

Solaris™ OS Guide for New System Administrators

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Introduction

Within this document you can find the most relevant 20 percent of technical information you will need to know when working with the Solaris™ Operating System (OS) and Sun™ platforms. It should answer 80 percent of your questions about the Solaris OS. The guide is primarily written for the Solaris OS, SPARC® Platform Edition, but most of the information should be applicable for the x86 platform as well.

This document is not intended to replace detailed books or comprehensive FAQs written about the Solaris OS (books and links are listed in the Appendix). Rather, this document is intended to serve as a "how to" collection for those who are new to Solaris OS system administration or those who are not administering Solaris systems on a daily basis. This content focuses on graphical workstations used for technical applications and should also be helpful to those who need to set up Sun systems for demonstrations or benchmarks.

Two special notes:

- Always keep track of changes made to your system by using a change log.
- Keep in mind that this document contains system-level procedures that can provoke system unavailability. Do not apply these procedures to productive systems unless you have made a careful analysis of the consequences.

1 System Booting and Testing

1.1 The OK-Prompt

Each Sun system has a Boot-PROM mode that can be accessed prior to starting the Solaris OS or while the OS is running. You may enter this mode by pressing `STOP-A` (hold down the STOP-key while pressing "a"). If the STOP-key is not available (PC keyboard), try `Ctrl-BREAK`.

Once you are in the Boot-PROM mode, an OK-Prompt is displayed. If the Solaris OS has been running, it is frozen now, but can be "reanimated" immediately by typing the command "`go`" at the OK-Prompt.

1.2 Testing at a Console

The Boot-PROM mode can be used either by means of a directly connected keyboard and monitor or by using a separately connected terminal.

If the system does not detect a keyboard while booting, input and output are automatically redirected to the first serial interface (`/dev/ttya`, often named "A"). You may attach a terminal or another computer (using a cross-over serial cable) to this port.

If this other computer happens to be a Sun workstation, you can use `tip hardwire` to monitor the boot console of the observed machine. After issuing the `tip` command, all boot messages will appear in the corresponding terminal window. To issue a `STOP-A` command on the observed host, you have to change tip to telnet-mode first with `Strg-]`. After that, enter a BREAK: `telnet> send brk`
If `tip` does not work, try `cu`: `cu -b8 -l/dev/cua/a` (`STOP-A` with `~%break`, end session with `~.`).
`/etc/uucp/Devices` has to embody these lines:

```
ACU cua/a - Any hayes
Direct cua/a - Any direct
```

1.3 Rebooting a Sun Workstation

Prior to rebooting, a Sun workstation should always be shut down in an appropriate manner. For this task, several alternative commands exist.

The best and cleanest methods are:

- `# init 5` Shut down all processes, switch off system afterwards.
- `# init 6` Shut down all processes, reboot system afterwards.
- `# init 0` Shut down all processes, display OK prompt afterwards.

In all three cases, the K* scripts in `/etc/rc0.d` are executed before the system shuts down or reboots. This is important for databases that have to be shut down, for web servers that are cleaning process ID files, and so on.

If there is no shell window available, try the preceding commands using a remote login. If that is not possible, the next step should be:

- `STOP-A`
- `OK sync` Sync file systems. Panic the OS afterwards, then reboot.

Attention: Watch out for big OS core dumps in `/var/crash/<hostname>` afterwards.

If `STOP-A` is not possible anymore, the computer has to be switched off and on.

1.4 Testing the System

Boot the system. Press `STOP-A` while the memory is being tested.

The following paragraphs will describe the most important commands only.

A detailed description can be found in "Hardware Diagnostics for Sun™ Systems: A Toolkit for System Administrators" (SunSolve Infodoc Number 23476 at http://sunsolve.sun.com/pub-cgi/show.pl?target=content/content9).

1.4.1 Banner

`banner` displays the following pieces of information:

- number, type, and frequency of CPUs
- memory
- MAC-Address and Host-ID
- Type of Console-Frame buffer
  - Sun-Globe: Creator 3D
  - Sun with face: Elite 3D
  - Self-describing Logo: PGX, Raptor GFX (=PGX32), Expert3D(lite) XVR-500, XVR-1000, and so on.

1.4.2 probe

`probe-scsi-all` lists all internal and external SCSI-attached devices. For IDE disks, use: `probe-ide-all`.

1.4.3 test all

`test all` runs all self-test procedures and can be used to find out details such as whether a network cable is working properly.

1.4.4 printenv and devalias

`devalias` lists all aliases, while `printenv` lists all variables. The variable `boot-device`, for example, defines from which path a machine shall boot. In most cases the value of this variable is `disk`. `disk` itself is an alias pointing to a particular device name.

Hint: To reset all variables to their default values, use `set-defaults` at the OK-prompt or press `STOP-N` while powering-on the system. Warning: By setting all variables to their default values, you could lose your boot device definition, and the system may not boot afterwards.

1.4.5 Disabling the Network-Interface Error Message

When network interfaces are present with no cable attached during boot time, "`Interface: No link`" error messages are printed multiple times for each interface. These can be disabled by setting `setenv tpe-link-test? false` at the OK prompt.

Note: This fix speeds up boot times when network cables are detached temporarily. For permanently unconnected interfaces, shut down the interface with `ifconfig unplumb <interface>` (using a root shell).

2 Administering Disks

2.1 Logical Device Names

All disks are numbered following a common naming scheme. This system consists of four parts:

- `c` ***C***ontroller number
- `t` ***T***arget-ID (for SCSI-devices this number corresponds to the SCSI-ID)
- `d` ***D***rive Number or LUN for RAID-devices (one ID, multiple disks)
- `s` ***S***lice, Partition number (see below)

These logical device names are stored as links in the directories `/dev/dsk` and `/dev/rdsk`. These links point to physical device names, but they are only needed for tasks like changing the boot device. Typical Solaris OS commands for administering drives expect logical device names as their parameters.

Example: `c0t0d0s0` typically is the first drive in a workstation, `c0t1d0s0` is the second one, `c0t6d0s0` is the internal CD-ROM-drive (often with SCSI-ID 6), and so on.

A refresh of the `/dev/dsk` and `/dev/rdsk` directories occurs either while booting (`boot -r` at the OK-Prompt) or during Solaris OS operation with `devfsadm` (`drvconfig;disks;devlinks` prior to the Solaris 8 OS). After this refresh, logical links should exist for all devices found upon boot time with `probe-scsi-all`.

2.2 Partitions

On a workstation with two internal disk drives, the command `format` generates the following output:

```
c0t0d0
c0t1d0
```

This listing displays disks, not single slices or partitions. The purpose of `format` is to create and administer these slices (or partitions). A disk may have up to eight slices. These may be displayed using the `format` subcommand `print - partition`.

If a default installation was used, the Solaris installer tool divides the OS disk into several slices: `/` (root), `/usr`, `/var` and `/export/home`. A Solaris 8 OS default installation creates three slices: (i) approximately 1 Gbyte root, (ii) swap (depending on memory capacity), and (iii) the remaining disk space for `/export/home`.

For workstations, this partitioning scheme is not optimal. The capacity of a partition cannot be expanded without data loss. In the case of a partition running out of space, symbolic links to other partitions have to be created. It is useful, especially for servers, to reserve one partition for the `/var` directory, so that growing log files or big files stored in `/var/tmp` by users cannot fill up the root partition, thus causing OS problems.

A workstation OS disk should be partitioned this way:

```
slice 0: /      root-Partition, incl. /usr, /var, /opt plus
                /export/home
slice 1: swap   swap-Partition, as large as physical memory
slice 2: backup Do not change this partition!
                It is always as big as the whole disk
slice 7: sds    A small space reserved for Solstice DiskSuite(TM)
                metadata
```

To be prepared for the use of the Solstice DiskSuite logical volume manager (SDS), it is recommended to preserve some space (30 Mbyte, approximately 60 cylinders) for copies of the "state replica databases." (More on that later. See also the chapter on Mirroring the Boot Disk with SDS.)

Starting with the Solaris 8 02/02 OS, Solaris Live Upgrade software automatically will be installed. Using Solaris Live Upgrade software, you can update a copy of the current root environment while the system is still running. To use this feature (for example, for testing a new OS version without changing the currently running system), there has to be enough space to create an alternate boot environment (ABE). Modern disks typically allow sufficient capacity for this partitioning:

```
slice 0: /       root-partition, incl. /usr, /var, /opt
slice 1: swap    swap-Partition, as large as physical memory
slice 2: backup  Do not change this partition!
                 It is always the size of the whole disk
slice 3: /export OS-independent data, home-directories
slice 4: <not mounted>, to be used as ABE with Live Upgrade
                  ( about 150% of the expected size of / )
slice 7: sds     A small space reserved for Solstice Disksuite metadata
```

The important partitions in this example ("/" and "/export") should be mounted "logging." This avoids lengthy and manual file system checks during reboot after a machine was not shut down properly. This option is not enabled by default. After installation, you need to replace "-" with "logging" in the last column of "/etc/vfstab" manually.

2.3 Crash Dumps

Starting with the Solaris 7 OS, crash dumps are written to the swap partition by default. This is another reason why swap should have the size of the physical memory.

During the next reboot, this file is read back from swap, compressed, and written to /var/crash/<host-name>, to allow for later analysis. Therefore, /var (or /, if no special partition for /var was defined) should also not be too small.

If a system with lots of gigabytes uses the swap partition as a dump device, the boot process can take some time because of the copying procedure mentioned above. In these cases, it is best to define a dedicated dump partition using dumpadm. Copying from a dedicated dump device (rather than from swap) to /var/crash is performed in the background.

Hint: Check and clean up the content of `/var/crash/<hostname>` frequently, so you have enough space in this directory for upcoming crash dumps.

2.4 Example

Suppose you have a Sun Enterprise™ 450 system and a bootable disk with a fully configured demo installed on it, but you do not know two things:

1. Where to put the disk (the system has 20 slots, and the system only boots correctly when the disk is placed in the same slot that it was in at installation time)
2. The root password

Start with putting the disk into an arbitrary slot, then follow this procedure:

Step 1: Insert a bootable CD (a Solaris Installation CD) and reboot the system. Interrupt with `STOP-A` , type `boot cdrom -s. cdrom` is an alias to the internal CD-ROM drive. If you are using an external drive, find out what the device path is (using `probe-scsi-all`) and boot from this path: `boot <long, cryptic device-path> -s`

Once the system has booted, you have a root-shell without entering a password.

Step 2: Now we are going to mount the disk. First let the Solaris OS rebuild the device tree with `devfsadm`. There should be eight new files in `/dev/dsk` afterwards.

Now use `format` subcommands `disk-print-partition` to verify that the new disk is correctly attached and to find out on which slice the root partition has been defined. Normally, slice 0 holds the root partition. Let us assume you inserted the disk into slot 2 of the system. Format should have recognized the disk as `c1t2d0` (SCSI-ID 2 attached to the first controller), with slice `c1t2d0s0` as the root partition. So you should be able to mount the disk: `fsck -Y /dev/rdsk/c1t2d0s0; mkdir /tmp/disk; mount /dev/dsk/c1t2d0s0 /tmp/dsk`

Step 3: First, reset the root password to "empty" by deleting the crypted characters between the colons in `/tmp/dsk/etc/shadow`. Then look into `/tmp/dsk/etc/vfstab` to find out if this disk was located in slot 2 in the original system. If that was the case, the root file system "/" should be mounted on `/dev/dsk/c1t2d0s0`. If the mount point you find in `/tmp/dsk/etc/vfstab` is different, switch the slot of the disk accordingly.

Step 4: Let's assume we really found `/dev/dsk/c1t2d0s0` in `/tmp/dsk/etc/vfstab`. This means the disk occupied slot 2 in the original system. Typically, a Sun Enterprise 450 system would boot from the first slot (`c1t0d0s0`) . Use the `/dev/dsk` directory to find out which physical device name `c1t2d0s0` points to, and write it down.

Step 5: Reboot, STOP-A and type: `boot <this physical device-Name>`

Step 6: You could define an alias `nvalias mydisk <this physical device-Name>` so you only need to type `boot mydisk` from now on. If you then define `setenv boot-device mydisk`, the system will always boot from `mydisk`.

2.5 Removable Devices

2.5.1 Volume Management

Removable devices are handled by Solaris Volume Manager software. This Volume Manager detects CD-ROMs and automatically mounts them to `/cdrom/cdrom0`.

Solaris Volume Manager will stumble when manually circumvented, for example, when a CD is removed using a paper clip instead of the appropriate command: `eject cdrom`. In such a case the Volume Manager can be restarted with `/etc/init.d/volmgt stop; /etc/init.d/volmgt start`.

2.5.2 Floppy

Insertion of a floppy disk (UNIX® or MS-DOS format) has to be communicated to the Volume Manager manually: `volcheck`

If `volcheck` was successful, the disk is mounted on `/floppy/floppy0`. Do not eject a floppy disk manually; always use `eject floppy`.

2.5.3 CD-ROM

CD-ROMs do not need `volcheck`. They are automatically detected and mounted to `/cdrom/cdrom0`. Ejecting the CD using `eject cdrom` is only possible while no shell or command occupies the cdrom path. `fuser -c /cdrom/cdrom0` prints out the process ID of that shell or command (`fuser -k` kills that process immediately).

Without volume management, CD-ROMs must be explicitly mounted and ejected (example for SCSI-ID 6):

- `mkdir /tmp/cdrom`
- `mount -F hsfs /dev/dsk/c0t6d0s0 /tmp/cdrom`
- (Work with CD mounted on `/tmp/cdrom`)
- `umount /tmp/cdrom`
- `eject /dev/dsk/c0t6d0s0`

Note: The Solaris OS detects file names with more than 8.3 characters on a CD only if that CD has been created with Standard ISO-9660 Rock Ridge extensions. If only Microsoft Joliet extensions (default for most Microsoft

Windows CD Burning tools) are present, all file names are truncated to 8.3 (that is, "long~f.txt" instead of "LongFilename.txt"). Always create both Rock Ridge and Joliet extensions when burning CDs to make sure they are readable on all platforms.

Workaround: Create a zip file with a name no longer than 8.3 characters and burn that file onto the CD. Unzipping the archive on the target platform will properly restore all long file names.

2.5.4 CD-R and CD-RW

Bundled with Solaris 8 OS software is a tool, `cdrw`, to burn CD-R or CD-RW media. This tool burns an ISO-Image, which can be created from a Solaris OS file system or directory using `mkisofs`.

Look at this example for the exact parameters:

```
#! /bin/sh
# ./nfscd <PARAMETER1> <PARAMETER2>
#       PARAMETER1 = Application ID
#       PARAMETER2 = from where
#
# ./nfscd SunNetManager /net/center2000/export/pkg/SUNWsnm

# set Umask
umask 022

# Remove old image
rm /data/disk.img

# Create image
mkisofs -A $1 -d -l -L -o /data/disk.img -P "Sun Microsystems" -p
"Solaris SPARC" -r -R -J -V "$1" -v $2

# Burn
cdrw -i /data/disk.img
```

2.5.5 USB Memory Sticks

Most newer Sun systems have USB ports. So that the memory stick will be recognized and mounted by the Volume Manager, create a directory `/rmdisk` with the same ownership and permission attributes as `/cdrom`. After a FAT file system memory stick is inserted into the USB slot, its content should be readable as `/rmdisk/<name>`. If this is not the case, look at freshly created links in `/dev/dsk/...` pointing to `usb` paths and try a manual mount:

```
mkdir /tmp/usbstick
mount -F pcfs /dev/dsk/c1t0d0s2:c /tmp/usbstick
```

2.5.6 Tapes

Tape drives are not under the control of Volume Management, and instead must be handled with commands like `tar`. Typically tape drives are connected to the system as external SCSI devices. Connection and configuration

can be performed while the Solaris OS is running. After running `devfsadm` (Solaris 8 OS) or `drvconfig;tapes;devlinks` with previous Solaris OS versions, you will find some logical links in the `/dev/rmt` directory. `0` describes the first tape drive found, `1` describes the second tape drive, and so on.

After that, you may access a specific tape drive using `tar tvf /dev/rmt/0`.

Note: Tapes written with SGI systems often can only be read using a different blocksize:
`tar tvfb 512 /dev/rmt/0`
In some rare cases an additional byte swap has to be performed:
`dd if=/dev/rmt/0 conv=swab | tar tvfb 512 -`

2.6 Cloning a Disk

Using this recipe you may "clone" one system to another. Both systems must belong to the same hardware family. For example, an Ultra™ 10 workstation can be cloned to another Ultra 10 machine, but it cannot be cloned to an Ultra 60 workstation.

If the hardware configuration of the target system does have minor differences to the root machine (different frame buffer, NICs), the target system should be reconfigured after the cloning process using `boot -r`.

2.6.1 Cloning Using Internal Disks

This method is appropriate for systems with easy-to-change internal disks:
- Ultra 30, Ultra 60, Ultra 80, or Sun Blade™ 100 workstations or E220R/E420R/E250/E450.
- Sun Enterprise™ 220R, 420R, 250, or 450 servers.

The following is an example using an Ultra 60 workstation:

- Put the target disk into the second internal disk bay.
- Boot with single-user mode (`STOP-A; boot -s`).
- Configure all disks using `devfsadm`.
- Type `format` to look up the names of the disks. In an Ultra 60 workstation, you will find `c0t0d0` and `c0t1d0`. `c0t1d0` is the topmost internal disk.
- Determine which disk is the source disk and which one is the target disk (and do not forget to back up your data!). In our case `c0t0d0` (the bottom disk) acts as the source and `c0t1d0` (the upper disk) is the target.
- `dd if=/dev/rdsk/c0t0d0s2 of=/dev/dsk/c0t1d0s2 Bs=128k` (This command does a 1:1 copy of the whole disk, including the partition table. If the source disk is a 9 Gbyte disk, while the target disk is of 18 Gbyte capacity, 9 Gbyte would be wasted.) Warning: Double-check this step, so you do not accidentally destroy your source disk!
- `fsck -Y /dev/rdsk/c0t1d0s0` (File system check of the root partition, typically slice 0.)
- Remove the source disk, and put the clone disk into the previous source slot. Reboot your newly created clone system.

- Systems with internal FC-AL disks (such as on Sun Blade 2000 workstations and Sun Fire™ 280R or V880 servers) need additional work: Boot the system using a bootable Solaris CD-ROM, mount the root file system and remove the files `/etc/path_to_inst` and `/etc/path_to_inst.old`. Then reboot the system interactively with `OK> boot -ar` and select `recreate /etc/path_to_inst` during boot.

2.6.2 Cloning Using a Crossover Cable

This method is not as fast as the internal disk copying process described in the preceding section, but it is suitable for systems where it is less easy to change the internal disks (as in an Ultra 10 or Ultra 5 workstation).

Warning: Remember to use the `/.rhosts` file only for this task. Delete it after completion to avoid a permanent security risk.

Target	***Source***

`boot`
use "Command line login" at login screen
Stop as many processes causing disk I/O as possible
`TERM=vt100`
`vi /etc/inet/hosts`
-> Insert target and source
`ifconfig hme0 plumb`
`ifconfig hme0 <target> netmask`
`255... up`
-> Test with `rsh source ls`
`rsh source "dd if=/dev/rdsk/c0t0d0s2`
`ibs=128k obs=8k" |`
`dd of=/dev/rdsk/c0t0d0s2`
`ibs=8k obs=128k`
(For 9 Gbyte, wait about 40 minutes.)
`STOP-A`
`boot cdrom -s` (with bootable CD)
`fsck -Y /dev/rdsk/c0t0d0s0`
	Insert target-IP in `/.rhosts`
	`sync; sync`

2.7 Mirroring the Boot Disk with SDS

Solaris Volume Manager (SVM), formerly known as Solstice DiskSuite (SDS) software, can configure disk subsystems for RAID 0, 1, 0+1 or 5. The most interesting feature for workstation installations is RAID 1, which allows you to mirror the disk that holds the root file system to be prepared for disk failures.

SVM is part of the Solaris 9 OS. For the Solaris 8 OS, you can find the SDS software on the second CD in the directory "EA." For the Solaris 7 OS or 2.6 OS, Server Edition, look on the "Easy Access Server" CD.

Let's assume a workstation has two internal disks, `c0t0d0` and `c0t1d0`. Both disks should be partitioned in exactly the same way: Slice 0 for / (root), slice 1 for swap and a small slice 7 for the State Replica Databases. Slice 2 is always defined as Backup-Partition (see chapter "Partitioning").

To copy the partition information from the first disk to the second disk, use this command:

```
# prtvtoc /dev/rdsk/c0t0d0s2 | fmthard -s - /dev/rdsk/c0t1d0s2
```

State Replica Databases are small files holding state information about the mirror. Each disk in a two-way mirror should hold at least three State Replica Databases:

```
# metadb -a -f -c 3 c0t0d0s3 c0t1d0s3
```

In the next step, create the first submirror on the first disk, holding the root file system:

```
# metainit -f d50 1 1 c0t0d0s0
```

Then create the second submirror on the second disk:

```
# metainit d52 1 1 c0t1d0s0
```

Build the first half of the mirror, using the first submirror:

```
# metainit d54 -m d50
```

Use `metaroot` to modify `/etc/vfstab` and `/etc/system` in a way that the system is able to boot from the metadevice `d54`:

```
# metaroot d54
```

Now reboot the system, then attach the second submirror `d54`. This action forces a "Mirror resync," copying the contents of the first disk onto the second one. This can impact system performance for a few minutes.

```
# metattach  d54 d52
```

To avoid error messages during an "emergency boot" from the second disk, the swap partition should be mirrored in the same fashion. Otherwise, the swap partition on the broken disk, `c0t0d0s1,` would still be referenced in `/etc/vfstab`.

Now the system may be booted either from the first disk (`boot disk`) or from the second disk (`boot disk1`).

If one of the disks is broken, Solstice DiskSuite software stops the boot process. This reason for this is that, to successfully boot after a failure, the majority of State Replica Databases must "survive." On our two-disk mirror only three out of the six replicas would have survived.

Servers with more than two disks should always have a third disk configured with State Database Replicas. Two-disk workstations have to be fixed manually, as described in the following example:

- State Database Replicas are configured on `c0t0d0s7` and `c0t1d0s7`, disk `c0t0d0` fails.
- The boot process stops with a Solstice DiskSuite error message and switches to Single User mode.
- Now the State Database Replicas on the failed disk have to be unconfigured:
  `metadb -d -f  c0t0d0s7`
- After the next reboot, partition the replacement disk exactly as in the surviving disk.

- Having done that, you now can create new State Database Replicas on the replacement disk: `metadb -a -c 3  c0t0d0s7`
- Upon the next reboot, the mirror will be resynchronized.

Hint: If you have a two-disk system, create three State Database Replicas on one disk, and four on the other one. Statistically there is a 50 percent chance to successfully reboot after a failure without manually using `metadb`. If you can tolerate unattended reboots after a disk failure in a two-disk configuration, create the same number of State Database Replicas on both disks and create this `/etc/system` entry: `set md:mirrored_root_flag=1`. More information on this topic can be found in the Sun BluePrints™ publication "Configuring Boot Disks With Solaris Volume Manager Software," (see: http://www.sun.com/blueprints/1002/817-0407-10.pdf).

3 Swap Space

3.1 Persistent Configuration in /etc/vfstab

```
#device         device          mount           FS      fsck    mount   mount
#to mount       to fsck         point           type    pass    at boot options
#
#/dev/dsk/c1d0s2 /dev/rdsk/c1d0s2 /usr          ufs     1       yes     -
/dev/dsk/c0t0d0s1       -       -       swap    -       no      -
/usr/local/swapfile.1   -       -       swap    -       no      -
...
swap    -       /tmp    tmpfs   -       yes     -
```

A swap file system can use a raw partition like `/dev/dsk/c0t0d0s1` or plain files like `/usr/local/swapfile.1`.

You may define multiple swap file systems. All of these are logically combined by mounting them to the `/tmp` mount point. This means as long as physical memory is available, writing files to `/tmp` will write to and use up memory.

This example:

```
/dev/dsk/c0t0d0s1       -       -       swap    -       no      -
/dev/dsk/c0t1d0s1       -       -       swap    -       no      -
/dev/dsk/c0t2d0s1       -       -       swap    -       no      -
...
swap    -       /tmp    tmpfs   -       yes     -
```

creates an additional 6 Gbyte of virtual memory (given that all partitions have a size of 2 Gbyte). The Solaris OS automatically stripes access to all disks.

3.2 "Raw Partition" Versus Plain File

The fastest swapping is no swapping at all. If physical swapping is unavoidable, use multiple partitions striped over a set of disks. Only use plain files if you need memory and no extra partitions or disks are available.

3.3 Temporary Configuration

Plain files can be used to add swap space during standard Solaris OS operations:

```
# mkfile 100m /usr/local/swapfile.1
# swap -a /usr/local/swapfile.1
# swap -l
```

This addition is temporary until the next reboot. Until then, `swap -d /usr/local/swapfile.1` unconfigures the additional swap space.

4 Installation and Maintenance

4.1 Installation From CD

During installation, you may follow all the instructions printed on the screen. There are only a few pitfalls possible:

- Name service: Choose NONE. If you choose something like NIS at this moment, and the network is not yet properly set up and no NIS server is available, the system may "hang" waiting for a response from the NIS server. It is better to configure NIS or DNS after completing the basic installation of the network (see one of the following chapters).
- Installation cluster: For workstations, you should always choose the "Entire Plus OEM Software"-cluster to make sure everything gets installed. For dedicated servers, unnecessary packages should be removed afterwards to minimize security risks. The Sun BluePrints publication "Minimizing the Solaris Operating Environment for Security: Updated for Solaris 9 Operating Environment" provides more information (see: http://www.sun.com/blueprints/1102/816-5241.pdf).
- Disk partitioning: To obtain the chance to partition the disk according to the recommendations given in the chapter "Partitioning" (root, swap and one small Solstice DiskSuite slice), choose "custom," not "default," when prompted for an installation method.

Starting with the Solaris 7 OS, the Installation CD comes with a pre-patched Solaris OS image. To upgrade previous quarterly updates to this image, use the "Maintenance Update."

For example: Installing the "Maintenance Update 7" (which comes with the Solaris OS 8 02/02 version) onto the Solaris OS 8 07/01 version, will upgrade the Solaris OS patches (and only those -- that is, there are no functionality enhancements) to the status found on the 02/02 image. The upgrade installation writes a mark into the `/etc/release` file: "Solaris 8 07/01 Maintenance Update 7."

The "Recommended Patch Cluster" is a different mechanism, since you can have a different combination of patches and patch versions in the "Recommended Patch Cluster" every month. This cluster can be downloaded from the BigAdmin Portal (http://www.sun.com/bigadmin) and should be installed after every Solaris OS installation.

After an installation, `root` can only log in at the system console, that is, a terminal connected directly to the system or a keyboard. To enable a Remote Login via `telnet, rsh,` and so on, one file has to be modified first: Comment out the line `CONSOLE=/dev/console` in `/etc/default/login.` Warning: This is a security risk!

Solaris OS 9 comes with `ssh` preinstalled. The default configuration does not allow `root` to log in via `ssh`, and X forwarding is switched off. Modify `/etc/ssh/sshd_config` if you want to change these settings.

4.2 Network Installation With Webstart Flash

If you need to install many machines, it's often easier to configure a server for network installation, using Solaris JumpStart™ software. This feature has been part of the Solaris OS for a long time. Beginning with the Solaris 8 OS, Webstart Flash can make it a lot easier to set up a network installation infrastructure to create a couple of hosts that are clones of a fully installed, patched and configured "master host."
This chapter describes the steps for setting up a basic Webstart Flash infrastructure.

4.2.1 Step 1: Setting Up the Boot Server

Insert CD "Solaris 8 Software, 1 of 2" (Use Solaris OE 8 07/01 or newer)

```
cd /cdrom/cdrom0/s0/Solaris8/Tools
setup_install_server -b /export/install/boot
```

4.2.2 Step 2: Definition of Client Profiles

Edit the file `/export/install/admin/sysidcfg`. This file contains all the answers to the questions posed during an interactive installation. Modify `netmask` and `default_route` to match your environment.

```
name_service=none
root_password=b6q5swye46cza
system_locale=en_US
timezone=MET
timeserver=localhost
network_interface=primary {netmask=255.255.255.0
default_route=192.168.0.1 protocol_ipv6=no}
security_policy=NONE
```

Now edit the file `/export/install/admin/rules`. Attention: This file has to be converted into a `rules.ok` file using `./check -r rules`. You can define a profile for a specific host name or "any" machine. In this example, if the host name matches `dumbledore`, `sb100_class` is used as a profile. After the installation is finished, the script `sb100_end` is executed.

```
hostname dumbledore  -   sb100_class sb100_end
any      -           -   any_class   any_end
```

`sb100_class` defines the installation method as `flash_install`. To determine which flash archive should be used, modify the `archive_location` line with an NFS path to the archive. To avoid mount errors, use the IP address, not the host name of the server:

```
install_type          flash_install
archive_location nfs  192.168.0.200:/export/install/flash/sb100.flar
partitioning          explicit
filesys               rootdisk.s1 1024 swap
filesys               rootdisk.s0 free /
```

The finish script `sb100_end` adds content to the `/etc/inet/hosts` and `/etc/vfstab` files. Webstart Flash generates clones, but each one with a unique host name and IP address, so the `/etc/inet/hosts` from the master host will not be installed. Additional host names other than `localhost` have to be added after installation:

```
#!/bin/sh
#
```

```
cat $SI_CONFIG_DIR/hosts.add >> /a/etc/inet/hosts
cat $SI_CONFIG_DIR/vfstab.add >> /a/etc/vfstab
$SI_CONFIG_DIR/set_root_pw
```

4.2.3 Step 3: Modify Hosts, Ethers and Netmasks

Before adding installation clients to the server, add the MAC addresses, IP addresses, and host names to the appropriate files on the server. Attention: Use the same netmask in `/etc/netmask` that was defined in the `sysidcfg` file. Otherwise the error message "rules.ok not found" will appear.

```
/etc/ethers
/etc/inet/hosts
/etc/inet/netmasks
```

4.2.4 Step 4: Share /export/install

Share the installation directory using the parameters "ro,anon=0".

```
share -F nfs -o ro,anon=0 /export/install
```

4.2.5 Step 5: Add Clients

Now all clients can be added:

```
cd /export/install/boot/Solaris8/Tools
add_install_client -c server:/export/install/admin \
-s server:/export/install/boot -p server:/export/install/admin \
dumbledore sun4u
```

`add_install_client` looks into `/etc/ethers` to find the host `dumbledore`. After that, the server listens for boot requests from dumbledore's MAC address. `add_install_client` needs three directories:

-c to look for the `sysidcfg` file

-s to look for a Solaris OS boot image

-p to look for `rules.ok`

4.2.6 Step 6: Installation of the Master Host

Install the Solaris OS on the master host, add patches, install software packages, configure, and so on. After that, create the flash archive:

```
flar create -c -n sb100 -x /data ./sb100.flar
```

The archive `sb100.flar` will be compressed and named `sb100`. `-x` excludes the `/data` directory. In this example, that directory should be mounted from a central file server (see finish script in step 2). After the `sb100.flar` archive is created, copy it to the `/export/install/flash` directory of the server (compare profile in step 2).

4.2.7 Step 7: Installation of the Other Hosts

Once the flash archive is available on the server, all other clients can be installed using `boot net - install` at the OK-prompt.

The generation of a 1-Gbyte archive (with the Solaris OS, and some additional software) takes roughly 40 minutes on a Sun Blade 100 workstation. The installation of this archive using a 100-Mbit network takes approximately 15 minutes.

Note: The master host and the clones do not have to belong to the same hardware series. It is possible to install a Sun Blade 2000 workstation with an archive created on a Sun Blade 100 machine. The master host should be installed with a recent version of the Solaris OS and "full installation plus OEM support."

Disclaimer:

4.3 Packages

Basically, packages are subdirectories or tar/compress/zip compressed subdirectories, which follow a common name scheme: The first four uppercase letters correspond to the U.S. stock ticker symbol (or a fantasy symbol) of the origin company and the following lowercase letters describe the function of the package.

Example: The package containing the drivers for the SunPCi-card is named `SUNWspci2`. "SUNW" for the ticker symbol, "spci2" for the function.

You will install a package by using `pkgadd` with the directory storing the package contents:

```
pkgadd -d /cdrom/cdrom0
```

`pkginfo` prints information on installed packages, and `pkgrm <Package-Name>` removes a package.

Example: You have just changed the frame buffer card in your workstation, removed Creator3D (ffb) and installed Elite3D (afb). Now, you encounter an error message while booting, telling you that "no console framebuffer" is available. This indicates that no Elite3D drivers are installed.

First, verify this speculation with: `pkginfo | grep -i afb`
This list would typically be empty if you had done a plain default Solaris OS installation when the Creator3D, not the Elite3D, was present in the system. Drivers for the Elite3D can be found on the Solaris OS CD, subdirectory `s0/Solaris/Product`.

Change to this directory, and enter the following command: `pkgadd -d . *afb*`
After a reboot, all Elite3D drivers are now installed and available.

To find out which files belong to which installed packages, consult the file `/var/sadm/install/contents`.

To find out which files are present in packages on a Solaris CD-ROM, for example, look into the `pkgmap` files:
`grep /cdrom/cdrom0/s0/Solaris_8/Product/*/pkgmap <file>`

The command `pkgchk -v <Package-name>` lists all files and directories associated to the package given.

4.4 Patches

A patch number contains two parts: the six-digit patch number, followed by a two-digit version number, for example: 123456-78.

Prior to the Solaris 8 OS, patches were supplied in `*.tar.Z` format. Solaris 8 OS patches are packaged as `*.zip` archives. For installing a patch, copy the archives to `/tmp` and extract them. Do not forget to remove the archives from `/tmp` after the installation has been completed:

```
zcat 123456-78.tar.Z | tar xvf -
unzip 123456-78.zip
```

After that, `patchadd <directory (= Patch number)>` installs the patch. In our example, `patchadd 123456-78.`

If no special parameters are given, `patchadd` installs patches in a way that they always can be removed with `patchrm <patch number>`. In order to be able to use this function, enough space in `/var/sadm/patch` is mandatory.

With `showrev -p | grep <patch number>` you can find out if a patch has already been installed.

5 X-Server and CDE User Interface

5.1 General Observations

The search sequence for X-Server or CDE-settings is always:

1. `$HOME/.dt/...`
2. `/etc/dt/...`
3. `/usr/dt/...`

System-wide configuration files should never be changed in `/usr/dt`. Always use `/etc/dt` to maintain a fall-back position in case something goes wrong. User-specific settings like menu extensions or changes to the front panel should always be stored in `$HOME/.dt`. In the following sections, `<DT>` will be used as a placeholder for all of the above.

5.2 Customizing the Login Screen

File: `<DT>/config/$LANG/Xresources`

Logo (Pixmap xpm or Bi

5.3.1 Multi-Screen

Multi-Screen means that CDE runs on every screen with a dedicated front panel. The mouse pointer can be moved between screens, but windows cannot. The display running on `ifb0` is called `:0.0`, the display on `ifb1 :0.1`

```
:0 Local   local_uid@console    root  /usr/openwin/bin/Xsun :0
                                   -nobanner
```

5.3.2 Xinerama

Xinerama (available since Solaris OS 7 11/99) is one virtual screen covering all physical screens. The mouse pointer and windows can be moved among screens, and CDE draws only to one front panel. There is only one display number `:0.0`. Xinerama is only possible with frame buffers of the same type.

```
:0 Local   local_uid@console    root  /usr/openwin/bin/Xsun :0
                                        -nobanner
```

Xinerama can define an overlap in X- and Y-direction. This can be used for edge blending with overlapping projectors or to "double" an image on two monitors (xoverlap=<horizontal resolution>). Example for 20% Edge Blending with 1280 pixel horizontal resolution:

```
:0 Local   local_uid@console    root  /usr/openwin/bin/Xsun :0
                                                    -nobanner
```

5.3.3 24-Bit Color Depth

CDE itself uses 8-bit color depth (256 colors) by default. This is acceptable, as each window can define its own individual color depth. Some frame buffers only have one color table. This may cause color map flashing with some applications. A workaround for this is to start CDE itself with 24-bit color depth. On PGX, you have to switch the frame buffer to 24-bit with `fbconfig -depth 24`.

Note: Some legacy applications expect the default visual to be 8-bit, not 24-bit. This can cause problems.

```
:0 Local   local_uid@console    root  /usr/openwin/bin/Xsun :0
                                                         -nobanner
```

5.4 A User-Defined CDE Front Panel

The application start mechanism in CDE is based on so-called "actions." Their behavior defines what happens when the user clicks on a CDE-Icon. Once defined, actions are referenced in various environments: menus, file manager, MIME-types, and definition files for the front panel.

5.4.1 Actions

CDE looks for `*.dt`-files in the following order:

```
$HOME/.dt/types
/etc/dt/types/$LANG/
/usr/dt/types/$LANG/
```

Example `StarOffice52.dt` (after installation of StarOffice™ software in `$HOME/.dt/types`):

```
ACTION StarOffice52
{
  LABEL       StarOffice 5.2
  TYPE        COMMAND
  EXEC_STRING „/opt/Office52/program/soffice" „%(File)Args%"
  ICON        So52
  WINDOW_TYPE NO_STDIO
  DESCRIPTION StarOffice
}
```

5.4.2 Icons

The definition of an action also contains an icon name. An icon name is resolved in this order:

```
$HOME/.dt/icons
/etc/dt/icons/$LANG/
/usr/dt/icons/$LANG/
naming scheme: <name>.<size=m|t|l>.<format=bm|pm>
```

`So52,` for example, is the icon file in `$HOME/.dt./icons/So52.m.bm`

5.4.3 Front Panels

The front panel can be extended easily by adding `*.fp`-files into `$HOME/.dt/types`. The default definitions are stored in:

- `/etc/dt/types/$LANG/`
- `/usr/dt/types/$LANG/`

Example (`$HOME/.dt/types/tools.fp`):

```
CONTROL Tools         (Always define the main control before sub panel)
{
   TYPE            icon
   CONTAINER_TYPE  BOX
   CONTAINER_NAME  Top
   POSITION_HINTS  first
   ICON            Dtagen     (This is a folder icon, Icon must
                              exist!)
   LABEL           Tools
}

SUBPANEL Toolspanel
{
   CONTAINER_NAME  Tools
   TITLE           My Tools
}

CONTROL StarOffice52
{
   TYPE            icon
   CONTAINER_TYPE  SUBPANEL
   CONTAINER_NAME  Toolpanel
   ICON            So52
   LABEL           Star Office 5.2
   PUSH_ACTION     StarOffice52          (compare ACTION StarOffice52)
   DROP_ACTION     StarOffice52
}
```

You may build a whole menu bar by adding additional CONTROLs in the SUBPANEL.

6 Frame Buffers and OpenGL

6.1 fbconfig

With the Solaris 8 OS, `fbconfig` is the unified interface for configuring frame buffers. Prior to the Solaris 8 OS software, each frame buffer driver had its own configuration utility, with a naming scheme corresponding to the logical device-names in `/dev/fbs`:

- `ffbconfig` Creator, Creator3D
- `afbconfig` Elite3D
- `ifbconfig` Expert3D, Expert3Dlite
- `m64config` PGX24 (onboard U5, U10), PGX64
- `gfxconfig` PGX32

Because the parameters are exactly the same, we will only mention `fbconfig` in the following paragraphs. If you do not specify a device for the frame buffer, `fbconfig` operates on the default (console) frame buffer.

You can find out which frame buffers are installed in a system by using `ls /dev/fbs`.
Afterwards, they can be addressed directly using their device names:

```
fbconfig -dev /dev/fbs/afb1 -propt -prconf
```

This prints configuration information (which frame buffer model, which resolution, and so on) for the second Elite3D frame buffer configured in the system. The first Elite3D would have the device name `afb0`.

```
fbconfig -res \?
```

shows a list with possible resolutions. A given resolution could be copied to the command:

```
fbconfig -res „1280x1024x86" -try -now
```

using "`cut&paste`".

`-try` and `-now` are options. `-try` changes the resolution for 10 seconds only. This way you can determine if the monitor is able to synchronize to the video signal. `-now` switches the resolution immediately, without the need to restart the X-Server. In some cases, however, the geometry of the X-Server may look distorted after `-now`. An X-Server restart using Exit and Login solves this problem.

```
fbconfig -g 1.7
```

sets the gamma factor to 1.7. The default value is 2.2, which often is perceived as too bright. To be activated, the new gamma factor does not need an X-Server restart. After a reboot, the newly set value is still valid.

6.2 OpenGL

OpenGL® will not be installed automatically during the Solaris OS installation process, although it has been packaged with the Solaris OS CDs since Solaris 2.5.1 OS.

The command `/usr/openwin/demo/GL/ogl_install_check` checks if OpenGL is installed correctly and which version it is. Note: The rotating ring also comes in handy when judging gamma correction values (see above).

It is recommended to always use the latest version of OpenGL. Xinerama, for example, is only supported with OpenGL 1.2.1 or later. OpenGL can be downloaded from http://www.sun.com/solaris/opengl.

Look at the `ogl_install-check` output: If it prints "`GLX: context is direct`", OpenGL uses DGA and applications may run at full speed. If it prints "`GLX: context is indirect`", OpenGL does not use DGA, probably because the application was called from a "su -" environment.

If you log into the window system using one user ID and then switch to another (using "su"), OpenGL will switch to "indirect mode." Due to a security feature in the Solaris OS, "su"-ing to a user other than the one who started the window system disables DGA (Direct Graphics Access) to the frame buffer, thus making OpenGL graphics slower than necessary.

If you wish, you can remove this security feature and thus make graphics fast for all users by doing the following:

- Become root
- Edit the permission in `/etc/logindevperm` from 0600 to 0666:
- `/dev/console 0666 /dev/fbs/* # frame buffers`
- Reboot

Note that any user will now have read/write access to the contents of your screen.

DGA will also be switched off when the `$DISPLAY` variable is set to "hostname:display", e.g. "`dumbledore:0.0`" or "`dumbledore.sun.com:0.0`". It's better to stick with the default ("`:0.0`") setting after locally logging into the machine.

6.3 Patch Matrix for Graphics

There is a small set of patches that are important for each installation where a frame buffer is involved. The collection depends on the Solaris OS version, OpenGL version, and type of frame buffer.

The following table only lists the patch numbers. Please download the most recent versions of the corresponding patches from http://sunsolve.sun.com and install them in the following order:

1. Frame buffer patch
2. X-Server patch
3. OpenGL
4. OpenGL patches

Graphics Patch Matrix			
GRAPHICS CARDS	**Solaris 9 OS**	**Solaris 8 OS**	**Solaris 7 OS**
PGX32 /64	112622	109154	107716
XVR-100	114538	114537	not supported
Expert3D (lite)	112540	108576	108787
XVR-500	112540	108576	not supported
XVR-600	114555	114554	not supported
XVR-1000	112565	112564	not supported
XVR-1200	114555	114554	not supported
Elite3D	111620	108604	106144
- and XFB			106148
- and VIS		109872	106147
Creator3D	112621	108605	106145
- and XFB			106148
- and VIS		109872	106147
OpenGL 1.2.3	32 Bit: 112628	32 Bit: 112628	32 Bit: 112628
	64 Bit: 112629	64 Bit: 112629	64 Bit: 112629
OpenGL 1.3	32 Bit: 113886	32 Bit: 113886	32 Bit: 113886
	64 Bit: 113887	64 Bit: 113887	64 Bit: 113887
XSun	112785	108652	108376

7 Administration

7.1 Hosts

You may use `admintool` or `smc` to create hosts, but it is also convenient to directly edit the file `/etc/inet/hosts`. Note: The file `/etc/hosts` is a link to `/etc/inet/hosts`.

A copy like `cp /etc/hosts.old /etc/hosts` would not overwrite the correct file.

A default Solaris OS installation starts the sendmail-daemon. This daemon writes error messages if no alias with a dot in its name is defined for the primary host name. To suppress the error message, define the primary host in the file `/etc/inet/hosts` like this:

```
192.168.0.2    myhost    myhost.domain.com       loghost
```

7.2 Serial Ports

Again, the best tool for infrequent use is `admintool` or, with the Solaris 9 OS, use the "Solaris Management Console" `smc`.

7.3 Printers

Again, the best tool for infrequent use is `admintool.` The Solaris OS 9 comes with a "Printer Setup Wizard" `/usr/sadm/admin/bin/printmgr.`

7.4 User Creation

The best tool for infrequent creation of user accounts is `admintool`. Beginning with the Solaris 9 OS, use the "Solaris Management Console" `smc`. Please do not specify `/home/<username>` as the home directory when you create a new user. It's better to use:
`/export/home/<username>`.

By default `/home/<username>` is a target of the Solaris automounter and is not writeable because of this. Some third-party software tries to use `/home/xyz`. Change the defaults or shut down the automounter to avoid any problems.

7.5 Shells and Environment Variables

The correct setting of environment variables is one of the most error-prone tasks during system setup. Unfortunately, the syntax for how to set those variables and how to set them permanently for one particular user differs greatly depending on which shell is used (or is defined as default for the user).

The most common shells are `sh`, `ksh` and `csh`. Beginning with the Solaris 8 OS, the popular `bash` shell is also available. `sh` is the default shell for `root` after installation. The default shell for a particular user is defined in the `/etc/passwd` file, for example: `demo:x:2003:10:Demo User:/export/home/demo:/bin/csh`

This table describes how to set variables using the different shells:

Shell	***Setting***	***Appending***	***Retrieving***	***Comments***
`sh`	`NAME=value1` `export NAME`	`NAME=value2:${value1}`	set (internal) env (exported)	Use "export" if subprocesses should see the value of NAME
`ksh`	`NAME=value1` `export NAME`	`NAME=value2:${value1}`	set (internal) env (exported)	Use "export" if subprocesses should see the value of NAME
`csh`	`setenv NAME value1`	`setenv NAME value2:${value1}`	printenv	No "export" needed
`bash`	`NAME=value1`	`NAME=value2:${value1}`	set|env|printenv	No "export" needed

Every shell reads a set of files during startup. A login shell (typically started after the user has logged into a system using `telnet`, `ssh`, and so on) reads a different set of files than a subshell. The following table describes which files are read:

Command	***Shell***	***---------- Files Read in This Order ----------->***			
Subshell (calling `sh`,`ksh`, `csh` or `bash` explicitly) `su`	`sh`				
	`ksh`				
	`csh`	`~/.cshrc`			
	`bash`	`~/.bashrc`	`~/.inputrc`	`/etc/inputrc`	
`su -`	`sh`	`/etc/profile`	`${HOME}/.profile`		
	`ksh`	`/etc/profile`	`~/.profile`		
	`csh`	`~/.cshrc`	`~/.login`		
	`bash`	`~/.bash_profile`	`~/.bash_login`	`/etc/profile`	`~/.profile`

Command	***Shell***	***----------> Files Read in This Order <----------***			
`telnet, ssh, rlogin`	`sh`	`/etc/profile`	`${HOME}/.profile`		
	`ksh`	`/etc/profile`	`~/.profile`		
	`csh`	`~/.cshrc`	`~/.login`		
	`bash`	`~/.bash_profile`	`~/.bash_login`	`/etc/profile`	`~/.profile`

Hint: `ksh`, `csh` and `bash` use "~" as a shortcut to the user's home directory

8 Network Connections

8.1 /etc-files

Solaris software stores network configuration files in the directory `/etc`. All configuration data, such as IP addresses, gateways, and so on, can be defined and changed at runtime level. However, only those definitions stored in `/etc` files will survive the next reboot.

The host name can be found in these files:

- `/etc/nodename`
- `/etc/hostname.<interface-name>`
- `/etc/inet/hosts`
- `/etc/net/{ticlts,ticots,ticotsord}/hosts`

`/etc/nodename` defines the name of the system. Looking from a network perspective, a system with multiple network interfaces and multiple IP addresses can have multiple names, each one defined in `/etc/inet/hosts`. One of these names may be equal to the nodename, but this is not necessarily the case.

Certain files create the connection between IP-addresses and interface names. These are named `/etc/hostname.<interface-name><number>`.

The most common interface names are:

`le`	Ethernet on older SPARC® systems
`hme`	FastEthernet on most UltraSPARC® systems
`eri`	FastEthernet on most UltraSPARC-III systems
`qfe`	FastEthernet on QuadFastEthernet-extension cards

Example: An Ultra 60 workstation with QFE (QuadFastEthernet) has five network interfaces: `hme0` (on board), `qfe0`, `qfe1`, `qfe2` and `qfe3` (on the QFE-card). Nodename is `hermione`, and the `/etc/inet/hosts` looks like this:

```
127.0.0.1       localhost
157.168.34.12         hermione    hermione.domain.com     loghost
191.133.23.10         dumbledore
```

The identity of the system in the corporate LAN using the address `157.168.34.12` should be `hermione`. Accordingly, the file `hostname.hme0` must contain the name `hermione`.

`dumbledore` is an address assigned by an Internet Service Provider (ISP): `191.133.23.10`. That cable is connected to the first QFE port, `qfe0`. So the file `hostname.qfe0` contains the string `dumbledore`.

`qfe1-3` are currently not used. Do not create `hostname.*` files for unused interfaces to avoid Solaris OS error messages complaining about interfaces with no network cables attached.

A system with more than one network interface will automatically route between the subnets (in our example `157.168...` and `191.133...`). During boot, the message "machine is a router" is printed. If this behavior is not desired, create an empty file `/etc/notrouter` and reboot.

The netmasks for the IP-addresses are defined in the file `/etc/netmasks`.

Do not change the nodename while the X-Server is running! It is better to log out from the current session and log in again using "Command Line Login" before changing the nodename or host name.

8.2 Virtual Interfaces

Occasionally, it may be useful to define two IP addresses for a system with only one physical network interface. For example, a demo workstation for use at a trade show should keep its corporate IP address while getting an additional address to communicate with the other hosts at the booth.

This can be done with "virtual interfaces." The procedure is exactly the same as it was described for two physical interfaces in the last chapter. The only difference is that we do not use `hme0` and `qfe0` this time, but `hme0` and `hme0:1`. So if you write `dumbledore` into `/etc/hostname.hme0:1`, the cable provided by the ISP at the trade show can be connected to `hme0`, and a QFE card will not be necessary.

8.3 ifconfig

`ifconfig -a` lists all interface definitions, physical as well as virtual ones, with IP-addresses and netmasks. Additionally, you can use `ifconfig` to define IP addresses and netmasks during runtime. Let's go back to our Ultra 60 workstation example again, but assume that this time `dumbledore` has not been defined in `/etc/inet/hosts` so that `qfe0` will be unused after reboot.

The first step now is to activate `qfe0` (load the driver): `ifconfig qfe0 plumb`

To start up the interface, type:

```
ifconfig qfe0 191.133.23.10 netmask 255.255.255.0 up
```

`ifconfig -a` shows the new configuration.

It is the same procedure for a virtual interface:

```
ifconfig hme0:1 plumb
ifconfig hme0:1 191.133.23.10 netmask 255.255.255.0 up
```

8.4 Routing

The default router (or standard-gateway) can be entered with its IP address into the file: `/etc/defaultrouter`. If you specify a host name in that file, make sure the host name is defined in `/etc/inet/hosts`.

The equivalent runtime commands are:

- Delete all current routes: `route flush`
- Define `1.2.3.4` as default router: `route add default 1.2.3.4`
- Check with `netstat -r`

If more than one network interface is available in your workstation, Solaris OS automatically turns on ip-forwarding.

- To check if ip-forwarding is switched on, use: `ndd -get /dev/ip_forwarding`
- To turn it on, use: `ndd -set /dev/ip_forwarding 1`
- To turn ip-forwarding off, use: `ndd -set /dev/ip_forwarding 0`

Another way of turning ip-forwarding off is to create the file `/etc/notrouter`, for example, by issuing the command `touch /etc/notrouter`.

8.5 NIS-Client

1. First enter the name of the NIS domain into `/etc/defaultdomain` (case-sensitive)
2. Then define the NIS server in `/etc/inet/hosts`
3. Start `ypinit -c` and type in the name of the NIS server
4. `/usr/lib/netsvc/yp/ypstart` or reboot

Now you have to tell the Solaris OS the tables (host names, users, and so on) for which it should use NIS. This is done with the file `/etc/nsswitch.conf`. To make Solaris software ask the NIS server if it cannot find a host name in the local `/etc/inet/hosts` file, append `nis` after `files` in the line starting with `hosts`.

There is a predefined file called `nsswitch.nis` in the `/etc`-directory, which contains NIS definitions for all available tables.

8.6 DNS-Client

1. Enter your DNS server into the file `/etc/resolv.conf`

   ```
   nameserver 192.168.0.1
   ```

   Now test the DNS server using `nslookup www.sun.com`

2. Tell Solaris OS software to use DNS when resolving host names. Edit `/etc/nsswitch.conf`, and add `dns` after `files` in the line starting with `hosts`.

   Now, not only `nslookup www.sun.com`, but also `ping www.sun.com` should be successful.

8.7 DHCP-Client

An interface can be configured to use DHCP if you create two empty files: `/etc/hostname.<interface>` and `/etc/dhcp.<interface>`. The Solaris OS software waits 30 seconds for a DHCP server to answer. This can be modified in `/etc/dhcp.<interface>: WAIT <time in seconds>`.

It is possible to start DHCP on an interface at runtime (in this example for interface `qfe0`):

```
ifconfig qfe0 plumb
ifconfig qfe0 dhcp start
```

8.8 sys-unconfig

If you want to change the network configuration and you are unsure which files are involved, there is an easy solution: `sys-unconfig` shuts down the machine. After the next reboot (enter boot at the OK prompt), all network-related questions you know from the Solaris OS installation tool are asked again (IP address, gateway, netmask, and so on).

8.9 10 or 100 Mbit, Half- or Full-Duplex?

You can query the state of a network interface with the command `ndd /dev/<interface-driver>.<interface-driver>` typically is `le, hme, eri` or `qfe`:

- `ndd /dev/eri link_status`: 0 = down, 1 = up
- `ndd /dev/eri link_speed`: 0 = 10 Mbit, 1 = 100 Mbit
- `ndd /dev/eri link_mode`: 0 = half-duplex, 1 = full-duplex

The Solaris OS default value for all network interface parameters is "autonegotiation." If the attached network equipment is not capable of autonegotiation, all parameters can be set manually. This is done by setting all unwanted properties to zero.

An example for 10 Mbit half-duplex:

```
ndd -set /dev/eri adv_100fdx_cap 0
ndd -set /dev/eri adv_100hdx_cap 0
ndd -set /dev/eri adv_10fdx_cap 0
ndd -set /dev/eri adv_10hdx_cap 1
ndd -set /dev/eri adv_autoneg_cap 0
```

Shut down the interface with `ifconfig unplumb` and restart it with `ifconfig plumb` afterwards. The

settings can also be defined in the `/etc/system` file (`set eri:adv_10hdx_cap = 1`).

8.10 Network Settings: Temporary vs. Persistent

What	*Valid Only for Runtime*	*Persistent After Reboot*

Hostname	`hostname <new name>`
	Do not use within CDE!
		`/etc/nodename`
		`/etc/hostname.<Interface>`
		`/etc/inet/hosts`

IP-Address	`ifconfig <Interface> plumb` `ifconfig <Interface> <IP> up`	`/etc/inet/hosts`
Netmask	`ifconfig <Interface> <netmask> up`	`/etc/netmasks`
Gateway	`route add default <IP Gateway>`	`/etc/defaultrouter`
DHCP-Client	`ifconfig <Interface> plumb` `ifconfig <Interface> dhcp start`	`touch /etc/hostname.<Inter-face>` `touch /etc/dhcp.<Interface>`

9 Network File System

9.1 NFS-Server

Solaris OS software stores information about directories, which are shared and can be mounted from other systems in the network, in the file `/etc/dfs/dfstab`. This file is a script containing `share` commands.

If this file does not contain any share commands, the Solaris OS does not start the NFS server daemon during reboot. Even when explicitly called, `/etc/init.d/nfs.server start` does nothing as long as `dfstab` is empty.

Example: Sharing `/export/home`

1. Insert `share /export/home` into `/etc/dfs/dfstab`.
2. If this has been the first entry, execute `/etc/init.d/nfs.server start`.
3. Enter `shareall`.
4. Check with `share` if `/export/home` has been correctly exported.

9.2 NFS-Client

A NFS client does not need any special daemons, but it is important that the NFS server is known by name. An IP-address (`mount 192.168.0.1:/export/home`) is not enough. All NFS servers must be defined in `/etc/inet/hosts`, NIS or DNS.

You can mount a network directory with `mount server:/export/home /tmp/home`. If this mount should be reestablished automatically at the next reboot, insert the mount into the file `/etc/vfstab`.

Note: When copying files from network directories as user "root," keep in mind that the local "root" does not act as "root" on the network directory, but as "nobody" (unless shared on the server with `anon=0`). Files in this directory that do not have read permission for "other" are not copied. To copy all files from a network directory as "root", do **not** use:

```
root# cd server:/data; tar cvf - | (cd data; tar xvf -)
```

Better use "rsh" to get root read permissions on the server:

```
root# rsh server "cd /data; tar cvf -" | (cd data; tar xvf -)
```

9.3 Differences From Other Popular UNIX Systems

The file `/etc/dfs/dfstab` is a Solaris OS specialty. Other popular UNIX systems (Linux, AIX, and so on) use `/etc/exports` which has a different syntax. `shareall` is known there as `exportfs -a`.

9.4 Automounter

The automounter allows automatic mounts of file systems when the user accesses the respective directory. In large networks with lots of hosts and users, it will be very helpful to always have directory paths like `/net/<host-name>` or `/home/<username>`.

Two files define the basic automounter operation: `/etc/auto_master` and `/etc/auto_home`.

`auto_master` comes predefined for the behavior described above. `/net` is automatically extended with the proper host name when accessed. How `/home` should be handled is defined in `auto_home`.

```
/net    -hosts    -nosuid,nobrowse
/home   auto_home -nobrowse
```

If `auto_home` contains the line

```
*    /export/home/&
```

the automounter becomes active when somebody enters `/home/joe` and mounts `/export/home/joe` to this mount point.

10 Tools

10.1 Compiler

The C, C++, and Fortran compilers typically are installed in the `/opt/SUNWspro/bin` directory, while common tools like `make` are in `/usr/ccs/bin`.

10.2 GNU-Tools

Almost all GNU-Tools are available as precompiled packages for the Solaris Operating System. They can be downloaded from http://www.sunfreeware.com. Beginning with the Solaris 8 OS, some important tools like Perl, gzip, and Apache are automatically installed. Most of the remaining GNU-Tools come as precompiled packages on the Solaris OS Companion CD.

10.3 SunPCi™ and SunPCi-II

Most workstations can be equipped with a SunPCi card. This is a complete PC on a PCi card, running Windows (98, ME, NT, 2000, XP). Here are some hints for the operation of this card:

- Encapsulate `/opt/SUNWspci2/bin/sunpci` into a small script that sets some environment variables:
  `setenv NVL_INTERFACE=hme0` (If SunPCi should use the `hme0` network interface)
  `setenv LANG=C`
  `setenv KBCP=850` (Example: German keyboard and codepage)
  `setenv KBTYPE=GR` (Remember MS-DOS ?)

- Make the C: image writeable not only for root, but for each user on the workstation: `chmod 666`. When a user starts `sunpci` for the first time, a subdirectory `pc` is created in the `HOME` directory of the user. To make the user work with the global C: image, interrupt the following creation of a user-specific image and edit the `sunpci.ini` file to point to the global image, as in `/pc/C.diskimage`, for example.

10.4 StarOffice Software

If StarOffice software is installed as "root" with `setup /net`, all users can choose a "workstation installation" during their individual install. A workstation installation only copies 1 Mbyte of data into the home directory of the user and otherwise uses the central installation. If StarOffice software is installed in `/opt/Office60`, a user can start his or her workstation installation by calling `/opt/Office60/program/soffice`.

10.5 Netscape Navigator™ Browser

Beginning with Solaris 8 OS, Netscape Navigator V4.7 is used as the standard browser. It is installed in

/usr/dt/bin/netscape. The Solaris 9 OS also offers the Mozilla-based version 7 of Netscape Navigator. This version can be found in /usr/dt/appconfig/SUNWns/netscape.

10.6 Miscellaneous

Hint: The registration reminder when starting the desktop can be disabled with "More Information – Never Register."

To disable the warning for all users, edit /etc/default/solregis and put in the following line: DISABLE=1

11 Hint Collection

11.1 Top Hints

- C-Shell: Define `set filec` and `set history=100 savehist=50` in `~/.cshrc`. The shell will complete file names and directories once you hit the ESC key, and `history` lists the last 100 commands. With `!13` command #13 can be re-issued. `!$` can be used as a variable for the last word of the former command, like in: `mkdir /export/home/demo/test`, then `cd !$`.
- Beginning with the Solaris 8 OS, `tcsh` is available, which allows editing the command line and browsing the history using the cursor keys.
- Process control: `ps -ef | grep <search text>` and then `kill <PID>` to search and kill a process can be replaced with `pkill <search text>` since the Solaris 8 OS `kill -9 -1` terminates all processes belonging to the current user.
- File editing: Those who do not like `vi` can use the CDE-Editor `dtpad`.

11.2 Analysis of the Hardware Configuration

11.2.1 prtdiag

The command `/usr/platform/`uname -i`/sbin/prtdiag -v` prints information on the number and type of CPUs, RAM, extension cards, and so on.

11.2.2 prtconf / path_to_inst

`prtconf` lists the hierarchical device tree. The mapping of physical devices (names in the `/devices`-directory) with logical devices (drivers in the /dev-directory) is described in the file `/etc/path_to_inst`. This file is rewritten during a `boot -r` or `devfsadm`. Editing this file is necessary after having moved an adapter card from one PCI slot to another one. `/dev/hme1` is connected to a specific PCI-Slot in `/etc/path_to_inst`. A simple reboot would not redefine this relationship. Warning: Editing `/etc/path_to_inst` manually requires high-level experience with device path handling. Editing errors can lead to unbootable systems!

11.2.3 Sun Explorer Software

This tool can be downloaded from SunSolve (http://sunsolve.Sun.COM/pub-cgi/show.pl?target=explorer/explorer). It collects all important system information. It can be used to prepare service calls, backup configuration data, snapshot configurations, and so on.

11.3 Analysis of Runtime Data

11.3.1 time/ptime

One of the simpler runtime analysis tools is `time` (0,1 sec. resolution) or `ptime` (1 msec resolution), which can be added to a command line:

```
time gzip j2sdk.tar.gz
```

The result is divided into user (=application) time, system (=OS) time, and elapsed time.

11.3.2 top / prstat / ps

A tool known as `top` on other platforms is `prstat` for Solaris OS software. `/usr/ucb/ps -aux` shows similar results, but they are unsorted and without auto-update.

`ps -L -p <process-ID>` lists whether a process has threads and, if so, the number of threads.

11.3.3 vmstat / mpstat

`vmstat -S <frequency in seconds>` lists details of the system load. The following rows are the most interesting ones:

`free:`	Free memory (near zero through Solaris 7 OS, because of disk cache used. Beginning with Solaris 8 OS, the correct size of free memory)
`page pi/po:`	Paging activity, measured in memory pages/second. Moderate paging activity is
`si/so:`	going on all the time and should not be considered harmful until combined with swapping activity (si/so greater than zero), which causes I/O to the swap device
`cpu us:`	User-time. This percentage is consumed by applications
`cpu sy:`	System-time. This percentage is consumed by the Solaris OS itself
`cpu id:`	Idle-time

`mpstat` prints similar information, one line per processor.

11.3.4 iostat

`iostat -xtcP <frequency in seconds>` lists the I/O load of a system. One line is printed for each partition or NFS-mount. The rows `kr/s` and `kw/s` show read and write throughput as Kbyte/sec. A "`svc_t`" bigger than 100 indicates that the disk is spending more time with head positioning than data transfer. Beginning with the Solaris 9 OS, `-txciP` can be used to print the partition names in `c0t0d0s0` format.

11.3.5 sdtperfmeter, xcpustate, and sdtprocess

`sdtperfmeter` is a graphical tool, which draws the `vmstat`-data as a bar or line chart. A minimized version of this tool is displayed in the CDE front panel.

Unfortunately `sdtperfmeter` only prints the cumulated CPU and I/O load. To get a bar chart for every CPU and disk installed in the system, download `xcpustate` from `http://wwws.sun.com/software/solaris/freeware/`. Start the tool with "`xcpustate &`" or "`xpustate -disk &`."

`sdtprocess` lists all processes in a sorted way. It is possible to look further into process properties, terminate processes, and so on.

11.3.6 32-Bit or 64-Bit?

`isainfo -kv` displays if the kernel is a 32-bit or 64-bit kernel. The 64-bit kernel is used automatically, starting with UltraSPARC II systems. With UltraSPARC II systems, the 32-bit kernel can be loaded explicitly with `boot kernel/unix` instead of `boot kernel/sparcv9/unix` at the OK prompt. With UltraSPARC III systems, only 64-bit kernels are available.

11.4 Debugging

11.4.1 Truss

The command `truss <command>` lists all system calls that an application calls during its execution. Because all parameters of these system calls and the return values are listed, one can see, for example, where an application looks for shared libraries or configuration files, and at which location they are finally found.

11.4.2 pstack, pmap, and so on

The "`p*-command`" prints out detailed information belonging to processes:

`pstack <PID>`	Prints the last function calls of a process.
`pldd <PID>`	Prints a list of shared libraries.
`pmap -x <PID>`	Prints the memory usage of the process and its modules.

11.4.3 snoop

`snoop` prints all packets that are sent through a network interface.
Example: `snoop -d eri0 host dumbledore` monitors all traffic on network port "eri0" that is exchanged with host "dumbledore".

11.5 Common Pitfalls

Observation	***Hint***
Boot process takes very long	OBP settings: Is `diag-switch? = true` ??
Cannot login with ftp (but telnet, ssh is fine)	User disallowed to use ftp in `/etc/ftpusers`
`vi` does not display correctly	Variable `TERM` defined? If not, set `TERM=vt100`

12 Books and Web Sites

12.1 Books

- A valuable collection of hints and tricks for UNIX:
  Jerry Peek, Tim O'Reilly, Mike Loukides,
  (ISBN 1565922603)

- A detailed view on all UNIX variants, including Solaris OS and Linux.
  Evi Nemeth, Garth Snyder, Scott Seebass, Trent R. Hein,
  (ISBN 0130206016)

12.2 Web Sites

http://www.sun.com	Home page of Sun Microsystems
http://www.sun.com/bigadmin	Everything a system administrator may need
http://www.sun.com/blueprints	Sun BluePrints publications on various topics, with monthly additions
http://docs.sun.com	All documentation for Sun products online
http://sunsolve.sun.com	Technical FAQs, infodocs, symptom/resolution database, patch downloads, and so on
http://www.sunfreeware.com	Freeware tools for the Solaris OS, precompiled
http://www.sunhelp.org	FAQ portal, other information
http://bhami.com/rosetta.html	"A Sysadmin's Universal Translator (ROSETTA STONE) OR What do they call that (command) in this world (Unix)?"