Solaris™ 9 System Administrator's Evaluation Guide

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Table of Contents

Introduction

This guide is designed to help System Administrators evaluate the Solaris™ 9 Operating Environment (OE). It includes information about what is new in the Solaris 9 platform, walks through the installation, and a test drive of the environment. The appendix also includes information about the business advantages of using the Solaris 9 OE as well as an analysis of the Solaris 9 platform compared to the competition.

What's New in the Solaris 9 OE

The overarching goal of the Solaris OE is to help organizations increase service levels while reducing service cost and risk. The key to reaching these goals is using systems that are scalable, available, manageable, and secure.

Scalability:
Companies offering Web–based services can no longer predict how many customers might visit their sites, but successful companies are those that can support millions of new customers overnight. Solaris 9 is the third major release of a complete 64–bit computing environment tuned for Sun's line of highly scalable 64–bit servers. Some of the new scalability features in Solaris 9 include:

- **Threading library improvements**. Significantly improves the scalability and performance of multi–threaded applications including Java–based applications.
- **Multiple page size support**. Improves virtual memory performance by allowing applications to use large page sizes, therefore improving resource efficiency and reducing overhead.
- **Remote Shared Memory API (RSMAPI).** Reduces the time required for cluster–aware applications to respond to events in a clustered configuration.
- **Network Cache and Accelerator (NCA).** Increases web server performance by maintaining an in–kernel cache of web pages accessed during HTTP requests.
- **mkfs Performance.** Reduces the length of time, in some cases from hours to minutes, taken to create UFS file systems (files).

Availability:
With businesses operating around the clock and around the globe, organizations no longer know when their customers might demand their services. The days of "planned downtime for maintenance" are long over; systems must now be designed to provide service at all times. The reliability of the Solaris 9 OE gives users confidence that their long–running and resource–intensive applications will execute without interruption. Important new features of the Solaris 9 OE that help users to deploy highly available services include:

- **Live Upgrade 2.0**. Allows the operating system to be upgraded while the system is still running. Significantly reduces the usual service outage associated with an operating system upgrade. Simple re–boot is the only downtime.
- **Solaris Flash**. Enables the creation of a single reference installation of the Solaris OE from an existing system configuration, which can then be replicated on several machines. Significantly reduces installation time, configuration complexity, administrative resources, and improves deployment scalability.
- **Modular Debugger**. Applies modern techniques to debug application programs and provides tools to analyze core dumps.
- **Sun StorEdge Traffic Manager (Multiplexed I/O)**. Enables failover in the event of network I/O path failure. Enhances storage availability and allows the application to route traffic to the storage tier more efficiently.

- **Network Multipathing (IPMP)**. Allows recovery from single–point network failures, increases outbound network throughput, and enhances dynamic reconfiguration capabilities.

Manageability:
As IT infrastructures grow larger and more complex, IT organizations must optimize for efficiency. Solaris 9 OE provides a rich set of management facilities that can simplify the process of securely installing and deploying the software stack, resulting in lower cost of operation. Solaris 9 software also delivers a comprehensive set of manageability tools, including:

- **Solaris 9 Resource Manager**. Provides improved functionality for allocating, monitoring and controlling system resources. Allows consolidation of multiple applications on a single system while maintaining required service levels.
- **Solaris Volume Manager**. Provides storage management tools and allows users to manage large numbers of disks and effectively utilize storage resources. Provides a fully–integrated, cost saving alternative to third party products.
- **Patch Manager**. Manages patches, with a new GUI interface, that are created for Solaris 9 OE and compatible releases. Gives system administrators better control over patches and the quality of installed software.

Security:
The Solaris OE has been built to securely interconnect with other systems and to be more secure from the viruses and worms that plague software designed without security and networking in mind. These aspects of network and platform security are critical whether building an enterprise network or providing services to millions of users over the Internet. Some of the new feature in Solaris 9 OE include:

- **Solaris Secure Shell**. Allows for strong authentication of both the client and server machines as well as user ids. Provides a secure method for system access including a lightweight VPN.
- **IPSec with Internet Key Exchange (IKE)**. IPSec increases security between both servers and communication channels so that only authorized parties can communicate with them. IKE is used to set up and manage larger numbers of secure networks. These modules have been approved for export at 128–bit encryption.
- **SunScreen™ 3.2 Firewall**. High speed, stateful packet–filtering firewall that offers advanced features that protect a single system or an entire network of servers. Now included with the Solaris 9 OE at no extra charge.
- **Kerberos v5 Server**. Improved single sign–on facility for applications and systems.
- **Role–based Access Control (RBAC)**. Enables assignment of rights to perform specific operations. Minimizes the chance that any user will go beyond their realm of expertise and inadvertently or intentionally make a change that results in a system failure.

Minimizing the software modules installed with any operating system is important in many secure facilities. Solaris 9 OE responds to this need by providing a tool that selectively removes software modules that are often installed by default that are not essential to system operation. We have done this by reducing the dependencies between the software packages in Solaris 9 OE and making the packages themselves smaller so they can be removed in a more granular fashion. More information about this can be found in the "What's New in the Solaris 9 Operating Environment" book, part of the "Solaris 9 What's New Collection" in the Solaris 9 documentation included with the software or on http://docs.sun.com.

Installation

Solaris 9 System Requirements

The Solaris 9 OE has the following system requirements:

- **Processor**. A SPARC® CPU−based system is required; a system with an UltraSPARC® CPU running faster than 400 Mhz. is strongly recommended.

- **Memory**. Requires 64 MB of RAM or greater.

- **Swap file**. Requires a slice that will not store files, typically a `swap` slice of at least 600 MB.

- **DVD or CDROM drive**. These drives are required for installation from the distribution media. To install Solaris 9 over a network you will need to prepare an install server that contains file system images and installation script files. For more information on obtaining the necessary media visit: http://www.sun.com/solaris/binaries/[1]

- **Disk Space**. The amount of disk space required depends upon the software group you chose. Use the following list as a guideline:
  - Entire Solaris Software Group Plus OEM Support – 2.4 GB
  - Entire Solaris Software Group – 2.3 GB
  - Developer Solaris Software Group – 1.9 GB
  - End User Solaris Software Group – 1.6 GB

  Additional disk space for optional components may also be required. For example, the StarOffice™ 5.2 software installation[2] on a SPARC system requires from 79 MB to 84 MB.

- **Network Connection (optional)**. A network connection either with direct Internet access or with an established gateway is required. The only exception to this requirement is if you use PPP to establish a modem connection. For connection through a proxy server, Solaris software requires that that device supports LAT. The Solaris 9 platform can work with any packet filtering firewall.

Installing the Solaris 9 OE

There are several methods for installing the Solaris 9 OE, and these are well covered in the *Solaris 9 Installation Guide*. This section contains a brief overview of the subject to get you started.

Types of Installs

The install method you choose[3] depends upon whether you are upgrading or creating a new installation, the type of system you are working with, whether that system is a standalone system, networked, or a group of systems. When a system is upgraded the install will preserve as much as possible systems settings and applications. The methods for installation of Solaris 9 software include:

- **CD−ROM or DVD media boot**

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[1] This download location requires you to log onto the site prior to download.
[2] For installation requirements on other platforms see: http://www.sun.com/software/staroffice/5.2/details.html#size.
[3] Chapter 3 of the installation guide "Choosing an Installation Method" will provide you more detail on this topic.

- **LAN boot**

- **Flash Archives**

Tip: *Whenever possible perform a fresh install and not an upgrade to get better performance.*

Note: Allow sufficient time for the installation. The installation time is dependant upon the components you install, the media, and the speed of the system you are installing. An advanced workstation using a DVD can install the Solaris 9 OE with its major components in about 45 minutes. A standard workstation using CD–ROM disks may require 3 hours for an installation.

Solaris Web Start Software

This is a program that is used to manage the installation of a single system. In most instances the program is used in a graphical mode, but it can also be used as a command line. Web Start lets you select installation details, and review or change them before applying your selections. It is covered in Chapter 14 of the *Solaris 9 Installation Guide*. You can use Web Start in the following instances: CD/DVD media boot and LAN boot. You can also use Web Start to install flash archives.

An install (rather than an upgrade) erases the hard disk and creates a new set of partitions. Web Start requires the following information for network workstation install: Host Name, IP Address, IP Subnet Mask, Router or Gateway, direct or proxy access the Internet (if unsure select Direct), Name Service (DNS, NIS, NIS+, LDAP or none), and the IP addresses of the name servers. You will also need to know your domain name, any search domains, and the root password for your system.

Initiating an Install

To initiate the pre–graphical portion of the installation, do the following:

1. Shut down the system by typing **init 0**.
2. Place either the Solaris Install CD, or the Solaris 9 DVD in to your CD/DVD drive.
3. At the ok prompt, type **boot cdrom** and press the Enter key.
4. Select the language you wish to use for the install.

The installer will then scan you drives for partitions that meet the mini–root installers space requirements and will display the available choices. It is recommended that you break out of the default installation at this point to create a custom partition scheme appropriate for the kind of work you will be doing.

5. Enter q at the prompt.
6. At the shell prompt (#) enter format and select from a list of disks on your system the one you want to use for your boot disk
7. Type p to enter the partitioning tool, type 1 to reconfigure partition 1 on the disk.
8. For the id tag type swap, for the flags type wu, starting cyl (cylinder) is 0 and partition size should be 600 MB.
9. Enter 'l' to label the disk (write the partition table) and "q" twice to exit from the utility.
10. Type /sbin/cd0_install to restart the installer from where you exited it.
11. Select the partition you wish to hold the installer; or accept the partition you just created.

The installer will copy first the "mini–root" environment; then the platform specific files to the swap partition. Once it has finished copying the files it needs it will reboot the system.

You are now in the graphical phase of the Web Start installation which is well covered in the *Solaris 9 Installation Guide* (Chapter 14).[4] It is recommended that you perform a default networked install, which will install the software you need to test the operating environment. Then proceed to install StarOffice, any supplemental software you wish, and GNOME from the additional disks in the distribution. Those installations are graphical and will either automatically launch or require you to click on the Installer icon found in their disk windows.

Solaris JumpStart™ Software

Solaris JumpStart software initiates on a new SPARC system when you insert either the Solaris 9 Software 1 of 2 CD–ROM or the DVD into the drive. The mini–root and a JumpStart boot image has already been installed, and a default profile is then selected based on your particular machine and disk size. The profile determines which software is installed and automatically installs it, without user intervention. Unlike the Web Start install, you are not called upon to select the type of software. However, you will still need to supply details on addressing, name services, and other variable information.

Sun's custom Solaris JumpStart installation method uses a single installation image controlled by a script file to manage the installation process over a network. The system that contains the files is referred to as the Solaris JumpStart server. A Solaris JumpStart server can be prepared from the downloadable Solaris net install files found on Sun's web site. Custom Solaris JumpStart installation is covered in Chapter 23 of the *Installation Guide*.

For example, you would use the custom Solaris JumpStart method to install Solaris 9 software on a Netra™ server since that system doesn't come with any media drives. Since the Netra system is also headless (you can't attach a monitor directly to it), you would log in remotely and from that system's prompt initiate a network install pointing to the Solaris JumpStart server. You can also connect through a serial port from a Netra system to a Windows environment or to another Sun system using the `hotwire` command in a Terminal window.

Setting up and testing a Solaris JumpStart server can take a significant amount of time, so the method isn't often used for a few different standalone installations. Custom Solaris JumpStart is used to install Solaris software on a large number of systems.

Live Upgrade

The Solaris Live Upgrade 2.0 is a unique feature meant to provide an upgrade path in a mission critical or high availability environment. It can be run in either a GUI or in the CLI mode. You can use Live Upgrade to install a Web Start Flash archive on the inactive boot environment to perform the remainder of the software installation after initialization of the new environment.

Live Upgrade creates a duplicate boot environment while the active boot environment is running. Once the upgraded boot environment is complete the system can switch over to the new configuration during a reboot. The beauty of the Live Upgrade method is that if anything fails you can simply reboot the system and select the previous boot environment to revert back to a working system. Refer to Chapter 29 of the *Installation Guide* for details on the Live Upgrade method.

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[4] You can find the "Solaris 9 Installation Guide" online at docs.sun.com.

Notes on Installing GNOME 1.4 Technology Preview

To install GNOME, first make sure your system meets the minimum system requirements:
- 128 MB of RAM or greater
- 275 MB free hard disk space in your /opt partition.[5]
- A graphics card running 24–bit color.[6]

Table 3 shows some Sun graphics cards and the command needed to run to switch to 24–bit color.

Table 3. *Command to switch common Sun graphics cards to 24–bit color.*

Card	fbconfig Output	Command to run (as root)
Sun Creator3D™ New[7]	`SUNWffb_config`	`ffbconfig –deflinear true`
Sun Creator3D™ Old[8]	`SUNWffb_config`	`ffbconfig –deflinear true –g 1.1`
Sun Elite3D™	`SUNWafb_config`	`afbconfig –deflinear true –g 1.1`
Sun Expert3D™	`SUNWifb_config`	`fbconfig –deflinear true –g 1.1`
PGX32	`TSIgfxp_config`	`pgxconfig –res 1280x1024 –depth 24`

Mach_64	`SUNWm64_config`	`m64config –res 1152x900 –depth 24`
		If that command returns an error try:
		`m64config –res 800x600 –depth 24`

WARNING: *Make sure your monitor will support 24–bit. If not your screen will blank and you will have to use an alternate method to connect to your system to set the mode back to its original setting. Write down the original setting, and use the same tool (either* `ffbconfig`, `afbconfig`, `fbconfig`, `pgxconfig` *or* `m64config`) *with the* `–propt` *option to display your current settings.*

Once you have set your graphics card to 24–bit color log out, and then log in again to restart the window manager and activate the change. Then insert the "Exploring the GNOME 1.4 Desktop" CD. Solaris will mount the CD and display it's contents. Double click on the icon labeled "`install`" and the installer will initialize, and guide you through the installation. Once completed, log out and then log back into your system selecting GNOME as your environment from the Login screen. GNOME comes with a complete Help system to get you started.

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[5] In most systems and in the default Solaris 9 install the /opt partition is part of your root (/) partition. You can find the amount of free disk space with the command `df –kl`.
[6] To find out what card you are using with the `/usr/sbin/fbconfig  list` command.
[7] If you have a Sun Creator3D™ card you need to run the command '/usr/sbin/ffbconfig –propt' If the output contains the phrase "Gamma Correction" then you have the new card.
[8] Ibid.

Solaris 9 Test Drive

In the sections that follow, we have included a brief interactive introduction to some of the new features in the Solaris 9 software. These instructions are not meant to be a comprehensive introduction to the Solaris OE, but rather a simple introduction to some of the new concepts and capabilities. It assumes that you have Solaris 9 software installed on your system and, for the first section, that you also have GNOME, the Netscape™ browser, and StarOffice software loaded. In order to test Solaris Volume Manager, you will need to have at least two physical disks, as well.

If you are reviewing the installation of Solaris 9 OE and the new features of the Solaris installation program like Solaris Flash and Live Upgrade, basic installation directions are available and detailed installation instructions are provided with the Solaris 9 media kit or at http://docs.sun.com.

Getting Started: The New Solaris Desktop

The desktop is a very good place to start evaluating Solaris 9 OE; the Solaris OE, along with GNOME, StarOffice software, and the Netscape browser, forms the basis for a very powerful and inexpensive desktop productivity computing solution. When combined with Sun's sub–$1000 Sun Blade™ 100 workstation or the Sun Ray™ desktop appliance, this software creates an enterprise–level solution that is powerful, inexpensive, and highly manageable.

Once Solaris 9 software is running, you should be presented with a logon screen. Before typing your user name, click on the "Options" button, drag down to the "Sessions" option, then over to the "GNOME 1.4" selection before releasing the mouse button. This way you will be logging into the GNOME 1.4 desktop environment which will be shipped with the Solaris 9 OE as a "Technology Preview" until the availability of GNOME 2.0 .

To log in, type your user name and, when prompted, your password in the appropriate boxes.

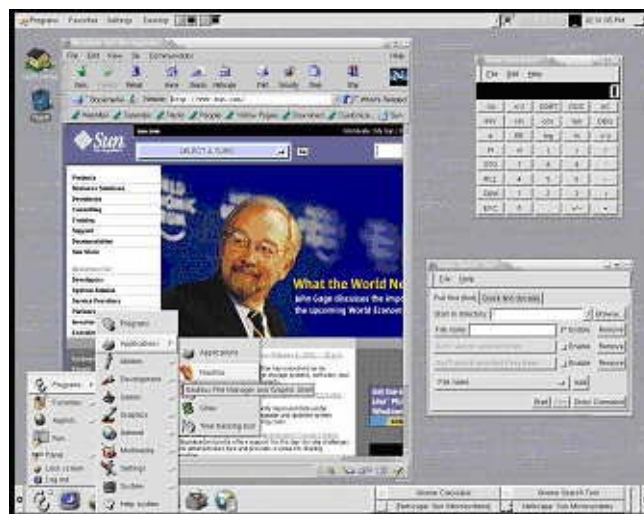GNOME will start and you will see a desktop approximately like the one below:

Figure 1 *The GNOME desktop on Solaris 9.*

A number of useful applications and applets are included with GNOME. Please take some time to acquaint yourself with the GNOME desktop; rolling your mouse over the icons on the bottom of the screen will cause a description of each of the applets to appear. Click on the GNOME "foot" icon on the

left bottom of the screen for the main menu or use the menus at the top of the screen to start additional programs.

You can start the Netscape browser by starting a terminal window and typing **`netscape &`** at the command prompt. GNOME frequently auto−installs an icon for the Netscape browser if it finds it installed; it is the "globe" icon shown on the bottom panel in the screen shot shown above. If such an icon appears on your desktop, you can start it just by clicking on the icon. Similarly, you can start the StarOffice application by typing **`soffice &`** at a command prompt within a terminal window.

As attractive and useful as these new desktop features are, however, most new features in the Solaris 9 OE are primarily aimed at systems in use as servers. The most important new features in the Solaris 9 Operating Environment are designed to make it easier to administer Sun server configurations. The rest of the Solaris Test Drive concerns the use of the new system administration tools and features.

Solaris 9 Resource Manger

The Solaris 9 Resource Manager is a major addition to Solaris 9 platform, and offers very sophisticated resource management functionality fully integrated with the operating system kernel. Solaris 9 Resource Manager offers the ability to monitor and control system performance and resources usage from either the Solaris Management Console or from the command line in ways that haven't previously been available to system administrators or developers. Resource allocation and management using Solaris 9 Resource Manager can be fully specified from the command line or from within the Solaris Management Console. This section will show you some examples of how this is done.

Among the more important features present in the Solaris 9 Resource Manager are the ability to:

- Allocate and pool system resources

- Monitor resources consumption

- Adjust resource allocations

- Generate accounting information on resource usage for capacity planning and billing.

Resource pooling can partition system resources, such as processors, and maintain those resource partitions even through a system reboot. The Solaris "fair share" scheduler will apportion the amount of CPU time afforded different processes.

Extended accounting is linked to project objects through tasks, a capability referred to as Tasks, Projects, and Accounting or TPA. Resource management is particularly useful in managing applications in multiple processor environments, both in vertically scaled systems (multiprocessor systems) or in horizontally scaled server farm or multi−server blade systems. Resource management is also extremely valuable in server consolidation projects.

Sample Users and Group

For an example of the usage of Resource Manager, we'll start the Solaris Management Console and try allocating processor usage by username first, then by groups, and finally by applications. In addition to all of the default users (`root`, `daemon`, `lp`, etc…), we'll create the additional users shown in Table 2

Table 2 *Additional users for the processor allocation example.*

Username	UID	Group	GID	Role
bob	101	sales	115	Salesperson
jane	102	sales	115	Salesperson
george	103	support	116	Support Engineer
kate	104	support	116	Support Engineer
jim	105	dev	117	Development Engineer
judy	106	dev	117	Development Engineer
BigDB	200	dba	120	main BigDB user

To create users and groups, do the following:

1. Start the Solaris Management Console by right clicking on the desktop and select the Solaris Management Console command from the Tools submenu on the Workspace menu or by entering the command **`/usr/sbin/smc`** at the command line.
2. Click on System Configuration, the Users, and finally User Accounts in the Navigation pane to view existing users (Figure 2).
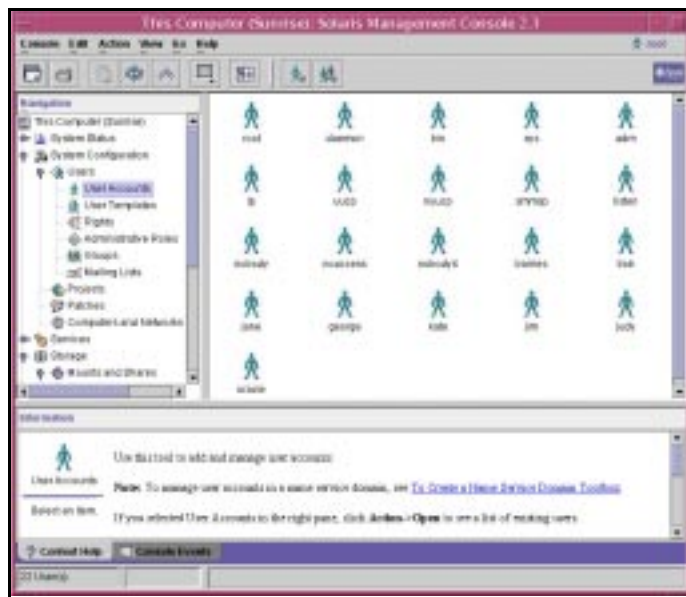

Figure 2 *The User Accounts panel shown here appears after all of the accounts have been created in Step 10.*

3. Select the Action menu, then the Add Multiple Users submenu, and then the With Wizard command.

4. In the wizard add all seven users as shown in Table 2 then complete the wizard to add them to the Solaris Management Console as shown in Figure 3.

Figure 3 *The final step of the Add Multiple Users wizard.*

5. Click on the Groups icon in the console Navigation pane

6. From the Action menu, select the Add Group command.

7. In the General tab enter the name **sales** for the group name in the Group Name text box, and enter 115 in the Group ID Number box.

8. Click on first **bob** and then **jane** in the Available Users list box, then click Add to add them to the Group Members list (you may need to click the Show All button).

9. Click the OK button to complete the assignment.

Figure 4 *The Add Groups wizard.*

10. Repeat steps 7–9 creating the support, dev, and dba groups (Group ID Numbers 116, 117, and 200) and adding their group members from Table 2 to those groups. When done, the User Accounts screen should appear as in Figure 2.

Monitoring Processor Loading

In order to demonstrate resource allocation, there is a simple program called nspin that is available for download on the BigAdmin web site at: http://www.sun.com/bigadmin/software/nspin/nspin This program creates execution threads to load the processors, as well as other loading factors.

To be able to observe resource consumption you must first generate work for the system to do. Begin by loading the nspin program using the following steps:

1. As a root session download `nspin` and copy it to in to the /bin directory. Enter **cd /bin**, press "return," then **chmod 777 nspin** at the prompt to ensure that `nspin` is executable by anyone on the system.

2. Open a Terminal window and enter the command **su – bob** (note the spaces on both sides of the "–") at the prompt to log in as "bob."

3. Enter the command **nspin &** at the prompt to initiate a single `nspin` thread.

    The ampersand puts the process in the background and reports the process ID

4. Open another terminal window and enter **su – george** to switch the user sessions to "george." Again **cd** to the directory containing the `nspin` program.

5. Enter **nspin –n 2 &** at the prompt, which creates two threads of execution for "george."

    The "–n 2" is used to create two processes, thereby creating a heavier load

6. Return to your "root" user session (or start up a new terminal window as `root`).

7. To monitor system usage, enter **prstat –J** at the prompt, or enter **smc &** at the prompt (if smc is not still running), and then open "This Computer" in the Solaris Management Console, Under "This Computer" open "System Status," then "Performance," then "System," and then "Users" as shown in Figure 5.
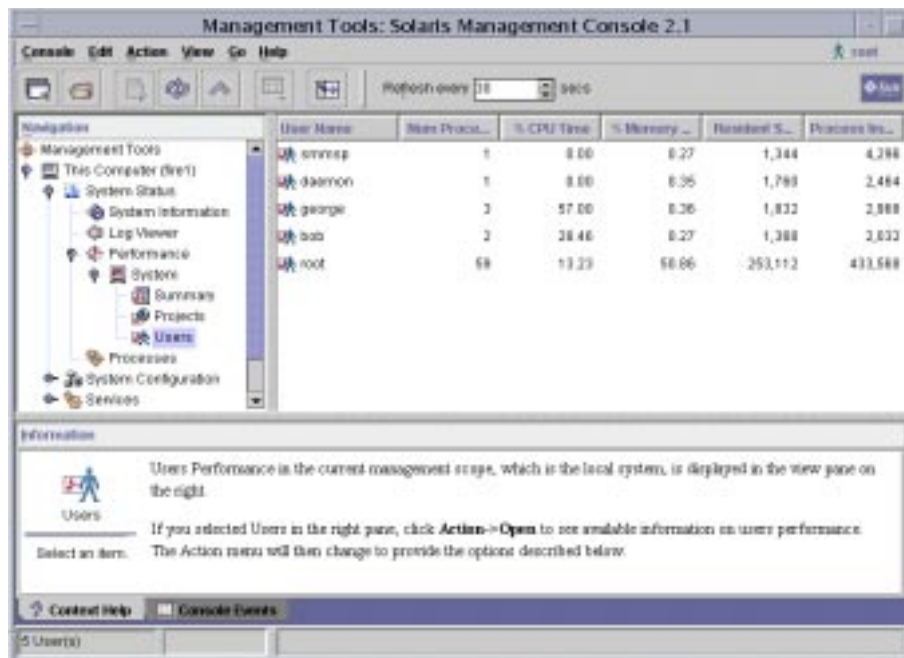

Figure 5 *The results of two users, one of which has twice as many threads of execution as another.*

8. Log out from the `george` and `bob` sessions by going to each terminal window and typing <ctrl>d or just exiting the terminal session.

Processor Allocation by User

In order to use the new Fair Share Scheduler, it must be enabled. The quickest way to do this is to log in as root and, from a command line, type **dispadmin -d FSS** and then reboot the system.

The most powerful use of the new Solaris 9 Resource Manager, of course, is controlling resource allocation. Three main kinds of control are provided by the Solaris 9 Resource Manager:

- User–based control

- Group–based control

- Application–based control

To test user–based control, we'll create a project for jane and judy, but with no group or role additions. We can then assign a usage share to each user. The procedure for user–based control follows:

1. Click on the This Computer icon, System Configuration icon, and then the Projects icon in the Solaris Management Console.

2. Select the Add Project command from the Action menu; the Add Project dialog box appears in Figure 5.

Figure 5 *The Add Project dialog box*

3. Enter the project name **user.jane** into the Project Name text box; then click the Resources Controls tab.

4. Click the "Users" tab and select "jane" from the Available Users list box, adding the account to the Project Members list box as shown in Figure 6.

Figure 6 *The Add Project dialog box, Users tab*

5. Click on the "Resource Controls" tab, then click the <u>A</u>dd button to open the Add Resource Control dialog box.

6. Select the `project.cpu-shares` control in the Add Resource Control dropdown list, enter **20** in the Threshold text box as shown in Figure 7.

Figure 7 *The Add Resource Control dialog box.*

7. Then click the <u>A</u>dd button and then the OK button to return to the Add Projects dialog box.

8. Click the OK button to create the project and have it appear in the Projects pane of the console.

9. Repeat Steps 2 – 8 creating project **user.judy** with a cpu–share of **30** assigned to that user.

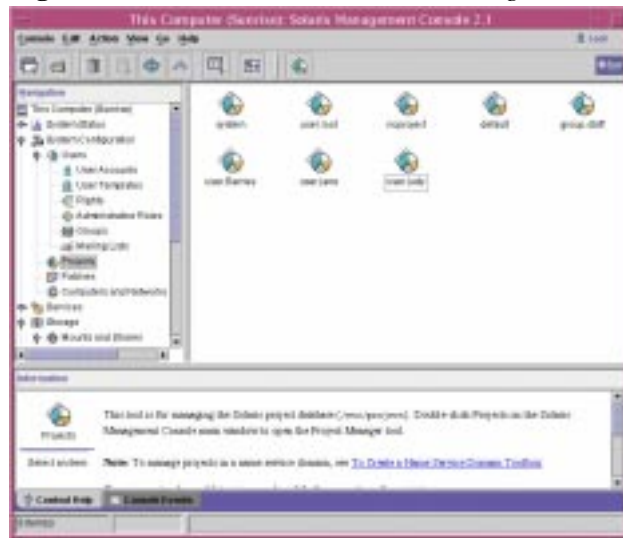Figure 8 shows you the resulting Projects panel.

Figure 8 *The Projects panel of the console.*

To load the system, we follow the same procedure above:

1. At a prompt enter **su – jane** and press the Enter key.

2. Change directories to the directory containing the nspin program using the **cd /<pathname>** command, if necessary.

3. Enter **nspin &** and press the Enter key.

4. Open a second Terminal window and repeat Steps 1 – 3 using **judy** as the username and the same **nspin &** command to launch the process.

5. Enter the command **prstat** to view user CPU usage

6. Or, in the console click on the Users icon in the Performance tree, as shown in Figure 9.
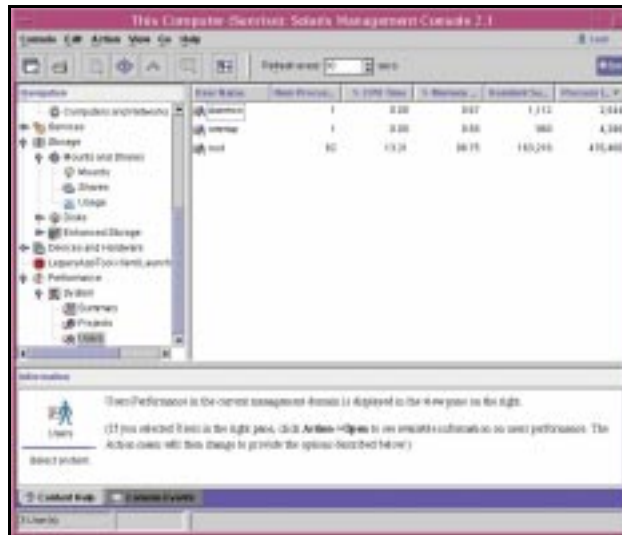
7. Log out Jane and Judy.

Figure 9 *The resulting usage based on two projects with 20 and 30 CPU shares of the Solaris Fair Share Scheduler.*

Processor Control by Application

As another example of the flexibility of the Solaris 9 Resource Manager we'll briefly touch on application–based control. Application–based control is important because it lets an organization control the desired Quality of Service (QoS) for an application based on it's resource requirements and apply any needed constraints based on business priorities. In this instance, we simulate a big enterprise database server by using nspin. Two instances, BigDB1 and BigDB2, are instantiated.

To demonstrate application–based control:

1. Create three projects:

   • **user.BigDB**, where you can add the dba group, and give this project **10** shares.

   • **BigDB1**, add the dba group, and give this project **40** shares.

   • **BigDB2** add the dba group, and give this project **50** shares.

2. Now log in to BigDB and start:

   newtask –p BigDB1 nspin &

   newtask –p BigDB2 nspin &

   nspin &

3. Use prstat or the console to examine project performance

What you will see is that the main instances (`BigDB1` and `BigDB2`) get 40% and 50% where the background processes get 10%.

4. Kill the `nspin` jobs and log the users out.

Solaris Volume Manager

The Solaris Volume Manager (SVM) is a new feature in the Solaris 9 OE, but is not entirely new functionality. It is the next generation of the product formerly known as Solstice DiskSuite™ sofwtare with new features added and now delivered as an integral part of the Solaris Operating Environment. It is presented both as a set of commands at the command line and in the Enhanced Storage tool in the Solaris Management Console. By providing Solaris Volume Manager integrated in the Solaris OE, Sun is meeting the needs of enterprise–level system customers who must manage more and more storage as part of their daily work. With Solaris Volume Manager, it is now possible to:

- "Break up" a large disk or storage array into many smaller disk partitions (up to 8192, lifting the former restriction of eight partitions to a single drive).
- Create and manage high–performance and fault tolerant volumes such as RAID 0 (striping), RAID 1 (mirroring), and RAID 5 (striping with parity).
- Preserve the volume configuration on a subdisk basis via Disk ID support, even when a disk is moved.
- Actively monitor disks to detect silent disk failures
- Manage logical volumes from any WBEM compliant application.

Sun also provides an upgrade path to migrate your settings and configuration (even mirrored root upgrades) from the Solstice DiskSuite sofwtare to SVM. For more information, refer to the *Solaris Volume Manager Administration Guide*.

In the sections that follow some capabilities of the SVM are illustrated. The first set of instructions covers performing volume management tasks with the SVM Graphical User Interface (GUI); the second covers performing tasks using the Command Line Interface (CLI). All tasks can be performed using either interface, and sys admins can freely choose the appropriate interface for the task at hand. In addition, one can save the command–line equivalents of the tasks performed in the GUI as a shell script, allowing for easy automation of complex tasks.

> **WARNING**: This section creates RAID structures from existing disk drives. During these operations, any existing data on these disks will be erased. Be sure that you work with non–critical data and follow the instructions carefully. We advise that if you are in any doubt about which disks are being written to, you should seek help from someone knowledgeable with administering disks under the Solaris OE

Creating a Striped Set With or Without parity from the GUI

Let's take a look at managing volumes using the Enhanced Storage tools in the Solaris Management Console. A striped volume without parity is RAID 0, and one with parity information recorded is RAID 5. You can create RAID 0 with two or more disks, while RAID 5 requires three or more disks (one being reserved for parity information). To open the SVM console tool:

1. Right click on the desktop and select the Solaris Management Console command from the Tools submenu on the Workspace menu.

   Or, start the console by entering the command **/usr/sbin/smc** at the command line.

2. Select the Open Toolbox command from the Console menu; then select a toolbox from either your server or your local computer.
    The console is populated with the tools for that toolbox.
3. When prompted to login, enter a root username and password.
4. Double click on the workstation name to open the tool tree in the left hand pane, double click on the Storage tool, and then double click on the Enhanced Storage tool as shown in Figure 10.
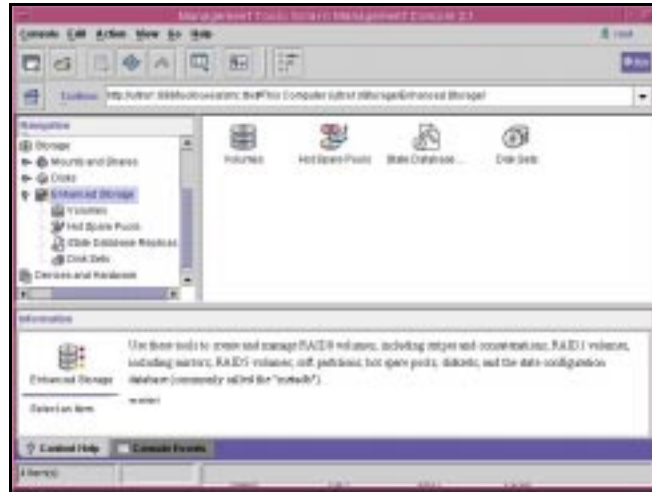

Figure 10. *The Enhanced Storage tool is where you create volumes based on disk sets, concatenations, mirrors, and striping.*

To create state databases:
1. Double click on the State Databases icon.
    A dialog box appears as Solaris searches for databases, and you will be presented with a blank screen if none are found.
2. With State Databases highlighted, select the Create Replica command from the Action menu
3. Follow the directions for creating the database replicas on the disks you wish to stripe.

When you complete this step you should see the dialog box shown in Figure 11.
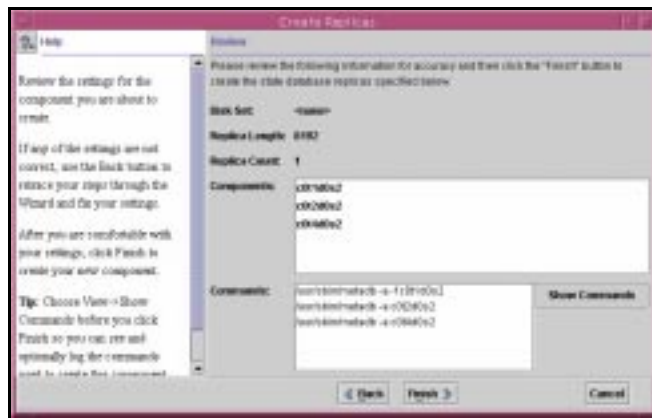
Figure 11. *The Create Replicas step shows you the state databases on your disks.*

To create a RAID volume:
1. Double click on the Volumes icon in the Enhanced Storage tool.
2. Click on the Create Volume command on the Action menu.
3. In the Create State Database Replicas click on the Don't Create State Database Replicas radio button (as we have already created them above), and click the Next button.
4. Select the None from the drop down list in the Select Disk Set step.

5. In the Select Volume Type step shown in Figure 12 select the volume type you wish to create then click the Next button. Explanations are in the left pane, and your choices are:
   - Concatenation (RAID 0)
   - Stripe (RAID 0).
   - Mirror (RAID 1),
   - RAID 5
   - Transactional Volumes
   - Soft Partitions

Figure 12. *The Select Volume Types step is where you choose the particular type of volume you will create.*

6. Name the volume (the default is d0), click Next and then select from the list of drives available to be added to the volume you are creating.
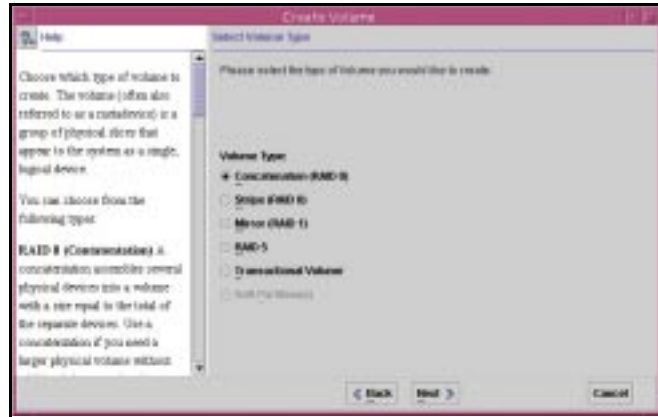   For RAID 0 or 5 you will be asked for the interlace volume, we recommend you accept the default and click the Next.
   For a Mirror or RAID5 you will be prompted to create a hot spare (online backup), the default is No.
7. Click No and after you examine the final Review screen (Figure 13) click the Finish button.

Figure 13. *The Review step shows you the particular type of volume and RAID level Solaris will create.*

The new volume (d0 if you used the default) will be shown in Volume tool with the icon shown in Figure 14. Disks are usually found in the /dev/dsk tree, but since this is a special device you will find it's representation as /dev/md/dsk/d0.

Figure 14. *A RAID disk icon is shown in the Volumes tool window.*

To create a file system on the volume:

8. Open a terminal window and at the shell prompt enter **newfs /dev/md/dsk/d0**. The New File System command asks you to confirm that you really want to erase the current file system. The command refers to the raw file system which has a rdsk instead of dsk in the path.
9. Type **y** and then press the Enter key and newfs will create the files system.
10. Create the mount point (if it does not exist) with the **mkdir –p /export/home2** command.
    The –p switch creates any portion of the path that does not yet exist.
11. Type **mount /dev/md/dsk/d0 /export/home2**.
12. After you return you to the shell prompt enter **df –kl** to examine your mounted file system.

You can automount the file system at startup by either editing the **/etc/vfstab** file using a text editor with the following line[9]:

---

[9] The line uses tabs, not spaces to separate values. The first value tells the system the location of the buffered volume, the second is the raw access file for the volume, the third is where the volume should be mounted, the fourth is what file system

```
/dev/md/dsk/d0       /dev/md/rdsk/d0      /export/home2       ufs    2    yes
-
```

Better yet, you might want to perform the addition of an automount in the Mounts and Shares tool of the Solaris Management Console. With the Mounts tool it is possible to create and manage mount points, which means that you no longer need to visit the `VFSTAB` file or enter commands like:
`mount 192.168.3.99:/share1/solaris /Macys` to mount a Network Attached Storage (NAS) device folder (`168.3.99:/share1/solaris`) to the mount point (the root folder `Macys`).

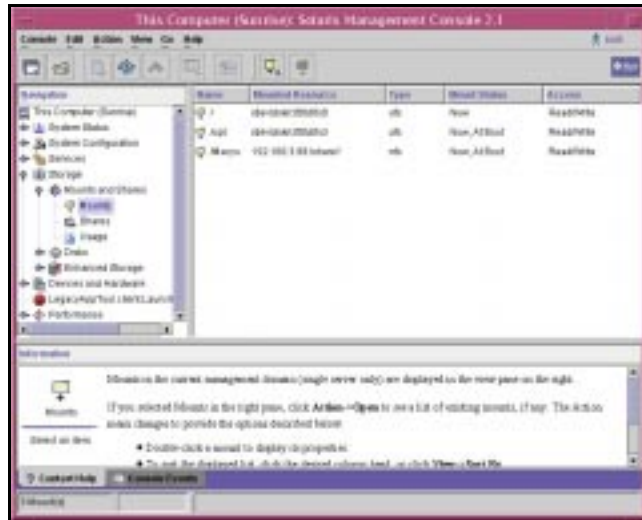The Mounts tool is shown in Figure 15.

Figure 15. *The Mounts tool is a convenient graphical method for creating and managing mount points in the* `vfstab` *database.*

Creating a Mirror from the Command Line

To create advanced storage structures with the SVM you must set up state databases, as a separate slice of your physical disk:

1. Enter the **format** command (as `root`) to setup a slice of the disk.

   Use slice 7; it does not need a label and only requires about 20MB of disk space, and creating smaller volumes is faster.

2. At the root prompt, enter **metadb -a -f c0t4d0s7**

   Replace the location identifier (`c0t4d0s7`) with the correct disk and slice used on your system.

3. Repeat Steps 1 and 2 for each of the disks you are going to be using for the test.

   The two slices we used were `c0t1d0s0` and `c0t4d0s0`. In our example we created two 4GB slices. Each part of the mirror must be the same size.

4. Setup the first disk by entering the command **metainit d51 1 1 c0t1d0s0**.

   The system will return `d51: Concat/Stripe is setup`.

5. Do the same with the second disk, by entering **metainit d51 1 1 c0t4d0s0**.

   Remember: you must substitute the correct disk slice labels that you actually used on your system.

6. Initialize the primary device in the mirror by entering **metainit d50 -m d51** at the command line.

7. Link in the second device with the **metattach d50 d52** command.

8. Create the file system for the mirror by issuing the **newfs /dev/md/dsk/d50** command.

Instead of using the names for the individual slices (`/dev/dsk/c0t1d0s0` and `/dev/dsk/c0t4d0s0`) you will now refer to the mirror device /dev/md/dsk/d50. You now should have a working mirror. To test your mirror:

---

is on the device (`ufs` is the default file system for the Solaris platform), the fifth is which disk check pass the system should check this disk with (the volume is not required for the system to boot to 2 is good), the sixth is whether or not you want the file system to mount when the system is booted and the last is the options you want the file system mounted with.

1. Create a directory for the test using the **mkdir /export/home2** command.
2. Mount the mirror file system by entering the mount **/dev/md/dsk/d50 /export/home2** command.
3. Copy some data to the mirror file system with the **cp -R /export/home/<username> /export/home2/** command.
4. Enter **umount /export/home2** command to unmount the mirror file system.
5. Mount the first physical slice with **mount /dev/dsk/c0t1d0s0 /export/home2**.
6. Enter **ls /export/home2**.
   You should see the data in it that you just copied to the home2 directory.
7. Unmount that file system with the **umount /export/home2** command again.
8. Look at the second physical slice with the mount **/dev/dsk/c0t4d0s0 /export/home2**.
9. Enter **ls /export/home2**.

The same data should appear in the home2 directory, which confirms the mirror was created.

Directory Services

One of the most important new features in the Solaris 9 OE is the integrated Sun™ ONE Directory Server (formerly iPlanet™ Directory Server.) This powerful, distributed directory server is designed to manage an enterprise−wide directory of users and resources. Sun ONE Directory Server is scalable, replicable and extensible, thus providing use for intranet applications, extranets you create for trading partners, and e−commerce applications to reach customers over the Internet anywhere in the world

Directory services provided by a directory server are the key to efficient network resource management. Using an efficient directory service can let an application more quickly search a network for users, systems, or printers, allow an application to store important information in a central repository, provide routing information and a variety of other functions. Directory services are seen to play an essential role in the future development of network−based applications, particularly those that rely on distributed services such as web services.

Most companies have many instances of directory services installed in databases, on mail servers, as a central service, and for specific applications or services. Best practices in IT infrastructures today merge these services and data into a single unified service, and the optimal way to do that is to have a consolidated service based on an open standard like LDAP.

The directory server is managed with the console where access rights, database management, directory configuration, and data replication may be specified. The Solaris 9 *System Administration Guide: DNS, NIS, and LDAP,* included in the Solaris 9 documentation and at http://docs.sun.com, describes this application in more detail.

Setting Up the Sun ONE Directory Server

Optimal configuration management of directory services is a complex subject, so this section introduces you to a default setup for a standalone directory server.

To setup the directory server in its default configuration:

1. Log in as root and enter **/usr/sbin/directoryserver setup** at the command prompt.

2. Continue with the configuration by pressing the Enter key, then press the default of 1 to configure the server followed by the Enter key.

3. Press the `Enter` key to accept a typical configuration (options 2), and accept the default choice for components by pressing the `Enter` key once more.

4. Accept the default directory suite components, press the `Enter` key to accept both (1, 2).

5. For the administration services press the `Enter` key to accept both (1, 2).

6. Input a Fully Qualified Domain Name (FQDN) for your system (e.g. **www.sun.com**) to add to the local system name and the fully qualified domain name. Press the Enter key.

   If the correct name doesn't appear, press `Ctrl+C`, and fix the name of your system in the Computers section of the Solaris Management Console, or by using the `hostname` command.

7. On the next screen, press the `Enter` key to accept the default of `nobody` for both user and group when asked which service to run.

8. Select `No` for directory server registration in the next screen, and in the following screen select `No` when asked to store your data on another directory server.

9. Accept the default directory server network port of `389`.

10. At the next prompt press the `Enter` key to accept the default identifier for the directory server, which should be your host name (and not your FQDN).

11. Provide the user name of the administrator and the password.

12. Choose the suffix of your directory tree: press the `Enter` key to accept the default which should be your fully qualified domain name broken in to its individual parts (`dc=sun`, `dc=com`).

13. On the next screen select the user name and password of the internal administrator, enter the FQDN for the administration name (e.g. sun.com), then press the `Enter` key.

14. Enter an easily remembered (like **55555**) administration port number between 1024 and 65535 (the installer selects a random number).

15. Accept the default of root for the user name of the administrator server, and press the `Enter` key.

The install tool will start the directory server using the options you selected, and output something similar to what follows.

```
[slapd-netra]: starting up server ...
[slapd-netra]: [06/Feb/2002:23:42:42 -0800] - iPlanet-Directory/5.1
B2001.292.0117 starting up
[slapd-netra]: [06/Feb/2002:23:42:59 -0800] - slapd started.  Listening
on all interfaces port 389 for LDAP requests
Your new directory server has been started.
Created new Directory Server
Start Slapd  Starting Slapd server configuration.
Success Slapd Added Directory Server information to Configuration
Server.
Configuring Administration Server...
Your parameters are now entered into the Administration Server
database, and the Administration Server will be started.

Changing ownership to admin user root...
Setting up Administration Server Instance...
Configuring Administration Tasks in Directory Server...
Configuring Global Parameters in Directory Server...
iPlanet-WebServer-Enterprise/6.0SP1 B10/12/2001 14:40

warning: daemon is running as super-user
[LS ls1] http://netra.workofstone.net, port 55555 ready to accept
requests

startup: server started successfully

Press Return to continue...
```

You now have a running Sun ONE Directory server.

The Sun ONE Directory Server Console

You can work in the console to view and change parameters and settings for the directory server. To use the console, do the following:

1. Enter the following command at a prompt:

    `/usr/sbin/directoryserver startconsole`

2. Login under the administration account.

    The console appears and display the domain name and the associated directory servers (Figure 16).
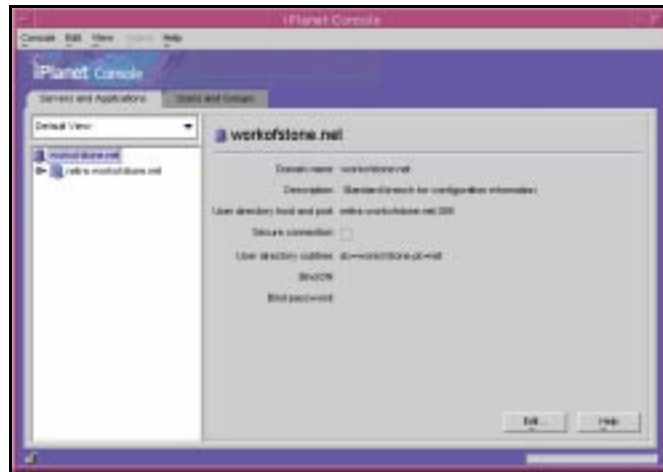
Figure 16. *The Server and Applications tab.*

3. Click the Users and Groups tab.

    Nothing will be displayed by default, as shown in Figure 17.

4. To view the existing groups click on the Search button.

    By default there is only one group, the Accounting Managers group.

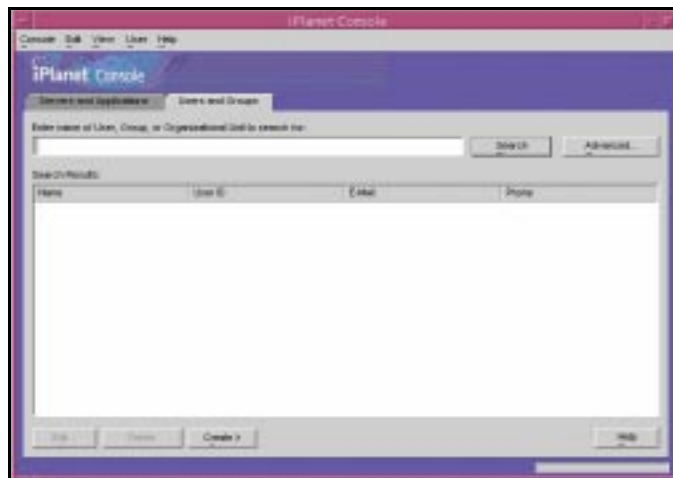5. Double click on this group to see and edit its properties.

Figure 17. *The Users and Groups tab.*

6. Click on the Servers and Applications tab, server name selection, on the Server Group selection to see its components (the Directory Server and the Administration Server), and finally on the Directory Server selection to see its information.
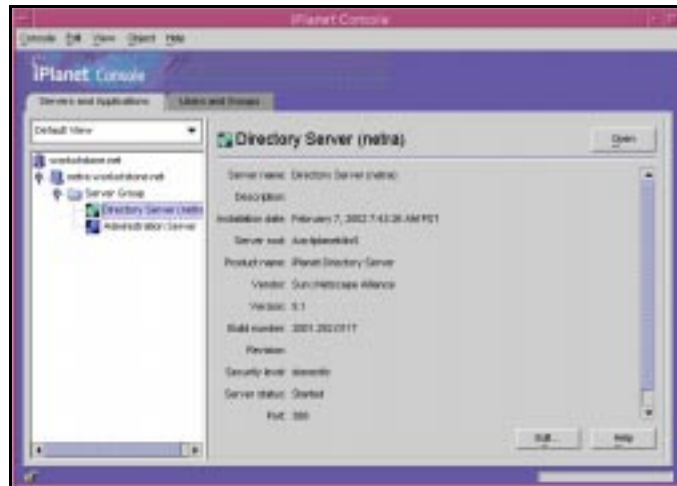
The result is shown in Figure 18.

Figure 18. *Directory Server information in the console*.

7. Click on the Open button at the top right of the screen to access that server's configuration task settings as shown in Figure 19.

From here you can stop and start the server, modify its configuration, check the current status and modify the data it holds.
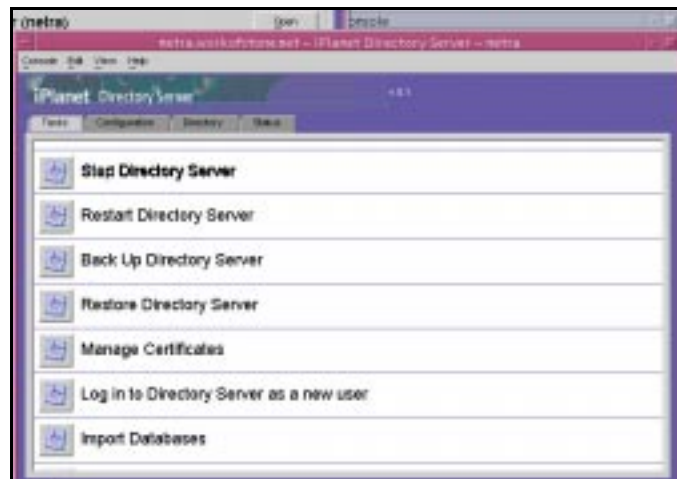
Figure 19. *The Tasks tab for a directory server*.

Reliability and Security

One of the more important security additions in the Solaris 9 OE is the Solaris Secure Shell tools, which are loaded by default to provide security for your system the moment it is powered on. The Solaris Secure Shell replaces the telnet, ftp, rsh (remote shell) and rcp (Remote Copy) tools that have historically been the means of connecting to and administering UNIX® systems remotely. Unlike the older tools which passed data (like passwords) in clear text, Solaris Secure Shell provides a fully–encrypted "VPN–like" environment for system administrators.

Solaris 9 software also ships with TCP Wrappers. Long a staple in the world of UNIX security; TCP Wrappers can control which remote systems can access services offered by the local host with limited firewall capabilities. With TCP Wrappers, it is possible to allow a computer access to the ftp server while blocking access to the telnet server, without disabling the telnet server in case it is needed.

Interoperability with Windows: SAMBA

SAMBA is a CIFS networking tool providing Windows compatible file and printer sharing services, as well as the WINS name service and Domain Authentication. It has been in use on UNIX systems for many years. Working with the SAMBA configuration file can be intimidating at first, so a tool called

SWAT has been included. SWAT is the SAMBA Web Administration tool and it makes working with SAMBA significantly easier.

To enable SWAT you need to add the following line to your `/etc/services` file:

```
swat  901/tcp
```

This tells the system what applications it can expect to find at certain ports. It is best to add that line in order in the file, which in the Solaris 9 distribution is at about line 104.

Next you need to add the following line to the end of your `/etc/inetd.conf` file:

```
swat   stream   tcp   nowait.400   root /usr/sfw/sbin/swat swat
```

Restart the `inetd` (Internet daemon) process so it will see the change you made. Run the following command to kill the current `inetd` process:

```
ps -ef | grep inetd
```

You will see output that will look similar to this:

```
# ps -ef | grep inetd
    root   189   1  0    Jan 21 ?          0:00 /usr/sbin/inetd
    -s
    root  3287 3260  0  18:28:46 pts/2    0:00 grep inetd
#
```

The PID is the second item on the `inetd` line and is shown in bold above (your PID# will be different). Restart the process with the `kill -HUP` command:

```
kill -HUP 189 (substitute the correct PID# here for your copy of inetd)
```

Figure 20. *On the Password page of SAMBA you can change the passwords for clients and servers that allow access to the SAMBA file and print services.*

Figure 21. *On the SWAT page you can get to different parts of the SAMBA configuration routine by clicking on the buttons across the top of the screen, and view configuration information by clicking on the links in the main body of the page.*

Now that the inetd service has restarted you can access the SWAT program from your web browser by going to the following address http://localhost:901//. For remote access use the systems external hostname or IP address http://system.domain:901/. When you connect you will be prompted for a username and password (as shown in Figure 20), use root and the root password to configure this file.[10]

You should see the home page for the SWAT program shown in Figure 21. That page contains links to information from the various SAMBA tools. Most of this information is cached on your local system and will appear whether or not you are connected to a network.

Open Source Tools

The Solaris 9 OE continues a policy of including the most popular and useful open source software to maximize value for Sun's customers. A sample of the tools included with Solaris 9 includes:

- bash – The Bourn Again Shell, a Bourn compatible shell with many enhancements. The presence of bash means that most Linux scripts can be moved to Solaris and run without modification.

- Gzip – The GNUZip utilities, widely used across many platforms (UNIX and non–UNIX) for file compression and expansion.

- Bzip2 – This block–sorting compression tool is a newer set of utilities that outperform gzip both in compression and speed. This tool is gaining acceptance in the UNIX world.

---

[10] If you make a mistake and are refused access you might have to exit the web browser and start it again. Some web browsers remember the username/password combination you entered, and reenter them at login during the same session, so it will keep failing until you stop it by shutting it down.

- `Gtar` – The GNUtar tool adds support for long directory names and on–the–fly compression (`compress`, `gzip` and `bzip2`)

- `ncftp` – an ftp client with many enhancements, including passive downloads and automatic retry for connecting to servers who are at their connection limit.

- `Glib` – A library used by many open–source developers. These libraries make it easer to download and install software from the open source community.

- `GTK+` – the GIMP toolkit, libraries for graphical user interfaces, also used by many developers. These libraries make it easer to download and install software from the open source community.

There are many other tools included on the Solaris software companion disk including editors, developer tools, multimedia programs, graphics programs, and many others useful for users in creating their own custom environment. The disk provides a convenient installation method for these programs.

Resources

Table 4 lists links to Web sites with useful information about the Solaris OE.

Table 4. *Table of Solaris OE Web Resources.*

Site	Link
Solaris Information	http://www.sun.com/solaris/
Sun's Sys Admin Resource: The BigAdmin[sm] Portal	http://www.sun.com/bigadmin/
Sun Product Documentation	http://docs.sun.com
Solaris Training	http://suned.sun.com/US/catalog/solaris.html
Solaris Family Comparison Matrix	http://www.sun.com/software/solaris/fcc.html

Appendix 1: Convincing your Management

This section helps provide you with some of the business reasons for adopting the Solaris 9 OE and includes helpful language in making your case to management.

The Solaris Operating Environment: An Overview

Sun's Solaris Operating Environment is designed to support the high−level infrastructure that today's successful organizations need. Because it is available, scalable, manageable and secure, the Solaris Operating Environment provides optimal support for the wide range of services necessary to both enterprise and Internet−based service−on−demand environments. The Solaris OE delivers the predictability of the data center with the agility of the Internet.

The Solaris Operating Environment is also the only OE to deliver a proven, unique strategy that focuses on industry standards, the Internet, innovation and integration and delivers lower cost of operations. With the need for a rock−solid foundation, it is no surprise that so many successful organizations are using Sun's Solaris Operating Environment:

- Gartner Dataquest (February 2002) reports that Sun continues its leadership of the RISC/UNIX server market with more than one out of three servers shipped in 2001 coming from Sun and running the Solaris OE.
- A Netcraft Web server survey (January 2002) states that most of the world's largest web sites are powered by Sun Servers running the Solaris OE.
- Solaris software also powers these company's web sites (Netcraft.com, 10/2001):
  - 53 of the Fortune 100 companies
  - Ten of the top eleven telecommunications companies in the Fortune 500
  - Four out of the tope five commercial banks in the Fortune 500
  - Seven of the top ten pharmaceutical companies in the Fortune 500

Investment Protection Through Compatibility and Open Standards

Investment protection drives Sun's commitment to binary compatibility. Reliance on open standards also offers asset protection, as Sun systems can be well integrated with the legacy systems that companies already have in place.

Compatibility is one of the hallmarks of software using the Solaris Operating Environment, and is a key feature enabling customers to move up the product line without ever having to port or recompile their applications. The Solaris OE has complete binary compatibility by supporting a public application Binary Interface (ABI) which guarantees that conforming applications will run on all Sun servers without modification – from desktop workstations to the 106−processor Sun Fire 15k server.

Sun is active in the Linux community and offers high−quality machines running Linux for applications that do not require the advanced capabilities of the Solaris platform. In order to protect Sun's customers' investments in Linux and make Solaris an "enterprise−level" deployment environment, Sun provides interoperability and commonality across both Linux and Solaris environments. Specifically, Sun is integrating many of the commands, utilities and libraries from Linux into Solaris OE. This allows Solaris users to bring popular Linux applications to Solaris OE, recompile them, and implement them in the same way they would on Linux. This feature gives Solaris users the best of both worlds: the flexibility of Linux software and the scalability and availability of Solaris OE.

Sun has long been a strong supporter of the Open Source community, recognizing that much of the software that has come from Open Source has become so widely−used as to be considered standard.

Sun has contributed important technologies to the open source movement, such as OpenOffice and NetBeans™ technologies, and participates in many other open source projects.

Sun's commitment to an open standards–based software vision is also exemplified by our support of Internet standards, including the IETF and our sponsorship of the Java™ Community Process for the Java platform. Because our products are based on open standards, Sun invests its efforts in creating superior implementations rather than vendor lock–in strategies. This ensures that Sun's partners have the freedom to innovate, bringing "best of breed" solutions to market on Sun systems. There are more than twelve thousand third–party applications running on the Solaris Operating Environment, giving Sun customers the greatest possible choice as they implement solutions.

Solaris 9 OE: The Best Foundation for Sun ONE Software

Solaris 9 OE is the foundation of Sun ONE: Sun's vision, architecture, platform and expertise for developing and deploying services on demand. The Sun ONE software stack is integratable. This means that, while it is possible to deploy the full array of Sun ONE products for the creation of web services, our adherence to open standards allows for nearly any product in the stack to be "swapped out" for products from different vendors.

Many Sun ONE services and components are included in the Solaris software distribution. This enables developers to start building Sun ONE web services immediately and helps sys admins and architects to become familiar with the applications and tools that comprise the Sun ONE software stack. Many popular open–source packages, such as Apache and Perl, are actually integrated into the Solaris OE.

Some of the other software included in the Solaris 9 media kit are:

- **StarOffice Software**: Sun's full featured office suite, based on the open–source OpenOffice.
- **Netscape Communicator**: A complete Internet access suite with web browsing, email and news client, and web page authoring modules.
- **Application Server**: The Sun ONE Application Server (formerly the iPlanet Application Server) will be included in a subsequent update to the Solaris 9 OE.
- **Database server**: A 30–day trial of the Oracle 9i Enterprise Edition server.
- **Development tools**: The latest version of the platform independent Java development language, as well as a 30 day trial license for the Forte™ tools (C, C++ and FORTRAN) and the Sun ONE Studio 3, Community Edition (formerly Forte for Java Community Edition)

By making an open network and industry standards the core of our products, Sun can integrate the best open systems software to build better solutions for our customers.

Competitive Positioning

The Solaris OE is designed to continue building upon Sun's key competitive advantages of scalability, availability, manageability, and security. Sun's delivery on the fundamentals is recognized with Network Computing's "Best Server Operating System 2001" award, in which it was declared that "if Sun Microsystems has proven one thing, it's that its operating system can stand the test of time and still beat the competition." The Solaris OE has earned many other awards including being rated the #1 UNIX Operating Environment, according to D.H. Brown Associates' 2001 UNIX OS Function Review (March 2001) and named the top UNIX OS by InfoWorld (January 2001)

Table 1. *A comparison of the features found in the Solaris 9 OE with other network operating systems.*

	Sun Solaris 9	IBM AIX 5L v5.1	IBM z/OS (10/01)	HP HP–UX 11i (12/01)	Linux 2.4 Kernel Distributions	Microsoft Windows .NET Server
Architectures Supported						
Platforms	SPARC	PowerPC	S/390 zSeries	PA–RISC, IA–64	IA–32, IA–64, SPARC, Motorola 68K, MIPS R3000 and R4000, Power PC, ARM, Alpha, S/390	IA–32, IA–64
Scalability						
Number of Bits	64	64	64	64	64	32/64
CPUs Supported	106	32	16	64	8/16/02	64 (DCE only)
Max Physical Memory	576GB (Sun Fire 15K)	256GB	64GB	256GB*	64GB (IA–32 requires PAE)	64/128GB on IA–64 (IA–32 requires PAE)
IPv6 Protocol	Yes	Yes	No	Yes	Add–on	Beta
RAS						
Dynamic Reconfiguration	Yes	No	Yes (but no hot swap online)	No	No	No
I/O Failover	Yes – StorEdge Traffic Mgr	No	Yes	Yes	Partial	Partial
IP Multipath/Failover	Yes	Yes	Yes	Yes	Yes	Yes
Hot Patching	Yes	No	No	No	No	No
Live Upgrade	Yes	Yes	Yes	No	No	No
Workload Management						
Single–instance Resource Manager	Yes Built–in w/SRM	Yes w/WLM	Yes w/IRD/WLM	Yes w/PRM/WLM	No	Limited Job Object on DCE only
System Partitions	Yes–DSDs	Yes – LPARs (only on p690)	Yes – LPARs	Yes– nPartitions, vPars	No	No
Dynamic Partitions Automated	Yes	No	Yes	Limited – vPars only	No	No
Dynamic Partitions	Yes	No	Yes–IRD	No	No	No
Dynamic Partition API	Yes–RCM	No	No	No	No	No
Infrastructure Services						
LDAP Directory	Yes iPlanet	Yes SecureWay	Yes SecureWay	Yes iPlanet	Yes Open LDAP	Yes Active Directory
Webserver	Yes – iPlanet	Yes – Apache	Yes – Apache	Yes – iPlanet	Yes – Apache	Yes – IIS

In–kernel http Cache	Yes	Yes	No	No	Partial – Tux only	No
Bandwith Management	Yes w/SBM	Yes	No	No	No	No
DHCP/Dynamic DNS	Yes	Yes	No	Yes	Yes	Yes – Active Directory
Java	J2SE v1.4.0	J2SE v1.3.0	J2SE v1.3.0	J2SE v1.3.0	J2SE v1.3.0	No

Security Components

Kerberos v5	Yes	Yes	No	Add–on	Yes	Yes
Role–based Access Control	Yes	No	Yes	No	No	Yes
PAMs	Yes	Partial	No, but similar available	Yes	Yes	No, but similar – GINA
IPSec/IKE	Yes	Yes	Yes	Yes	Yes	Yes
Firewall	Yes (SunScreen 3.1 Lite)	No	No	Yes IP Filter	Yes	No

Storage Management

Journaling File System	Yes	Yes	Yes	Yes	Yes	Yes
Volume Manager	Yes Solaris Volume Mgr	Yes	Yes	Yes	Optional (Veritas Vol. Mgr.)	Limited
Cluster Filesystem	Yes – Sun Cluster 3.0	Yes – GPFS	Yes – Parallel Sysplex	No	No	No

System Management

Centralized Multi–server Mgmt. Tool	Yes – SunMC	Yes – RSCT	Yes – Tivoli	Yes – SCM	No – 3rd Party	Yes – MMC
Web–based Management GUI	Yes	Yes	Yes – msys	Yes	Yes	Yes
Network Boot With DHCP	Yes	No	No	No	No	Yes
WBEM	Yes	Yes	No	No	No	Yes
Network Install	Yes	Yes	No	Yes	Yes	Partial (requires 3rd party tools)

Linux support

Linux APIs	Yes	Yes	No	Yes	Yes	No
Open Source Tools	Yes	Yes	Yes	Yes	Yes	No

Investment Protection

Full Backward/ Forward Compatibility	Yes Solaris App Guarantee	No 64–bit apps – recompile	Yes	Partial 11.0 to 11i Limited pre–11 to 11i	No	No