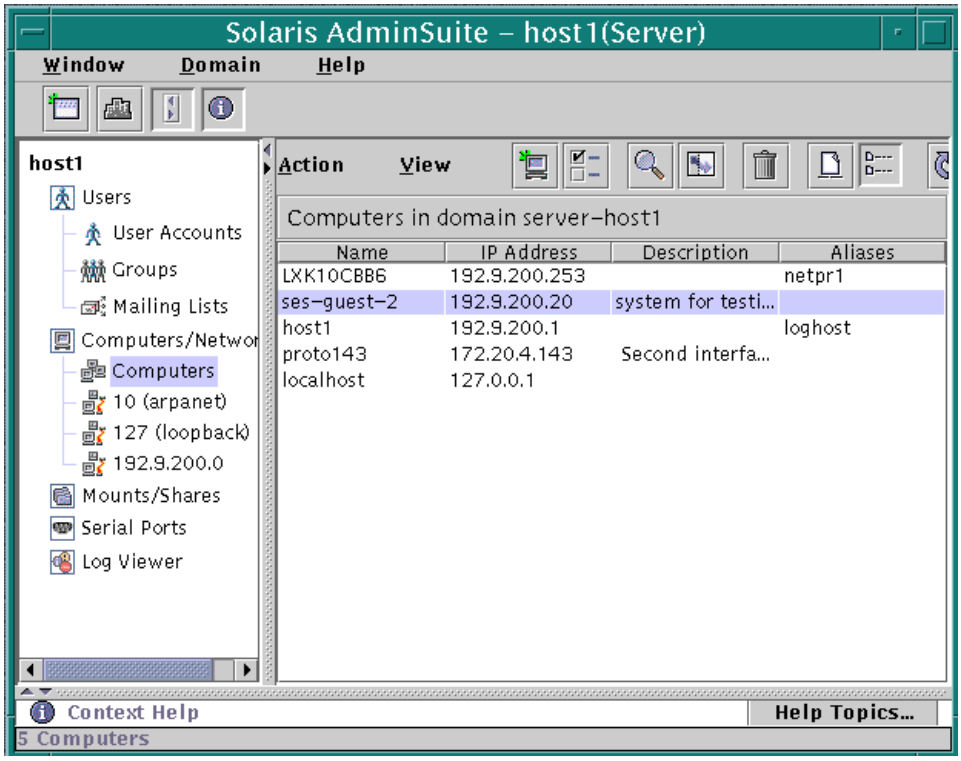


Figure 10-56 Solaris AdminSuite – New Computer Confirmation Window

Discussion – What view options were used to create the display in Figure 10-56?

Renaming a Host

To change the name of an existing host, perform the following steps:

1. In the Computers (host list) window, click the host that you want to rename.
2. Click Action➤Rename.

   The Rename Computer window is displayed as shown in Figure 10-57).

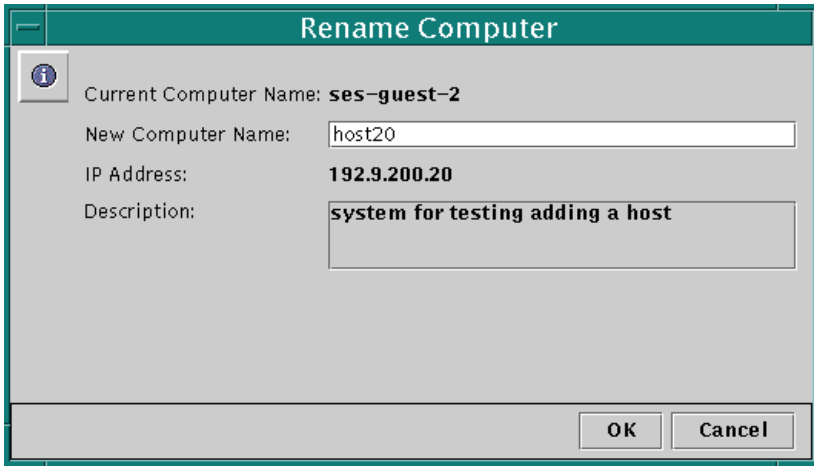


Figure 10-57 Rename Computer Window

3. In the New Computer Name field, enter the new host name.
4. Click OK.

5. Display the list of hosts (showing the modified host name).

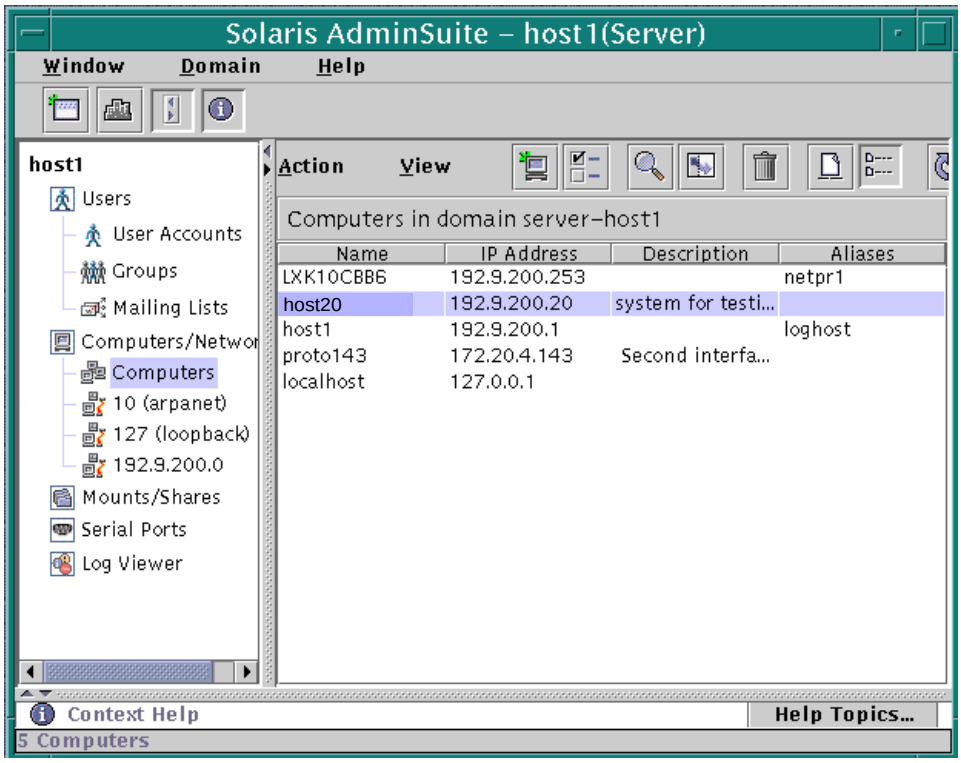


Figure 10-58 Solaris AdminSuite – Renamed Computer Confirmation Window

Mounts/Shares Feature

You can access the Solaris AdminSuite's Mounts/Shares feature from the main menu (the same as all of the other Solaris AdminSuite features). The Mounts/Shares feature includes the following:

- Mounts
- Shares
- File System Usage

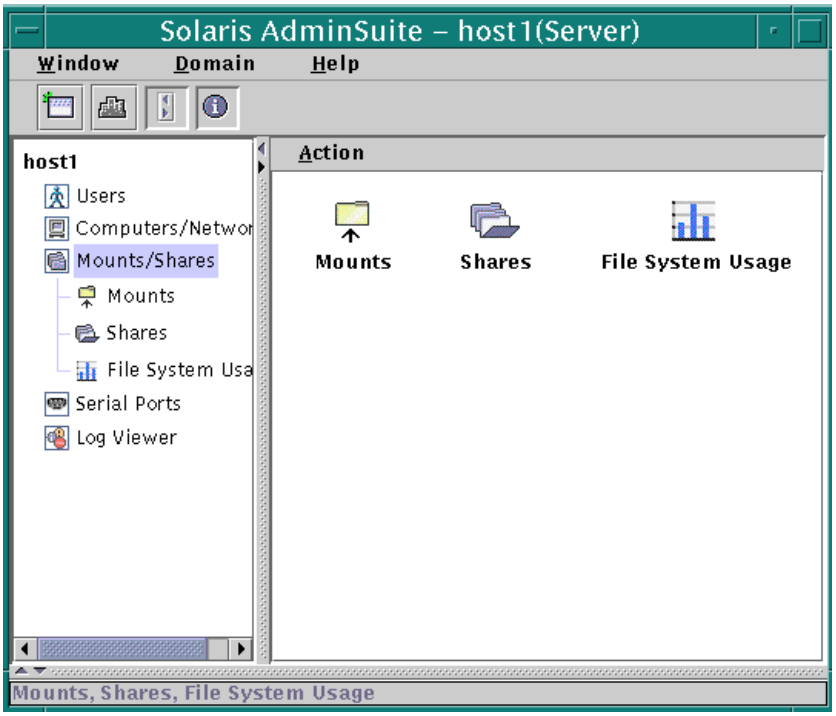


Figure 10-59 Solaris AdminSuite – Mounts/Shares Window

The Mounts feature displays all file system mounts that are visible to the server that is named in the title bar. To use the Mounts/Shares feature, perform the following steps:

1. To display currently mounted resources, click Mounts.

Note – The resources are initially displayed alphabetically by mount point directory.

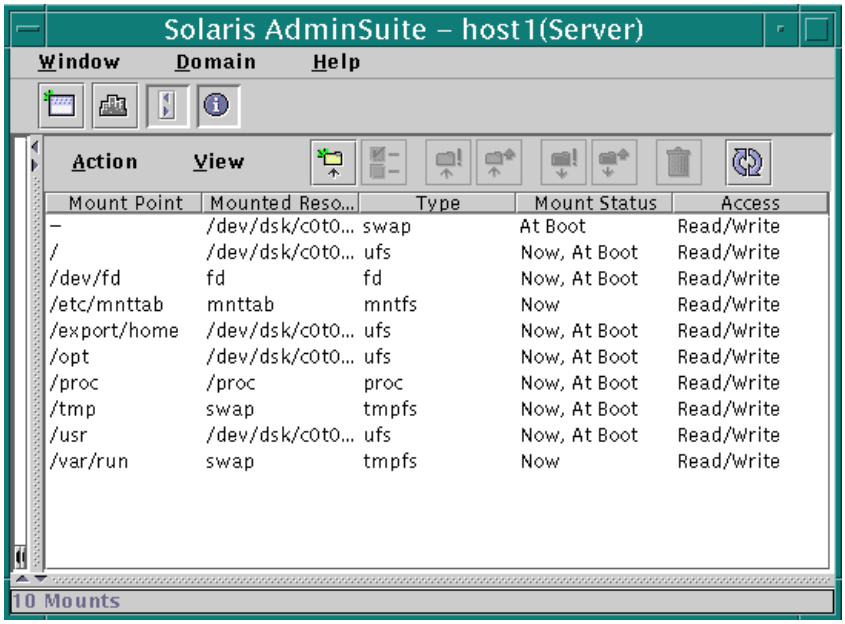


Figure 10-60 Solaris AdminSuite – Mounted Resource Window

You can change the display order using the View menu.

1. Click View➤Sort by➤*sort_category*.

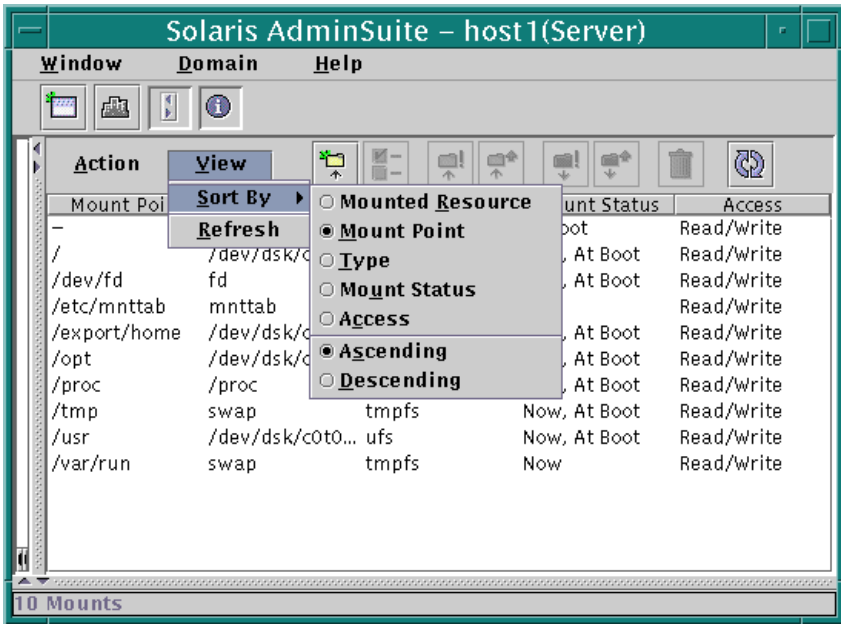


Figure 10-61 Solaris AdminSuite – Mounted Resource View Sort By Menu

To acquire statistics on mounted file systems, complete the following steps:

2. Click the file system (`/mnt` in this example).

3. Click Action➤Properties.

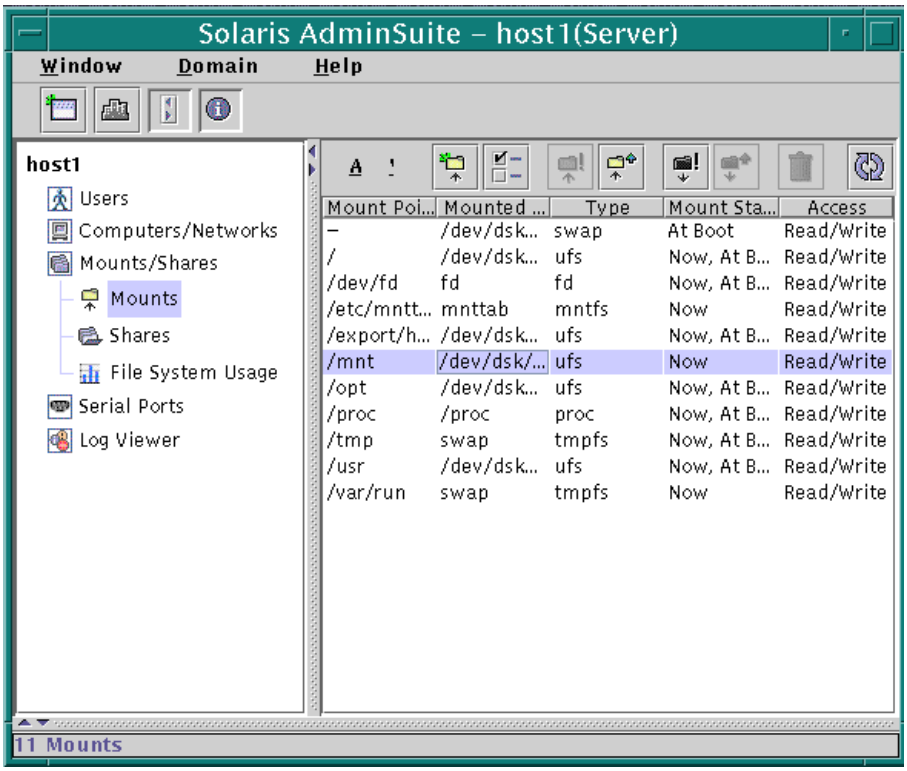


Figure 10-62 Solaris AdminSuite – `/mnt` File System Selected

The mount properties are reported in two pages. The first page contains the mount point name and its corresponding slice. Additionally, the mount status (for example, Now or Mount at Boot), and the access mode (for example, Read/Write or Read Only) are reported.

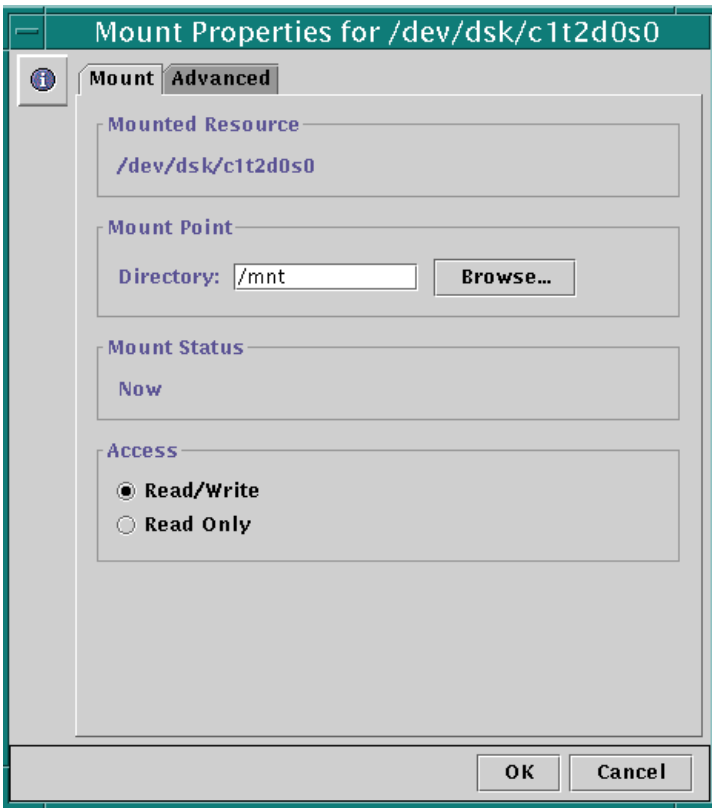


Figure 10-63 Mount Properties Window

The second page displays the mount options, and it reports how damaged file systems are handled. For damaged file systems, you can also select how many times damage to a file system can be detected in a given time frame, before the file system is shut down.

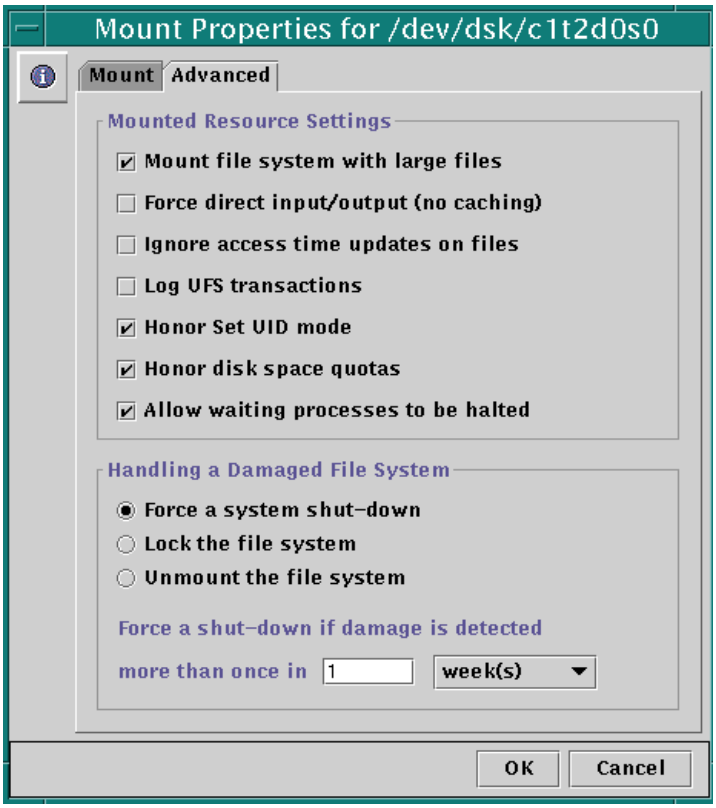


Figure 10-64 Mount Properties Window, Advanced

File System Usage

The output of the File System Usage menu item is similar to the output of the `df -k` command. This window displays the mounted file systems' mount points, the total amount of allocated space, the total space currently in use, and the amount of remaining space.

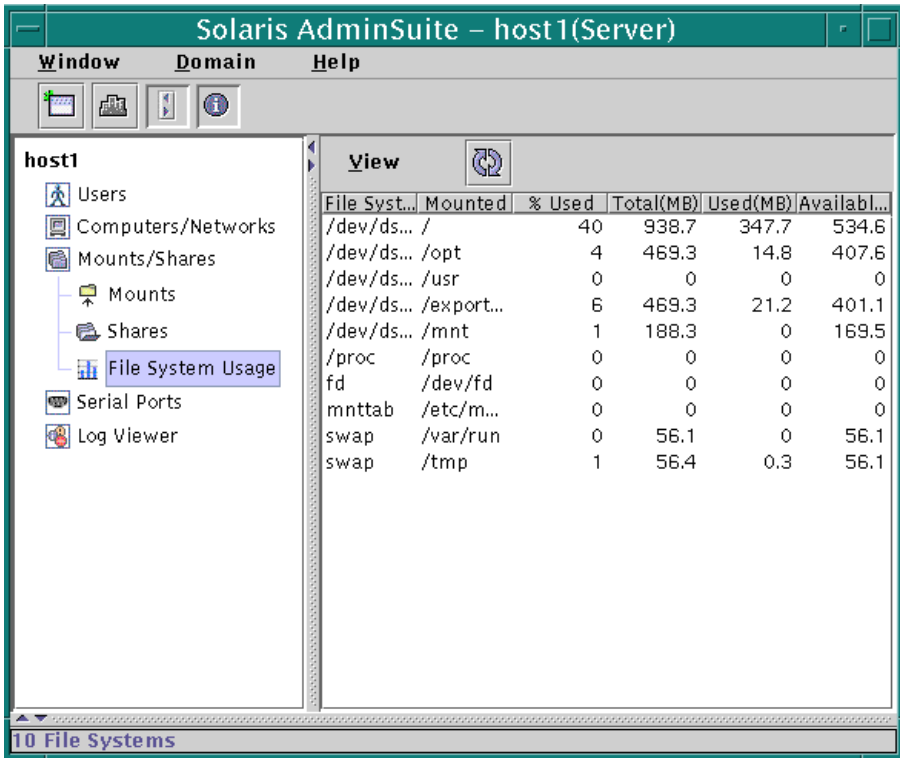


Figure 10-65 Solaris AdminSuite – File System Usage Window

The File System Usage window contains a sort mechanism similar to those in the other Solaris AdminSuite features; however, the sort fields correspond to the data fields displayed within this window.

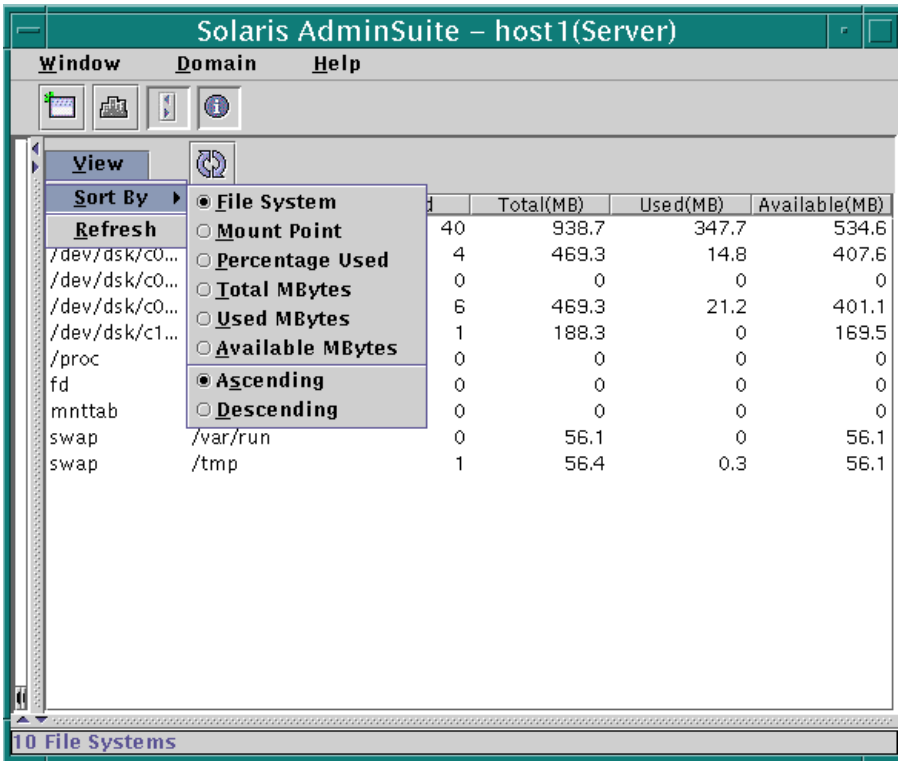


Figure 10-66 Solaris AdminSuite – File System Sort Criteria

Serial Ports Feature

Selecting the Serial Ports menu item allows you to configure the serial ports on the system.

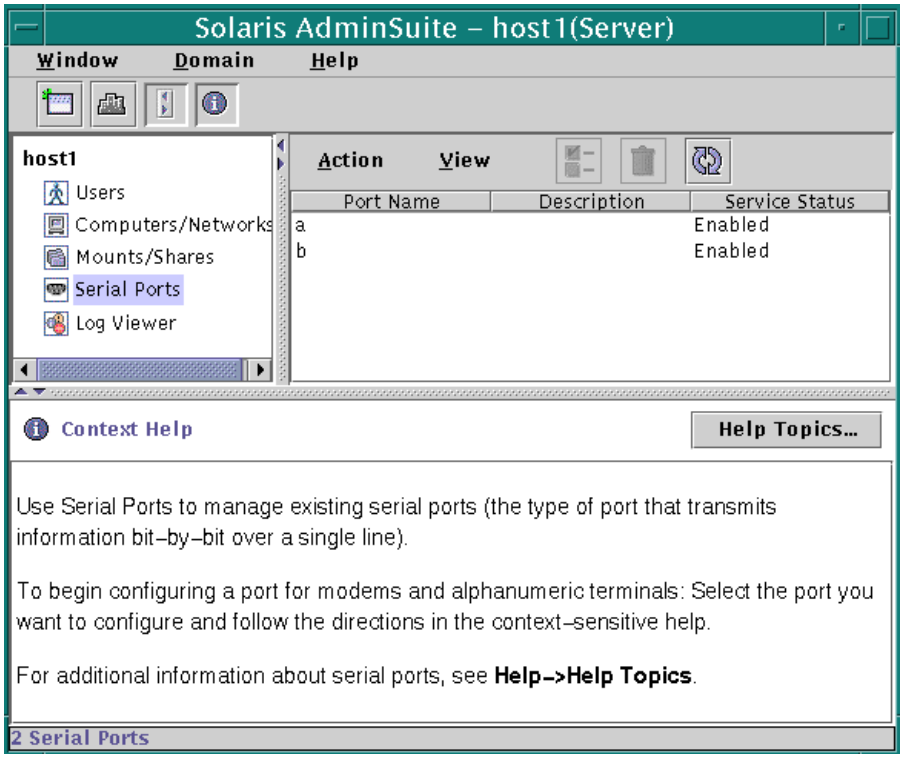


Figure 10-67 Solaris AdminSuite – Serial Ports Window

The ports are initially displayed alphabetically, but you can alter the display by performing the following steps:

1. Click View➤Sort by➤*sort_characteristic.*

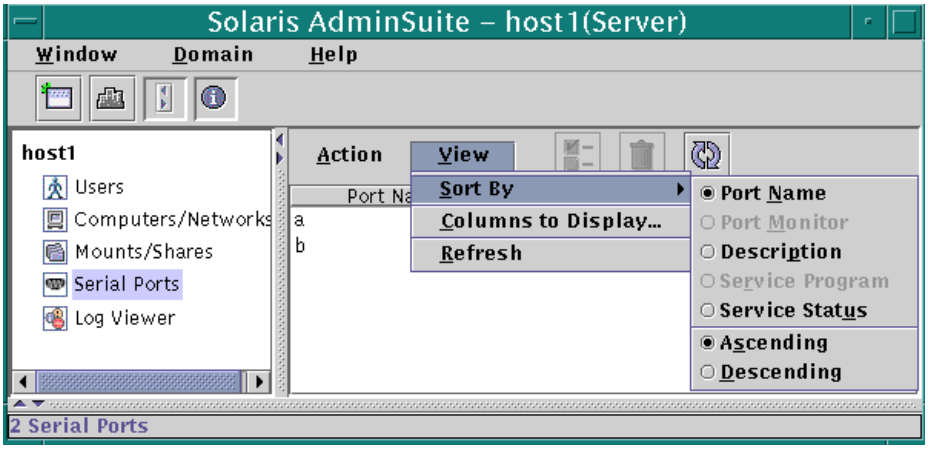


Figure 10-68 Solaris AdminSuite – Serial Ports View Sort By Menu

To alter the types of information displayed, perform the following steps:

1. In the Serial Ports display, click View➤Columns to Display.

   The Columns to Display window is displayed, as shown in Figure 10-69.

2. Click any item in the Available Columns list, and click Add.

3. Click any item in the Columns to Display, and click Remove.

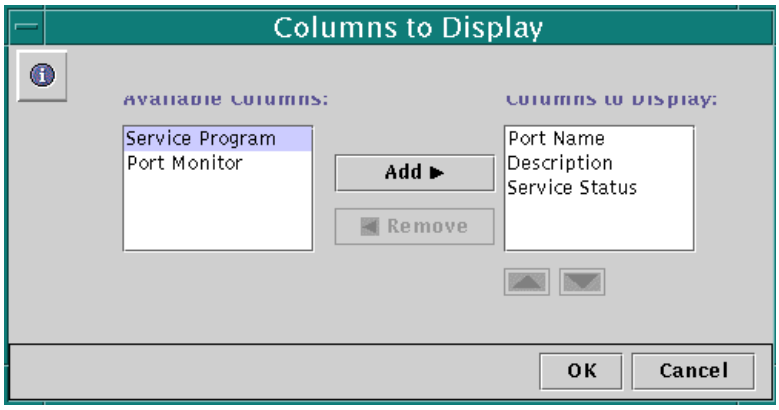


Figure 10-69 Columns to Display Window

4. Click OK.

Figure 10-70 illustrates a serial ports view with all columns displayed.

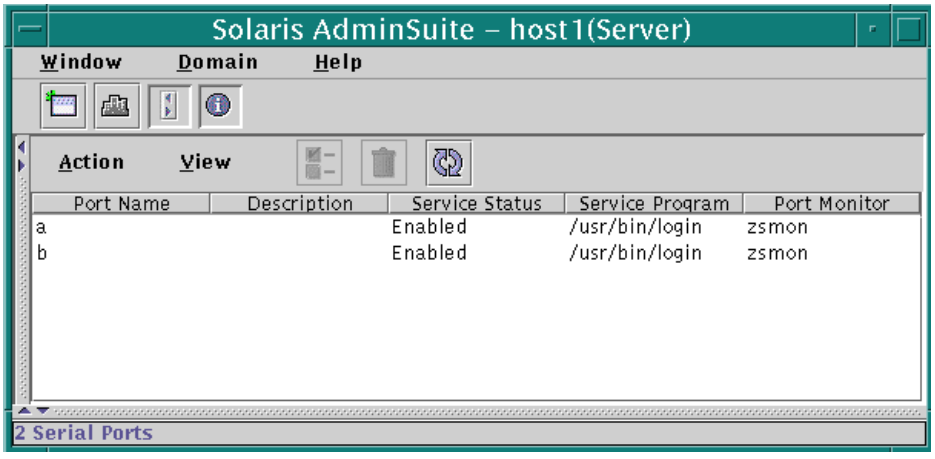


Figure 10-70 Solaris AdminSuite – Serial Ports Window

Configuring Serial Ports

Configuring a serial port differs only slightly from configuring other Solaris AdminSuite features.

To configure any serial port, perform the following steps:

1. Click the serial port that you want to configure.
2. Click Action➤Configure %*configuration_mode*.

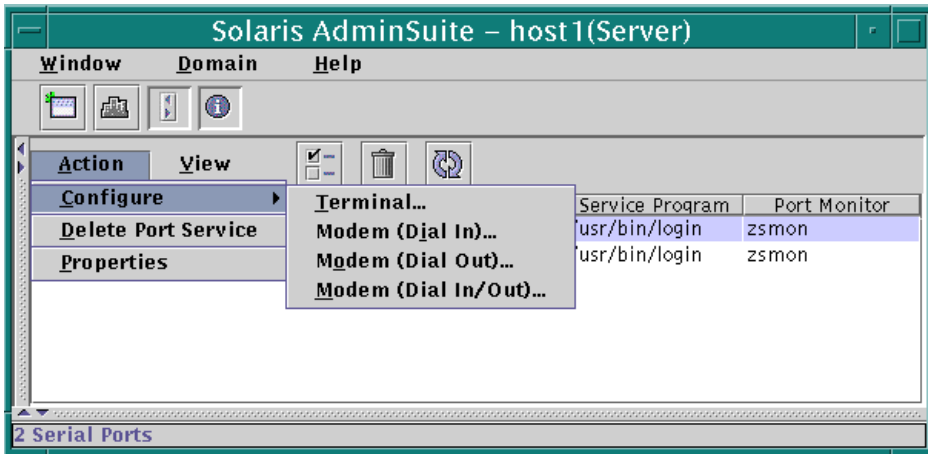


Figure 10-71 Solaris AdminSuite – Serial Ports Action Menu

This sequence displays a confirmation window that has your selection already displayed within the appropriate fields.

3. Confirm the options are correct.

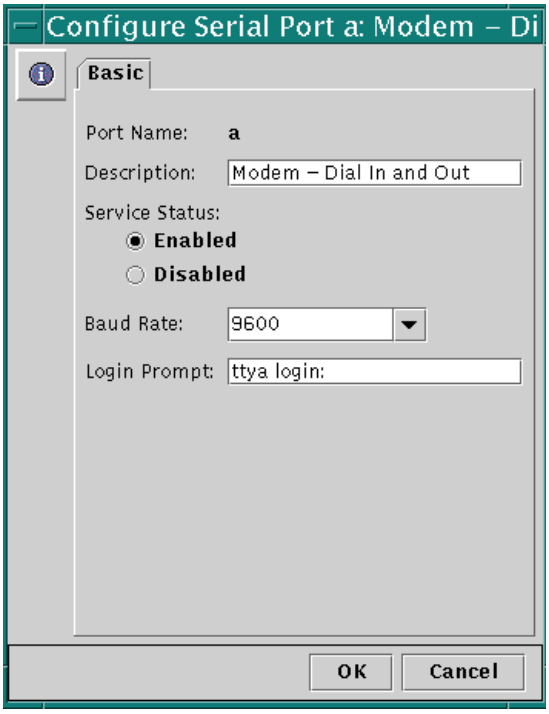


Figure 10-72 Configure Serial Port Window

4. Click OK.

You can use an alternative method for modifying serial port configuration.

To modify the serial port configuration, perform the following steps:

1. Click the serial port that you want to configure.
2. Click Action➤Properties.
3. The basic properties page is identical to the Configure Serial Port pop-up. You can manually modify any field within the page.
4. Advanced properties, such as carrier detection, timeout, and port monitor are configured on the Serial Port advanced properties page.

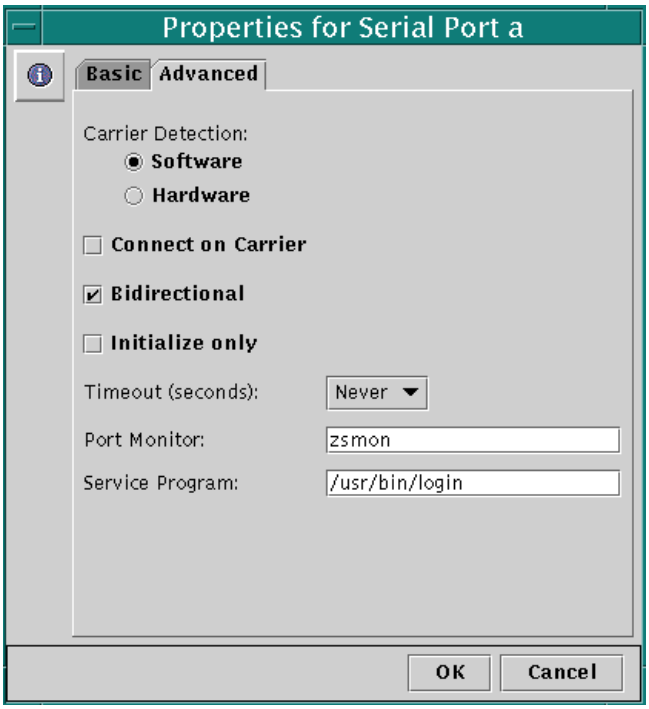


Figure 10-73 Properties for Serial Port Window

5. When you are satisfied with your modifications, click OK.
6. Use the Storage Manager to add a remote mount point and mount the NFS file system, `/usr/share/man`, from a network server.

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- List the benefits of the Solaris Management Console
- Install the Solaris Management Console software
- Add an application to the Solaris Management Console
- List the features of Solaris AdminSuite
- Install the Solaris AdminSuite software
- Create and modify user accounts using the Users feature of Solaris AdminSuite
- Add hosts to the server using the Computers/Networks feature of Solaris AdminSuite
- Manipulate mount states on existing file systems using the Mounts/Shares feature of Solaris AdminSuite
- Configure serial ports using the Serial Ports feature of Solaris AdminSuite

Naming Services Overview 11

Objectives

Upon completion of this module, you should be able to:

- Describe the concept of a naming service
- List the available naming services
- Compare the functionality of naming services
- Describe the name service switch process and determine which configuration is appropriate for your network

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- *Solaris Naming Administration Guide*, Sun Part Number 806-1387-10

Name Services Overview

The name service concept centralizes the shared information in your network. A single machine, the name server, maintains the information previously maintained on each individual host. The name servers provide information, such as host names and IP addresses, user names, passwords, and automount maps.

Other hosts in your network, *clients*, request the information from the name server. This name server system responds to clients, and translates or resolves their requests from its memory-based (cached) or disk database(s).

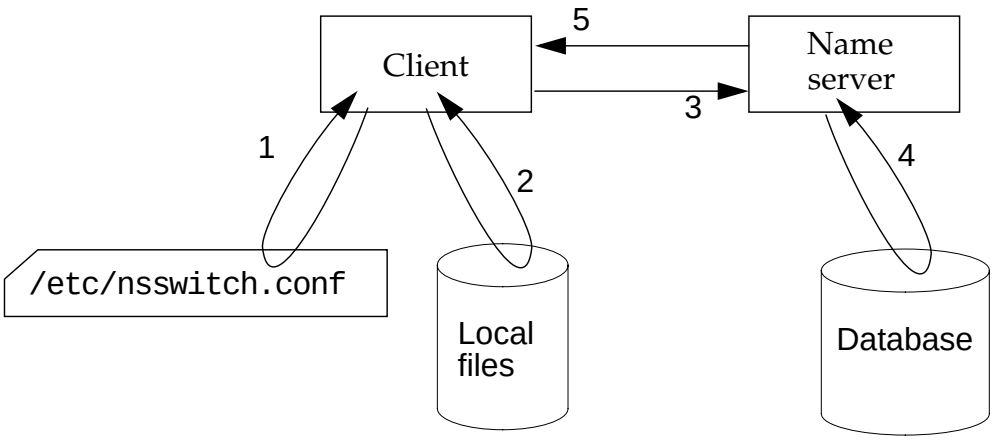


Figure 11-1 Overview of Name Service Functionality

The name service concept provides:

- Ease of management:
  - Single point of administration
  - Consistent information
  - Uniform view of network
- Immediate reflection of changes to all clients
- Assurance that clients do not miss updates

  In a file-based scheme, updates received using `ftp` or copied in some way to client machines could be missed if a host were down or off the network when the changes were propagated.
- Secondary servers prevent a single point of failure

  While a single master server is all that is required, the name service scheme allows for the creation of secondary servers (sometimes referred to as *slaves* or *replicas*). These secondary servers maintain a copy of the master's database, receive changes and updates to the database from the master, and participate in client resolution. As such, they not only overcome a single point of failure, but also play a role in increased network performance.

Available Name Services

Some common name service solutions address specific needs or architectures, as follows:

- Domain Name Service (DNS) – This name service is used within a TCP/IP network to translate host names to their associated IP addresses.
- Network Information Service (NIS) – This name service provides a centralized lookup for LAN resources, such as user accounts, host names and addresses, services, automount maps, and other key files that would otherwise be needed on each host of the LAN.

- Network Information Service Plus (NIS+) – This name service provides a centralized lookup location for LAN resources. However, NIS+ is greatly expanded to support today's intranet with the features of a hierarchical naming structure, distributed administration, built-in security authentication, and cross–domain lookups.
- Lightweight Directory Access Protocol (LDAP) – This name service extends the naming services with a directory service. While a naming service allows you to look up an object given its name, a directory service also allows these objects to have attributes. Therefore, in addition to lookup, you can also get the attributes for these objects or search for objects given their attributes. LDAP is only one implementation of a directory service.

DNS Overview

The DNS is application software that primarily provides for the distributed administration of IP addresses throughout the Internet. It also does the following:

- It enables local administrators to maintain information about their own local hosts and enables them to share this information with others throughout the Internet.
- It is commonly implemented by the Berkeley Internet Name Domain (BIND) software developed at the University of California at Berkeley. Sun uses a port of the BIND software.

You can use DNS to resolve host name and IP address requests on the intranet. If you connect your network to the Internet, you must use DNS because it is the name service used to resolve host name and IP address requests, and organize the millions of hosts and domains, on the Internet.

A *domain* is a collection of network hosts that share some common information. DNS domain names are dot-notated, and the names of hosts within the domain include the host name plus the domain name. For example, the host `merton` in the domain `sun.com` would be known to other systems, outside of the domain, as `merton.sun.com`.

All hosts known to DNS are included within the DNS namespace. The DNS namespace is divided into hierarchical domains. The namespace begins with the `root` (`.`) domain and includes all subdomains. Figure 11-2 on page 11-6 shows several top-level domains.

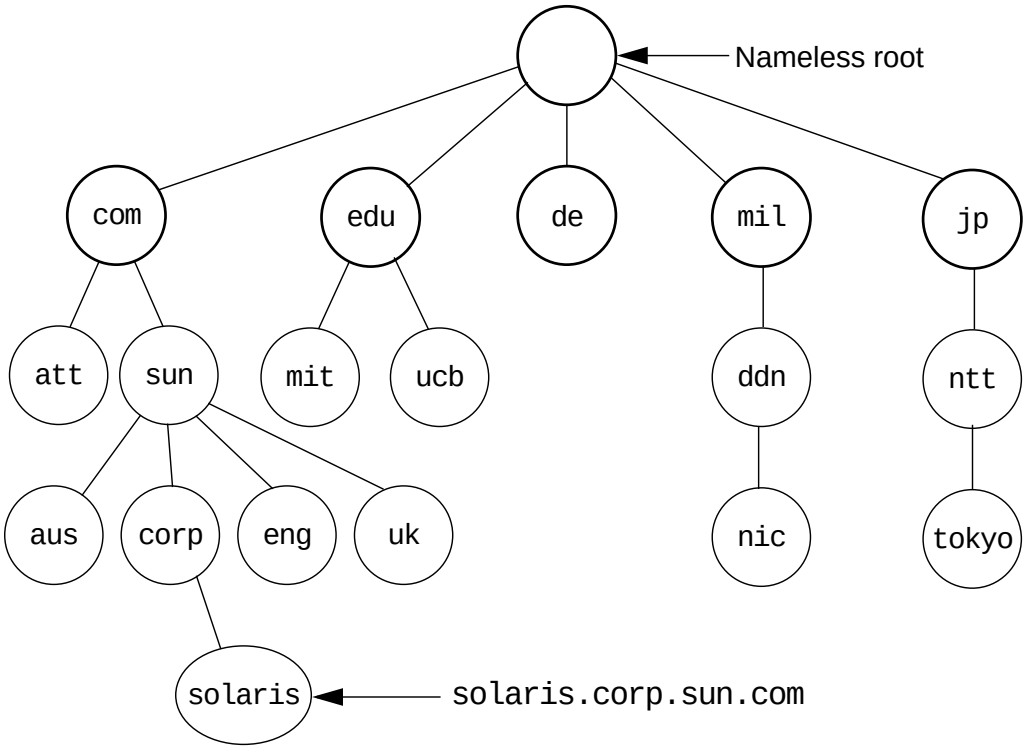


Figure 11-2 Top-Level Domains

The DNS `nsswitch` *Template*

The `nsswitch` template file for DNS is in `/etc/nsswitch.dns`, and the keyword is `dns`.

Top-Level Domains

The top-level domains are administered by Network Solutions, the NSI registry. Administration of the lower-level domains is delegated to the various organizations that are a part of the Internet.

The top-level domain you choose can depend on which one best suits the needs of your organization. Large organizations tend to use the organizational domains while small organizations or individuals often choose to use a country code.

Network Information Service Overview

NIS focuses on making network administration more manageable by providing centralized control over a variety of network information. NIS stores information about workstation names and addresses, users, the network itself, and network services. This collection of network information is referred to as the NIS *namespace*.

NIS Domains

NIS uses domains to arrange the machines, users, and networks in its namespace. However, it does not use a domain hierarchy, therefore, an NIS namespace is flat.

You cannot directly connect a NIS domain to the Internet using just NIS. However, organizations that want to use NIS and also be connected to the Internet can combine NIS with DNS. You can use NIS to manage all local information and use DNS for Internet host lookup. NIS provides a forwarding service that forwards host lookups to DNS if the information cannot be found in a NIS map. The Solaris Operating Environment also allows you to set up the `nsswitch.conf` file so that lookup requests from hosts go only to DNS, or to DNS and then NIS if the requests are not found by DNS, or to NIS and then DNS if the requests are not found by NIS.

Client-Server Arrangement

By running the NIS service, you can distribute administrative database maps among a variety of servers (master and slaves), and update those databases from a centralized location in an automatic and reliable fashion to ensure that all clients share the same name service information in a consistent manner throughout the network.

NIS Maps

NIS namespace information is stored in NIS *maps*. NIS maps were designed to replace UNIX `/etc` files, as well as other configuration files, so they store more than names and addresses. As a result, the NIS namespace has a large set of maps.

NIS maps are database files created from source files in the `/etc` directory (or a special directory you specify). The NIS domain maps typically include the following files:

- `auto_home`
- `auto_master`
- `bootparams`
- `ethers`
- `group`
- `hosts`
- `netgroup`
- `netmasks`
- `networks`
- `protocols`
- `passwd`
- `rpc`
- `services`
- `aliases`
- `timezone`
- IP nodes

Note – NIS administrators can also create custom maps for their specific network environment needs.

The NIS `nsswitch` *Template*

The `nsswitch` template for NIS is `/etc/nsswitch.nis` and the keyword is `nis`.

The NIS+ Environment

NIS+ enables you to store information about workstation addresses, security information, mail information, Ethernet interfaces, printers, and network services in locations where all workstations on a network can have access to it.

NIS+ Namespace

The NIS+ namespace is dynamic because updates can occur and be put into effect at any time by any authorized user.

The NIS+ namespace is hierarchical, and similar in structure to the DNS name service. The hierarchical structure allows you to configure a NIS+ namespace to conform to the logical hierarchy of an organization. The namespace's layout of information is unrelated to its physical arrangement. Thus, you can divide a NIS+ namespace into multiple domains that can be administered autonomously. Clients can have access to information in other domains, in addition to their own if they have the appropriate permissions.

An Example of the NIS+ Hierarchical Namespace

A software company named Solar, Inc. (`solar.com.`), with three divisions: Engineering (`eng`), Sales (`sales`) and Finance (`fin`). Set up the NIS+ namespace hierarchy illustrated in Figure 11-3. Each branch represents a domain. The Engineering branch has subdomains for development and software.

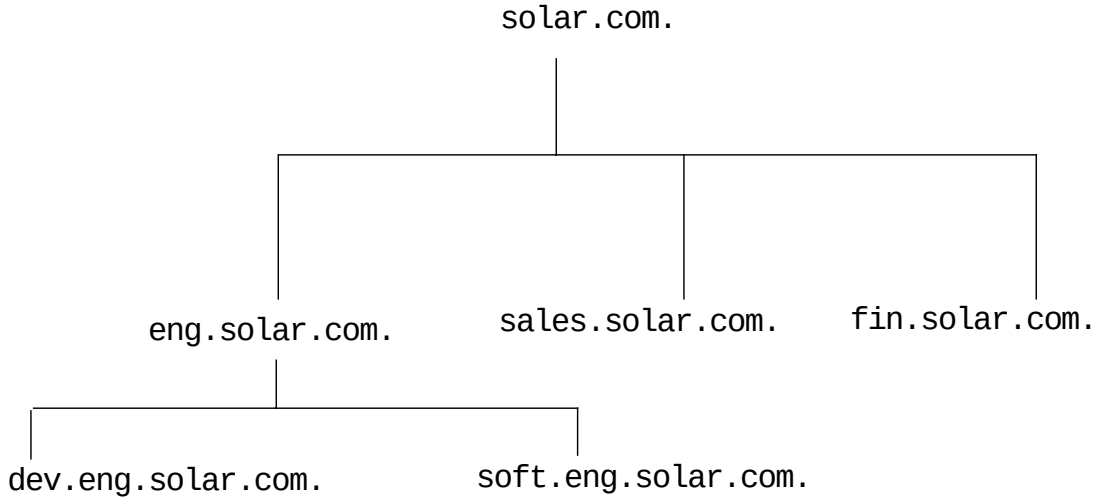


Figure 11-3 NIS+ Hierarchical Namespace

NIS+ Tables

The objects controlled in NIS are maps, and the objects controlled in NIS+ are tables.

Each NIS+ domain can contain the following table objects:

- `auto_home`
- `auto_master`
- `bootparams`
- `client_info`
- `cred`
- `ethers`
- `group`
- `hosts`
- `mail_aliases`
- `netgroup`
- `netmasks`
- `networks`
- `passwd`
- `protocols`
- `rpc`
- `sendmailvars`
- `services`
- `timezone`

The NIS+ `nsswitch` *Template*

The `nsswitch` template for NIS+ is `/etc/nsswitch.nisplus` and the keyword is `nisplus`.

Lightweight Directory Access Protocol (LDAP) Overview

The implementation of NIS within the Solaris Operating Environment provided a mechanism for advertising (identifying and locating) network objects and resources. Two major drawbacks are its flat structure (a single domain) and the proprietary nature of the naming services.

NIS+ is an improvement to the NIS structure. NIS+ is built in a hierarchical structure so that it more closely resembles the internal structure of an organization and, therefore, it can access multiple domains (provided the authorization and authentication features are properly enabled). However, like NIS, NIS+ is somewhat proprietary (Every organization cannot access the information).

These proprietary naming services are often decipherable only from within an organization or group of organizations (and sometimes from within a particular application), and they create islands of information that must translate requests for information from the World Wide Web.

With the implementation of standardized directory services, an organization can configure one or more servers to direct requests for information through the organization to the appropriate servers.

A standardized directory service implies that all participating organizations adhere to a common rule set for hierarchical naming structures, authorization and authentication practices, and configuration of various other attributes.

The X.500 Directory Access Protocol (DAP) is one such standard; however, when organizations attempt to implement it, many find it difficult to administer, and this becomes a barrier to the success of the directory server concept as a whole. Additionally, implementation of the X.500 structure often requires the power and resources of a UNIX system, thus putting up a barrier to the world of personal computer users. It is readily apparent that an easier to administer, lighter weight protocol is needed, so more than 40 companies have joined with Netscape and the University of Michigan to support a Lightweight Directory Access Protocol (LDAP) as a proposed standard for Internet directories.

Common Uses of LDAP

LDAP is useful when you need a resource locator; however, it is practical only in read-intensive environments where you do not need frequent updates. You can use LDAP as a repository for the same information stored in NIS and NIS+. The following lists some common uses:

- A resource locator for an online phone directory. Authorized users can update it as necessary to maintain its accuracy. This eliminates the need for a printed phone directory (which is outdated as soon as a change is made following the printing).

Note – LDAP is useful for phone directories that are updated relatively infrequently, but would be ineffective for sales transaction databases that center around constantly updating data.

- The address book in most e-mail clients
- A repository of information for Web-based applications that support sales and inventory-control processes. However, you must keep in mind that heavy-transaction oriented sites are better suited to other relational databases, which are suited to those applications.
- For automatically locating network resources. It provides a mechanism to locate printers, file servers, and network services.
- To centralize network management. Instead of maintaining duplicate information across many servers, the LDAP server is configured so that a single directory can be accessed by all applications.
- To tighten security. Authorization and authentication attributes can be configured to control access to applications, resources, and modifications.

These are just a few of the possibilities. The list is limited only by the creativity of the administrators that implement LDAP.

LDAP applications are grouped three ways: LDAP used to locate network users and resources, those used to manage these resources, and those that provide authentication and authorization security features.

The LDAP `nsswitch` *Template*

The `nsswitch` template for LDAP is `/etc/nsswitch.ldap` and the keyword is `ldap`.

The Name Service Switch

All Solaris Operating Environment workstations use `/etc/nsswitch.conf` as the name service switch. The `/etc/nsswitch.conf` file is used by the operating system for any network information lookups. It is commonly referred to as the *name service switch file*. The `/etc/nsswitch.conf` file determines which sources of information your system uses and the order in which those sources are used.

The `nsswitch.conf` Configuration Files

The Solaris 8 Operating Environment includes the following five templates for the name service switch configuration file:

- `/etc/nsswitch.files` – The template name service switch file that, when copied to the `/etc/nsswitch.conf` file, permits only searches of the local `/etc` files.

- `/etc/nsswitch.dns` – The template name service switch file that, when copied to the `/etc/nsswitch.conf` file, searches only the local `/etc` files for all entries with the exception of the hosts entry. The hosts entry can be directed to use DNS for lookup.

- `/etc/nsswitch.nis` – The template file that uses the NIS database as the primary source of all information except the `passwd`, `group`, `automount`, and `aliases` maps, which are directed to use the local `/etc` files first and then the NIS databases. With the name service search order for the `passwd` and `group` files established as the local files first followed by the NIS database, there is no need for a plus (+) in the `passwd` file.

- `/etc/nsswitch.nisplus` – The template file that uses NIS+ as the primary source for all information except the `passwd`, `group`, `automount`, and `aliases` tables, which use the local `/etc` files first and then the NIS+ databases.

- `/etc/nsswitch.ldap` – The template file that uses LDAP as the primary source for all information except the `passwd`, `group`, `automount`, and `aliases` tables, which use the local `/etc` files first and then the LDAP databases.

After determining which naming service to use, you select the appropriate template file; /etc/nsswitch.files, /etc/nsswitch.dns, /etc/nsswitch.nis, /etc/nsswitch.nisplus, or /etc/nsswitch.ldap and copies it to /etc/nsswitch.conf.

The /etc/nsswitch.nis *Template*

The following example is the default /etc/nsswitch.nis file (which references name service resolution provided by NIS) that is provided with the installation of the Solaris 8 Operating Environment software:

```
#
# /etc/nsswitch.nis:
#
# An example file that could be copied over to /etc/nsswitch.conf; it
# uses NIS (YP) in conjunction with files.
#
# “hosts:” and “services:” in this file are used only if the
# /etc/netconfig file has a “-” for nametoaddr_libs of “inet” transports.
jade!7

# the following two lines obviate the “+” entry in /etc/passwd and
/etc/group.
passwd:                 files nis
group:                  files nis

# consult /etc “files” only if nis is down.
hosts:                  nis [NOTFOUND=return] files
ip nodes:               files
#Uncomment the following line and comment out the above to resolve
#both IPv4 and IPv6 addresses from the ipnodes databases. Note that
#IPv4 addresses are searched in all of the ipnodes databases before
#searching the hosts databases. Before turning this option on, consult
#the Network Administration Guide for more details on using IPv6.
networks:               nis [NOTFOUND=return] files
protocols:              nis [NOTFOUND=return] files
rpc:                    nis [NOTFOUND=return] files
ethers:                 nis [NOTFOUND=return] files
netmasks:               nis [NOTFOUND=return] files
bootparams:             nis [NOTFOUND=return] files
publickey:              nis [NOTFOUND=return] files

netgroup:               nis

automount:              files nis
```

```
aliases:                files nis

# for efficient getservbyname() avoid nis
services:               files nis
sendmailvars:           files
printers:               user files nis

auth_attr:              files nis
prof_attr:              files nis
```

This example `/etc/nsswitch.nis` file identifies NIS as the *only* source of data for `hosts`, `netgroup`, and `netmasks` entries. Alternatively, the lines for `passwd`, `group`, and `automount` have `files` followed by `nis`. This indicates that the system uses the local files first and the NIS database second for lookups.

If you are using NIS as the naming service, copy the `/etc/nsswitch.nis` file to the `/etc/nsswitch.conf` file.

Modification of the `/etc/nsswitch.conf` *File*

After copying the appropriate template file to `/etc/nsswitch.conf`, you might have to modify the file to enable the operating system to access network information. For example, to enable `hosts` to be resolved using local files first, DNS second, and NIS third, the line for `hosts` would appear as follows:

```
hosts:    files  dns    nis
```

Conversely, to restrict login access to only those users with local accounts, you can remove `nis` from the line for `passwd` as in this example:

```
passwd:    files
```

The name service switch file contains a list of over 19 databases, their name service sources for resolution, and the order in which these sources are searched. As shown in Table 11-1, one or more sources from this list can be specified for each database.

Table 11-1 Database Sources

Source	Description
`files`	Refers to the client's local `/etc` files
`nisplus`	Refers to an NIS+ table
`nis`	Refers to an NIS map
`user`	Applies to the `printers` entry.
`dns`	Applies *only* to the `hosts` entry
`ldap`	Refers to a Directory Information Tree (DIT)
`compat`	Supports an old-style "+" syntax for `passwd` and `group` information

Name Service Switch Status and Action Values

Suppose the default `/etc/nsswitch.nis` file shown on page 11-16 was copied to the `/etc/nsswitch.conf` file. The name service switch now presents some action values for several of the entries. The naming service search for resolution from the source specified returns a status code that presents an appropriate value in response to the user requesting NIS information. Table 11-2 describes these status codes.

Table 11-2 Name Service Search Return Status Codes

Status Code	Description
`SUCCESS`	Requested entry was found
`UNAVAIL`	Source was unavailable
`NOTFOUND`	Source contains no such entry
`TRYAGAIN`	Source returned “I am busy, try later” message

Actions

For each status code, two actions are possible. Table 11-3 describes these actions.

Table 11-3 Status Code Actions

Action	Description
`continue`	Try the next source
`return`	Stop looking for the entry

The default actions are

- `SUCCESS = return`
- `UNAVAIL = continue`
- `NOTFOUND = continue`
- `TRYAGAIN = continue`

The following entry assumes that the NIS name service is running, the syntax for this entry means that only the NIS `hosts` table is searched. If a NIS server has no map entry for a host lookup, the system would *not* reference the local files. Remove the `[NOTFOUND=return]` entry if you want to search the NIS `hosts` table and the local `hosts` file.

```
hosts: nis [NOTFOUND=return] files
```

Table 11-4 shows the naming service features.

Table 11-4 Naming Service Features

	Files	**NIS**	**NIS+**	**DNS**	**LDAP**
Intended Scope (Best fit)	Small local network LAN	LAN	Multiple LANs	LAN WAN	LAN WAN
Name space	Flat	Flat	Hierarchical	Hierarchical	Hierarchical
Template for `nsswitch.conf`	`nsswitch.files`	`nsswitch.nis`	`nsswitch.nisplus`	`nsswitch.dns`	`nsswitch.ldap`
Object that stores information	File	Map	Table	Zone files	Directory information tree (DIT)

Exercise: Reviewing Naming Services

Exercise objective – In this lab, you evaluate your understanding of the naming services concepts presented in this module.

Preparation

If necessary, refer to your lecture notes to answer these exercise questions.

Tasks

Answer the following questions:

1. What are the four name service solutions mentioned in this module?

   _____

   _____

2. What are two main services provided by DNS?

   _____

   _____

3. What types of information does NIS+ enable you to store?

   _____

   _____

4. What are the map files used in NIS?

   _____

   _____

   _____

5. What file is referred to as the name service switch file and why?

   _____

   _____

6. If you decide to use the NIS for name service resolution, what template file would you use to create the name service switch file?

   _____

   _____

7. What does it mean if the following entry exists in the name service switch file?

   ```
   hosts: nis [NOTFOUND=return] files
   ```

   _____

   _____

8. Is the following an appropriate entry to the `/etc/nsswitch.conf` file? Why or why not?

   ```
   groups: dns files nis
   ```

   _____

   _____

Exercise Summary

Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Task Solutions

1. What are the four name service solutions mentioned in this module?

   DNS, NIS, NIS+, and FNS.

2. What are two main services provided by DNS?

   DNS provides host name to IP address translation and the concept of each system belonging to a domain.

3. What types of information does NIS+ enable you to store?

   NIS+ enables you to store information about workstation addresses, security information, mail information, Ethernet interfaces, printers, and network services in locations where all workstations on a network can have access to it.

4. What are the map files used in NIS?

   - `auto_home`
   - `auto_master`
   - `bootparams`
   - `ethers`
   - `group`
   - `hosts`
   - `netgroup`
   - `netmasks`
   - `mailaliases`
   - `networks`
   - `protocols`
   - `passwd`
   - `rpc`
   - `services`
   - `aliases`
   - `timezone`
   - `client_info`
   - `sendmailvars`

5. What file is referred to as the name service switch file and why?

   The `/etc/nsswitch.conf` *file is referred to as the name service switch file because it is used by the operating system for any network information lookups. This file indicates whether DNS, NIS, NIS+,* or *local files are to be used for name service resolution, and if more than one naming service is to be used, this file indicates the order in which these services should be accessed.*

6. If you decide to use the NIS for name service resolution, what template file would you use to create the name service switch file?

   `/etc/nsswitch.nis`

7. What does it mean if the following entry exists in the name service switch file?

   ```
   hosts: nis [NOTFOUND=return] files
   ```

   Assuming that the NIS name service is running, the syntax for this entry means that only the NIS hosts table is searched. If a NIS server has no map entry for a host lookup, the system would not reference the local files. Remove the `[NOTFOUND=return]` *entry if you want to search the NIS hosts table and the local hosts file.*

8. Is the following an appropriate entry to the `/etc/nsswitch.conf` file? Why or why not?

   ```
   groups: dns files nis
   ```

   This entry does not make sense because `dns` *only applies to the* `hosts` *entry in the name service switch file.*

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- ❑ Describe the concept of a naming service
- ❑ List the available naming services
- ❑ Compare the functionality of naming services
- ❑ Describe the name service switch process and determine which configuration is appropriate for your network

NIS 12

Objectives

Upon completion of this module, you should be able to:

- Describe the NIS components, master server, slave server, and client, and the NIS processes
- Configure an NIS master, slave, and client
- List the steps to add a new NIS map
- Use commands to update and propagate an NIS map

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- *Solaris Naming Administration Guide*, Sun Part Number 806-1387-10
- *Solaris Naming Setup and Configuration Guide*, Sun Part Number 806-1386-10

Introduction to NIS Concepts

NIS enables the creation of server systems that act as central repositories for several of the administrative files found on UNIX systems. The benefits of NIS include:

- Centralized administration of files
- Better scaling of file administration as networks grow

As Figure 12-1 illustrates, NIS is organized into named administrative domains. Within each domain exists one NIS master server, zero or more slave servers, and one or more clients.

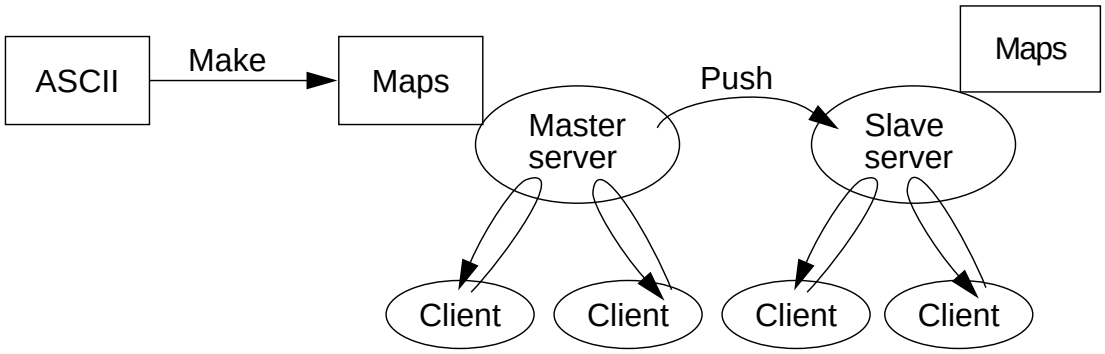


Figure 12-1 NIS Domains

NIS Master Server

Within each domain, the NIS master server:

- Contains the original `/etc` ASCII files used to build the NIS maps
- Contains the NIS maps generated from the ASCII files
- Provides a single point of control for the entire NIS domain
- Is easy to set up

NIS Slave Servers

Within each domain, the NIS slave servers:

- Do not contain the original `/etc` ASCII files (which are used to build the NIS maps)
- Contain copies of the NIS maps copied from the NIS master server
- Provide a backup repository for NIS map information
- Provide redundancy in case of server failures
- Provide load sharing on large networks

NIS Clients

Within each domain, the NIS clients:

- Do not contain the original `/etc` ASCII files (which are used to build the NIS maps)
- Do not contain any NIS maps
- Bind to the master server or a slave server to obtain access to the administrative file information contained in that server's NIS maps
- Dynamically rebind to another server in case of server failure
- Make all appropriate system calls aware of NIS

Note – All hosts in the NIS environment are clients, including the NIS master and slaves.

NIS Processes

The two main processes involved in the running of an NIS domain are:

- `ypserv` – Runs on master and slave servers
- `ypbind` – Runs on master and slave servers, as well as client systems

There are three daemons that used in an NIS domain on the master server:

- `rpc.yppasswdd`
- `ypxfrd`
- `rpc.ypupdated`

Figure 12-2 illustrates a domain with these NIS processes and daemons.

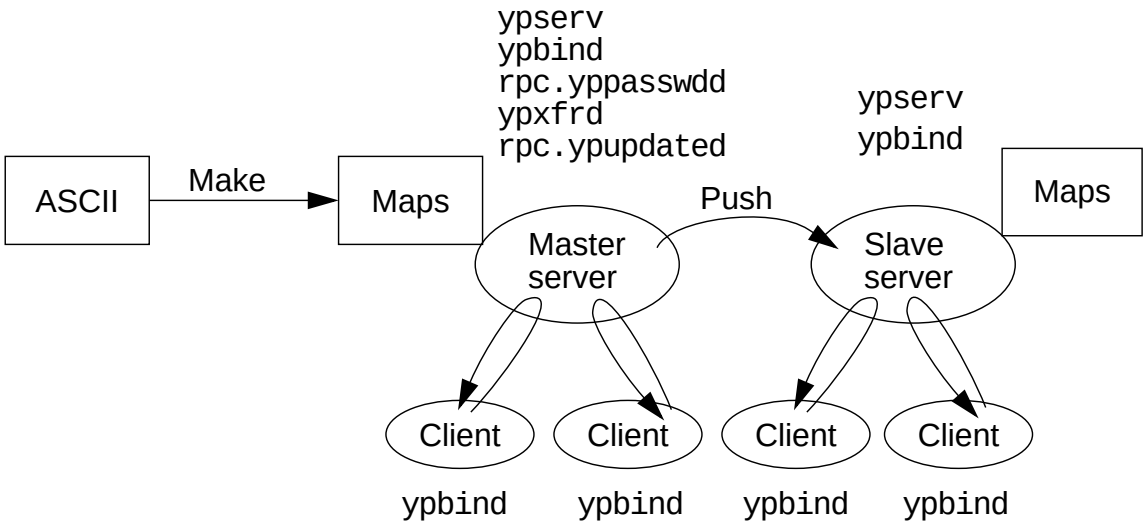


Figure 12-2 NIS Processes and Daemons

The `ypserv` *Daemon*

The `ypserv` daemon is a utility that:

- Runs on master and slave servers
- Answers `ypbind` requests from clients
- Responds to client information requests

The `ypbind` *Daemon*

The `ypbind` daemon is a process that:

- Runs on all NIS systems, servers as well as clients
- Makes initial client-to-server binding requests
- Stores binding information in the `/var/yp/binding/`*`domainname`* directory
- Rebinds to another server if the connection is lost with the initial server
- Requests NIS map information at the library-call level

The `rpc.yppasswdd` *Daemon*

The `rpc.yppasswdd` daemon is a process that:

- Allows users to change their passwords
- Updates the `/etc/passwd` and `/etc/shadow` files on the master server
- Updates the NIS password map
- Provides or “pushes” the NIS password map to all slave servers

The `ypxfrd` *Daemon*

The `ypxfrd` daemon is a process that:

- Runs on the NIS master server only
- Responds to slave requests (using `ypxfr`) to pull the maps from the master
- Transfers NIS maps at high speed

The `rpc.ypupdated` *Daemon*

The `rpc.ypupdated` daemon is a process that:

- Runs on the NIS master server only
- Updates the `publickey` map if secure RPC is enabled

The Structure of NIS Maps

NIS maps are located in the `/var/yp/`*`domainname`* directory (where *`domainname`* is the name of the NIS domain). There are two files (`.pag` and `.dir` file) for each map in this directory.

NIS Maps Filenames

The syntax for the NIS maps is:

`map``.`*`key`*`.pag or `*`map`*`.`*`key`*`.dir`

where:

- *`map`* – The base name of the map (`hosts`, `passwd`, and so on)
- *`key`* – The map's sort key (`byname`, `byaddr`, and so on)
- `pag` – The map's data
- `dir` – An index to the .`pag` file if the `.pag` file is large

The .`dir` file can be empty if the `.pag` file is small.

Map Contents and Sort Keys

The *contents* of each map is a key and value pair. The *key* represents the data used to perform the lookup in the map while the *value* represents the data returned upon a successful lookup. Maps can be duplicated in the /var/yp/*domainname* directory; they represent the results of the sorting of the map's data based on different keys.

For example, the map /var/yp/*domainname*/hosts.byaddr.pag contains the data for the hosts map indexed by host IP addresses. Similarly, the /var/yp/*domainname*/hosts.byname.pag map contains the same host data using the host name as the lookup key. For the domain name training, the following would be a list of the NIS map files for the hosts map:

- /var/yp/training/hosts.byname.pag
- /var/yp/training/hosts.byname.dir
- /var/yp/training/hosts.byaddr.pag
- /var/yp/training/hosts.byaddr.dir

Commands to Read Maps

You can use two commands to read maps:

- ypcat [-k] *map* – This command is similar to the cat *file* command
- ypmatch [-k] *value map* – This command is similar to the grep *value file* command

Generating NIS Maps

To generate NLS maps, you need the source files, which are located in either the `/etc` directory on the master server or copied to an alternative directory. You should not keep the source files in `/etc` because the contents of the maps are then the same as the contents of the local files on the master server. This is a special problem for `passwd` and `shadow` files, because all users would have access to the master server maps and the root password would be passed to all YP clients through the `passwd` map.

If you choose to locate the source files in another directory, you must modify the `/var/yp/Makefile` by changing the `DIR=/etc` line and the PWDIR=`/etc` line to `DIR=/`*`your-choice`* and `PWDIR=/`*`your-choice`*, where *`your-choice`* is the name of the directory you are using to store the source files. This enables you to treat the local files on the server as if they were those of a client. (You should first save a copy of the original `Makefile`.)

The following is an excerpt from the default `Makefile` showing the variable `DIR` and `PWDIR` set to their default values:

```
#
# Copyright (c) 1998, by Sun Microsystems, Inc.
# All rights reserved.
#
#ident  "@(#)Makefile   1.23    98/05/01 SMI"
#
#----
# It is somewhat confusing to note that Solaris 2.x uses /etc/auto_master
# instead of the 4.x /etc/auto.master file name because of NIS+ treating
a
# "." in a special way.
#
# Set the following variable to "-b" to have NIS servers use the domain
name
# resolver for hosts not in the current domain.
#B=-b
B=
DIR =/etc
#
# If the passwd, shadow and/or adjunct files used by rpc.yppasswdd
# live in directory other than /etc then you'll need to change the
# following line.
# DO NOT indent the line, however, since /etc/init.d/yp attempts
# to find it with grep "^PWDIR" ...
#
PWDIR =/etc
DOM = `domainname`
NOPUSH = ""
ALIASES = /etc/mail/aliases
YPDIR=/usr/lib/netsvc/yp
```

The `ypinit` *Command and the NIS* `Makefile`

The NIS maps are generated by the NIS configuration binary, `/usr/sbin/ypinit`, and the `make` command. The `ypinit` command reads the `/var/yp/Makefile` for source file locations and converts ASCII source files into NIS maps.

Password File

For security reasons, and to prevent unauthorized root access, the files used to build the NIS password maps should not contain an entry for `root`.

To do this, copy the files to an alternative directory and modifying the `PWDIR` entry in the `Makefile`.

Figure 12-3 on page 12-12 shows the important files on the NIS master.

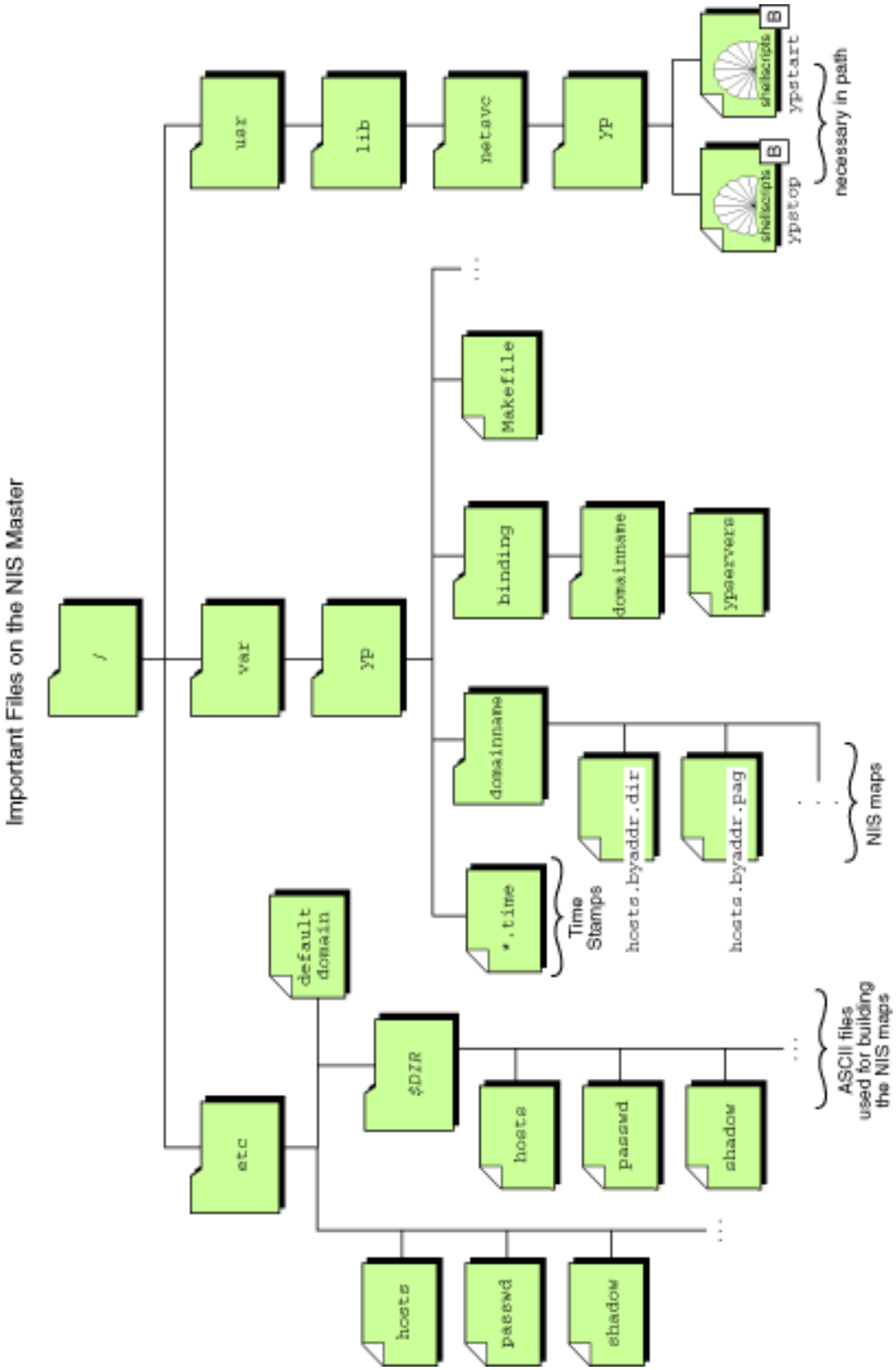


Figure 12-3 Important Files on the NIS Master

Configuring the NIS Master Server

To set up the NIS name service master server, perform the following steps:

1. Determine which machines within your network domain will be NIS servers; there will be one NIS master and as many NIS slaves as needed. Typically, *all* systems within the domain will be NIS clients.

Note – The NIS kit that was supplied with releases before the Solaris 2.6 Operating Environment is no longer provided. NIS is now part of the release rather than a separate file.

---

2. Copy the `/etc/nsswitch.nis` file to `/etc/nsswitch.conf` and modify it, if necessary.
3. Choose an NIS domain name. This is usually less than 32 characters in length. (The maximum length is 256 characters.)
4. Execute the `domainname` command to set the local NIS domain.
5. Create an `/etc/defaultdomain` file with the domain name.
6. Make sure to maintain the format established by the original files, and update the text files in the `/etc` directory (all of the files that are used for NIS maps) on the master server with information about the domain.

Note – You can also copy the network information files to some other location on the system and modify them there rather than modifying them in the `/etc` directory.

---

7. Use the `touch` command to create zero-length files with the following names: `/etc/ethers`, `/etc/bootparams`, `/etc/locale`, `/etc/timezone`, `/etc/netgroup`, and `/etc/netmasks`. These files are necessary for the creation of the complete list of NIS maps as directed in the `Makefile`. When you initialize NIS, you will receive error messages for each of these files if they do not exist.

✓

8. Install an updated `Makefile` in `/var/yp` if you intend to use NIS on the system that functions as your JumpStart™ server. This provides entries that create a map for the `/etc/locale` file.

   To create a `Makefile` that supports unassisted JumpStart installation capability, make the following changes:

   a. Add the following text after the existing `*.time` entries; all beginning white space must be tabs:

```
locale.time:  $(DIR)/locale
        -@if [ -f $(DIR)/locale ]; then \
                sed -e "/^#/d" -e s/#.*$$// $(DIR)/locale \
                | awk '{for (i = 2; i<=NF; i++) print $$i, $$0}' \
                | $(MAKEDBM) - $(YPDBDIR)/$(DOM)/locale.byname; \
                touch locale.time; \
                echo "updated locale"; \
                if [ ! $(NOPUSH) ]; then \
                        $(YPPUSH) locale.byname; \
                        echo "pushed locale"; \
                else \
                : ; \
                fi \
        else \
                echo "couldn't find $(DIR)/locale"; \
        fi
```

   b. Append the word `locale` to the line beginning with the word `all`.

   c. Add the following line after the `auto.home:  auto.home.time` entry:

      ```
      locale:  locale.time
      ```

9. Create or populate the file `/etc/locale` and make an entry for each domain on your network using the following format:

   `domainname      locale`

   For example:

   ```
   classroom.Central.Sun.COM     en_US
   ```

10. Edit the `Makefile`, and change every reference to the `*.attr` to add the security subdirectory to the pathname, as follows:

```
$(DIR)/auth_attr
$(DIR)/exec_attr
$(DIR)/prof_attr
$(DIR)/audit_user
```

becomes:

```
$(DIR)/security/auth_attr
$(DIR)/security/exec_attr
$(DIR)/security/prof_attr
$(DIR)/security/audit_user
```

Note – Step 10 is necessary.

11. Initialize the master server using the local `/etc` files by executing the `ypinit -m` command.

```
# ypinit -m
```

a. The program prompts you for a list of slave servers. When you complete your list, press Control-D. You can make entries for all slaves now or rerun the command after you determine that you need more or fewer slave servers.

b. The program asks if you want to terminate on the first fatal error. If you answer `n`, the procedure completes the creation of the NIS database files. If you answer `y`, the process aborts with the first error. You can fix it and restart the `ypinit` program.

The following dialog provides the text feedback displayed as the program begins:

```
# ypinit -m
In order for NIS to operate successfully, we have to construct a list of
the NIS servers. Please continue to add the names for YP servers in order
of preference, one per line. When you are done with the list, type a
<control D> or a return on a line by itself.
                next host to add: server1
                next host to add:  ^D
The current list of yp servers looks like this:
server1
Is this correct?  [y/n: y]  y
Installing the YP database will require that you answer a few questions.
Questions will all be asked at the beginning of the procedure.
Do you want this procedure to quit on non-fatal errors? [y/n: n] n
OK, please remember to go back and redo manually whatever fails.  If you
don't, some part of the system (perhaps the yp itself) won't work.
```

Note – If you have to restart the `ypinit` program, you are prompted to destroy the `/var/yp/`*`domainname`* directory.
Answer `y`.

---

12. Start the NIS daemons on the master server with the following command:

```
# /usr/lib/netsvc/yp/ypstart
```

13. Once `ypbind` is running you need to complete the following steps to build the `mail.aliases` map.

```
# cd /var/yp
# /usr/ccs/bin/make
```

If you want to stop the NIS service running on the NIS master, issue the following command:

```
# /usr/lib/netsvc/yp/ypstop
```

Caution – Installations that select Core, End User, or Developer software configuration clusters do not have all of the necessary files in the `/usr/lib/netsvc/yp` to allow a host to function as an NIS server.

Accessing and Testing the NIS Service

The initial way that users access NIS information is during login. When the user types in a user name and password, the NIS database verifies this information before it enables a login shell. If the user's home directory is on a remote system in the NIS domain, the NIS `auto_home` map will reference the server information and automatically mount the appropriate directory.

There are some informative commands that display information in the NIS database. You can use these commands to test NIS service.

The most commonly used NIS commands are:

Note – You do not have to be the superuser to use these commands.

- `ypcat` – Prints values from the NIS database.

  Example: Print the information from the `hosts` database

```
$ ypcat hosts
129.0.0.1     localhost
192.9.200.1   host1 loghost
192.9.200.2   host2
192.9.200.6   host6
192.9.200.8   host8
192.9.200.101 server1
192.9.200.102 server2
```

- `ypmatch` – Prints the value of one or more keys from the NIS database.

  Example: Match individual host entries

```
$ ypmatch host1 server1 hosts
192.9.200.1   host1
192.9.200.101 server1
```

Example: Match a specific user in the password database

```
$ ypmatch user1 passwd
user1:Q7icI6NRPEmak:11001:10:User1:export/home/user1:/bin/ksh
```

- `ypwhich` – Returns the name of the NIS server that supplies the NIS map services to an NIS client.

  Example: Return the name of the NIS master server

```
$ ypwhich
server1
```

  When used with the `-m` option, the `ypwhich` command provides a list of all databases and the name of the master server.

  Example: List all databases on masterserver

```
$ ypwhich -m
auto.home    server1
auto.master    server1
timezone.byname    server1
netmasks.byaddr    server1
publickey.byname    server1
<remaining output omitted>
```

Configuring the NIS Client

Typically, you configure all systems within a NIS domain as clients:

1. Copy the `/etc/nsswitch.nis` file to `/etc/nsswitch.conf` and modify it if necessary.

2. Edit the `/etc/hosts` file to ensure that the NIS master server and all slave servers have been defined.

3. Execute the '`domainname` *`domainname`*' command to set the local NIS domain. For example,

```
# domainname classroom.Central.Sun.COM
```

Note – You can use this command to set the name of a domain within a classroom in the central region training center.

---

4. Create or populate the `/etc/defaultdomain` file with the domain name.

5. Initialize the system as an NIS client with the following command:

```
# ypinit -c
```

6. When prompted for a list of NIS servers, enter the names of the NIS master and all slave servers.

7. Start the NIS software with the following command:

```
# /usr/lib/netsvc/yp/ypstart
```

8. On the newly configured NIS client, test the NIS functionality by entering the following command:

```
# ypwhich -m
```

The output should include the name of the NIS master server along with the database maps it is serving.

Configuring the NIS Slave Server

You must have at least one NIS slave server provide backup should the NIS master server become unavailable. You can do this by using the following steps on the system that is designated to become the slave server:

1. Copy the `/etc/nsswitch.nis` file to `/etc/nsswitch.conf` and modify it if necessary.

2. Edit the `/etc/hosts` file to ensure that the NIS master and all NIS slave servers have been defined.

3. Execute the `domainname` command to set the local NIS domain.

```
# domainname domainname
```

For example,

```
# domainname classroom.Central.Sun.COM
```

4. Create or populate the `/etc/defaultdomain` file with the domain name. Add a one-line entry to represent the selected domain name (for example, *`domainname`* in step 3).

5. Initialize the system as an NIS client with the following command:

```
# ypinit -c
```

6. When prompted for a list of NIS servers, enter the NIS master host followed by the name of the local host and all other NIS slave servers on the local network.

7. On the NIS master, ensure that the `ypserv` process is running by running this command:

```
# ps -ef | grep ypserv
```

If it is not running, refer to the previous section on how to start NIS daemons on the master.

8. Return to the proposed NIS slave system and run `ypstart`.

```
# /usr/lib/netsvc/yp/ypstart
```

9. Initialize the system as an NIS slave with the following command:

```
# ypinit -s master
```

where *master* is the name of the NIS master.

Note – If you did not add the name of the NIS slave server when you initially configured the NIS master server using the `ypinit` command, run the `ypinit -m` command once more on the NIS master server. In the process of updating the NIS master, the script prompts you for confirmation when it is about to destroy the existing domain database. Confirm by entering **y**.

---

10. Stop the NIS daemons on the slave server with the following command:

```
# /usr/lib/netsvc/yp/ypstop
```

11. Restart the NIS daemons on the slave server with the following command:

```
# /usr/lib/netsvc/yp/ypstart
```

12. On the newly configured NIS slave server, test the NIS functionality with the following command:

```
# ypwhich -m
```

The output should include the name of the NIS master server along with a list of database maps it is serving to the NIS domain.

Updating the NIS Map

Database files change as time goes on and your NIS maps must be updated. To update the NIS maps (on the master server), perform the following steps:

1. Update the text files in your source directory (typically `/etc` unless it was changed in the `Makefile`) with the new or modified information.

2. Change to the `/var/yp` directory.

```
# cd /var/yp
```

3. Refresh the NIS database maps by executing the `make` command.

```
# /usr/ccs/bin/make
```

Updating the Hosts Map and Propagating to Slave Servers

The following steps manually update the NIS `hosts` map on the master server and propagate all maps to the slave servers:

1. Edit a map source file on the NIS master.

```
# vi /etc/hosts
```

2. Remake and push the NIS maps to the slave servers.

```
# cd /var/yp; make
```

The following commands manually "pull" only the host maps from the master server.

```
# /usr/lib/netsvc/yp/ypxfr hosts.byaddr
# /usr/lib/netsvc/yp/ypxfr hosts.byname
```

You can also pull all of the maps from the master server at once using the following command:

```
# ypinit -s nis_master
```

Updating the NIS Password Map

If the NIS master is running the `rpc.yppasswdd` daemon, you can update any client system to the NIS password map by using the `yppasswd` or `passwd` commands (Figure 12-4).

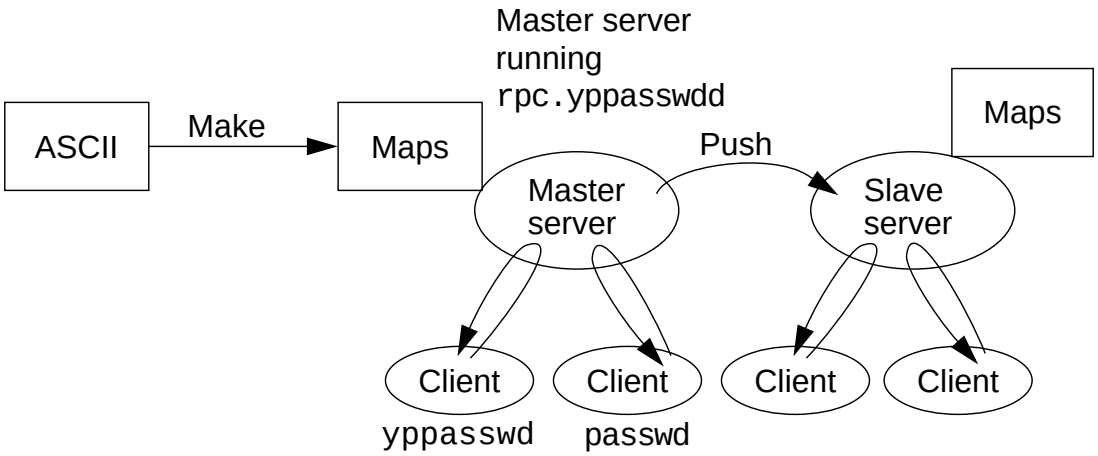


Figure 12-4 Updating the NIS Password Map

The following describes what you need to do to be successful at updating of the password map:

- Running the `rpc.yppasswdd` daemon on the NIS master server

```
# /usr/lib/netsvc/yp/rpc.yppasswdd /etc/passwd -m passwd
```

The `rpc.yppasswdd` daemon updates the NIS master's `/etc/passwd` file and `passwd` map whenever users change their NIS password (with the `passwd` or `yppasswd` commands). The `passwd` map is then pushed to all slave servers.

- Run the `passwd` command on any NIS client.

```
% passwd
Changing NIS password for user1 on server1.
Old password:
New password:
Retype new password:
NIS entry changed on server1
```

Updating the NIS Slave Server Map

Sometimes maps fail to propagate and you must use `ypxfr` manually to retrieve new map information. To automate the updating and propagating of NIS maps on slave servers, you can install shell scripts to run as `cron` jobs. Because maps have different rates of change, scheduling a map transfer using the `crontab` command enables you to set specific propagation times for individual maps.

Sun provides several template scripts in the `/usr/lib/netsvc/yp` directory that you can use and modify to meet local site requirements. These scripts are useful when slave servers are down during NIS map propagations. In such cases, the slave server might not receive the update unless you run a "safety valve" script (Figure 12-5).

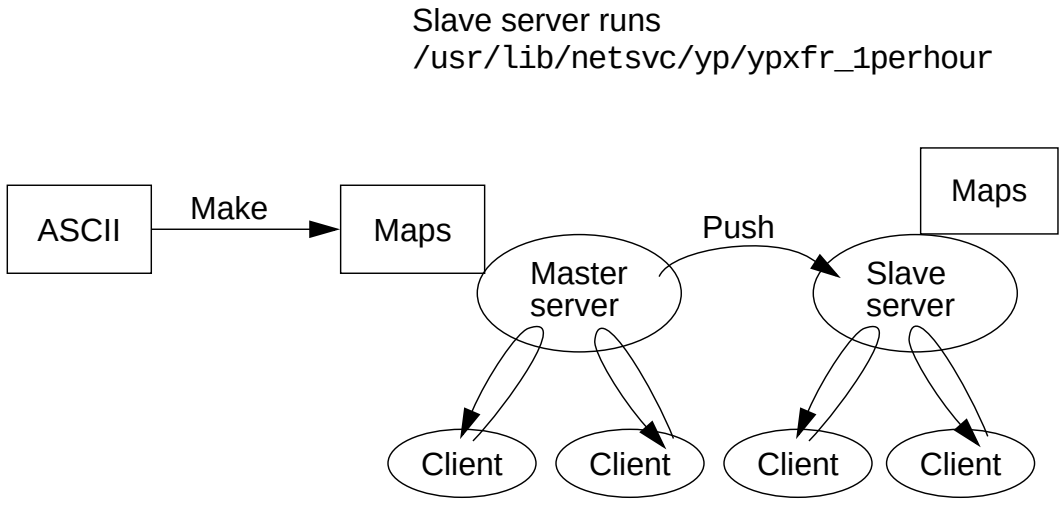


Figure 12-5 Updating `passwd` Maps on Slave Servers with Scripts

The following text is the contents of the `ypxfr_1perhour` script that, if run hourly using `cron`, ensures that the NIS slave server's `passwd` map is never more than one hour out of date.

```
#! /bin/sh
#
# @(#)ypxfr_1perhour.sh 1.9 92/12/18 Copyright 1999 Sun Microsystems,
# Inc.
#
# ypxfr_1perhour.sh - Do hourly NIS map check/updates
#

PATH=/bin:/usr/bin:/usr/lib/netsvc/yp:$PATH
export PATH

# set -xv
ypxfr passwd.byname
ypxfr passwd.byuid
```

Updating Other Scripts

There are scripts called `ypxfr_1perday` and `ypxfr_2perday`. The `ypxfr_1perday` script checks or updates the following maps daily:

- `group.byname`
- `group.bygid`
- `protocols.byname`
- `protocols.bynumber`
- `networks.byname`
- `networks.byaddr`
- `services.byname`
- `ypservers`

The `ypxfr_2perday` script checks and updates the following NIS maps twice per day:

- `hosts.byname`
- `hosts.byaddr`
- `ethers.byaddr`
- `ethers.byname`
- `netgroup`
- `netgroup.byuser`
- `netgroup.byhost`
- `mail.aliases`

Makefile *Syntax and New Maps*

You can build custom NIS maps for use with local utilities or with Sun utilities, such as the automounter. By generating an NIS automounter map and setting up all NFS clients appropriately, NFS-mountable resources become available over the network with minimum administration. Changes need to be made only to the NIS master server, and the NFS server grants NFS access to clients within the entire NIS domain.

The make *Utility*

Building customized NIS maps is essentially a lesson in the `make` utility. The `make` utility:

- Is used by programmers to build programs
- Is used by administrators to build NIS maps
- Can be generalized to build customized NIS maps

The `make` utility receives its instructions from the `Makefile` file. The `Makefile` uses variable definitions (called *macros*), targets, and dependencies.

You can use macros as variables, similar to those that are used in a shell script. A macro is defined at the beginning of the `Makefile` and is used throughout the `Makefile` by prefixing the macro name with a dollar sign (`$`).

The `make` utility builds *targets*. Targets need dependencies. *Dependencies* can represent other targets that must be built before the original target is considered "made." This structure enables you to nest the target and dependency pairs to an arbitrary depth, allowing for hierarchical building of complex code structures.

When making NIS maps, you should keep the target and dependency relationship is fairly simple.

First Section of `Makefile`

The NIS `Makefile` is located in the `/var/yp` directory and is composed of four main sections. The first section contains the following macro definitions:

```
#B=-b
B=
DIR =/etc
PWDIR =/etc
DOM = `domainname`
NOPUSH = ""
ALIASES = /etc/mail/aliases
YPDIR=/usr/lib/netsvc/yp
SBINDIR=/usr/sbin
YPDBDIR=/var/yp
YPPUSH=$(YPDIR)/yppush
MAKEDBM=$(YPDIR)/makedbm
MULTI=$(YPDIR)/multi
REVNETGROUP=$(SBINDIR)/revnetgroup
STDETHERS=$(YPDIR)/stdethers
STDHOSTS=$(YPDIR)/stdhosts
MKNETID=$(SBINDIR)/mknetid
MKALIAS=$(YPDIR)/mkalias
```

Second Section of `Makefile`

The second section contains the first target, `all`.

```
all: passwd group hosts ethers networks rpc services protocols \
    netgroup bootparams aliases publickey netid netmasks c2secure \
    timezone auto.master auto.home auth.attr exec.attr prof.attr \
    user.attr audit.user
```

The `all` target has several dependencies, each of which represents one of the NIS maps to be built. This enables the entire set of NIS maps to be built by typing:

```
# cd /var/yp; make
```

The `all` target is not considered to be built until each of its targets is first built in turn. Each of the targets for all depends on another target.

When adding custom maps to NIS, the name of the new map to be built should be added to the end of the `all` target list (`auto.direct` in the following example).

```
all: passwd group hosts ethers networks rpc services protocols \
    netgroup bootparams aliases publickey netid netmasks c2secure \
    timezone auto.master auto.home auth.attr exec.attr prof.attr \
    user.attr audit.user auto.direct
```

Fourth Section of `Makefile`

The entry in the fourth section of the `Makefile` for each of the dependencies specified in the `all` target is:

```
passwd: passwd.time
group: group.time
hosts: hosts.time
ethers: ethers.time
networks: networks.time
rpc: rpc.time
services: services.time
protocols: protocols.time
netgroup: netgroup.time
bootparams: bootparams.time
aliases: aliases.time
publickey: publickey.time
netid: netid.time
passwd.adjunct: passwd.adjunct.time
group.adjunct: group.adjunct.time
netmasks: netmasks.time
timezone: timezone.time
auto.master: auto.master.time
auto.home: auto.home.time
$(DIR)/netid:
$(DIR)/timezone:
$(DIR)/auto_master:
$(DIR)/auto_home:
$(PWDIR)/shadow:
```

Using the previous example of an `auto.direct` map, add a new map to the NIS domain by appending the appropriate entries to the end of this "second level" target/dependency pair.

```
...
auto.direct: auto.direct.time
...
$(DIR)/auto_direct:
```

Therefore, the final lines from the fourth section would look like this after the `auto.direct` map was modified.

```
auto.master: auto.master.time
auto.home: auto.home.time
auto.direct: auto.direct.time
$(DIR)/netid:
$(DIR)/timezone:
$(DIR)/auto_master:
$(DIR)/auto_home:
$(DIR)/auto_direct:
$(PWDIR)/shadow:
```

The target in this case, `auto.direct`, depends on another target, `auto.direct.time`.

Third Section of `Makefile`

In the third section of the `Makefile`, the final target and dependencies are defined, along with instructions on how to build each map in the domain.

You must add the following lines to the `Makefile` to build a new `auto_direct` map:

```
auto.direct.time:  $(DIR)/auto_direct
        -@if [ -f $(DIR)/auto_direct ]; then \
                sed -e "/^#/d" -e s/#.*$$// $(DIR)/auto_direct \
                | $(MAKEDBM) - $(YPDBDIR)/$(DOM)/auto.direct; \
                touch auto.direct.time; \
                echo "updated auto.direct"; \
                if [ ! $(NOPUSH) ]; then \
                        $(YPPUSH) auto.direct; \
                        echo "pushed auto.direct"; \
                else \
                : ; \
                fi \
        else \
                echo "couldn't find $(DIR)/auto_direct"; \
        fi
```

You should be aware of the following:

- `auto.home.time` depends on `$(DIR)/auto_home`.

  In this case, the dependency is a file. The `make` utility checks the timestamp of the target (assumed to be a file, and in the current directory) against the timestamp of the dependency (usually in the `/etc` directory). If the target has a newer modification time than the dependency, the target is not built, and this section is skipped. If, on the other hand, the dependency has a more recent modification timestamp, the target is built according to the instructions in the section that immediately follows.

- Subsequent lines of `make` instructions are indented by tabs. (This is required.)

- You can use `make` macros in the instructions.

- Instructions that begin with the at (`@`) sign are *not* echoed to the screen. Removing the `@` sign is useful for debugging new instructions.

- Instructions that begin with a leading dash (`-`), occurring before the leading `@` sign, do *not* have error messages echoed to the terminal.

Building NIS Maps

Most map builds consist of the following sequence of actions, which are specified in the third section of the `Makefile`:

1. Extract the source file key and value pairs of information using the `awk` or `sed` commands.
2. Send these key and value pairs to the `makedbm` program to generate the NIS map.
3. Use `touch` on the timestamp file so that this map is not remade unless and until the source file is updated.
4. Echo the message stating the map has been updated.
5. Push the map to the slave servers.
6. Echo a message stating the push is done.

Caution – The first time you build a new map, the slave servers do not know of its existence and so the push process attempt fails. Send an interrupt (Control-C) to the build process when the push process hangs, and execute the `ypxfr` command on the map from the slave server(s) to complete the build process. (This is necessary only during the first build of a new NIS map.)

Note – Details of the `awk`, `sed`, and `makedbm` programs are beyond the scope of this class.

Exercise: Configuring NIS

Exercise objective – In this lab, you configure a NIS master server and one NIS client.

Preparation

Choose two partners for this lab and determine which systems will be configured as the NIS master server and which will serve as the NIS slave and NIS client. You use the NIS master as the Jumpstart server later in the course. Verify that entries for all systems exist in the `/etc/hosts` file. Refer to your lecture notes as necessary to perform the steps listed.

Task Overview

In this exercise, you accomplish the following:

- On the system that will become the NIS master server, replace the `/var/yp/Makefile` file with an updated copy that references `/etc/locale`. Your instructor will provide the `Makefile`.

- Use the following commands and files to create and configure an NIS master server. Configure only a master server. Verify that the configuration works using the `ypwhich -m` command.

```
/etc/nsswitch.nis
/etc/nsswitch.conf
/etc/defaultdomain
/etc/ethers
/etc/bootparams
/etc/locale
/etc/netmasks
/etc/timezone
/etc/security/audit_user
/etc/security/auth_attr
/etc/security/exec_attr
/etc/security/prof_attr
domainname
ypinit
ypstart
```

- Use the following commands and files to create and configure an NIS client. Verify that the configuration works using the `ypwhich -m` command.

```
/etc/nsswitch.nis
/etc/nsswitch.conf
domainname
/etc/defaultdomain
ypinit
ypstart/etc/nsswitch.nis
/etc/nsswitch.conf
/etc/defaultdomain
/etc/ethers
/etc/bootparams
/etc/locale
/etc/netmasks
/etc/timezone
/etc/security/audit_user
/etc/security/auth_attr
/etc/security/exec_attr
/etc/security/prof_attr
domainname
ypinit
ypstart
```

- Use the following commands and files to create and configure an NIS slave server. Verify that the configuration works using the `ypwhich -m` command.

  ```
  /etc/nsswitch.nis
  /etc/nsswitch.conf
  domainname
  /etc/defaultdomain
  ypinit
  ypstart
  ypcat
  ```

- Use the following commands and files to create and update a new NIS map, `auto.home`. Verify that the new map works using the `ypcat` command.

  ```
  /etc/nsswitch.nis
  /etc/nsswitch.conf
  domainname
  /etc/defaultdomain
  ypinit
  ypstart
  ```

Tasks

Perform the following steps to create the NIS master and configure the NIS maps.

Setting up the NIS Master

1. Install an updated `Makefile` in the `/var/yp` directory. If you intend to use NIS on the system that will act as your JumpStart server, you must update the `/var/yp/Makefile` file so that it creates a map from `/etc/locale` file.

2. If available, get the modified `Makefile` from the classroom server (includes the entries for `locale` discussed in step 8 of the "Configuring the NIS Master Server" section on page 12-14).

Note – The exact directory location on the server might be different from the one in this example.

```
# cd /net/classroom_server/export/software
# cp Makefile /var/yp/Makefile
```

Refer to the "Configuring the NIS Master Server" section on page 12-13 for more information about the changes required to include `/etc/locale` in the `Makefile`.

3. Create the file `/etc/locale` and make an entry for your NIS domain.

```
your.domain      en_US
```

4. Add the `timehost` alias to the `/etc/hosts` entry for the NIS master, for example:

```
172.16.64.103     nis_master  loghost   timehost
```

5. Because this system will be the source for NIS database information supplied to the network, you can comment out the +auto_master entry in the /etc/auto_master file.

```
# Master map for automounter#
# +auto_master
/net            -hosts          -nosuid,nobrowse
/home           auto_home       -nobrowse
/xfn            -xfn
```

6. For the same reason given in the previous step, you can comment out the +auto_home entry in the /etc/auto_home file. Modify two lines in the /etc/auto_home file by commenting out the single entry for +auto_home and adding a global entry for all user accounts located in /export/home on the NIS master as shown:

```
# Home directory map for automounter
#
# +auto_home
*    nis_master:/export/home/&
```

7. Use the touch command to create the following files.

```
# cd /etc
# touch ethers bootparams netgroup
```

8. Create the /etc/timezone file with the appropriate entry for your timezone. The example that follows is for the US/Mountain timezone in the Central.Sun.COM domain.

```
US/Mountain        your.domain
```

9. Copy the /etc/nsswitch.nis file to the /etc/nsswitch.conf file.

```
# cd /etc
# cp nsswitch.nis nsswitch.conf
```

10. Select a name to use as your NIS domain name. Set it using the domainname command. Replace *your.domain* with your own domain name.

```
# domainname your.domain
```

11. Populate the `/etc/defaultdomain` file with your domain name.

    # **domainname > /etc/defaultdomain**

12. Create the following entry in the `/etc/dfs/dfstab` file for the user home directories:

    share -F nfs -d “home dirs” /export/home

13. Share the new file system entries to the network:

    a. If no directories are currently shared by the NIS master, run the following command to start sharing the file systems configured in the `/etc/dfs/dfstab` file:

    # **/etc/init.d/nfs.server start**

    b. If the NIS master is already sharing other directories, run the `shareall` command to share the new entries created in the `/etc/dfs/dfstab` file.

    # **shareall**

14. Create user accounts for all users in your group. Create their respective home directories in `/export/home`. For example, `/export/home/user1` for `user1`, `/export/home/user2` for `user2`, and so on.

15. To enable the automatic mounting of a user’s directory on any host in the NIS domain, modify the user entries in the `/etc/passwd` file from `/export/home/`*`username`* to `/home/`*`username`*.

16. Use the `ypinit` command as follows to set up this system as a NIS master:

    a. Run `ypinit -m` to start the setup process.

    ```
    # ypinit -m
    ```

    b. The `ypinit` command lists the current system as an NIS server, and then asks for the next host to add as a NIS slave server. In this lab, you set up only a master and a client. Press Control–D to terminate the list.

    ```
    next host to add: master_server
    next host to add: Control-d
    (list of servers)
    is this list correct? [y/n: y] y
    ```

    c. Indicate that you do not want `ypinit` to quit on nonfatal errors. The `ypinit` command then proceeds to build the required maps.

    ```
    ...quit on nonfatal errors? [y/n: n] n
    ```

    If the initialization process is successful, `ypinit` displays a message indicating that the current system was set up as a Master server without any errors. This message is displayed even if nonfatal errors were encountered in the procedure.

    If the initialization process fails, correct the problems indicated by the error messages and repeat steps a, b, and c.

17. Start the NIS daemons.

    ```
    # /usr/lib/netsvc/yp/ypstart
    ```

18. Once the `ypserv` daemon is running you should run the `make` command to build the mail aliases map.

    ```
    # cd /var/yp

    # /usr/ccs/bin/make
    ```

19. Use the `ypwhich` command to verify that this system is the NIS master.

    ```
    # ypwhich -m
    ```

Setting up the NIS Slave Server

20. Copy the `/etc/nsswitch.nis` file to the `/etc/nsswitch.conf` file.

```
# cd /etc
# cp nsswitch.nis nsswitch.conf
```

21. Edit the /etc/hosts file to ensure that the NIS master servers has been defined.

22. Use the `domainname` command to set the NIS domain for this client. Replace *`nisdomain`* with your own domain name.

```
# domainname your.domain
```

23. Populate the `/etc/defaultdomain` file with your domain name.

```
# domainname > /etc/defaultdomain
```

24. Use the `ypinit` command as follows to set up this system as an NIS client:

    a. Run `ypinit -c` to start the setup process.

```
# ypinit -c
```

    b. When prompted for a list of NIS servers, enter the NIS master host followed by the name of the local host (which subsequently becomes a slave server) and all other NIS slave servers on the local network, then enter Control–D to terminate the list.

```
next host to add: master_server
next host to add: slave_server
next host to add: Control-d
(list of servers)
is this list correct? [y/n: y] y
#
```

25. Start the NIS daemons.

```
# /usr/lib/netsvc/yp/ypstart
```

26. Use the `ypwhich` command to verify that this system is using NIS and is bound to the NIS master.

```
# ypwhich -m
```

27. Initialize the system as an NIS slave with the following command:

    # **ypinit -s** *master_server*

    where *master_server* is the name of the NIS master.

Note – If you did not add the name of the NIS slave server when you initially configured the NIS master using the `ypinit` command, run the **`ypinit -m`** command once more on the NIS master and add the slave server's host name. In the process of updating the NIS master, the script prompts you for confirmation when it is about to destroy the existing domain database. Confirm with **`y`**.

---

28. Stop the NIS daemons on the slave server with the following command:

    # /usr/lib/netsvc/yp/ypstop

29. Restart the NIS daemons on the slave server with the following command:

    # /usr/lib/netsvc/yp/ypstart

30. On the newly configured NIS slave server, test the NIS functionality by entering the following command:

    # ypwhich -m

    The output should include the name of the NIS master server along with a list of database maps it is serving to the NIS domain.

31. Use `ypcat` to list the `ypservers` known to the local domain. The output should include the name of the local host you just configured as an NIS slave server:

    # ypcat -k ypservers
    master_server
    slave_server

Setting up the NIS Client

32. Copy the `/etc/nsswitch.nis` file to the `/etc/nsswitch.conf` file.

```
# cd /etc
# cp nsswitch.nis nsswitch.conf
```

33. Use the `domainname` command to set the NIS domain for this client. Replace *`your.domain`* with your own domain name.

```
# domainname your.domain
```

34. Populate the `/etc/defaultdomain` file with your domain name.

```
# domainname > /etc/defaultdomain
```

35. Use the `ypinit` command as follows to set up this system as an NIS client:

    a. Run `ypinit -c` to start the setup process.

```
# ypinit -c
```

    b. The `ypinit` command asks for a list of NIS servers, and for you to add them in order of preference. Enter the name of the NIS master server, the NIS slave server, and press Control–D to terminate the list.

```
next host to add: master_server
next host to add: slave_server
next host to add: Control-d
(list of servers)
is this list correct? [y/n: y] y
```

36. Start the NIS daemons.

```
# /usr/lib/netsvc/yp/ypstart
```

37. Use the `ypwhich` command to verify that this system is using NIS.

```
# ypwhich -m
```

Testing Dynamic Rebind

38. On the previously-configured NIS client, confirm that it is still bound to the NIS master by entering the following command:

```
# ypwhich
master_server
```

The output should contain *only* the name of the NIS master server.

39. Test the ability of the client to bind with the NIS slave server when the master is unavailable:

Note – This does *not* work if you entered *both* the NIS master and the NIS slave host names when you ran the `ypinit -c` command. It searches only for `ypservers` listed in the `/var/yp/binding/`*`domainname`*`/ypservers` file, which is created as a result of running the `ypinit -c` command.

---

a. Abort the NIS master to run level `0` (the monitor level) using the `Stop-A` key sequence. You should see the `ok` prompt:

```
ok
```

b. Return to the NIS client and determine to which NIS server it is bound. This can take a minute or two for the client to rebroadcast for a server and bind with the NIS slave.

Allowing a few moments for the NIS client to bind to the slave server, the output should contain *only* the name of the NIS slave server.

```
# ypwhich
slave_server
```

During the period while the NIS client is attempting to bind with the NIS slave server, the response from the `ypwhich` command is shown as follows:

```
# ypwhich
Domain domainname not bound on hostname.
```

For example:

```
# ypwhich
Domain classroom.Central.Sun.COM not bound on host1.
```

40. On the NIS master, type `go` at the `ok` prompt.

```
ok go
```

Adding a Custom Map to the NIS Master Database

If the custom `auto_direct` map entry does not already exist in the `Makefile` you acquired from the classroom server, use the following steps to add it.

41. Add `auto.direct` at the end of the list of maps that exist in the *second* section of the `/var/yp/Makefile`:

```
all: passwd group hosts ethers networks rpc services protocols \
    netgroup bootparams aliases publickey netid netmasks c2secure \
    timezone auto.master auto.home auth.attr exec.attr prof.attr \
    user.attr audit.user auto.direct
```

42. Add `auto.direct` at the end of the list of maps that exist in the forth section of the `/var/yp/Makefile`:

    The final lines from the *fourth* section should look like the following after you modified the after the `auto.direct` map.

```
auto.master: auto.master.time
auto.home: auto.home.time
auto.direct: auto.direct.time
$(DIR)/netid:
$(DIR)/timezone:
$(DIR)/auto_master:
$(DIR)/auto_home:
$(PWDIR)/shadow:
$(DIR)/auto_direct:
```

43. If not already there, add the following lines to the `Makefile` in the *third* section to build a new `auto_direct` map:

```
auto.direct.time:  $(DIR)/auto_direct
        -@if [ -f $(DIR)/auto_direct ]; then \
                sed -e "/^#/d" -e s/#.*$$// $(DIR)/auto_direct \
                | $(MAKEDBM) - $(YPDBDIR)/$(DOM)/auto.direct; \
                touch auto.direct.time; \
                echo "updated auto.direct"; \
                if [ ! $(NOPUSH) ]; then \
                        $(YPPUSH) auto.direct; \
                        echo "pushed auto.direct"; \
                else \
                : ; \
                fi \
        else \
                echo "couldn't find $(DIR)/auto_direct"; \
        fi
```

44. Create an entry in the `/etc/auto_master` file to reference a new map, `auto_direct` (to be configured in subsequent steps):

```
# Master map for automounter
#
#+auto_master
/net            -hosts          -nosuid,nobrowse
/home           auto_home       -nobrowse
/xfn            -xfn
/-              auto_direct     -nosuid
```

45. On all hosts, rename the existing `/usr/share/man` directory to `/usr/share/man2`:

```
# mv /usr/share/man /usr/share/man2
```

46. Create the `/etc/auto_direct` file with the following:

```
/usr/share/man      -ro     nis_master:/usr/share/man2
```

47. Add an entry to the `/etc/dfs/dfstab` file on the NIS master to share `/usr/share/man2` and share the directory.

```
# vi /etc/dfs/dfstab
share -o ro /usr/share/man2
# shareall
```

48. Change to the /var/yp directory.

    # **cd /var/yp**

49. Refresh the NIS database maps by executing the make command. This command hangs because a new auto.direct map has been added to the NIS master and make attempts to push it to the NIS slave server who refuses to accept it. Press Control-C to interrupt the make command.

    # **/usr/ccs/bin/make**

50. To force the NIS slave server to manually pull this map, issue the following command:

    # **/usr/lib/netsvc/yp/ypxfr auto.direct**

51. Reboot all NIS slaves and NIS clients using the init 6 command:

    # **init 6**

52. Log in to NIS slave and NIS client to test previously created (non-root) NIS user accounts.

53. Verify that your home directory automounted from the NIS master server.

    $ **pwd**

54. Attempt to access the /usr/share/man directory using the man command.

    $ **man ls**

    $ **mount**

    If the content of the man page for ls is displayed, you were successful in creating the new /etc/auto_direct map and having the mount take place automatically as a result of the command requiring access to the man pages in /usr/share/man.

Exercise Summary

Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- ❑ Describe the NIS components, master server, slave server, and client, and the NIS processes
- ❑ Configure an NIS master, slave, and client
- ❑ List the steps to add a new NIS map
- ❑ Use commands to update and propagate an NIS map

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Objectives

Upon completion of this module, you should be able to:

- List the main components for setting up a JumpStart network installation
- Set up boot services on a subnet using the `setup_install_server` script
- Describe the JumpStart client boot sequence
- List the files necessary to support JumpStart boot operations
- Describe the use of the `sysidcfg` file with and without name service support
- Set up a JumpStart installation server to provide the Solaris 8 Operating Environment with the software necessary to install clients.
- Describe the use of the `add_to_install_server` and `modify_install_server` scripts
- Add install clients to the install servers and boot servers
- Create a configuration server with customized `rules` and class files
- Use the `pfinstall` command to test configuration and installation files
- Boot install clients
- Configure NIS name service support for the JumpStart program

Additional Resources

Additional resources – The following references provide additional details on the topics discussed in this module:

- *Solaris 8 Advanced Installation Guide*, Part Number 806-0957-10.
- Kasper, Paul Anthony and Alan L. McClellan. *Automating Solaris Installations - A Custom JumpStart™ Guide.* ISBN 0-13-312505-X.

Introduction to JumpStart

JumpStart is an automatic installation (auto-install) process available in the Solaris 8 Operating Environment. JumpStart allows you to install Solaris automatically and configure it differently depending on characteristics of client systems. JumpStart implementations use these identifying characteristics to select the correct configuration for each client system.

Who Should Use JumpStart and Why?

System administrators who need to install multiple systems with similar configurations can use JumpStart to automate the installation process. JumpStart eliminates the need for operator intervention during the installation process.

Advantages of using JumpStart include the following:

- It frees system administrators from the lengthy question and answer session that is part of the interactive installation process
- It enables system administrators to install different types of systems simultaneously
- It installs the Solaris Operating Environment and unbundled software automatically
- It simplifies administration tasks when widely-used applications must be updated frequently

JumpStart provides networked computing environments with considerable time savings when multiple or ongoing installations are required.

JumpStart Components

There are three main components to JumpStart:

- *Boot and client identification services* – These are provided by a networked boot server.

  A boot server provides the information that a JumpStart client needs to boot using the network. This includes RARP, TFTP, and bootparams information, and the identity of servers that will provide installation and configuration services. The boot server must reside on the same subnet as the client, but the install and configuration servers may reside on other network segments.

  The boot server can also provide client identification information. This information answers the system identification questions normally asked by the interactive installation routine. It is possible for one server to provide boot, installation, and configuration services.

- *Installation services* – These are provided by a networked install server.

  An install server provides an image of the Solaris Operating Environment that the JumpStart client uses as its source of data to install. The install server shares a Solaris image either from a delivery CD-ROM, or from an area on a local disk. Because the Solaris 8 Operating Environment is delivered on two CD-ROMs, only the Core and End User configuration clusters can install without spooling the OS onto a local disk. JumpStart clients use NFS to mount the OS image during the installation process.

- *Configuration services* – These are provided by a networked configuration server.

  A configuration server provides information that a JumpStart client uses to partition disks and create filesystems, add or remove Solaris packages, and perform other configuration tasks. Clients select a configuration based on identifying information known as a “class”. A configuration server shares a directory that contains a “rules” file and “class” files that allow clients to obtain appropriate configuration information.

If any one of the three main components is improperly configured, the JumpStart clients can:

- Fail to boot
- Fail to find a Solaris Operating Environment image to load
- Ask questions interactively for configuration
- Fail to partition disks, create file systems, and load the operating environment.

Using `add_install_client`

The script `add_install_client` allows you to establish support for clients on JumpStart servers. Because JumpStart components may exist on more than one server, you must select options to `add_install_client` and specify arguments that reflect the overall JumpStart configuration in place.

The general syntax of `add_install_client` is described here, but its use for specific configurations is described throughout the module.

The `add_install_client` script adds support for JumpStart clients by updating information as required on the install server. The files that these updates affect can include `/tftpboot`, `/etc/dfs/dfstab`, `/etc/bootparams`, `/etc/inetd.conf`, and `/etc/nsswitch.conf.`

The `add_install_client` script must run from the install server's installation image, either on CD-ROM or spooled to disk, or the boot server's boot directory. On the Solaris 8, 1 of 2 CD-ROM, this directory is `/cdrom/cdrom0/s0/Solaris_8/Tools`. In an OS image spooled to disk below /export/install, this directory is `/export/install/Solaris_8/Tools`.

Command Syntax

Options and arguments for add_install_client include the following:

```
add_install_client -i IP_address -e Ethernet_address \
-s server:path -c server:path -p server:path client_name platform_group
```

Options

- `-i` Specifies the IP address of the client. This option is not required if an entry for the client exists in a naming service in use on the boot server or in the `/etc/inet/hosts` file.
- `-e` Specifies the Ethernet (MAC) address of the client. This option is not required if an entry for the client exists in a naming service in use on the boot server or in the `/etc/ethers` file.
- `-s` *server:path* specifies the server and absolute path of the Solaris installation image used for this installation. This option is not required if the boot server also acts as the install server. This option is only required when running `add_install_client` from a boot server.
- `-c` *server:path* specifies the server and absolute path of the directory that holds configuration information (rules and class files).
- `-p` *server:path* specifies the server and absolute path of the directory that holds the *`sysidcfg`* file.

The *`client_name`* argument specifies the name of the client as recorded in `/etc/inet/hosts` and `/etc/ethers`.

The *`platform_group`* argument specifies the hardware platform type as reported by `uname -m` (for example., sun4u, sun4m, sun4c).

Setting Up Boot Services

A boot server allows JumpStart clients to boot via the network, and provides installation and configuration server information.

This section describes JumpStart boot services including:

- The JumpStart client boot sequence
- Boot operation support files
- Adding a bootable Solaris Operating Environment image
- Using the `add_install_client` script to specify a boot server that is separate from an install server

JumpStart Client Boot Sequence

Figure 13-1 illustrates the JumpStart client boot process.

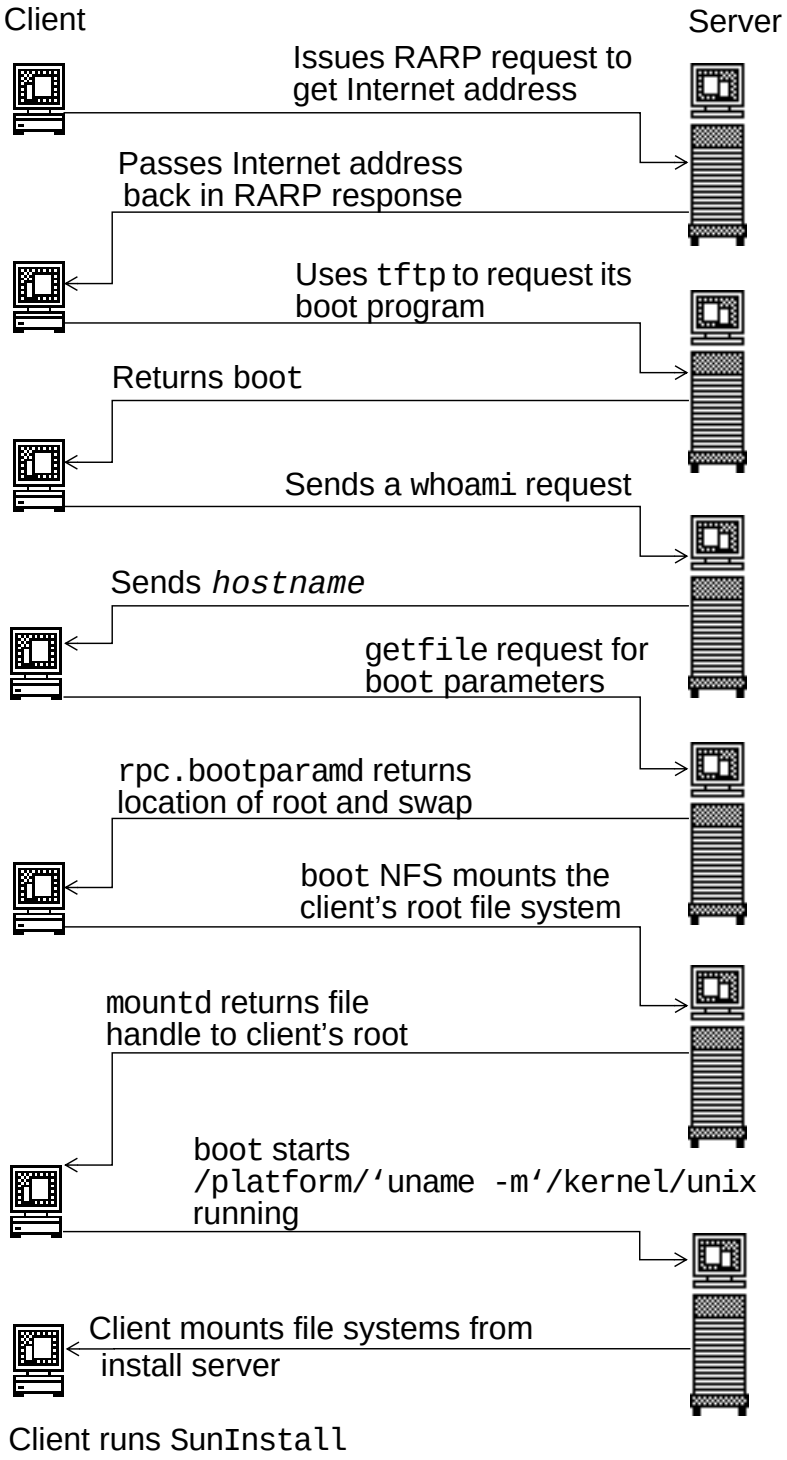

Figure 13-1 The JumpStart Client Boot Process

The following steps describe how the JumpStart process works:

1. When a network workstation boots, the boot PROM (programmable read-only memory) issues a Reverse Address Resolution Protocol (RARP) broadcast to the network. On receiving the RARP request, the boot server translates the Ethernet address to an Internet address.

   The boot server running the RARP daemon, `/usr/sbin/in.rarpd`, looks up the Ethernet address in the `/etc/ethers` file, checks for a corresponding name in the`/etc/hosts` file, and passes the Internet address back to the client.

2. The client's boot PROM sends a Trivial File Transfer Protocol (TFTP) request for its boot program.

3. The server searches for a symbolic link named for the client's Internet Protocol (IP) address expressed in hexadecimal format. This link points to a boot program for a particular Solaris release and client architecture. For SPARC™ systems, the file name is *`hex-IP-address.architecture.`*

```
C009C864.SUN4U -> inetboot.sun4u.Solaris_8-1
```

4. The server uses the `in.tftpd` daemon to transfer the `boot` program to the client. The client then runs the `boot` program.

5. The `boot` program tries to mount the `root` file system. To do so, it issues a `whoami` request to discover the client's host name. A server running the boot parameter daemon, `rpc.bootparamd`, looks up the host name, and responds to the client. Then, the `boot` program issues a `getfile` request to obtain the location of the client's root and swap space.

6. The server responds with the information obtained from the `/etc/bootparams` file.

7. Once the client has its boot parameters, the boot program on the client mounts the `/` (root) file system from the boot server. The client loads its kernel and starts the `init` program. When the boot server is finished bootstrapping the client, it redirects the client to the configuration server.

8. The client searches for the configuration server using `bootparams` information. The client mounts the configuration directory and runs `sysidtool`. The client then uses bootparams information to locate and mount the installation directory where the Solaris image resides. The client then runs the `SunInstall` program and installs the operating environment.

Boot Operation Support Files

For boot operations to proceed, the following files and directories must be properly configured on the boot server: `/etc/ethers`, `/etc/hosts`, `/etc/bootparams`, `/etc/dfs/dfstab`, and `/tftpboot`.

On a network running the NIS or NIS+ name services, the identification information from the JumpStart server files must also be incorporated in the domain database maps.

The `/etc/ethers` *File*

When the JumpStart client boots, it has no IP address so it broadcasts to the network using RARP and its Ethernet address. The JumpStart server receives the request and attempts to match the client's Ethernet address with an entry in the local `/etc/ethers` file.

If a match for the Ethernet number is found, the client name is matched to an entry in the `/etc/hosts` file. In response to the RARP request from the client, the JumpStart server sends the IP address from the `/etc/hosts` file back to the client. The client then continues the boot process using the IP address.

If a match is not found, the client cannot acquire its IP address and cannot continue the boot process. The usual (repeating) message displayed on the screen of a JumpStart client when this occurs is the following:

```
Timeout waiting for ARP/RARP packet
```

An entry for the JumpStart client can be created by editing the `/etc/ethers` file or as one of the arguments to the `add_install_client` script. The following example is an entry in the `/etc/ethers` file for a JumpStart client:

```
8:0:20:2f:90:3d client1
```

The `/etc/hosts` *File*

The `/etc/hosts` file is the local database that associates the names of hosts with their IP addresses. The JumpStart server references this file when trying to match an entry from the local `/etc/ethers` file in response to a RARP request from a client.

If a match is not found, the client cannot acquire its IP address and cannot continue the boot process. The usual (repeating) message displayed on the screen of a JumpStart client when this occurs is the following:

```
Timeout waiting for ARP/RARP packet
```

An entry for the JumpStart client can be created by editing the `/etc/hosts` file or as one of the arguments to the `add_install_client` script. The following example is an entry in the `/etc/hosts` file for a JumpStart client:

```
192.9.200.100 client1
```

The /tftpboot *Directory*

The /tftpboot directory contains the inetboot.SUN4x.Solaris_8-1 file that is created for each JumpStart client when the add_install_client script is run. When booting over the network, the client's boot PROM makes a RARP request and when it receives a reply, the PROM broadcasts a TFTP request to fetch the inetboot file from any server that responds and executes it. For example, the inetboot file created for a JumpStart client with a sun4u architecture is named inetboot.SUN4U.Solaris_8-1. Two additional symbolic links to this file are also created at the same time containing the IP address and the architecture of the client system. The long listing output of a /tftpboot directory that supports one sun4u client with an IP address of 192.9.200.100 appears as follows:

```
# ls -l /tftpboot
total 344
lrwxrwxrwx   1 root     other         26 Apr 15 21:20 C009C864 ->
inetboot.SUN4U.Solaris_8-1*
lrwxrwxrwx   1 root     other         26 Apr 15 21:20 C009C864.SUN4U ->
inetboot.SUN4U.Solaris_8-1*
-rwxr-xr-x   1 root     other     159768 Apr 15 21:20
inetboot.SUN4U.Solaris_8-1*
-rw-r--r--   1 root     other        315 Apr 15 21:20 rm.192.9.200.100
```

The inetboot program makes another RARP request, then uses the bootparams protocol to locate its root file system. It then mounts the root file system across the network using the NFS protocol and runs the kernel.

If the files in the /tftpboot directory are unavailable to the JumpStart client when the boot process is initiated, the client cannot retrieve bootparams information for the root file system and stops the boot process without displaying an error message.

The `/etc/bootparams` *File*

The `/etc/bootparams` file contains entries that network clients use for booting. JumpStart clients retrieve the information from this file by issuing requests to a server running the `rpc.bootparamd` program. The `/etc/bootparams` file can be used in conjunction with, or in place of, other sources for the `bootparams` information. When the JumpStart client makes the request, the server references the `/etc/bootparams` file and responds with the file system information required for NFS mount to enable network installation.

If the required entries are not in the `/etc/bootparams` file, the JumpStart client cannot determine the appropriate server and file system to mount, and stops at the beginning of the boot process without displaying an error message.

Entries in this file are created by the options and arguments entered as part of the `add_install_client` script. The following example is an entry in the `/etc/bootparams` file for a JumpStart client named `client1`:

```
client1
root=server1:/export/install/Solaris_8/Tools/Boot
install=server1:/export/install
boottype=:in
sysid_config=server1:/export/config
install_config=server1:/export/config
rootopts=:rsize=32768
```

The following lists describes the entries:

- `client1` – The JumpStart client name
- `root=server1:/export/install/Solaris_8/Tools/Boot` – The boot server name and directory for the `root` file system
- `install=server1:/export/install` – The server name and directory for the Solaris software image
- `boottype=:in` – Indicates a network boot and installation
- `sysid_config=server1:/export/config` – The server name and directory for the JumpStart configuration file system
- `install_config=server1:/export/config` – The server name and directory for the operating environment installation files
- `rootopts=:rsize=32768` – Mount options for the root file system and NFS read size

The `/etc/dfs/dfstab` *File*

The `/etc/dfs/dfstab` file lists local file systems to be shared to the network. Typically, when you initially set up the JumpStart server, you must manually update this file with an entry for the configuration directory you want to share to the network to support remote installation. This file is again populated with the installation directory location as a result of the `add_install_server` script.

If the required entries are not in the `/etc/dfs/dfstab` file, the JumpStart client cannot mount the file systems specified in the `/etc/bootparams` and displays the following error message:

```
panic - boot: Could not mount filesystem

Program terminated
ok
```

Adding a Bootable Image

To enable the client for JumpStart network installation, you must set up an install server, boot server, and a configuration server (see the "JumpStart Components" on page 13-4).

You can set up a *boot* server that uses the Solaris 8 software image located on the CD-ROM by using the following steps:

1. Ensure that the system has an empty directory (`/export/install`, for example) with approximately 156 Mbytes of available disk space.

2. Insert the Solaris 8 Software CD-ROM 1 of 2 in the CD-ROM drive, allowing `vold` to automatically mount the CD-ROM.

3. Change the directory to the location of the `setup_install_server` script.

```
# cd /cdrom/cdrom0/s0/Solaris_8/Tools
```

4. Run the `setup_install_server` script:

```
# ./setup_install_server -b /export/install
```

Note – The `add_install_client` to create JumpStart clients and the `rm_install_client` to remove an existing JumpStart client are also in this directory.

Adding Install Clients

You can create a JumpStart client using a server named `server1` to provide only the boot function JumpStart component. You use another system as the install server (named server2) for the Solaris 8 software image installation and configuration components by running the `add_install_client` command to create a client named `client1` with a `sun4u` architecture, as follows:

```
# ./add_install_client
-s server2:/export/install -c server2:/export/config \
-p server2:/export/config client1 sun4u
```

Run this command from the `/export/install/Solaris_8/Tools` directory on the boot server (`server1`). The arguments to options `-s`, `-c`, and `-p`, redirect the JumpStart clients to `server2` for the configuration information and the Solaris 8 software image.

Setting Up Client Identification

When a JumpStart client boots for the first time, the booting software first tries to obtain system identification information (such as the system's host name, IP address, locale, timezone, and `root` password) from a `sysidcfg` file and then from the name service database. Therefore, you can use a `sysidcfg` file to answer system identification questions during the initial part of the installation regardless of whether or not a name service (NIS or NIS+) is used. If the JumpStart server provides this information, the client bypasses the initial system identification portion of the Solaris 8 Operating Environment installation process without administrator intervention.

Without the `sysidcfg` file or a name service database, the client displays the appropriate interactive dialog boxes to request needed identification information.

Using the `sysidcfg` *File to Identify a Client*

In the absence of a name service on the network, the `sysidcfg` file must be present to automate system identification.

Table 13-1 lists the keywords and arguments used in the construction of the `sysidcfg` file.

Table 13-1 Keywords and Arguments of the `sysidcfg` File

Keyword	Argument

`name_service {domain_name}`	`name_service=NIS`, `NIS+`, `OTHER`, `NONE`
	
	Options for NIS and NIS+:
	`{domainname=`*`domain_name`*
	`name_server=hostname(`*`ip_address`*`)}`
	
	Options for DNS:
	`{domainname=`*`domain_name`*
	`name_server=`*`ip_address,ip_address,`*
	`ip_address` (three maximum)
	`search=domain_name,domain_name,`
	`domain_name,domain_name,`
	`domain_name,domain_name`
	(six maximum, the total length is less than or equal to 250 characters)`}`

`network_interface`, `hostname`, Internet Protocol (IP) address, `netmask`, DHCP, IPv6	`network_interface=NONE,PRIMARY,`
	`or` *`value`*
	`{hostname=`*`hostname`* `ip_address=`*`ip address`* `netmask=`*`netmask`*
	`protocol_ipv6=`*`yes/no`*`}`
	
	If DHCP *is* used, specify: `{dhcp`
	`protocol_ipv6+yes_or_no}`
	
	If DHCP is *not* used, specify:
	`{hostname=`*`host_name`*
	`ip_address=`*`ip_address`*
	`netmask=`*`netmask`*
	`protocol_ipv6=`*`yes_or_no`*`}`

`root_password`	`root_password=`*`root_password`* (Encrypted password from `/etc/shadow`)

Table 13-1 Keywords and Arguments of the `sysidcfg` File (Continued)

Keyword	Argument

`security_policy`	`security_policy=kerberos`, `NONE`
	
	Options for kerberos:
	`{default_realm=`*`FQDN`* `admin_server=`*`FQDN`* `kdc=`*`FQDN1`*`,`*`FQDN2`*`,`*`FQDN3`*`}`
	where FQDN is a fully qualified domain name.
	
	Note: You can list a maximum of three key distribution centers (KDCs), but at least one is required.

`system_locale`	`system_locale=`*`locale`* (Entry from `/usr/lib/locale`)
`terminal`	`terminal=`*`terminal_type`* (Entry from `/usr/share/lib/terminfo` database)
`timezone`	`timezone=`*`timezone`* (Entry from `/usr/share/lib/zoneinfo/`)
`timeserver`	`timeserver=localhost`, *`hostname`*, or *`ip_addr`*

Sample `sysidcfg` *File*

The following rules apply to the `sysidcfg` file:

- Keywords can be in any order.
- Keywords are not case sensitive.
- Keyword values can be optionally enclosed in single (') or double (") quotes.
- Only the first instance of a keyword is valid; if a keyword is specified more than once, the first keyword specified is used.

The following is an example of a `sysidcfg` file:

```
# Sample sysidcfg file for SPARC systems
system_locale=en_US
timezone=US/Mountain
timeserver=localhost
terminal=vt100
name_service=NONE
security_policy=NONE
root_password=Hx23475vABDDM
network_interface=PRIMARY {protocol_ipv6=yes netmask=255.255.255.0}
```

Locating the `sysidcfg` *File*

The location of the *`sysidcfg`* file (host and absolute directory path) is specified by the `-p` argument to the `add_install_client` shell script used to create JumpStart client information files. (See "Using add_install_client" on page 13-5 and "Adding Install Clients" on page 13-17).

As previously mentioned, you can use the `sysidcfg` file to answer system identification questions during the initial part of installation regardless of whether a name service (NIS or NIS+) is used. When this file is used with the NIS naming service, identification parameters, such as `locale` and `timezone` can be provided from the name service. The `sysidcfg` file necessary for installing a JumpStart client on a network running the NIS name service is typically shorter and a separate `sysidcfg` file for each client is unnecessary.

You can use the `/etc/locale`, `/etc/timezone`, `/etc/hosts`, `/etc/ethers` and `/etc/netmasks` files as the source for creating NIS databases to support client JumpStart installations. The following paragraphs provide a brief explanation of how each file, when created or modified and then converted to its respective database map, determines a specific identification parameter for the client installation process.

The `/etc/locale` *File*

To enable NIS support for a network installation of a JumpStart client, you must create the `/etc/locale` file if it does not exist (this assumes that the `system_locale` keyword is not provided in a `sysidcfg` file). When converted to its respective NIS map, `locale.byname`, it provides the installation program running on the JumpStart client with the default language information. If this information is not available, the client installation displays a dialog box and prompt for it.

The following is an example of the content found in the `/etc/locale` file on an NIS master for the `Central.Sun.COM` domain that sets the default language to English.

```
Central.Sun.COM         en_US
```

Note – You can also specify separate entries based on a host name rather than a domain. For a list of possible `locale` entries for this file, run the '`locale -c`' command.

Setting Up Locale

If the installation media contains multiple languages, you are prompted for the language to use during installation unless the installation process can determine the default localization.

On the NIS server, complete the following steps:

1. Make the following changes to the `/var/yp/Makefile` file:

   a. Add the following text after the existing `audit.user.time` entry (approximately line 424):

```
locale.time:  $(DIR)/locale
        -@if [ -f $(DIR)/locale ]; then \
               sed -e "/^#/d" -e s/#.*$$// $(DIR)/locale \
               | awk '{for (i = 2; i<=NF; i++) print $$i, $$0}' \
               | $(MAKEDBM) - $(YPDBDIR)/$(DOM)/locale.byname; \
               touch locale.time; \
               echo "updated locale"; \
               if [ ! $(NOPUSH) ]; then \
                       $(YPPUSH) locale.byname; \
                       echo "pushed locale"; \
               else \
               : ; \
               fi \
        else \
               echo "couldn't find $(DIR)/locale"; \
        fi
```

The /etc/timezone *File*

To enable NIS support for a network installation of a JumpStart client, you must create the /etc/timezone file. If it does not exist (this assumes that the timezone keyword is not provided in a sysidcfg file). When converted to its respective NIS map, timezone.byname, it provides the installation program running on the JumpStart client with the default time zone information. If this information is not available, the client installation displays a dialog box and prompts for it.

The following is an example of the content found in the /etc/timezone file on an NIS master for the Central.Sun.COM domain that sets the default timezone to U.S. Mountain Standard Time:

```
US/Mountain        Central.Sun.COM
```

Note – You can also specify separate entries based on a host name rather than a domain. A list of possible locale entries for this file exists in the /usr/share/lib/zoneinfo directory.

The /etc/hosts *File*

To enable NIS support for a network installation of a JumpStart client, you must update the /etc/hosts file to include the client IP address and host name. When converted to its respective NIS map, hosts, it provides the installation program running on the JumpStart client with its IP address. Additionally, this file must have a timehost alias specified so the client can obtain the time of day information required for installation. Typically, this alias is assigned to the JumpStart server or the NIS master. If the client IP address information is not available, the client installation displays a dialog box and prompts for it.

The following is an example of the content found in the /etc/hosts file on a JumpStart server named server1 for a client named client1 with an IP address of 192.9.200.100 (includes the timehost alias assigned to the server):

```
192.9.200.1     server1     timehost
192.9.200.100    client1
```

The `/etc/netmasks` *File*

To enable NIS support for a network installation of a JumpStart client, you must update the `/etc/netmasks` file to include the local network netmask value. When converted to its respective NIS map, `netmasks.byaddr`, it supplies the installation program running on the JumpStart client with the local netmask value. If the client netmask information is not available, the client installation displays a dialog box and prompts for it.

The `/etc/netmasks` file contains network masks used to implement IP subnets. It supports both standard subnetting as specified in Request for Change (RFC)-950 and variable length subnets as specified in RFC-1519. When using standard subnets, there should be a single line for each network that is submitted in this file with the network number, any number of SPACE or TAB characters, and the network mask to use on that network. You can specify network numbers and masks in the conventional IP '.' (dot) notation (such as IP host addresses, but with zeroes for the host part). For example, you can use:

```
192.9.200.0     255.255.255.0
```

to specify that the Class C network, `192.9.200.0`, should have eight bits of host field and twenty-four bits in the network field.

Note – See the `man` page for `netmasks` for more examples of subnets.

Setting Up an Install Server

To enable a networked client to install the Solaris Operating Environment, the JumpStart install server must have the Solaris Operating Environment release software image available either on the local disk or from a CD-ROM shared to the network. The most common configuration for the JumpStart install server is to have this software available from the local disk. You use the `setup_install_server` script to accomplish this task. This script was previously described in "Adding a Bootable Image" on page 13-16.

The Solaris Operating Environment releases before release 8 (Solaris 7, 2.6, 2.5, and so on), had only one CD-ROM that contained the entire operating environment. The Solaris 8 Operating Environment has three; an installation CD-ROM, 1 of 2, and 2 of 2. To establish an installation server that contains the capability provided by the three CD-ROM set, you must make use of three different installation scripts:

To set up a install server that uses the Solaris 8 software image located on the local disk, perform following steps:

1. Ensure that the system has an empty directory (`/export/install`, for example) with approximately 700 Mbytes of available disk space.

2. Insert the Solaris 8 Software CD-ROM 1 of 2 in the CD-ROM drive, allowing `vold` to automatically mount the CD-ROM.

3. Change the directory to the location of the `setup_install_server` script.

```
# cd /cdrom/cdrom0/s0/Solaris_8/Tools
```

4. Run the `setup_install_server` script to copy the release software from the CD-ROM to the local disk (this process takes about one hour):

```
# ./setup_install_server /export/install
```

There are two additional scripts that add functionality to the JumpStart boot or installation server; `add_to_install_server` and `modify_install_server`. For more information, see "Adding a Bootable Image" on page 13-16.

The `add_to_install_server` *Script*

The `add_to_install_server` script located on the Solaris 8 Software CD-ROM 2 of 2 enables the installation of supplemental CD-ROM products directories to an existing install server. If you do not use this script to install the additional Solaris Operating Environment release software located on CD-ROM 2 of 2, you will be limited to Core and EndUser software clusters.

To add the Solaris 8 Operating Environment supplemental software products to an existing install server, perform the following steps (this process takes about 15 minutes):

1. Insert the Solaris 8 Software CD-ROM 2 of 2 in the drive.

   The `vold` daemon automatically mounts the CD-ROM.

2. Change the directory to the location of the `add_to_install_server` script.

```
# cd /cdrom/cdrom0/Solaris_8/Tools
```

3. Run the `add_to_install_server` script to install the additional software into the installation directory on the JumpStart server (assuming the location to be `/export/install`).

```
# ./add_to_install_server /export/install
```

The `modify_install_server` *Script*

The `modify_install_server` script located on the Solaris 8 Software Installation CD-ROM enables an interactive WebStart style of installation on the client.

Warning – Running the `modify_install_server` script actually defeats the purpose of the JumpStart program. It disables the non-interactive benefit of the JumpStart program. The resulting installation process will be *interactive*.

Setting up the Configuration Server

This section elaborates on the JumpStart configuration server setup. This system provides the configuration files for the JumpStart clients as previously discussed (see "Jumpstart Components: section).

The configuration directory minimally contains the following files:

- The `rules` file

  The `rules` file classifies the machines on your network using a set of predefined keywords (included in Appendix A, "The JumpStart `rules` and Class Files"). It also specifies the *class* file to be used by each class of machines.

- A *class* file for each category of machines you have determined on your network

  The class files specify how the installation is to be done and what software is to be installed. The name of a class file is chosen by the system administrator and should follow UNIX file name conventions.

- The `check` script

  You must run the `check` script after the `rules` and `class` files are created. It checks the syntax in the `rules` and `class` files. If there are no syntax errors, the `check` script creates the `rules.ok` file.

- The `rules.ok` file is created from the `rules` file by the `check` script. It is read during the automatic installation process (the `rules` file is not looked at).

- Optional `begin` and `finish` scripts.

- The begin and finish scripts are used to perform pre-installation and post-installation tasks. These scripts are available to perform more advanced customization of the installation process, such as answering the power management question that is asked when the newly-installed system first boots.

Setting Up a Configuration Server Directory

To set up a configuration directory, perform the following steps:

1. Select the system that will be the JumpStart configuration server and create the directory where you want to store the configuration information files. For the purpose of this discussion, use the `/export/config` directory as the name.

2. Mount the CD-ROM and copy the contents of the `/cdrom/sol_8_sparc/s0/Solaris_8/Misc/jumpstart_sample` directory located on the Solaris 8 Software CD 1 of 2 to your local `/export/config` directory. The `jumpstart_sample` directory from the CD-ROM contains template configuration files that you can customize; the `rules` file, several class files, a finish script, and the `check` script.

3. Share the configuration directory.

   - Add an entry to share the configuration directory to the network in the `/etc/dfs/dfstab` file. For example:

```
share -d “configuration directory” /export/config
```

   - Execute the `/etc/nfs.server start` command.

Note – If the system is already an NFS server, you need to run only the `shareall` command.

---

4. Determine the different classes of machines that are or will be on your network and create the /export/config/`rules` file.

   During the auto-install process, the install client is matched to a class in the `rules` file. Each class defined in the `rules` file has a specified file, called a *class* file, associated with it that is used to install the software.

5. Determine what installation parameters to use for each class (category) of machines you listed in step 4 and create an `/export/config/`*`class`* file for each (see the "Creating the Class Files" section on page 13-35). The class file specifies how to partition the disk, what software clusters and packages to install, and what file systems to mount. (See the `host_class` template file in the configuration directory.)

6. Create `begin` and `finish` scripts. (This is optional.)

   A *`begin`* *script* is run before the class file; that is, before the actual installation of software specified in the class file. A *`finish`* *script* is run after the class file but before the system is rebooted. You can use it to modify the files or file systems of the newly installed system.

7. After configuration of the `rules` file, the class files, and the begin and finish scripts, run the `check` script. This script checks the `rules` and class files for correctness and basic syntax. If no fatal errors are found, the `rules.ok` file is created from the `rules` file. It is the `rules.ok` file that is used by the client during the installation process.

   a. If the configuration server is running the Solaris 8 Operating Environment, run the following commands:

```
# cd /configuration_directory
# ./check
```

   If the configuration server is not running the Solaris 8 Operating Environment, use the `-p` option to specify the path to the Solaris 8 distribution.

   b. Mount the Solaris 8 distribution CD-ROM on the configuration server (unless the configuration server is also the install server and you copied the distribution to the install server).

   c. Run the following commands:

```
# cd /configuration_directory
# ./check -p /path_to_Solaris_distribution
```

Creating the `rules` *File*

The `rules` file classifies the machines on your network. You should have a template of a `rules` file (an actual file called `rules`) in your configuration directory after you copy the `jumpstart_sample` directory to your configuration directory.

The `rules` file is read sequentially. As soon as the system finds a match in the `rules` file, it stops reading the file and continues with the JumpStart process. The fields are defined in Table 13-2 on page 13-32.

Syntax

```
[!] match_key match_value [&& [!] match_key match_value]* \
begin class finish
```

Table 13-2 describes the fields in the `rules` file.

Table 13-2 Fields in the `rules` File

Field	Definition
match_key	A predefined keyword that describes an attribute of the system being installed. Examples of system attributes include physical memory size, disk sizes, kernel architecture, and so on. Keywords are used to help match a machine to a particular class for installation and are interpreted with respect to the install client.
match_value	The value (or range of values) selected by the system administrator for the *match_key*.
begin	The name of the `begin` script. A `-` is used in the `begin` field if no `begin` script is to be run during the automatic installation process.
class	The name of the `class` file. The names for the `class` files are chosen by the system administrator and must follow UNIX file name conventions.
finish	The name of the `finish` script (or a dash, –).

Using the && Symbols

You can use several keywords in a rule. They are joined together by the logical AND symbol, `&&`.

Using the ! Symbol

The logical NOT `!` symbol, is used in front of a keyword to express negation. That is, to express that the install client's value for *`match_key`* does not equal the *`match_value`* specified in the rule.

Comments

You can use comments in the `rules` file.

A comment begins after a hash(#) sign. If a line starts with a #, then the entire line is a comment line. If a # is found in the middle of a line, everything after the # is considered a comment.

Note – Blank lines are also allowed in the `rules` file.

Available Keywords

Use the following keywords to classify the machines on your network. See Appendix A, "The JumpStart `rules` and Class Files," for a detailed description of each keyword.

Table 13-3 Keywords

Keywords		
`any`	`hostname`	`model`
`arch`	`installed`	`network`
`domainname`	`karch`	`totaldisk`
`disksize`	`memsize`	

Examples of `rules` *File Entries*

The following is an example of the `rules` file entries.

```
#
# The first five rules listed here demonstrate specifics:
#
hostname   client1     -     host_class     set_root_pw
hostname   client2   -   class_basic_user     -
network   192.43.34.0  &&  ! model 'SUNW,Ultra-5_10'  -   class_net3   -
model    'SUNW,Ultra-5_10'   -   class_ultra    complete_ultra
memsize   64-96   &&   arch   sparc   -   class_prog_user   -
#
# The following rule matches any system.
any   -    -   class_generic   -
```

In this `rules` file example:

- The first rule matches a machine on a network called `client1`. The class file is `host_class` and the finish script is `set_root_pw`.
- The second rule matches a machine with host name `client2`. The class file is `class_basic_user`.
- The third rule matches a machine on network 192.43.34 that is not an Ultra 5 or 10. The class file is `class_net3;` there is no `begin` or `finish` script.
- The fourth rule matches a machine that is an Ultra 5 or 10. The class file is `class_ultra`, and there is a `finish` script called `complete_ultra`.
- The fifth rule matches a machine with memory between 64 and 96 Mbytes and a SPARC architecture. The class file is `class_prog_user`.
- The sixth rule matches any machine. The class file is `class_generic` and there is no `begin` or `finish` script

Creating the Class Files

A class file, which is specified in a rule, determines how the installation is performed on the client and what software is installed. Unlike the `rules` file, class files do not have required names. However, just as for the `rules` file, there are predefined keywords that require certain parameters.

Keywords and Arguments

The following keywords and argument parameters are used in a class file to specify how the installation is to be done and what software to install. Refer to Appendix A, "The JumpStart `rules` and Class Files," for a detailed description of each of the keywords and parameters listed in Table 13-4.

Table 13-4 Keywords and Argument Parameters for `class` Files

Keywords	Parameters
`install_type`	`initial_install | upgrade`
`system_type`	`standalone | dataless | server`
`partitioning`	`default | existing | explicit`
`cluster` *`cluster_name`*	`add | delete`
`package` *`package_name`*	`add | delete`
`usedisk`	*`disk_name`*
`dontuse`	*`disk_name`*
`locale`	*`locale_name`*
`num_clients`	*`number`*
`client_swap`	*`size`*
`client_arch`	*`kernel_architecture`*
`filesys`	*`device size file_system optional_parameters`*

Examples of Class Files

This section contains examples of class files.

Example 1

```
# Select software for programmers
install_type       initial_install
system_type        standalone
partitioning       default
filesys            any   100 swap  # specify size of swap
filesys            server1:/usr/share/man - /usr/share/man ro,soft
cluster            SUNWCprog
package            SUNWman  delete
package            SUNWypr  add
package            SUNWypu  add
```

This class file installs a system for programmers. The partitioning is determined by the software to be installed and the swap size is set to 100 Mbytes. The configuration cluster `SUNWCprog` contains packages for developing software in the Solaris 8 Operating Environment. The man pages from this cluster are deleted because they are mounted from `server1`, a server on the network. The NIS server packages, `SUNWypr` and `SUNWypu` are added.

The list of possible entries for the `cluster` keyword as it relates to the interactive installation names are shown in Table 13-5.

Table 13-5 Possible Entries for the `cluster` Keyword

Interactive Installation Name	Cluster File Name
`Core`	`SUNWCreg`
`User`	`SUNWCuser`
`Developer`	`SUNWCprog`
`Entire Distribution`	`SUNWCall`
`Entire Distribution plus OEM`	`SUNWCXall`

Example 2

```
install_type    initial_install
system_type     standalone
partitioning    explicit
filesys         c0t3d0s0  150   /
filesys         c0t3d0s1  128   swap
filesys         c0t3d0s6  800   /usr
filesys         c0t3d0s7  free  /var
filesys         c0t1d0s7  all   /opt
cluster         SUNWCall
package         SUNWman   delete
```

Note – This class file is intended for an end-user with a small disk who does not need the manual pages package, `SUNWman`.

Appendix A of the *Solaris 8 System Installation and Configuration Guide* contains a description of the clusters and packages available on the Solaris 8 software distribution CD-ROM.

Testing the Configuration with the `pfinstall` *Command*

The `pfinstall` command checks the *semantics* of your class files. It tests what happens during the automatic installation process, without actually performing an installation.

This command is successful only if the configuration and install server are the same system or the two systems are both running the same version of the Solaris 8 Operating Environment.

Running the `pfinstall` *Command*

To run the `pfinstall` command, perform the following steps:

1. If you have copied the entire CD-ROM Solaris 8 Operating Environment distribution to the local disk, run the `pfinstall` command (optional).

Syntax

```
# /usr/sbin/install.d/pfinstall -D | -d disk_file \
[-c path_to_distr] class_file_name
```

Options

`-D` Performs a dry run installation on the system disks using the class file *`class_file_name`*. It displays the resulting disk configuration and software selected, but no information is written to the disks.

`-d` Tests the *`class_file_name`* against the disk configuration described in the file *`disk_file`*. The *`disk_file`* file contains output from the running of the `prtvtoc`(1M) command on various disks. This gives you the ability to test your class file on various disk configurations.

`-c` Specifies the path to the Solaris 8 Operating Environment distribution

✓

`pfinstall` *Examples*

This section presents three examples of the `pfinstall` command run to test the default class file `host_class` and includes some of the system output.

Example 1

Testing the class file, `host_class`, against the Solaris 8 Operating Environment installation image located on the CD-ROM:

```
# cd /export/config
# /usr/sbin/install.d/pfinstall -D -c /cdrom/cdrom0/s0 prog_class
Parsing profile
       0: install_type   initial_install
       1: locale         en_US
       2: system_type    standalone
       3: partitioning   default
       4: cluster        SUNWCuser
       5: cluster        SUNWCown   delete
       6: cluster        SUNWCtltk  delete
       7: cluster        SUNWCxgl   delete
       8: cluster        SUNWCxil   delete
       9: filesys         srvr:/usr/openwin  -  /usr/openwin ro,intr

Processing default locales

Processing profile
        - Selecting cluster (SUNWCuser)
        - Deselecting cluster (SUNWCown)
        - Deselecting cluster (SUNWCtltk)
```

<output truncated>

Example 2

Testing a disk file, `4GBdisk` file and the `host_class` file, against the Solaris 8 installation image located on the CD-ROM:

Note – The `4GBdisk` file is created from the output of the `prtvtoc` command run on a 4-Gbyte disk. This disk file can be used to create standard disk partitioning on JumpStart clients with 4-Gbyte disks.

```
# cd /export/config
# /usr/sbin/install.d/pfinstall -d 4GBdisk -c /cdrom/cdrom0/s0 prog_class

....<some output deleted> ...

Verifying disk configuration

Verifying space allocation
- Total software size:  399.62 Mbytes

Preparing system for Solaris install

Configuring disk (c0t0d0)
           - Creating Solaris disk label (VTOC)
                slice:  0  (              /)  tag:  0x2   flag:  0x0
                slice:  1  (           swap)  tag:  0x3   flag:  0x1
                slice:  2  (        overlap)  tag:  0x5   flag:  0x0
                slice:  3  (               )  tag:  0x0   flag:  0x0
                slice:  4  (               )  tag:  0x0   flag:  0x0
                slice:  5  (               )  tag:  0x0   flag:  0x0
                slice:  6  (               )  tag:  0x0   flag:  0x0
                slice:  7  (   /export/home)  tag:  0x8   flag:  0x0

Creating and checking UFS file systems
        - Creating / (c0t0d0s0)
        - Creating /export/home (c0t0d0s7)

<output truncated>
```

Example 3

Testing an install image that has been copied from the CD-ROM Solaris 8 software distribution to the local `/export/install` directory against the `host_class` file:

```
# cd /export/config
# /usr/sbin/install.d/pfinstall -D -c /export/install host_class

....<some output deleted> ...

SUNWtleu....done.    1.81 Mbytes remaining.
SUNWnamdt...done.    1.80 Mbytes remaining.
        SUNWnamos...done.    1.60 Mbytes remaining.
SUNWnamow...done.    1.52 Mbytes remaining.

Completed software installation

Solaris 8 software installation succeeded
Solaris 8 packages fully installed
                SUNWxwrtx
                SUNWxwrtl
                SUNWwsr
                SUNWwbapi
<some output omitted>
Customizing system devices
        - Physical devices (/devices)
        - Logical devices (/dev)

Installing boot information
        - Installing boot blocks (c0t0d0s0)

Installation log location
        - /a/var/sadm/system/logs/install_log (before reboot)
        - /var/sadm/system/logs/install_log (after reboot)

Mounting remaining file systems
        - Mounting /a/export/home (/dev/dsk/c0t0d0s7)

Installation complete

Test run complete. Exit status 0.
```

Using install_scripts

Use add_install_client and rm_install_client to add or remove clients to the install server or boot servers that you must set up to support the JumpStart installation, because these commands update the /etc/bootparams file.

Running the add_install_client *Script*

The add_install_client command must be run from the install server's Solaris installation image (a mounted Solaris Operating Environment CD-ROM or a Solaris Operating Environment CD-ROM copied to disk) or the boot server's boot directory (if a boot server is configured). The Solaris installation image or the boot directory must be the same Solaris Operating Environment release that you want installed on the client.

Syntax

```
# ./add_install_client -e ethernet_addr -i ip_addr \
-s install_svr:/distr -c config_svr:/config_dir \
-p sysid_config_svr:/sysid_config_dir client_name client_arch
```

- -e Specifies the Ethernet address of the install client and is necessary if the client is not defined in the name service.
- -i Specifies the IP address of the install client and is necessary if the client is not defined in the name service.
- -s Specifies the name of the install server and the path to the Solaris 8 Operating Environment distribution. This option is necessary if the client is being added to a boot server.
- -c Specifies the configuration server and the path to the configuration directory.
- -p Specifies the configuration server and the path to the sysidcfg file. This option is available on Solaris 8 Operating Environment and later distributions.

You can apply the following associations to the examples of the `add_install_client` command arguments:

Install server	*`install_svr`*
Distribution	copied to `/export/install`
Configuration server	*`config_svr`*
Configuration directory	`/export/config`
Boot server	*`boot_svr`*
Install client	*`client_name`*
Client architecture	*`client_arch`*

Adding a Client Using a Solaris CD-ROM Image on the Local Disk

To create a JumpStart client from a server that has the Solaris 8 software copied to the local disk (see "Setting Up an Install Server" on page 13-26), perform the following steps:

1. Change the directory to the location of the installed Solaris 8 Operating Environment image:

```
# cd /export/install/Solaris_8/Tools
```

2. Create the JumpStart client using the `add_install_client` script found in the local directory. The following command creates a `sun4u` architecture client named `client1` using `server1` as its install and configuration server:

```
# ./add_install_client -s server1:/export/install \
-c server1:/export/config \
-p server1:/export/config client1 sun4u
```

Note – The location of the Solaris 8 software installation files (`-s` option) in the command indicate the `/export/install` directory. The location of the JumpStart configuration files (`-c` option) on `server1` in the previous command indicate the `/export/config` directory. Discussion of the JumpStart configuration files is subsequent to this section.

Adding a Client Using a Solaris CD-ROM Image From the CD-ROM

To create a JumpStart client from a server that does *not* have the Solaris 8 software CD-ROM Image copied to the disk, perform the following steps:

1. Insert the Solaris 8 Software Installation CD-ROM in the drive.

   The `vold` daemon automatically mounts the CD-ROM.

2. Change the directory to the location of the `add_install_client` script on the Solaris 8 CD-ROM 1 of 2:

```
# cd /cdrom/cdrom0/s0/Solaris_8/Tools
```

3. Create the JumpStart client using the `add_install_client` script found in the that directory. The following command created a `sun4u` architecture client named `client1` using the Solaris 8 software CD-ROM for its installation and a local directory (`/export/config`) on server1 for the `sysidcfg` and other configuration files:

```
# ./add_install_client -c server1:/export/config \
-p server1:/export/config client1 sun4u
```

Note – Additionally, running the previous `add_install_client` command creates an entry in the `/etc/dfs/dfstab` file to share the `/cdrom` directory to the network for mount by the JumpStart client. Installation software is obtained from the media.

The `/etc/bootparams` *File Content*

The `/etc/bootparams` file is updated each time the `add_install_client` script is run. The resulting content provides the server name(s) and the directory locations for the installation and configuration files.

Content With Locally Available Installation Files

A server named `server1` with Solaris 8 software files copied to the local disk (see "Adding a Client Using a Solaris CD-ROM Image on the Local Disk" on page 13-43) and shared to the network has a `client1 /etc/bootparams` entry as follows:

```
client1 root=server1:/export/install/Solaris_8/Tools/Boot
install=server1:/export/install boottype=:in
sysid_config=server1:/export/config install_config=server1:/export/config
rootopts=:rsize=32768
```

Content from the CD_ROM Installation Files

A server named server1 with Solaris 8 software files shared to the network from the `/cdrom` directory (see "Adding a Client Using a Solaris CD-ROM Image From the CD-ROM" on page 13-44) has a `client1 /etc/bootparams` entry as follows:

```
client1 root=server1:/cdrom/sol_8_sparc/s0/Solaris_8/Tools/Boot
install=server1:/cdrom/sol_8_sparc/s0 boottype=:in
sysid_config=server1:/export/config install_config=server1:/export/config
rootopts=:rsize=32768
```

The `/etc/dfs/dfstab` *File Content*

The `/etc/dfs/dfstab` file is populated with the appropriate entry for either the local file system or the CD-ROM, depending on the directory location from which the `add_install_client` command is run. If the location of the shell was `/cdrom/cdrom0/s0/Solaris_8/Tools`, the entry in the `/etc/dfs/dfstab` would be updated with a `share` command for the CD-ROM. Conversely, if the location of the shell was `/export/install/Solaris_8/Tools` (or some other arbitrary installation directory location), the `/etc/dfs/dfstab` would be updated with a `share` command for that local directory.

Referencing the Solaris Software from Locally Available Installation Files

The following `/etc/dfs/dfstab` file entry reflects the shared directory (`/export/install`) of installation files from a local disk:

```
share  -F nfs  -o ro,anon=0 /export/install
```

Referencing the Solaris Software from CD-ROM Installation Files

The following `/etc/dfs/dfstab` file entry reflects the shared directory of installation files from the CD-ROM:

```
share -F nfs -o ro,anon=0 /cdrom/sol_8_sparc/s0
```

Note – All directory entries listed in the `/etc/bootparams` *must* be shared file systems.

Initiating a JumpStart Installation

Once you have created the boot, install, and configuration services for the local network, you must boot the JumpStart client.

Boot Install Clients

You can use one of the following methods to boot a JumpStart client.

- New machines

  Turn on the machine.

- Existing machines

  Issue the following command:

  ok **boot net - install**

Note – If your local network is running the NIS name services, you *must* update the appropriate maps to support the JumpStart installation, otherwise, the client boot process will be unsuccessful.

JumpStart Capabilities and Limitations

Table 13-6 compares the capabilities and limitation of the JumpStart program.

Table 13-6 JumpStart Capabilities and Limitations

	Capabilities	**Limitations**
Solaris Operating Environment software	Installs the Solaris Operating Environment on new systems. Upgrades existing Solaris 2.1 Operating Environment and later systems to later releases.	Default partition sizes for previous Solaris Operating Environment releases can prevent the use of the JumpStart upgrade to later releases.
Site-specific customizations	Allows for site-specific profiles and scripts to be added for flexibility.	None.
Sun unbundled products	Have no specific support in the Solaris 8 Operating Environment.	Use with Sun unbundled products is not prohibited with the Solaris 8 Operating Environment JumpStart product, but you must write product-specific scripts to install the software packages in the product. You also have to consider disk partitioning and software licensing for the product.
Third-party products	Have no specific support in the Solaris 8 Operating Environment.	Use with third-party products is not prohibited with the Solaris 8 Operating Environment JumpStart product, but you must write product-specific scripts to install the software packages in the product. You also must consider disk partitioning and software licensing for the product

Table 13-6 JumpStart Capabilities and Limitations (Continued)

	Capabilities	**Limitations**
Patches	Can be applied automatically.	None.
Configurations supported	Installs: Servers Standalone systems Dataless systems	Does not install diskless clients.
Operations handled by default	Partitions disks and sizes of file systems. Assigns host name and name service domain (NIS+, NIS, or local files).	Requires more administrative steps; for example, the script `set_root_pw`, which is located in the `jumpstart_sample` directory is the script needed to assign root password. Requires IP addresses to be manually allocated by the administrator.
Operation handled by additional scripts	Enables arbitrary site-specific customization, such as: setting up a second Ethernet port on a machine and making it a router; adding additional non-`root` users to a local system, setting up print servers; adding known print servers to a print client; and adding entries to the automount map.	None.
Network configuration/ routers		Requires a boot server on the local network or subnet. Allows install servers to be placed on the opposite side of a router.

Table 13-6 JumpStart Capabilities and Limitations (Continued)

	Capabilities	**Limitations**
Concurrent use/batch mode	Has no software limitation on the number of clients that can be installed concurrently.	Has physical limitations that include: The install server is more responsive if its copy of the Solaris Operating Environment distribution is on disk, rather than on the CD-ROM device, which is slow for random accesses. The number of clients concurrently doing an installation also negatively affects performance.

Worksheet for Configuring for JumpStart Installation Exercise

Install server name:_____

Timehost server name:_____

Note – Without an assigned `timehost` entry for one of the Solaris Operating Environments, the JumpStart process becomes interactive, prompting you for the `timehost` information. The NIS master is a good candidate for this exercise.

Solaris Operating Environment distribution location at:
_____

Configuration server name:_____

Configuration directory:_____

Boot server name:_____

Directory containing client support:_____

Install client's name:_____

Install client's IP address:_____

Install client's Ethernet address:_____

Install client's architecture:_____

Exercise: Configuring for a JumpStart Installation

Exercise objective – In this lab, you will configure a JumpStart server to support one install client.

Preparation

This exercise requires a functioning NIS environment. Use the NIS master as the JumpStart server, and the NIS client as the install client. Do not use any existing NIS slave servers as JumpStart Clients. The locale map must be included in the NIS Makefile. Verify that the `/etc/bootparams`, `/etc/timezone`, `/etc/ethers`, `/etc/netmasks`, and `/etc/locale` files exist and are under NIS control.

Locate the Solaris 8 Software CD-ROM 1 of 2. The JumpStart server will share this CD to allow the client to install the operating environment.

Determine the Ethernet (MAC) address of the client system.

Unshare any NFS shared directories and remove any share commands from `/etc/dfs/dfstab`.

This exercise demonstrates loading the End User configuration cluster from a shared Solaris 8 software 1 of 2 CD. Only the Core and End User configuration clusters can load using JumpStart in this way. JumpStart installations using the Developer, Entire Distribution, or Entire Distribution with OEM support configuration clusters require loading a Solaris 8 image to disk from the Solaris 8 software 1 of 2 and 2 of 2 CDs, and using that image to load JumpStart clients. Refer to your lecture notes as necessary to perform the steps listed.

Tasks

Complete the following steps:

1. On the NIS master server, log in as the user `root`.

2. Edit the `/etc/ethers` file and add an entry for the JumpStart client; for example:

   ```
   8:0:20:2f:90:3d    client1
   ```

3. Edit the `/etc/hosts` file and add an entry for the JumpStart client if one does not already exist. Add the `timehost` alias to the JumpStart server's entry; for example:

   ```
   192.9.200.1      server1   loghost    timehost
   192.9.200.100    client1
   ```

4. Edit or check `/etc/netmasks` to be certain it contains the network number and subnet mask for your network; for example:

   ```
   192.9.200.0 255.255.255.0
   ```

5. Edit the `/etc/timezone` file and add an entry that associates your local time zone with the name of your NIS domain. Entries in this file are case sensitive; for example:

   ```
   US/Mountain       nisdomain
   ```

6. Edit the `/etc/locale` file and add an entry that associates your locale with the name of your NIS domain. Entries in this file are case sensitive; for example:

   ```
   nisdomain       en_US
   ```

7. Update the NIS maps by running the `make` command.

   ```
   # cd /var/yp
   # /usr/ccs/bin/make
   ```

8. Insert the Solaris 8 software CD-ROM 1 of 2 in the CD-ROM drive. Create the directory `/export/config`.

   ```
   # mkdir /export/config
   ```

9. Change directory to `/cdrom/cdrom0/s0/Solaris_8/Misc/jumpstart_sample`.

   ```
   # cd /cdrom/cdrom0/s0/Solaris_8/Misc/jumpstart_sample
   ```

10. Copy the content of the `jumpstart_sample` directory to `/export/config`. This places sample JumpStart configuration files in `/export/config` that you will use to complete the exercise.

    # **cp -r * /export/config**

11. Change directory to `/export/config`. Move the `rules` file to `rules.orig`.

    # **cd /export/config**
    # **mv rules rules.orig**

12. Create a new file called `rules` that contains the following entry. Enter the name of your JumpStart client instead of `client1`:

    `hostname` *`client1`* `- host_class finish_script`

13. Edit the `/export/config/host_class` file so that it specifies an initial install, a standalone system type, explicit partitioning, the End User software cluster, and partitions for root (/), swap, and /usr. Use partition sizes and device names appropriate for the JumpStart client system; for example:

```
install_type    initial_install
system_type     standalone
partitioning    explicit
cluster         SUNWCuser
filesys         c0t0d0s0 300 /
filesys         c0t0d0s1 128 swap
filesys         c0t0d0s6 free /usr
```

14. In `/export/config` create a file called `finish_script` that contains the following lines. Replace *`nisdomain`* with your NIS domain name.

```
#!/bin/sh
touch /a/noautoshutdown
rm /a/etc/defaultdomain
rm -r /a/var/yp/binding/nisdomain
cp /a/etc/nsswitch.files /a/etc/nsswitch.conf
```

    These commands configure the JumpStart client to avoid using the autoshutdown power-saving feature, and remove the NIS client configuration.

15. Change the permission mode of `finish_script` to 555.

    # **chmod 555 finish_script**

16. Run the `/export/config/check` program and correct any problems in the `rules` or `host_class` files that it reports. Verify that the `rules.ok` file exists once `check` completes successfully.

    # **./check**

17. In `/export/config`, create a file called `sysidcfg` that contains the following lines. The string `cCHuD9l9gmxUI` is a 13-character encrypted string for the password `cangetin`. You could replace this string with a different encrypted password string by copying one from your own `/etc/shadow` file.

    ```
    security_policy=none
    network_interface=primary {protocol_ipv6=no}
    root_password=cCHuD9l9gmxUI
    ```

    These lines answer the installation questions about implementing Kerberos security and the IPv6 protocol, and supply a root password.

18. Edit `/etc/dfs/dfstab` to add an entry for the `/export/config` directory as follows:

    ```
    share -o ro /export/config
    ```

19. If the NFS server daemons are not running, start them:

    # **/etc/init.d/nfs.server start**

20. If the NFS server daemons are already running, run `shareall`:

    # **shareall**

21. Change directory to `/cdrom/cdrom0/s0/Solaris_8/Tools.`

    # **cd /cdrom/cdrom0/s0/Solaris_8/Tools**

22. Use the `add_install_client` program to add support for your JumpStart client. The following command example is appropriate for a server that will provide access to the operating environment using a mounted Solaris 8 1 of 2 CD-ROM. Replace *`server1`* with the name of your JumpStart server, *`client1`* with the name of your JumpStart client, and *`sun4x`* with either `sun4u`, `sun4m`, or `sun4c`, depending on the type of client system you are using.

```
# ./add_install_client -c server1:/export/config \
-p server1:/export/config client1 sun4x
```

23. What action does `add_install_client` report that it takes regarding the following:

    `/etc/dfs/dfstab`: _____

    `/etc/inetd.conf`: _____

    `/etc/nsswitch.conf`: _____

    `/tftpboot`: _____

    `rarpd` daemon: _____

    `bootparamd` daemon: _____

24. Update the NIS maps by running the `make` command.

    ```
    # cd /var/yp
    # /usr/ccs/bin/make
    ```

25. Boot the JumpStart client:

    ```
    ok boot net - install
    ```

Exercise Summary

Discussion – Take a few minutes to discuss the experiences, issues, or discoveries that you had during the lab exercises.

- Experiences
- Interpretations
- Conclusions
- Applications

Task Solutions

23. What actions does `add_install_client` report that it takes regarding the following:

    `/etc/dfs/dfstab`: *Copies the original to dfstab.orig, adds a line to share slice 0 of the CD.*

    `/etc/inetd.conf`: *Enables tftp.*

    `/etc/nsswitch.conf`: *Changes the bootparams entry.*

    `/tftpboot`: *Creates the directory, copies inetboot into it.*

    `rarpd daemon`: *Starts it.*

    `bootparamd daemon`: *Starts it.*

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- ❑ List the main components for setting up a JumpStart network installation
- ❑ Set up boot services on a subnet using the `setup_install_server` script
- ❑ Describe the JumpStart client boot sequence
- ❑ List the files necessary to support JumpStart boot operations
- ❑ Describe the use of the `sysidcfg` file with and without name service support
- ❑ Set up a JumpStart installation server to provide the Solaris 8 Operating Environment with the software necessary to install clients.
- ❑ Describe the use of the `add_to_install_server` and `modify_install_server` scripts
- ❑ Add install clients to the install servers and boot servers
- ❑ Create a configuration server with customized `rules` and class files
- ❑ Use the `pfinstall` command to test configuration and installation files
- ❑ Boot install clients
- ❑ Configure NIS name service support for the JumpStart program

Solaris Administrator Workshop 14

Objectives

Upon completion of this module, you should be able to:

- Install the Solaris 8 Operating Environment using both the WebStart and the interactive methods
- Partition a disk to a specified format
- Build new file systems and mount the file systems
- Configure an automount
- Set up an NIS domain
- Create additional swap space
- Set up an NFS mount
- Configure RBAC to allow a `non-root` user to shut down a system
- Create a local and a network printer

Solaris Operating Environment Administrator Workshop

This workshop provides practice using skills learned from this course and its prerequisites. It is designed to take an entire day to complete. To assure adequate time, it is best to begin the software installation steps (steps 1 and 2) at the end of the day preceding the workshop.

Note – It is less important to complete all the steps in the workshop than it is to understand the steps you do complete. Accordingly, work at a pace that promotes comprehension for the entire team, and complete as many steps as time permits.

This workshop also requires students to work in teams. Each team will use three systems. Review all of the steps in the workshop before starting, and divide the work among team members appropriately. Work systematically, and coordinate your activity.

As you work though the steps, take time to understand the solution to each step before proceeding to the next. The goal of this workshop is to promote understanding of administration concepts through practice.

Use the Configuration Steps section and the Configuration Solutions section as complementary resources. The Configuration Steps describe what to accomplish on which systems, but these steps do not tell you how. The Configuration Solutions section offers general advice on how to accomplish the required tasks. Consider dividing responsibility for the information these sections contain among members of your team.

System Preparation

This workshop requires systems configured with two disks, of at least 2 Gbytes each.

Each system requires an external tape drive. Turn off the power to the external tape drive before installing the Solaris 8 Operating Environment.

Identify groups of three systems. The configuration goals in the workshop refer to systems by number (*system1*, *system2*, and *system3*). Determine the host name and IP address for each system.

Detach any servers, that could supply identification information to the systems, from the network as they load the Solaris 8 Operating Environment, because that can interfere with the JumpStart process later in the exercise.

On all systems, set all OpenBoot™ PROM (OBP) parameters to their default values before starting to configure them.

Obtain an updated Network Information Service (NIS) `Makefile` from a classroom server. This `Makefile` should contain entries for a locale map, and corrections for role-based access control (RBAC) related entries.

Configuration Overview

This workshop contains steps to configure three systems so they provide or require services as follows:

- *system1* – NIS slave, JumpStart™ server, `man` page server, work area server
- *system2* – NIS master, `home` directory server, application server
- *system3* – NIS client, JumpStart client

Configuration Steps

Perform the following steps to complete the Solaris administrator workshop:

1. Use the Solaris™ WebStart installation method to configure *system1* and *system2* as follows:

   a. Configure the `swap` area.

      - Use the default placement of the `swap` area and set the size to the minimum size listed.

   b. Complete the system identification information.

      - Use host name, IP address, and netmask information provided by your instructor.
      - Elect to use no naming service. Specify the time zone and time information appropriate for your location.
      - Use `cangetin` for the `root` password.

   c. Complete the configuration information.

      - Disable power management.
      - Select a locale appropriate for your location.
      - Do not install additional products.
      - Perform a custom installation. Install the entire Solaris 8 Operating Environment software distribution.

   d. Complete the file system layout.

      - Configure only one disk, as follows:

Slice	Use	Size
0	`/`	200
1	`swap`	(fixed)
5	`/opt`	300
6	`/usr`	(remainder)
7	`/export/home`	100

2. Use the interactive installation method to configure *system3* as follows:

   a. Complete the system identification information.

      - Use host name, IP address, and netmask information provided by your instructor.
      - Use `cangetin` for the `root` password.

   b. Complete the configuration information.

      - Disable power management. Select a locale appropriate for your location.
      - Install the entire Solaris 8 Operating Environment software distribution.

   c. Complete the file system layout.

      Configure only one disk, as follows:

Slice	Use	Size
0	`/`	300
1	`swap`	128
6	`/usr`	(remainder)

Note – Complete the software installation on all three systems before proceeding.

---

3. On *system1*, divide an unused disk into three partitions where:

   ▼ One has enough space to hold the entire Solaris 8 Operating Environment software release (from the 1 of 2 and 2 of 2 CD-ROMs)

   ▼ The other two use at least 500 Mbytes each.

4. Create file systems and make the changes required to:

   ▼ Automatically `mount` the larger file system to on `/export/install`

   ▼ Automatically `mount` the 500-Mbyte file systems on `/data1` and `/data2`.

5. Mount all three filesystems manually before continuing.

6. On *system1*, load the Solaris 8 software into `/export/install` to support JumpStart operations. Load the software from both the 1 of 2 and 2 of 2 CD-ROMs.

7. On all systems, modify the template initialization file for the Bourne and Korn shells so it includes the appropriate definitions of the following environment variables.

```
EDITOR
LPDEST
ENV
```

Note – Use a printer name that matches the printer you intend to set up. Your instructor can supply values as required.

---

8. On all systems, create an initialization file for the user `root` so it sets the same variables listed in the previous step, and it changes the `root` prompt to display the system name.

   a. Which of these variables is not appropriate for the current `root` shell?

9. Using unique UID numbers, `/export/home` as a base path for home directories, and the Korn shell as a default shell, add users to the three systems as follows:

   - On *system2*, create two users called `user1` and `user2`.
   - On *system1*, create two users called `user3` and `user4`.
   - On *system3*, create two users called `user5` and `user6`.

10. Verify that the correct initialization files for these users are in place.

11. On all systems, make the required changes for each system to communicate with the others using the network.

12. Set up all systems to allow remote `root` logins.

13. On *system2* and *system3*, identify and remove packages that store `man` pages below `/usr/share/man`. Be sure to remove the main package (SUNWman) for the on-line `man` pages.

14. On *system1*, share the man pages that the other systems are now missing. Share this so that in later steps, *system1* could mount its own man pages using the automounter. Make this a read-only share.

15. On *system2* and *system3*, add a direct map to the automount service so these systems automatically mount the man pages from *system1*.

16. On *system2*, make the changes required to share the current home directories of user1 and user2.

17. On *system2*, modify the entries in /etc/passwd for user1 and user2 so they both use home directories below /home instead of /export/home.

18. On *system2*, make changes to the existing indirect map in the *automount* service to support mounting home directories for user1 and user2.

Note – Attempt to use just one entry in the indirect map to accomplish this task.

---

19. Set up NIS as follows:

    a. Make certain the following files in /etc are brought under NIS control:

       - bootparams
       - ethers
       - locale
       - netmasks
       - timezone
       - netgroup

    b. Use an updated Makefile supplied by your instructor. This Makefile should contain entries for a locale map and corrections for RBAC-related entries.

    c. Establish *system2* as an NIS master server.

    d. Establish *system1* as an NIS slave server.

    e. Establish *system3* as an NIS client.

20. Update *system2* to include /etc/auto_direct in NIS. Make sure that the NIS slave server uses the new map.

21. Set up *system2* to treat *system1* and *system3* as trusted hosts for remote root operations.

22. From *system1*, copy the home directories for user3 and user4 to the corresponding location on *system2*.

23. From *system3*, copy the home directories for user5 and user6 to the corresponding location on *system2*.

24. Recursively remove these users' home directories from *system1* and *system3*.

25. On *system2*, duplicate the users you originally created on *system1* and *system3*.

    a. Change the user's home directories to fall below /home instead of */export/home*.

    b. Update NIS.

    c. Remove the original user definitions from *system1* and *system3*.

    d. On *system2*, change ownership of these *home* directories so they match the users who should own them.

    e. Verify that the user logins work on all systems.

26. Change the host name of *system3* in all files where it is specified. Update the NIS master accordingly.

27. Create a new group called class1, and associate user1 and user2 with class1 as a secondary group.

28. Create a directory called /data1/workgroup on *system1*.

    a. Change permissions for /data1/workgroup so all files created within it are owned by the class1 group.

    b. Make the changes required to have *system2* and *system3* mount /data1/workgroup from *system1* when they boot.

    c. Verify that files created in /data1/workgroup are owned by the group class1.

29. Configure all systems with attached external tape drives to make use of those devices.

30. On all systems, create a new device alias at the OBP level and use it as the default `boot` device.

31. Establish *`system2`* as the `loghost`.

32. Enable `inetd` tracing on all systems.

33. On the `loghost`, save `inetd` tracing messages to a file called `/var/log/inetlog`.

34. Configure *`system1`* and *`system3`* to pass `inetd` tracing messages to the `loghost`. Test that messages from `telnet` are correctly logged.

35. On all systems, use a script provided by your instructor to announce all run-level changes.

    a. Edit this script to use the `logger` command to send run-level change messages to the `syslog` utility.

    b. On all systems, modify `/etc/syslog.conf` to log these messages locally into a file called `/var/log/runlevel.`

36. On *`system2`* and *`system3`*, partition a spare disk so it holds at least four equal partitions, and create filesystems as follows:

Note – These four partitions must be identical in size.

---

    a. Create two file systems that use default characteristics from `newfs`.

    b. Create one file system with an inode ratio of 1 inode per 16384 bytes of data space.

    c. Create one file system that uses a 1 percent `minfree` value.

    d. Compare and describe the differences in the values reported by `df -k` for these file systems.

    e. Permanently `mount` one of these file systems as `/morespace`.

37. On *system2* and *system3*, create a 30 Megabyte `swap` file in `/morespace`. Make the changes required to permanently add this file to the `swap` area used on these systems. Verify the new `swap` configuration.

38. On all systems, use `coreadm` to enable saving global core files.

    a. Set the global core file path to `/corefiles/core.nodename.filename.PID`

    b. Run a `csh` process on each system.

    c. Send the `SIGABRT` signal to each `csh` processes to generate `core` files.

    d. For each `csh` process, verify the presence of a `core` file in the current directory and in `/corefiles`.

39. On *system2* and *system3*, change the NFS mounts for the `man` pages to `cachefs` mounts. Make these changes permanent.

40. On *system3*, configure RBAC to allow a non-`root` user to shut down the system.

41. Create a local or network printer on *system2*.

42. Configure *system1* as a JumpStart server to load the Solaris Operating Environment on *system3*.

    a. Use the memory size parameter as the identifying class criteria.

    b. Specify that the client should load the core Solaris Operating Environment installation level.

    c. Specify a disk configuration for *system3* that places the operating environment in one partition.

    d. JumpStart *system3*.

43. Back up the `root` file system on the JumpStart server.

44. Destroy the JumpStart server's `root` file system.

45. Restore the JumpStart server's `root` file system.

46. Verify that *system3* can still use the JumpStart services from this server.

Configuration Solutions

The following section provides configuration advice for completing the workshop. The information in this section is intended to support the tasks described in the Configuration Steps section of the workshop. Except as noted, refer to the Configuration Steps section to know on which systems require each specific action.

Note – The step numbers that follow match those in the Configuration Steps section.

---

1. Installing the Solaris Operating Environment on all three servers takes between an 60 and 90 minutes to complete. It is best to begin steps 1 and 2 before the end of the day preceding the workshop.

   Generally it is sufficient to get the systems to begin installing software from the 1 of 2 CD-ROM, and allow that process to complete over night. The remaining installation from the 2 of 2 CD-ROM takes approximately 20 minutes, and can be completed at the beginning of the day as you prepare to begin the workshop.

   system1 and *system2* install using WebStart. This process takes approximately 15 to 25 minutes longer than installing using the interactive installation method. *system3* installs using the interactive method.

   After specifying localization information, WebStart asks about installing additional products and has items pre-selected. De-select all items to avoid requests later for the additional CD-ROMS where this software resides.

   When configuring disks using WebStart, you may need to adjust the size of the last partition you configure in order for the total size to calculate without error.

2. *system3* is installed using the interactive installation method. Refer to step 1 above for general advice about installing the Solaris operating environment on all three systems.

Note – Complete the software installation on all three systems before proceeding.

---

3. To use the `format` utility to partition an external disk, follow these general steps:

   a. Run `format` and select an unused disk.

   b. Enter the `partition` menu. From the `modify` item select `All Free Hog`.

   c. Change the default free hog partition from 6 to 0. Set partitions 1 and 3 both to 500 Mbytes.

   d. Label the disk and quit the `format` utility.

   On a 2-Gbyte disk this results in a partition 0 large enough to hold the Solaris 8 image required for JumpStart operations later in the workshop.

   The Solaris 8 software image from the 1 of 2 and 2 of 2 CDs combined uses about 632 Mbytes of space, so a slice of at least 800 Mbytes is desirable. The 500(+) Mbyte slices are for general use throughout the lab.

4. To make the required file systems available you must run `newfs`, edit the `/etc/vfstab` file, and create directories for mount points as follows:

   a. Run `newfs` for each file system. If you used the partitioning advice in step 3 above, you would run `newfs` for partitions 0, 1, and 3. For example:

```
# newfs /dev/rdsk/c0t1d0s0
```

   b. Edit the `/etc/vfstab` file to add a line for each of these new file systems: `/export/install`, `/data1` and `/data2`. For example:

```
/dev/dsk/c0t1d0s0 /dev/rdsk/c0t1d0s0 /export/install ufs 2 yes -
```

   c. Create the required mount-point directories for these file systems.

5. Use the `mount` command to manually mount all three filesystems. For example:

```
# mount /dev/dsk/c0t1d0s0 /export/install
```

6. Loading the Solaris 8 software image from both delivery CD-ROMS can take up to 90 minutes to complete, depending on the speed of the CD-ROM and the type of system involved.

   From the `/cdrom/sol_8_sparc/s0/Solaris_8/Tools` directory on the 1 of 2 CD-ROM, run `setup_install_server` to load software into `/export/install`.

   From the `/cdrom/sol_8_sparc_2/Solaris_8/Tools` directory on the 2 of 2 CD-ROM, run `add_to_install_server` to add software into `/export/install`.

7. Edit the `/etc/skel/local.profile` file. Add definitions for the following variables:

```
EDITOR=vi
LPDEST=printer1
ENV=$HOME/.kshrc
```

   Set the `LPDEST` variable to the name of the printer you intend to establish later in the workshop.

   Add these variables to the list of those that are exported. For example:

```
export PATH EDITOR LPDEST ENV
```

8. In the `/.profile` file, add the lines required to set the appropriate variables. For example:

```
PS1="system1# "
EDITOR=vi
LPDEST=printer1
export EDITOR LPDEST PS1
```

Note – Set the `PS1` variable to the name of the system in question.

---

   a. *The* `ENV` *variable is not appropriate for the Bourne shell used by* `root`*.*

9. Use either `admintool` or `useradd` to add the required users. If you use `admintool`, the `.profile` file should be automatically copied into the home directory of each user. If you use `useradd`, you must rename `local.profile` to `.profile` in the home directory of each user.

   Use UID numbers 1001 through 1006 for `user1` through `user6`.

   Use home directories called `/export/home/user1` through `/export/home/user6` for `user1` through `user6`.

10. Check that the `.profile` file exists in the home directory of each user and that it matches the content of `/etc/skel/local.profile`.

11. Edit `/etc/hosts` to add the IP address and host name of the other two systems in your group. Only one `loghost` entry, associated with the current host, should exist in each file.

12. Edit `/etc/default/login` and comment out the CONSOLE variable.

13. To list packages related to `man` pages, try the following commands:

```
# pkginfo | grep anual
# pkginfo | grep man
# pkginfo | grep pages
# pkginfo | grep Pages
```

   To find packages that store files in `/usr/share/man`, use `pkgchk`. For example:

```
# pkgchk -v SUNWman
```

   Use `pkgrm` to remove at least the `SUNWman, SUNWzsh, SUNWwsr, SUNWjvman` packages. Other packages, such as `SUNWgzip,` also install `man` pages in `/usr/share/man`, so these may remain after removing the other packages. Ignore them.

14. To avoid a deadlock condition on *`system1`* you must rename `/usr/share/man` to a different directory, for example: `/usr/share/man.share`. You can then share `/usr/share/man.share` on *`system1`* using the `dfstab` file.

   Until NIS services are established that include a direct map for the `man` pages, the `man` pages will be unavailable on *`system1`*. This NIS configuration happens in step 20.

You must use the directory name you choose to share here as the directory to mount in the direct map in step 15.

To share the man pages given the example above, enter the following line to /etc/dfs/dfstab:

```
share -o ro /usr/share/man.share
```

Start the NFS server daemons:

```
# /etc/init.d/nfs.server start
```

15. To add a direct map to the automount service, edit /etc/auto_master and create /etc/auto_direct as follows:.

    a. Add the following entry to /etc/auto_master:

```
/- auto_direct
```

    b. In /etc/auto_master, comment out the +auto_master entry.

    c. Create a file called /etc/auto_direct that contains a line to mount the man pages from *system1*. For example:

```
/usr/share/man   -ro  system1:/usr/share/man.share
```

    Be certain that the path you ask to mount matches the path that the server is sharing.

    d. After making these changes, it is necessary to run the automount command to update automountd.

16. To share the home directories for user1 and user2, edit /etc/dfs/dfstab and start the NFS server daemons as follows:

    a. Edit /etc/dfs/dfstab and add a line to share /export/home. For example:

```
share /export/home
```

    b. Start the NFS server daemons:

```
# /etc/init.d/nfs.server start
```

17. Edit the /etc/passwd file and change the references to /export/home/user1 and /export/home/user2 to read /home/user1 and /home/user2 respectively.

18. Add the following entry to `/etc/auto_home` to allow the home directories of `user1` and `user2` to `mount` automatically. Use the host name appropriate for your system.

```
* system2:/export/home/&
```

In `/etc/auto_home`, comment out the `+auto_home` entry.

You can test this configuration by logging in as `user1` or `user2` on *`system2`*.

19. To set up the NIS master server, slave server and client, perform the following:

    a. The NIS master requires the following changes:

    - Use `touch` to update or create the following files in `/etc`: `bootparams`, `ethers`, `locale`, `netmasks`, `timezone`, and `netgroup`.
    - Set the NIS domain name using the `domainname` command.
    - Record the NIS domain name in `/etc/defaultdomain`.
    - Make a backup copy of `/var/yp/Makefile`.
    - Copy an updated NIS `Makefile` into `/var/yp`. Your instructor should supply this `Makefile`.
    - Run `ypinit -m` to establish the NIS master configuration. Supply the name of the NIS slave server as requested.
    - Copy `/etc/nsswitch.nis` to `/etc/nsswitch.conf`.
    - Start the NIS daemons by running: `/usr/lib/netsvc/yp/ypstart`.

Note – On the master server, copying the `nsswitch.nis` file to `nsswitch.conf` before running `ypinit -m` causes the `ypinit` process to indicate that the server was set up with errors. To avoid this problem, copy this file as required after running `ypinit -m`.

---

    b. The NIS slave server requires the following changes:

    - Use `touch` to update or create the following files in `/etc`: `bootparams`, `ethers`, `locale`, `netmasks`, `timezone`, and `netgroup`.
    - Set the NIS domain name using the `domainname` command. Use the same domain name as the master.
    - Record the NIS domain name in `/etc/defaultdomain`.

- Run `ypinit -c` to temporarily establish a NIS client configuration. Supply the name of the NIS master and slave servers as requested.

Note – Add the master server first, and the slave server second. If you do not do this, the NIS slave server will not transfer new maps when you add them in subsequent steps.

- Copy `/etc/nsswitch.nis` to `/etc/nsswitch.conf`.
- Start the NIS client daemon by running: `/usr/lib/netsvc/yp/ypstart`.
- Run `ypinit -s` *`master`* to establish the NIS slave server configuration. Replace `master` with the name of the NIS master server.
- Start the NIS server daemons by running: `/usr/lib/netsvc/yp/ypstart`.

c. The NIS client requires the following changes:

- Set the NIS domain name using the `domainname` command. Use the same domain name as the master.
- Record the NIS domain name in `/etc/defaultdomain`.
- Run `ypinit -c` to establish a NIS client configuration. Supply the name of the NIS master and slave servers as requested.
- Copy `/etc/nsswitch.nis` to `/etc/nsswitch.conf`.
- Start the NIS client daemon by running: `/usr/lib/netsvc/yp/ypstart`.

20. Adding the direct map for `/etc/auto_direct` requires the following:

a. Modify `/var/yp/Makefile` on the NIS master in the following ways:

- Add `auto.direct` to the target called "`all`".
- Duplicate the section that runs `makedbm` for the `auto.home.time` entry and replace the string `home` with `direct`.
- Add the item `auto.direct: auto.direct.time` to the dependency list below the entry for `auto.home`.
- Add the item `$(DIR)/auto_direct:` in the same list below the similar entry for `auto_home`.

b. Run `make` on the NIS master for the changes to take effect.

This command will hang when the master tries to update the slave server. Use `Control-c` to stop it. Go on to step c.

c. On the NIS slave server run the following command to transfer the new map:

```
# /usr/lib/netsvc/yp/ypxfr auto.direct
```

Note – The NIS slave server must have been set up to `bind` to the NIS master before itself in order for this last command to work.
Refer to step 19 b for more information.

---

d. On systems other than the NIS master that have their own local `/etc/auto_direct` file used to access man pages, remove that file from `/etc`.

21. To set up a system to trust others for `root` operations, create a `/.rhosts` file that lists the names of the hosts you want to trust.

22. To copy home directories from the system where they reside to a different system, use the following commands. Substitute the destination server name for *system2*.

```
# cd /export/home
# rcp -r user* system2:/export/home
```

23. To copy home directories from the system where they reside to a different system, use the following commands. Substitute the destination server name for *system2*.

```
# cd /export/home
# rcp -r user* system2:/export/home
```

24. To recursively remove home directories from a system, use the following commands:

```
# cd /export/home
# rm -r user*
```

25. To move users and their home directories to the NIS master server, perform the following:

    a. On the NIS master server, Use `admintool` to duplicate the users you originally created on *system1* and *system3*. Be certain to:

       - Use `UID` numbers `1003` through `1006` for `user3` through `user6`.
       - Use home directories called `/home/user3` through `/home/user6` for `user3` through `user6`.
       - Elect not to create home directories.

    b. On the NIS master server, change directory to `/var/yp` and run `/usr/ccs/bin/make` to update NIS.

    c. On *system1* and *system3*, use `admintool` or `userdel` to remove local definitions for `user3` through `user6`.

    d. On the NIS master, change ownership of the user's home directories as follows:

```
# cd /export/home
# for i in 3 4 5 6
> do
> chown -R user$i:staff user$i
> done
```

    e. Use `su - user#`, or `login` using CDE to verify that the user logins work on all systems.

Note – It may be necessary to `reboot` *systems1* and *system3* once to allow all users to log in.

---

26. To change a system's name, you can manually edit the following files and replace the old name with the new one:

```
/etc/hosts
/etc/hostname.hme0
/etc/nodename
/etc/net/ticots/hosts
/etc/net/ticotsord/hosts
/etc/net/ticlts/hosts
```

    Reboot the system when finished.

On the NIS master server, edit /etc/hosts to reflect the new name. Change directory to /var/yp and run /usr/ccs/bin/make.

27. On the NIS master server use admintool or groupadd to add a group called class1. Use admintool or usermod to associate user1 and user2 with class1 as a secondary group.

    On the NIS master, change directory to /var/yp and run /usr/ccs/bin/make.

28. To create a directory that uses SETGID permissions and that can be mounted by other systems, perform the following:

    a. Create the directory /data1/workgroup. Change the group ownership to class1 and apply the SETGID bit and permissions as follows:

```
# chgrp class1 /data1/workgroup
# chmod g+s /data1/workgroup
# chmod 775 workgroup
```

    b. On the system where /data1/workgroup resides, edit /etc/dfs/dfstab and add the following line:

```
share /data1/workgroup
```

    Verify that the NFS server daemons mountd and nfsd are running, and run shareall to share the new directory.

    c. On the systems that will mount /data1/workgroup, edit /etc/vfstab and add the following line. Replace *system1* with the name of the server system.

```
system1:/data1/workgroup    -   /data1/workgroup    nfs   -   yes   -
```

    Create the required directory to use as a mount point and manually mount the directory from the server:

```
# mkdir -p /data1/workgroup
# mount /data1/workgroup
```

    As user1 or user2, create a test file in /data/workgroup and verify it is owned by the group class1:

```
# su - user1
$ cd /data1/workgroup
$ touch testfile
$ ls -l testfile
$ exit
```

29. To configure a system to make use of an attached external tape drive, perform the following:

    a. If the external tape drive is currently turned off and device files do not exist for it, perform the following:

    - Use `init 0` to shut the system down to run state 0.
    - Power on the drive.
    - Use `boot -r` to perform a reconfiguration reboot, or run `devfsadm -v` after Solaris loads to build devices for the tape drive.

    b. If the external tape drive is currently turned on and device files exist for it, perform the following:

    - Change directory to `/dev/rmt` and display a long listing of the files in that directory.
    - Identify the directory to which these symbolic links point.
    - Change to that directory; for example, `/devices/pci@1f,0/pci@1/pci@4/SUNW,isptwo@4` and remove all of the tape-related device files you find.
    - Change directory back to `/dev/rmt` and remove the symbolic links from that directory.
    - Use `reboot -- -r` to perform a reconfiguration reboot, or run `devfsadm -v` to build devices for the tape drive.

30. To create a new device alias called `mydisk` that allows the system to `boot` from the default boot disk, perform the following:

    a. Use `init 0` to shut the system down to run state 0.

    b. At the OBP level, display the current boot disk device alias:

```
ok devalias disk
```

    c. Use `show-disks` to select the corresponding boot disk device.

    d. Use `nvalias` to create a new device alias called `mydisk`. Insert the path you selected using `show-disks`, and complete the path so it matches the default alias for the `boot` device. For example,

```
ok nvalias mydisk /pci@1f,0/pci@1,1/ide@3/disk@0,0
```

e. Set the `boot-device` parameter to use the new alias, and `boot` the system from it. For example,

```
ok setenv boot-device mydisk
ok boot
```

31. To establish a single system as a `loghost` in a NIS environment perform the following:

    a. On the NIS master, verify that the correct server is associated with the `loghost` alias in `/etc/hosts` file. If it is not correct, update `/etc/hosts` with this information and use `make` to update the NIS maps.

    b. Use `ypcat hosts` to verify that all NIS clients refer to the correct system as the `loghost`.

32. To enable `inetd` tracing, perform the following:

    a. Edit `/etc/init.d/inetsvc` and change the line that reads:

```
/usr/sbin/inetd -s &
```

    so it reads:

```
/usr/sbin/inetd -s -t &
```

    b. Stop and re-start the `inetd` daemon:

```
# /etc/init.d/inetsvc stop
# /etc/init.d/inetsvc start
```

33. To configure a host to save `inetd` tracing messages in a file called `/var/log/inetlog`, perform the following:

    a. Use `touch` to create `/var/log/inetlog`

    b. Edit the `/etc/syslog.conf` file and add the following line:

```
auth.notice <tab> /var/log/inetlog
```

    c. Command `syslogd` to re-read it's configuration file:

```
# pkill -HUP syslogd
```

34. To configure a system to pass `inetd` tracing messages to the `loghost`, perform the following:

    a. Edit the `/etc/syslog.conf` file and un-comment the following line:

```
#auth.notice <tab> ifdef(`LOGHOST', /var/log/authlog, @loghost)
```

    b. Command `syslogd` to re-read it's configuration file:

```
# pkill -HUP syslogd
```

    c. Test this configuration as follows:

    - Use `tail -f` to view new entries in `/var/log/inetlog` on the `loghost`.
    - Use `telnet` to access a system other than the `loghost` and verify messages go to `/var/log/inetlog` on the `loghost`.

35. Your instructor will provide a script called `banner`. Place this script in `/etc/init.d` and set its permission mode to `755`.

    a. Create hard links for the `banner` script as follows:

```
# cd /etc/init.d
# ln banner /etc/rc0.d/K40banner
# ln banner /etc/rcS.d/K40banner
# ln banner /etc/rcS.d/S99banner
# ln banner /etc/rc1.d/K40banner
# ln banner /etc/rc1.d/S99banner
# ln banner /etc/rc2.d/K40banner
# ln banner /etc/rc2.d/S99banner
# ln banner /etc/rc3.d/S99banner
```

    b. To edit the `banner` script to use the `logger` command to send run-level change messages to the `syslog` utility, perform the following:

    Add a line that reads:

```
logger -p local0.info "From banner script: CHANGED RUN-LEVEL $3"
```

    once before the line that reads:

```
[ $_INIT_PREV_LEVEL = 2 -o $_INIT_PREV_LEVEL = 3 ] && exit 0
```

    and again before the line that reads:

```
echo ""; /usr/bin/banner "RunLevel $_INIT_RUN_LEVEL"; echo""
```

c. To log these messages locally, use `touch` to create`/var/log/runlevel.` Modify `/etc/syslog.conf` to include a line that reads:

```
local0.info <tab> /var/log/runlevel
```

d. Cause `syslogd` to re-read it's configuration file:

```
# pkill -HUP syslogd
```

36. To use the `format` utility to divide an external disk into four equal partitions, follow these general steps:

a. Run `format` and select an unused disk.

b. Enter the `partition` menu. From the `modify` item select `All Free Hog`.

c. Use the default free hog partition (6). Set partitions 0, 1, 3, and 4 to 400 MBytes each. Set all other partition sizes to zero.

d. `Label` the disk and quit the `format` utility.

This results in a disk with four equal partitions and one free hog partition, partition 6, that takes up all remaining space. For later workshop steps to function properly, it is important that partitions 0, 1, 3, and 4 use exactly the same amount of space.

a. To create file systems that use default characteristics use the `newfs` command as follows. Replace `c1t3d0s0` with a slice name appropriate for your system.

```
# newfs /dev/rdsk/c1t3d0s0
```

For the workshop use slice 0 and 1 on the spare disk for these new filesystems.

b. To create a file system with an inode ratio of 1 inode per 16384 bytes of data space, use `newfs` as follows. Replace `c1t3d0s3` with a slice name appropriate for your system.

```
# newfs -i 16384 /dev/rdsk/c1t3d0s3
```

For the workshop use slice 3 on the spare disk for this new filesystem.

c. To create a file system that uses a 1 percent `minfree` value, use `newfs` as follows. Replace `c1t3d0s4` with a slice name appropriate for your system.

```
# newfs -m 1 /dev/rdsk/c1t3d0s4
```

For the workshop use slice 4 on the spare disk for this new filesystem.

d. To compare filesystem characteristics, run the `df` command and name the filesystem you wish to examine. Compare the values reported in the `kbytes`, `used`, and `avail` columns. Run `df` once for each filesystem. In the following example, replace `c1t3d0s0` with each slice name appropriate for your system:

```
# df -k /dev/dsk/c1t3d0s0
```

The file system with the lower inode count will show a larger value in the `kbytes` and `avail` column than the default file systems. The file system with the higher `minfree` value will show the same `kbytes` value as the default file systems, but a higher `avail` value.

Use `fstype -v` on the default file systems to determine their `minfree` values. For example:

```
# fstyp -v /dev/dsk/c1t3d0s0 | more
```

e. To add a permanent `mount` for `/morespace`, edit the `/etc/vfstab` file to add a line for the new filesystem. For example:

```
/dev/dsk/c0t1d0s0 /dev/rdsk/c0t1d0s0 /morespace ufs 2 yes -
```

37. To create a `swap` file and permanently make use of it, perform the following:

a. Assuming that the `/morespace` directory exists, use `mkfile` to create a `swap` file as follows:

```
# mkfile 30m /morespace/swapfile
```

b. To permanently add this file to the `swap` area used on a system, add an entry for it in the `/etc/vfstab` file as follows:

```
/morespace/swapfile     -       -       swap    -       no      -
```

After adding this entry in /etc/vfstab, run /sbin/swapadd to add the file into the current swap space. There is no man page available for the swapadd script.

You could otherwise use the swap command to add the swap file:

```
# swap -a /morespace/swapfile
```

Use swap -l to list the devices and files currently used for swap space.

38. To use coreadm to configure saving global core files, and subsequently test the configuration, perform the following:

    a. Use the following commands to create a directory to hold core files, set the global core file path to /corefiles/core.nodename.filename.PID, and enable saving global core files:

```
# mkdir /corefiles
# coreadm -g /corefiles/core.%n.%f.%p
# coreadm -e global
```

    b. Enter csh to run a C-shell.

    c. To send the SIGABRT signal to each csh processes, identify the process you want to use, and use kill or pkill to send the signal. For example:

```
# pgrep -l csh
# pkill -ABRT csh
```

    SIGABRT is signal number 6.

    d. Verify the presence of a core file in the directory where you started the C-shell, and in /corefiles. Verify that the name of the file in /corefiles matches what you specified with coreadm. For example:

```
# file core
# file /corefiles/*
```

39. In this workshop, systems use the auto_direct automounter map under NIS control to gain access to man pages. To stop using this mechanism and start using cachefs, changes are required on the NIS master server and the clients that will mount the man pages.

a. To stop using the automount service to mount man pages, on the NIS master perform the following:

- Edit /etc/auto_direct and comment out the entry that allows the man pages to mount automatically.
- Change directory to /var/yp and run /usr/ccs/bin/make to update NIS.

b. Verify that no other system is using a local direct map to access man pages using the automount service.

c. On systems that will use cachefs to mount the man pages, perform the following:

- Move /usr/share/man to /usr/share/man.orig
- Create a new directory called /usr/share/man
- Use the following cfsadmin command to create a cache directory:

```
# cfsadmin -c /export/cachedir
```

- Use the following mount command to create a cachefs mount of the man pages from the server sharing them. Substitute the correct server name for *system1* and specify the directory it's sharing:

```
# mount -F cachefs -o
backfstype=nfs,cachedir=/export/cachedir,cacheid=manpages,demandconst \
system1:/usr/share/man.share /usr/share/man
```

- Add the following line to /etc/vfstab to make the cachefs mount happen when the system boots. Substitute the same names as with the previous command:

```
system1:/usr/share/man.share - /usr/share/man cachefs - yes \
backfstype=nfs,cachedir=/export/cachedir,cacheid=manpages,demandconst
```

d. Test the /etc/vfstab configuration by unmounting and re-mounting the man pages:

```
# umount /usr/share/man
# mount /usr/share/man
```

40. To configure RBAC to allow a non-root user to shut down the system, perform the following:

a. Use roleadd to add a role:

```
# roleadd -u 2000 -g 10 -d /export/home/stopsys -m stopsys
```

b. Set the password for the stopsys role to cangetin:

```
# passwd stopsys
```

c. Edit /etc/security/prof_attr to add the following line:

```
Shut:::Able to shut down the system:
```

d. Use rolemod to add the Shut profile to the stopsys role:

```
# rolemod -P Shut,All stopsys
```

e. Add a new user called user20 with useradd and associate it with the stopsys role:

```
# useradd -u 2001 -g 10 -d /export/home/user20 -m -s /bin/ksh -R stopsys
user20
```

f. Set the password for user20 to cangetin:

```
# passwd user20
```

g. Edit /etc/security/exec_attr to add the following line:

```
Shut:suser:cmd:::/usr/sbin/shutdown:uid=0
```

h. Test the new configuration by logging in as user20, switching identity to the stopsys role, and attempting a system reboot using shutdown:

```
$ su - stopsys
Password:
$ /usr/sbin/shutdown -i 6 -g 0
```

Note – The default NIS nsswitch.conf configuration looks for files before NIS with respect to users, roles, and RBAC information.

---

41. To create a network without incorporating its configuration into NIS, perform the following steps:

a. Start printmgr:

```
# /usr/sadm/admin/bin/printmgr
```

b. Select files as your naming service.

c. From the `Printer` menu select `New Network Printer`. Use information provided by your instructor to enter appropriate information for the following fields. Exit `printmgr` when finished.

- Printer Name
- Description
- Printer Type
- File Contents
- Fault Notification
- Destination
- Protocol

Incorporating a printer configuration into NIS requires modification of the NIS `Makefile`. Your instructor may have a modified `Makefile` available for this purpose.

42. To configure a JumpStart server for this workshop, perform the following:

The following steps take place on the JumpStart client:

a. Log in as the user `root`.

b. Shut down the system to run-level 0 and use the `banner` command to determine how much memory is installed in the system.

The following steps take place on the NIS master server:

a. Log in as the user `root`.

b. Edit the `/etc/ethers` file and add an entry for the JumpStart client; for example:

```
8:0:20:2f:90:3d    system3
```

c. Edit the `/etc/hosts` file and add an entry for the JumpStart client if one does not already exist. Add the `timehost` alias to the NIS master server's entry; for example:

```
192.9.200.1      system2   loghost    timehost
192.9.200.100    system3
```

d. Edit or check `/etc/netmasks` to be certain it contains the network number and subnet mask for your network; for example:

```
192.9.200.0 255.255.255.0
```

e. Edit the `/etc/timezone` file and add an entry that associates your local time zone with the name of your NIS domain. Entries in this file are case sensitive; for example:

```
US/Mountain      nisdomain
```

f. Edit the `/etc/locale` file and add an entry that associates your locale with the name of your NIS domain. Entries in this file are case sensitive; for example:

```
nisdomain      en_US
```

g. Update the NIS maps by running the `make` command.

```
# cd /var/yp
# /usr/ccs/bin/make
```

The following steps take place on the server where you spooled the Solaris 8 Operating Environment image:

a. Log in as the user `root`.

b. Create the directory `/export/config`.

```
# mkdir /export/config
```

c. Change directory to `/export/install/Solaris_8/Misc/jumpstart_sample`

```
# cd /export/install/Solaris_8/Misc/jumpstart_sample
```

d. Copy the content of the `jumpstart_sample` directory to `/export/config`. This places sample JumpStart configuration files in `/export/config` that you will use to complete the exercise.

```
# cp -r  *  /export/config
```

e. Change directory to `/export/config`. Move the `rules` file to `rules.orig`.

```
# cd /export/config
# mv rules rules.orig
```

f. Create a new file called `rules` that contains the following entry. Enter a memory size range that includes the amount of memory installed on the JumpStart client. For example:

```
memsize  64-256    -   host_class     -
```

g. Edit the `/export/config/host_class` file so that it specifies an initial install, a standalone system type, explicit partitioning, the Core software cluster, and partitions for root (/) and swap. Use device names appropriate for the JumpStart client system; for example:

```
install_type    initial_install
system_type     standalone
partitioning    explicit
cluster         SUNWCreq
filesys         c0t0d0s0 free /
filesys         c0t0d0s1 128 swap
```

h. Run the `/export/config/check` program and correct any problems in the `rules` or `host_class` files that it reports. Verify that the `rules.ok` file exists once `check` completes successfully.

```
# ./check
```

i. In `/export/config`, create a file called `sysidcfg` that contains the following lines. The string `cCHuD9l9gmxUI` is a 13-character encrypted string for the password `cangetin`.

```
security_policy=none
network_interface=primary {protocol_ipv6=no}
root_password=cCHuD9l9gmxUI
```

j. Edit `/etc/dfs/dfstab` to add entries for the `/export/config` and `/export/install` directories as follows:

```
share -o ro /export/config
share -o ro,anon=0 /export/install
```

k. If the NFS server daemons are not running, start them:

```
# /etc/init.d/nfs.server start
```

l. If the NFS server daemons are already running, run `shareall`:

```
# shareall
```

m. Change directory to `/export/install/Solaris_8/Tools`.

```
# cd /export/install/Solaris_8/Tools
```

n. Use the `add_install_client` program to add support for your JumpStart client. Replace *`system1`* with the name of your JumpStart server, *`system3`* with the name of your JumpStart client, and `sun4`*`x`* with either `sun4u`, `sun4m`, or `sun4c`, depending on the type of client system you are using.

```
# ./add_install_client -c system1:/export/config \
-p system1:/export/config system3 sun4x
```

The following steps take place on the JumpStart client:

a. Boot the JumpStart client:

```
ok boot net - install
```

43. To back up the `root` file system on the JumpStart server, perform the following:

a. Use `init S` to bring the system down to single-user mode.

b. Use `ufsdump` to backup the `root` filesystem. For example:

```
# ufsdump 0u /
```

44. To destroy the JumpStart server's `root` file system, recursively remove the `/kernel`, `/devices`, and `/dev` directories as follows. Halt the system when finished.

```
# rm -r /kernel /devices /dev
# halt
ok
```

45. To restore the JumpStart server's `root` file system, perform the following:

a. Boot from the Solaris 8 1 of 2 CD-ROM to single-user mode.

```
ok boot cdrom -s
```

b. Insert the `root` filesystem backup tape, and execute the following commands to re-build it (Use appropriate device names for your system.):

```
# newfs /dev/rdsk/c0t0d0s0
# mount /dev/dsk/c0t0d0s0 /mnt
# cd /mnt
# ufsrestore -r
# rm restoresymtable
# cd /
# umount /mnt
# fsck /dev/rdsk/c0t0d0s0
# reboot
```

c. Log in as `root` and eject the CD-ROM.

46. Attempt to `boot` the JumpStart client and install the operating system again.

```
ok boot net - install
```

Check Your Progress

Before continuing on to the next module, check that you are able to accomplish or answer the following:

- ❑ Install the Solaris 8 Operating Environment using both the WebStart and the interactive methods
- ❑ Partition a disk to a specified format
- ❑ Build new file systems and mount the file systems
- ❑ Configure an automount
- ❑ Set up an NIS domain
- ❑ Create additional swap space
- ❑ Set up an NFS mount
- ❑ Configure RBAC to allow a `non-root` user to shut down a system
- ❑ Create a local and a network printer

The JumpStart `rules` *and Class Files*

A

Table A-1 describes the keywords for the `rules` file.

Table A-1 Keywords for the `rules` File

Keyword	Description
`any`	The match always succeeds. The *`match_value`* field is ignored. Use a dash (–) as a placeholder for the *`match_value`*.
`arch`	The machine's processor type as reported by the `/usr/ucb/mach` command or by `uname -p` in the Solaris 8 Operating Environment.
`domainname`	The domain name of the network in which the machine has been configured as reported by the `domainname` command. The domain name is used by a client to request and obtain name service information.
`disksize`	This keyword is used with two parameters for the *`match_value`* field:
`device`	Any disk device name, such as `c0t3d0` or the special word `rootdisk.`
`size_range`	The size of the disk specified in Mbytes. For example, `disksize c0t3d0 250-300 ...`, which matches a target 3 disk that is between 250 and 300 Mbytes in size.
`hostname`	The host name assigned to the machine as reported by the `uname -n` command.

Table A-1 Keywords for the `rules` File (Continued)

Keyword	Description
`installed`	This keyword uses two parameters for the *`match_value`* field: • *`disk`* – The value of the *`disk`* parameter can be `any`, `bootdisk`, or a disk slice name (such as `c0t3d0s5`). If `any` is used, the rule is applied to any disk attached to the system. If `rootdisk` is used, only the disk where the `root` file system resides is considered. • *`version`* – The version parameter can be `any`, `upgrade`, or a version name (such as `Solaris_2.2`). If `any` is used, any Solaris Operating Environment or SunOS release is considered. If `upgrade` is used, any upgradable Solaris 2.1 Operating Environment or greater release is matched.
`karch`	The machine's kernel architecture, as reported in the output of `/usr/ucb/arch -k` or the `uname -m` command.
`memsize`	The amount of physical memory on the machine (in Mbytes). This is the third field of the line beginning with `Memory` in the output from the `prtconf` command. A range must be specified for the *`match_value`* field for this keyword. For example, a *`match_value`* field value of 16–32 specifies a physical memory size of 16–32 Mbytes of memory.
`model`	The model number of the machine. This is system dependent and varies by manufacturer. Samples can be seen on line 5 of the output from the `prtconf` command. Table A-2 shows the model numbers for various machines. If the model name includes spaces, enclose the entire model name in quotes. For example, specify a Sun 4/110 as '`Sun 4_100 Series`'.
`network`	The network number of the IP address assigned to the machine which is determined after the subnet mask has been applied. (The network number always ends with a 0.)

Table A-1 Keywords for the `rules` File (Continued)

Keyword	Description
`totaldisk`	The total amount of disk space on the machine (in Mbytes). Specify a range for the *`match_value`* field for this keyword.

Table A-2 describes the model names.

Table A-2 Model Names

Machine	Model
4/110	Sun-4™_100 Series
4/200	Sun-4_200 Series
ss1	Sun-4_60
ss1+	Sun-4_65
slc™	Sun-4_20
IPC™	SUNW,Sun 4_40
ELC™	SUNW,Sun 4_25
IPC	SUNW,Sun 4_50
ss2	SUNW,Sun 4_75
4/300	Sun SPARCsystem 300
4/400	Sun SPARCsystem 400
4/600	SUNW,SPARCsystem-600
ss10	SUNW,SPARCstation-10
classic	SUNW,SPARCclassic
lx	SUNW,SPARCstation-LX
SC1000	SUNW,SPARCserver-1000
SC2000	SUNW,SPARCcenter-2000

Initial Install Keywords and Arguments

Class files contain the following keywords and parameters:

`install_type initial_install`

This keyword specifies the type of installation the class file describes. The values `initial_install` and `upgrade` are the values supported in the Solaris 2.2 Operating Environment. Every class file must contain this keyword; otherwise, the `check` script exits with a fatal error and the `rules.ok` file is not created.

`system_type (standalone | dataless | server)`

This keyword defines the type of system being installed. If this keyword is not used in the class file, the system type defaults to `standalone.`

`partitioning (default | existing | explicit)`

The keyword `partitioning` defines how the disk is partitioned during installation. If this keyword is not specified in a class file, the partitioning type `default` is used.

`default`

This keyword indicates that the installation process partitions the disk based on the software selected. This means that the installation process selects the disks and slices on which to install the selected packages. The rootdisk is selected first. However, if the selected packages do not fit on this disk, an additional disk is selected. Pre-existing data on a disk can be overwritten unless it is preserved. Refer to Appendix C of the *Solaris 2.2 System Configuration and Installation Guide* for information on backing up data, or use the `filesys` keyword to preserve partitions.

`existing`

This keyword indicates that the existing partitions and file systems on the disk should be used; no repartitioning is done. It also implies that all file systems except `/`, `/usr`, and `/var` are preserved. The disk is not repartitioned.

When the `existing` keyword is specified, the last mount point field from the file system superblock is used to determine which file system mount point the partition represents.

If the system has duplicate file systems (for example, two `/usr`, two `/`, and so on), the installation aborts. Use the `filesys` keyword (see page C-10) with the argument `existing` to specify which file systems to preserve.

`explicit`

`This keyword configures only the file systems specified with the filesys keyword.`

`cluster` *cluster_name* `(add | delete)`

This keyword is used to specify the cluster (or configuration cluster) to be installed. There are four configuration clusters included in the Solaris 2.2 distribution: `SUNWCall`, `SUNWCprog`, `SUNWCuser`, and `SUNWCreq`. In addition to the configuration clusters, there are also various clusters, which are defined groups of packages. See Appendix A of the *Solaris 2.2 System Configuration and Installation Guide* for more details on clusters and packages.

You can specify only one configuration cluster. If the cluster specified is one of those listed previously, the third field (`add` or `delete`) is ignored. Otherwise, the third field indicates whether the cluster should be added or removed from the previously specified configuration cluster. If no configuration cluster is specified, the end-user configuration cluster (`SUNWuser`) is used.

`package` ***`package_name`*** `(add | delete)`

This keyword defines which package is to be installed. The third field specifies whether the package is added or deleted from the configuration cluster and clusters previously specified. If the third field is not specified, `add` is assumed.

Your class files can contain any number of `package` keywords.

`usedisk` ***`disk_name`***

This keyword specifies which disk is to be used with default partitioning. The installation process then uses only the disks specified by `usedisk`. The ***`disk_name`*** is given in the form `c`*`x`*`t`*`y`*`d`*`z`*; for example, `c0t2d0`.

Your class files can contain any number of `usedisk` keywords.

`dontuse` ***`disk_name`***

This keyword explicitly specifies that ***`disk_name`*** is not to be used by the installation process.

Your class files can contain any number of `dontuse` keywords.

`locale` *`locale_name`*

Install all localization packages associated with the selected software for the *`locale_name`* specified; for example, usage for the French locale is `locale fr.`

`num_clients` *number*

This keyword indicates the number of diskless clients that the server supports. (The default number of clients is five.) The installation process then allocates enough space for each diskless client's root and swap file systems.

This keyword can only be used when `system_type` is `server` (see page C-6).

`client_swap` *`size`*

This keyword indicates the amount of swap space allocated for each diskless client (the default size is 24 Mbytes). Use this keyword only when `system_type` is `server.`

`client_arch` *`kernel_architecture`*

This keyword specifies that the client has a different kernel architecture than the server. It tells the installation process to install packages on the server to support this client architecture. The default is to install client support based on the assumption that the client has the same architecture as the server.

Use this keyword only if `system_type` is `server.` You can specify multiple `client_arch` keywords in your class files.

`filesys` *`device size file_system optional_parameters`*

This keyword is used to specify a size (in Mbytes) and device for the file system indicated. You can use any number of `filesys` keywords in your class files.

device

This keyword is specified as one of the following:

any – Use any disk that meets the install software's criteria.

device_name (c*x*t*x*d*x*s*x*) – Explicitly state where the file system is to be placed.

rootdisk.s*n* – Specify the logical name for the disk where the root file system is to reside. The s*n* suffix indicates a specific slice on the disk.

server:path – A remote file system. Remote file systems are not changed by the installation process, but are set up so that the newly installed machine automatically mounts them when it boots.

Using *server:path* with the filesys keyword adds NFS mount entries to the /etc/vfstab file of the newly installed system.

size

This keyword is specified as one of the following:

num – Allocate *num* Mbytes for the file system during installation.

existing – Use the current size of the partition. If you use existing as the value of the *size* field, the *device* field must specify a real device (*device_name* or rootdisk.s*n*).

auto – Automatically size the partition based on the software selected.

all – Use the entire disk for the file system.

`free` – Use the remaining space on the disk for the file system. If `free` is used as an argument to `filesys`, make the `filesys` entry the last entry in your class file for the specified disk.

`start:size` – Explicitly partition the device. *`start`* is the cylinder where the slice begins; *`size`* is the number of cylinders for the slice. If you use *`start:size`* for the size argument to the `filesys` keyword, the *`device`* field must specify a real device *(`device_name` or `rootdisk.sn`).*

`ip_address` – Use only when installing a dataless client and use *device* as the *`server:path.`* This value indicates to the server the IP address of the dataless client providing the `/usr` and `/usr/kvm` file systems. "–" – Use a dash (–) as the value of the *`size`* field when the *`device`* field is *`server:path`*, but you are not installing a dataless client.

`file_system`

This argument to the `filesys` keyword is optional. If it is not used, the *`device`* is set up as specified by the other arguments, but no file system is created. If it is used, its value is either:

`mount_point_name` – A real file system name indicating the mount point for the *`device`*.

`swap` – The *`device`* to be used for swap.

optional_parameters

This argument to `filesys` is optional. If you use it, specify the following:

`preserve` – Preserves the data on an existing partition. Use only when the *`size`* field is `existing.`

mount_options

A general string of mount options used to add to the `/etc/vfstab` entry for the file system. Use *`mount_options`* only when the *`file_system`* field specifies a real file system (a local file system or a remotely mounted file system).

Upgrade Parameters

The following keywords and argument values are used in a class file in which the type of installation is an upgrade. The `install_type` keyword is the only one required; all others are optional.

`install_type upgrade`

This keyword defines the type of installation described by the remainder of the class file. The values `initial_install` and `upgrade` are supported in the Solaris 2.2 environment.

`locale` *`locale_name`*

The localizations for the specified *`locale_name`* added during the upgrade. Multiple `locale` keywords can be specified.

`cluster` *`cluster_name`* `(add | delete)`

Which cluster is to be installed. If the specified *`cluster_name`* already exists on the system, it is automatically upgraded. The `add` and `delete` field indicates whether the cluster should be added or deleted from the configuration cluster and clusters previously specified. If you use this keyword in an upgrade, `delete` does not remove an existing cluster from the system.

`package` *`package_name`* `(add | delete)`

The package to be installed. If the specified *`package_name`* already exists on the system, it is automatically upgraded. The `add` and `delete` field indicates whether the package should be added or deleted from the configuration cluster and clusters previously specified. If you use this keyword in an upgrade, `delete` does not remove an existing package from the system.

Time Zones

The following is a list of legitimate time zone names. This information was gathered from the `/usr/share/lib/zoneinfo` directory.

CET	Jamaica	Brazil/East
CST6CDT	Japan	Brazil/West
Cuba	Libya	Canada/Atlantic
EET	MET	Canada/Central
EST	MST	Canada/East-Saskatchewan
EST5EDT	MST7MDT	Canada/Eastern
Egypt	NZ	Canada/Mountain
GB-Eire	Navajo	Canada/Newfoundland
GMT+10	PRC	Canada/Pacific
GMT+11	PST8PDT	Canada/Yukon
GMT+12	Poland	Chile/Continental
GMT+13	ROC	Chile/EasterIsland
GMT+8	ROK	Mexico/BajaNorte
GMT+9	Singapore	Mexico/BajaSur
GMT-1	Turkey	Mexico/General
GMT-10	W-SU	Mideast/Riyadh87
GMT-11	WET	Mideast/Riyadh88
GMT-12	Australia/Broken-Hill	Mideast/Riyadh89
GMT-2	Australia/LHI	US/Alaska
GMT-3	Australia/NSW	US/Aleutian
GMT-4	Australia/North	US/Arizona
GMT-5	Australia/Queensland	US/Central
GMT-6	Australia/South	US/East-Indiana
GMT-7	Australia/Sturt	US/Eastern
GMT-8	Australia/Tasmania	US/Hawaii
GMT-9	Australia/Victoria	US/Michigan
HST	Australia/West	US/Mountain
HongKong	Australia/Yancowinna	US/Pacific
Iran	Brazil/Acre	US/Samoa
Israel	Brazil/DeNoronha	US/Yukon

System Configuration Using NIS+

If your network is running NIS+, perform the following steps on the name server:

1. Create the locale table.

   a. If your system is not in NIS compatibility mode, issue the command:

   ```
   # nistbladm -D access=og=rmcd,w=r,n= -c \
   locale_tbl name=SI,nogw= locale=,nogw= \
   comment=,nogw= locale.org_dir.'nisdefaults -d'
   ```

   b. If your system is in NIS compatibility mode, issue the command:

   ```
   # nistbladm -D access=og=rmcd,nw=r -c locale_tbl \
   name=SI,nogw= locale=,nogw= comment=,nogw=\
   locale.org_dir.'nisdefaults -d'
   ```

2. Use the following format to add an entry, which specifies the domain's default locale, to the locale table for each domain:

   ```
   domainname locale
   ```

3. Use the `nistbladm` command to add the entries to the locale table. For example, the following command adds the locale `US/Eastern` to the domain `garden` (the default domain returned by the `nisdefaults -d` command):

   ```
   # nistbladm -a name=sun_com. locale=de\
   comment=german locale.org_dir,'nisdefaults -d'
   ```

Configuring System Information

Certain information, such as the Ethernet address, host name, and IP address of the machine to be installed must be configured on the network name server so that the system can access the information during the automatic installation process.

If the network name server is running the Solaris 2.*x* environment, use Host Manager to update the `ethers` and `hosts` databases; otherwise, perform the following steps:

1. Update the network `ethers` database (`/etc/ethers`) by entering the Ethernet address and host name for the system to be installed.

2. Update the network `hosts` database (`/etc/hosts`) by entering the IP address and host name for the system to be installed.

3. Add the hostname alias `timehost` to one of the existing hosts in the `/etc/hosts` file.

4. Rebuild the network NIS+ tables.

   For NIS+, issue the following commands on the NIS+ master server:

```
#nisaddent -avf /etc/ethers ethers
#nisaddent -avf /etc/hosts hosts
```

Setting Up Time Zone

To set up a time zone, perform the following steps:

1. Create or update the `timezone` database (`/etc/timezone`) by entering the time zone and the client name.
2. Update the `netmasks` database (`/etc/netmasks`) even if there is no actual subnetting in use.
3. Rebuild the network NIS+ tables.

   For NIS+, issue the following commands on the NIS+ master server:

```
#nisaddent -avf /etc/timezone timezone
#nisaddent -avf /etc/netmasks netmasks
```

Adding Time Zone Information to the Name Server Switch File

To add time zone information to the name server switch file, add the following line to the `/etc/nsswitch.conf` file of the NIS+ servers:

```
timezone:            nisplus
```

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