AIX 5L
System Administration I: Implementation

(Course Code AU14)

Student Notebook

ERC 10.0

IBM Certified Course Material

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Course Description

AIX 5L System Administration I: Implementation

Duration: 5 days

Purpose

The purpose of this course is to enable the students to install, customize, and administer the AIX 5L Version 5.3 operating system in a multiuser environment using pSeries systems.

Audience

Anyone responsible for the system administrative duties implementing and managing AIX 5L Version 5.3 operating system on an IBM pSeries system.

Prerequisites

The student attending this course should be able to:

- Log in to an AIX system and set a user password
- Execute basic AIX commands
- Manage files and directories
- Use the vi editor
- Use redirection, pipes, and tees
- Use the utilities find and grep
- Use the command and variable substitution
- Set and change Korn shell variables
- Write simple shell scripts

These skills can be acquired by taking the AIX 5L Basics course or through equivalent AIX/UNIX knowledge.

Objectives

On completion of this course, students should be able to:

- Install the AIX 5L Version 5.3 operating system, software bundles, and filesets
- Perform system startup and shutdown

- Understand and use the system management tools
- Manage physical and logical devices
- Perform file system management
- Create and manage user and group accounts
- Perform and restore system backups
- Utilize administrative subsystems, including cron to schedule system tasks, and security to implement customized access of files and directories
- Describe basic networking concepts

Contents

Curriculum relationship

This course should follow the AIX 5L Basics course. A basic understanding of AIX environment and simple commands is recommended before taking this course.

Agenda

Day 1

Welcome
Unit 1 - Introduction to pSeries/AIX System Administration
Activity: su
Unit 2 - AIX V5.3 Installation
Activity: Configuration Assistant
Unit 3 - System Management Interface Tool (SMIT)
Exercise: Using SMIT
Unit 4 - AIX Software Installation and Maintenance
Exercise: AIX Software Installation
Unit 5 - Configuring AIX Documentation
Exercise - Information Center
Unit 6 - WebSM
Exercise: Configuring WebSM server
Unit 7 - System Startup and Shutdown
Exercise: System Startup and Shutdown

Day 2

Unit 8 - Devices
Exercise: Devices
Unit 9 - System Storage Overview
Let's Review: LVM Terminology
Unit 9 (Cont)
Activity: LVM Commands
Unit 10 - Working With the Logical Volume Manager
Activity: Volume Groups
Unit 10 (Cont)
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Unit 11 - Working with File Systems
Activity: Inodes and NPBI

Day 3

Unit 11 (Cont)
Exercise: Working with File Systems
Unit 12 - Managing File Systems
Exercise: Managing File Systems
Unit 13 - Paging Space
Exercise: Paging Space
Unit 14 - Backup and Restore

Day 4

Day 5

Unit 1. Introduction to pSeries/AIX System Administration

What This Unit Is About

This unit introduces basic pSeries configurations and describes the roles of the system administrator.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Define the terminology and concepts of the pSeries
- List common configurations available with the pSeries
- Describe the roles of the system administrator
- Obtain root access with the **su** command

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Activity

References

GA23-2674	*Exploring IBM RS/6000 Computers*
SG24-4690	*A Technical Introduction to PCI-Based RS/6000 Servers*
SG24-2581	*Managing AIX on PCI-Based RISC System/6000 Workstations*
SG24-5120	*RS/6000 System Handbook*

www.ibm.com/eserver/pseries

Unit Objectives

After completing this unit, you should be able to:

- Define the terminology and concepts of the pSeries
- List common configurations available with the pSeries
- Describe the roles of the system administrator
- Obtain root access with the **su** command

Figure 1-1. Unit Objectives AU1410.0

Notes:

What Is RISC Technology?

Reduced **I**nstruction **S**et **C**omputing processors aim to:

- Implement the most used instructions in hardware
- Execute multiple instructions in one cycle
- Provide synergy between hardware and software

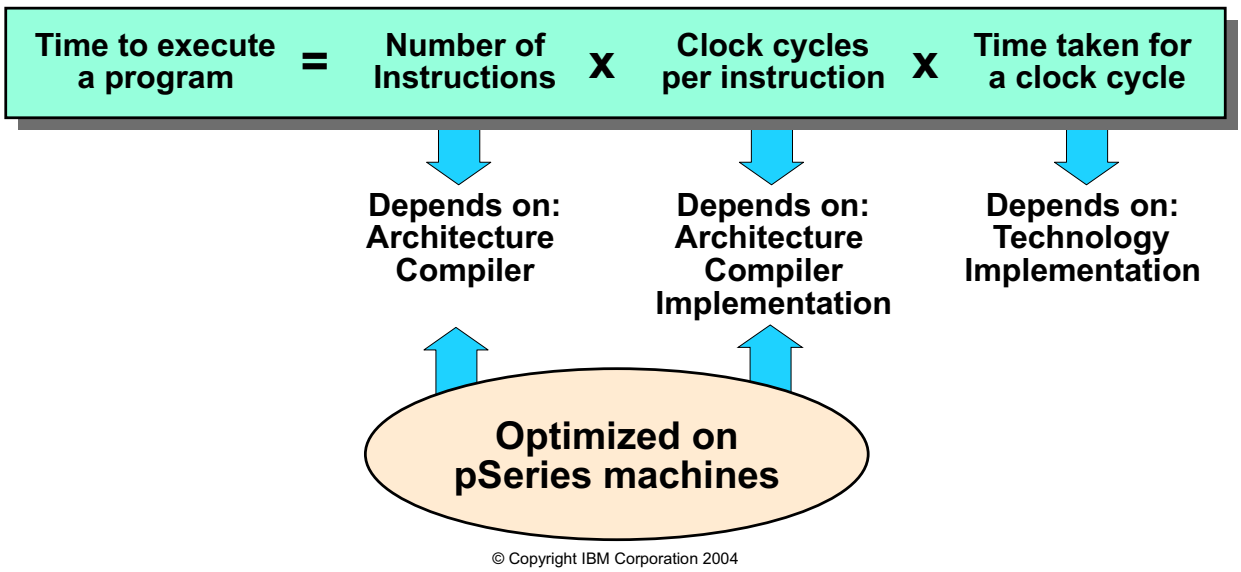


Figure 1-2. What Is RISC Technology? AU1410.0

Notes:

The pSeries servers use RISC processors and where formally called RS/6000 systems, where the RS stood for RISC System.

Reduced **I**nstruction **S**et **C**omputing **(RISC)** architecture was originally developed by IBM in the 1970s. Its basic objective was to provide a reduced instruction set that would execute very fast with maximum efficiency in the hardware. More complex instructions would be implemented in the software.

The simple RISC-based instruction is typically executed in one system clock cycle (or less using superscalar techniques). IBM has enhanced the standard RISC technology by introducing the newer **P**erformance **O**ptimized **W**ith **E**nhanced **R**isc **(POWER)** architecture. The original POWER architecture has also evolved into the POWER2 and PowerPC architectures.

The POWER architectures are designed with the newest in circuitry engineering and multiprocessor technologies and yield very fast performance.

The instructions are handled in a **superscalar** (parallel) fashion by the processor which further increases the performance offered by a RISC system.

Support for 64-bit architecture has been provided since AIX V4.3. This support provides improved performance for specialized applications with:

- Large address spaces (up to 16,384,000 terabytes)
- Access to large datasets for data warehousing, scientific and multimedia applications
- Long integers in computations

A major enhancement to AIX since version 5.1 was the introduction of the 64-bit kernel. The 64-bit AIX V5.3 kernel is designed to support these requirements. The 32-bit and the 64-bit kernel are available. Only 64-bit CHRP-compliant PowerPC machines are supported for the 64-bit kernel on the POWER platform. The primary advantage of a 64-bit kernel is the increased kernel address space allowing systems to support increased workloads. This ability is important for a number of reasons:

- Data sharing and I/O device sharing are simplified if multiple applications can be run on the same system
- More powerful systems will reduce the number of systems needed by an organization, thereby reducing the cost and complexity of system administration

Server consolidation and workload scalability will continue to require higher capacity hardware systems that support more memory and additional I/O devices. The 64-bit AIX 5L kernel is designed to support these requirements.

pSeries System Bus Types

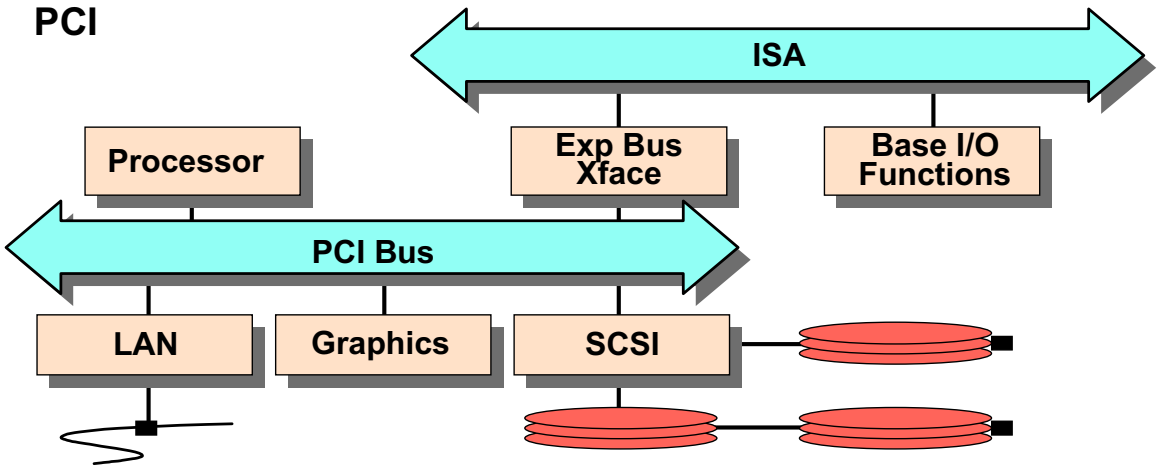


Figure 1-3. pSeries System Bus Types AU1410.0

Notes:

The job of the bus is to provide the highway for information to flow between the pSeries system elements and the optional I/O feature cards (for example, SCSI adapters, token-ring cards) that are plugged into the adapter slots.

pSeries Systems

Peripheral Component Interconnect (PCI) buses are an open industry specification which supports complete processor independence. The PCI bus works across multiple operating system platforms. IBM uses this technology in all of its pSeries.

pSeries also contain an ISA (Industry Standard Architecture) bus for use with some built-in devices like the diskette drive and keyboard.

Built-in ISA support remains in AIX V5.3.

Some older model PCI systems also contain ISA slots that would accept standard ISA cards. With AIX V5.2 and later, ISA cards are no longer supported.

The first IBM RISC-based machines at that time called RS/6000s) were based on IBM's MCA (Micro Channel Architecture). The MCA systems are sometimes referred to as

classical systems. These were very popular and still make up a large portion of the installed bases. MCA machines can be easily recognized by the physical key on the front of the machines. PCI and MCA are basically the same from an administrative viewpoint. There are differences primarily in the startup procedure. For more information, see the MCA section in the appendix.

With AIX V5.2, MCA architectures are no longer supported.

A good source for hardware information is:
http://publib16.boulder.ibm.com/pseries/en_US/infocenter/base/

Workstation Configuration

Single-User Graphical Workstation

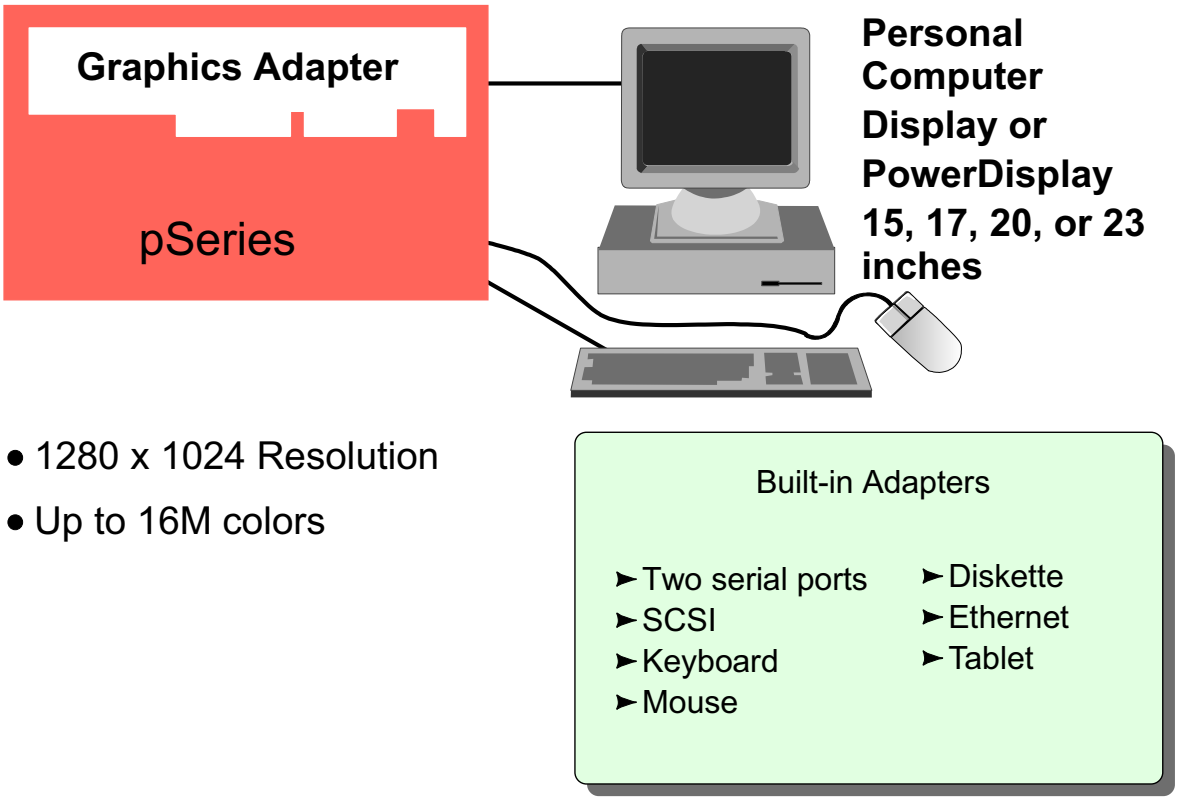


Figure 1-4. Workstation Configuration AU1410.0

Notes:

One common configuration for the pSeries is as a single-user graphical workstation suitable for graphics applications such as CAD/CAM.

In this configuration the pSeries has a graphics display (referred to as an LFT - Low Function Terminal) which is attached to a graphics adapter inside the system unit. A keyboard, mouse, and optional graphics tablet are plugged into special ports on the system board.

There are a number of graphics cards available for the different pSeries models which differ in speed, resolution, number of colors supported, 2D or 3D support, and so forth. There are corresponding displays that can be used from personal computer displays through to the 23-inch PowerDisplay.

Server Configurations

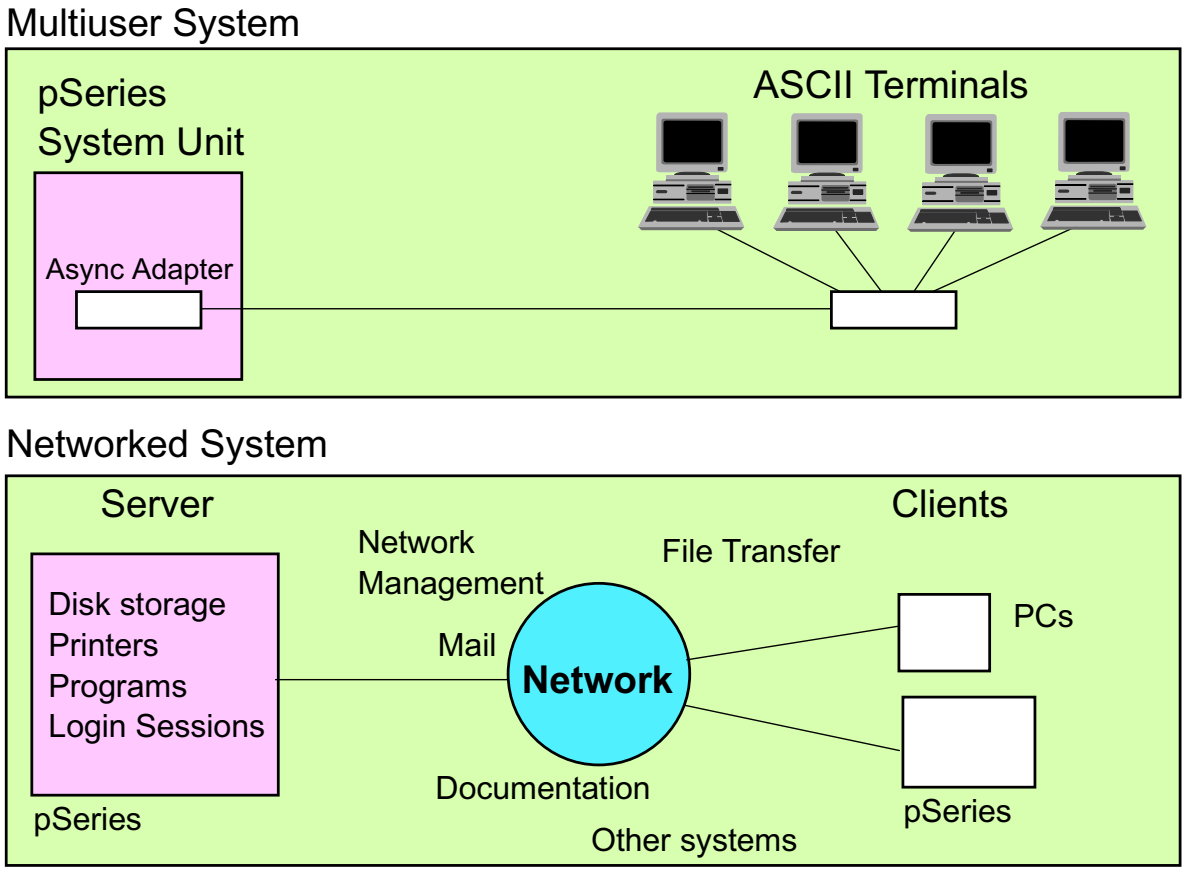


Figure 1-5. Server Configurations AU1410.0

Notes:

Some multiuser systems consist only of ASCII terminals connected locally or over a telephone line by modem. Two ASCII devices can be connected to the serial ports provided on pSeries. All further ASCII devices will require an asynchronous adapter card.

More complex systems consist of many pSeries and other devices such as PCs connected over a local area network (LAN) like Ethernet or token ring. In this case the pSeries requires the appropriate communications adapter card.

PC Connectivity

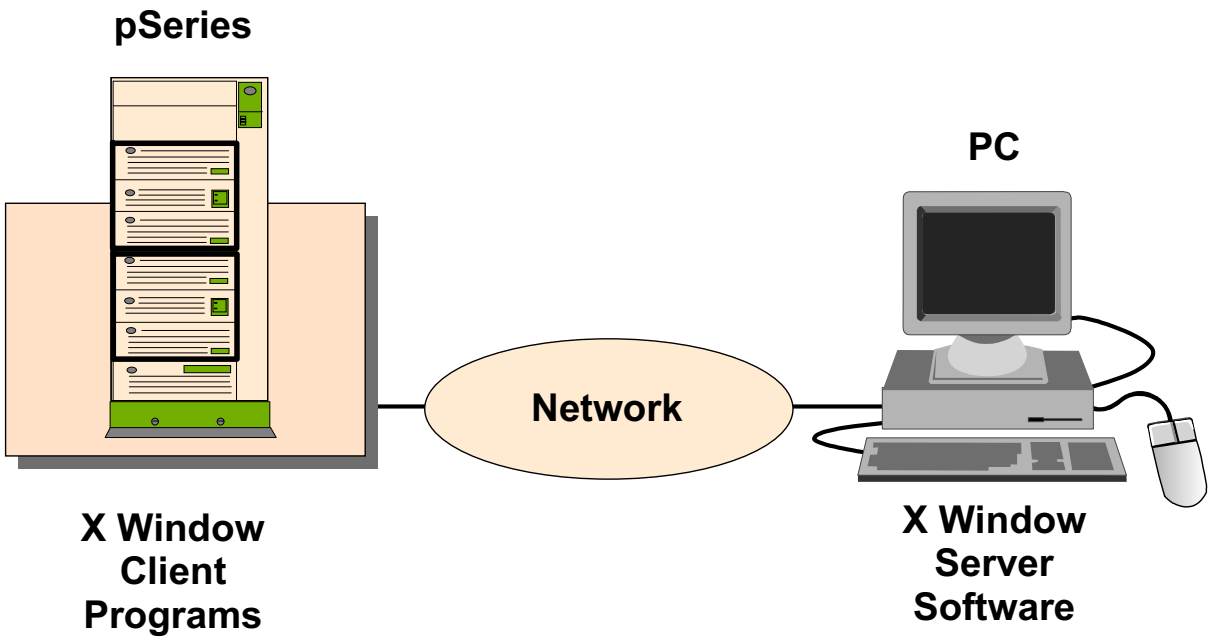


Figure 1-6. PC Connectivity AU1410.0

Notes:

Very commonly, pSeries are accessed via a network using PCs.

One way to connect is using **telnet**. Another method, which is growing in popularity, is to install software on the PC to give the PC the capability to function as an X-Window Server. This allows the PC to function as a graphics display station for the pSeries. There are many commercially available software packages for several different operating systems that provide this functionality.

Uniprocessor (Uni)

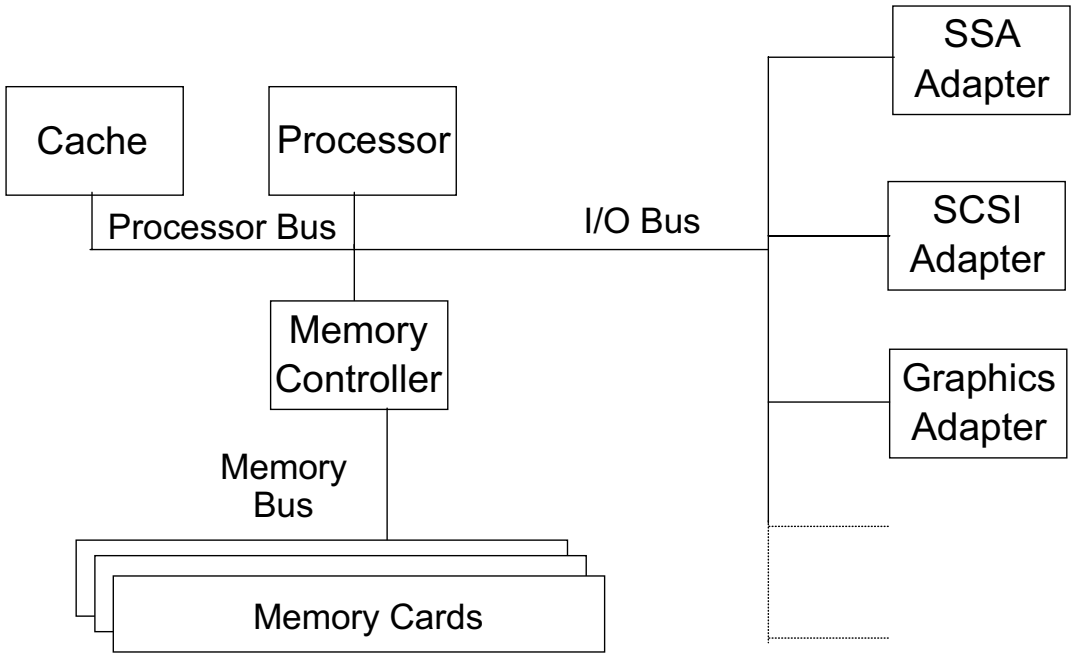
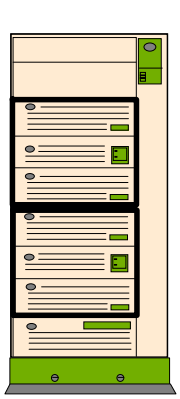


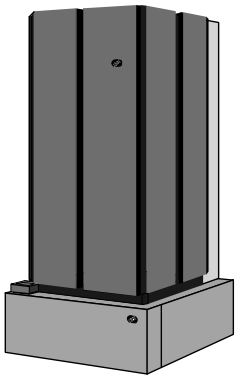
Figure 1-7. Uniprocessor (Uni) AU1410.0

Notes:

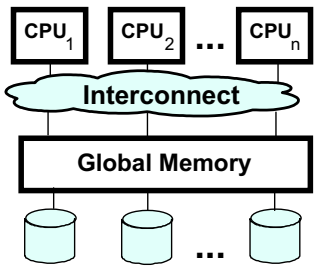
The term uniprocessor refers to a machine with only one processor. The processor is connected to the memory and other adapters via the bus. Today, the I/O busses are based on the Peripheral Component Interconnect (PCI) architecture.

SMP and Cluster 1600



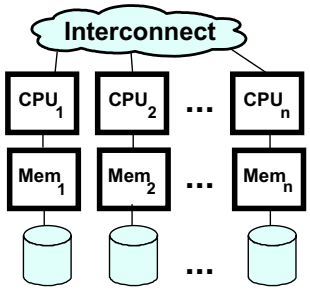


Shared Memory



Multiple processors accessing the same memory and all disk
SMP

Shared Nothing



Loosely-coupled processors linked by high-speed interconnect
Cluster 1600

Figure 1-8. SMP and SP AU1410.0

Notes:

The **Symmetric MultiProcessor** (SMP) architecture supports a single copy of the operating system which is shared by all processors. Memory and disk are also shared. pSeries SMP models support both PCI and MCA buses and can support up to 24 processors. With AIX V5.2, MCA architectures are no longer supported.

The **IBM Cluster 1600 systems** (originally called **IBM Scalable PowerParallel** or **SP**) are a set of up to 16 rack-mounted pSeries or RS/6000 systems, called nodes. The nodes fit in 128 slots on the Cluster 1600. These nodes used to be restricted to special RS/6000 models which fit into specialized frames. A thin node took one slot, a wide node took two slots and a high node took four slots. Today the Cluster 1600 can incorporate the regular pSeries models up to and including p690 machines.

Each Cluster 1600 node has its own memory, operating system, expansion slots, and disk. A high-speed network called the SP Switch (up to 480 MB/sec.) is available to connect the nodes together. The Cluster 1600 uses the Parallel System Support Programs (PSSP) to control its environment.

The Cluster 1600 system is ideal for any parallel computing, high CPU-usage (such as modeling and numerical analysis) and I/O-intensive applications (such as Data Mining, OLTP, DB2/PE and Oracle Parallel Query/Server).

Logical Partitioning (LPAR)

- Resources allocated in flexible units of granularity

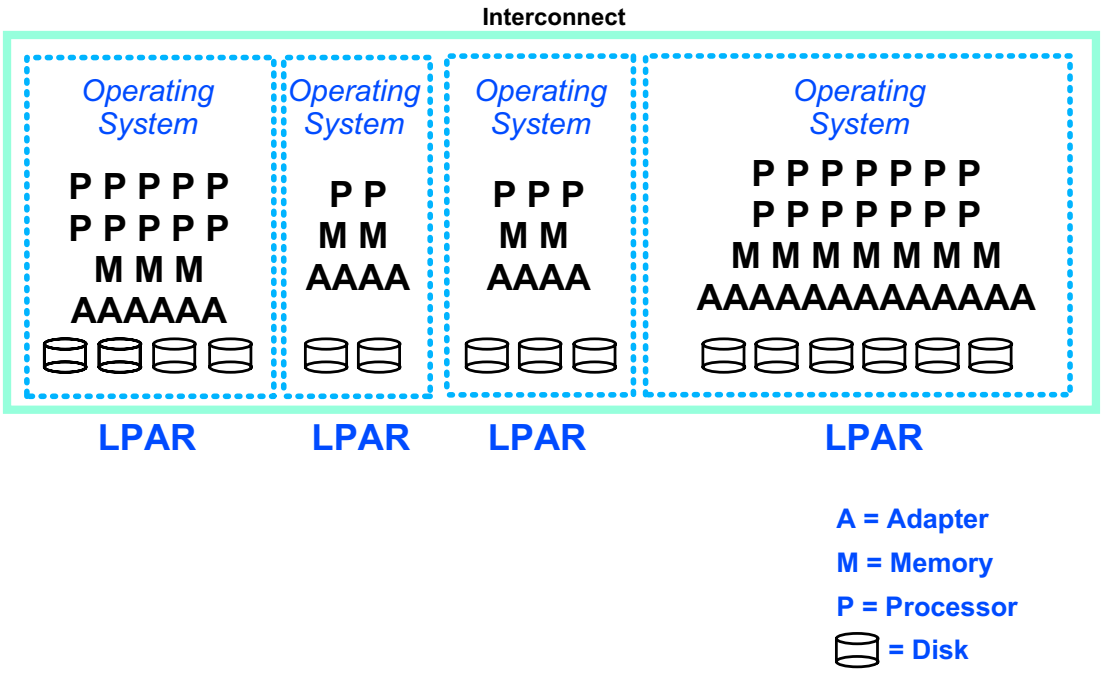


Figure 1-9. Logical Partitioning (LPAR) AU1410.0

Notes:

Introduction

This visual illustrates that LPARs can have resources allocated based on the needs of the workload rather than the amount contained in a physical building block. In the diagram above, there are four partitions, each with various amounts of resources.

Adding or Removing Resources Dynamically

On the pSeries implementation of LPARs, you can dynamically add and remove resources (CPUs, memory, and I/O slots) to and from a partition while the operating system is running.

For dynamic partitions, the partition must be running AIX 5.2 (or later) and both the managed system and the HMC must be running a version of firmware dated October 2002 or later. All partitions running AIX 5.1 and Linux are static partitions which means

the partitions must be reactivated (that is, rebooted) to change the resource configuration.

When memory is moved from one partition to another with dynamic LPAR, memory is written to all zeroes by the system firmware. Likewise, I/O adapters are fully reset when moved.

Allocating Disks

Disks are not allocated to partitions individually. Instead, the I/O slot containing the adapter controlling one or more disks is allocated to a partition.

Role of the System Administrator

- Preinstallation planning of:
  - User accounts/groups
  - Storage allocation/paging space
  - Subsystem (printing, networks...)
  - Standard naming conventions
  - Determine system policies
- Install and configure hardware
- Configure the software
- Configure the network
- System backup
- Create/manage user accounts
- Define and manage subsystems
- Manage system resources (for example, disk space)
- Performance monitoring
- Capacity planning
- Managing licenses for products
- Document system configuration and keep it current

Figure 1-10. Role of the System Administrator AU1410.0

Notes:

There are a number of distinct tasks which the system administrator on a UNIX or AIX system must perform. Often there will be more than one system administrator in a large organization, and the tasks can be divided between the different administrators.

Who Can Perform Administration Tasks?

- Usually exclusive to the **root** user
  - Bypasses any file permissions
  - Very dangerous to login as root
  - Keep root password secure
- Some tasks can be performed by other users in special groups such as system, security, printq and lp
- **su** command allows you to obtain root's permissions or permissions of any user whose password you know

```
$ su root
```

or

```
$ su - root
```


Figure 1-11. Who Can Perform Administration Tasks? AU1410.0

Notes:

AIX security permissions restrict the performance of administrative tasks to the **root** user (and sometimes other users in special groups; for example, **system** for general tasks, **security** for user administration, **printq** for AIX Print Subsystem printer management, **lp** for System V Print Subsystem printer management.) This means that the **root** user's password must be kept secure and only divulged to the few users who are responsible for the system.

A certain amount of discipline is also required when using the **root** ID, because typing errors made as **root** could do catastrophic system damage. For normal use of the system, a non-administrative user ID should be used, and only when superuser privilege is required should the root user ID be used.

To obtain superuser **(root)** privileges while logged in as a normal user, you can use the **su** command. This prompts you for root's password and then give you a shell with root privileges so that you can perform commands. When you have performed the required tasks you should exit from the **su** command in the same way as exiting from a normal shell

(for example, **<ctrl-d>** or the **exit** command.) This will prevent accidents which could damage the system.

The **su** command allows you to assume the permissions of any user whose password you know.

Every time the **su** command is used an entry is placed in the file /**var**/**adm**/**sulog** (this is an ASCII text file). This makes it easy to record access as the superuser. Normal logins are recorded in the file /**var**/**adm**/**wtmp.** To read the contents of this file use the command: **who** /**var**/**adm**/**wtmp**.

The **su** command can also be specified with the "**-**" (dash) option. The "**-**" specifies that the process environment is to be set as if the user had logged into the system using the login command. Nothing in the current environment is propagated to the new shell. For example, using the **su** command without the "**-**" option, allows you to have all of the accompanying permission of root while keeping your own working environment.

Activity: su

Figure 1-12. Activity: su AU1410.0

Working with su

Activity Instructions

In this activity, you look at several ways to invoke the privileges of the root user.

Direct Logins to root

Start by directly logging in as root.

1. Log in as user **root**. The password is **ibmaix**.
2. Open a terminal. (if necessary)
3. Determine your current directory and your home directory.
4. To verify that you do, in fact, have root privileges, **cat** out the file /**etc**/**security**/**passwd**. This file holds the encrypted passwords for the users on your system. Only root can look at this file. More details on this file will be mentioned later in the course.

Did you see the contents of the file? _____

5. Log out of the system.

Using the su command

6. Log into the system using the login name **team01** and the password **team01**.
7. Open a terminal. (if necessary)
8. Determine your current directory and your home directory.

   current directory:
9. Check to see if you have privileges to view /**etc**/**security**/**passwd.**

Did you see the contents of the file? _____

10. Change to the /**tmp** directory.
11. Now switch user to **root** without using the "-" (dash) option.
12. Determine your current directory and your home directory.

Has anything changed? _____

13. Do you have **root** privileges? Check /**etc**/**security**/**passwd**. _____
14. Change to the /**etc** directory.
15. Exit back to **team01**.
16. Check you current directory. Does **su** affect you current directory? _____
17. Now try using the **su** command with the "-" (dash) option. What is your home directory? If you're not sure, check before performing the **su**. _____
18. Determine your current directory and your home directory.

    current directory:

Is there any thing different this time? _____

19. Check /**etc**/**security**/**passwd** to make sure you have root privileges.
20. Exit back to **team01** and log out.

END

Consider the following questions:

What is the difference between the **su** command used with and without dash?

What situations would it be helpful to use the dash and not use the dash?

Are there disadvantages of logging in directly as root?

Working with su

Activity Instructions with Hints

In this activity, you will look at several ways to invoke the privileges of the root user.

Direct Logins to root

Start by directly logging in as root.

1. Log in as the user **root**. The password is **ibmaix**.

   In the box, enter: **root**
   In the box, enter root's password: **ibmaix** (You will not see the password appear on the screen)

2. Open a terminal. (if necessary)

   On the tool bar at the bottom, click the small triangle above the “pencil and paper” icon (fourth icon from the left). This will open a drawer of icons.

   Click ONCE on the Terminal icon. This should bring up a terminal window. All of the commands for this exercise should be typed at the command line in this window.

3. Determine your current directory and your home directory.

   # pwd
   # echo $HOME

4. To verify that you do, in fact, have root privileges, **cat** out the file **/etc/security/passwd**. This file holds the encrypted passwords for the users on your system. Only root can look at this file. More details on this file will be mentioned later in the course.

   # cat /etc/security/passwd

   Did you see the contents of the file? _____

5. Log out of the system.

   On the blank area of the screen (not in a window), press and hold down the right mouse button. A drop-down menu should appear. Continue holding the right mouse button and drag the cursor to the bottom of the menu to the **“Log out...”** selection. Then, release the mouse button.

   Click **“Continue logout”**

   A new log in box should appear.

Using the su command

6. Log into the system using the login name **team01** and the password **team01**.

   In the box, enter: **team01**
   In the box, enter password: **team01** (You will not see the password appear on the screen)

7. Open a terminal. (if necessary)

On the tool bar at the bottom, click the small triangle above the “pencil and paper” icon (fourth icon from the left). This will open a drawer of icons.

Click ONCE on the Terminal icon. This should bring up a terminal window. All of the commands for this exercise should be typed at the command line in this window.

8. Determine your current directory and your home directory.

   current directory:

   $pwd
   $echo $HOME

9. Check to see if you have privileges to view **/etc/security/passwd**.

   $cat /etc/security/passwd

   Did you see the contents of the file? _____

10. Change to the **/tmp** directory.

    $cd /tmp
    $pwd (to confirm)

11. Now switch user to **root** without using the “-” (dash) option.

    $su or **$su root**

    root's Password: **ibmaix**

12. Determine your current directory and your home directory.

    current directory:

    # pwd
    # echo $HOME

    Has anything changed? _____

13. Do you have **root** privileges? Check **/etc/security/passwd**. _____

    # cat /etc/security/passwd

14. Change to the **/etc** directory.

    # cd /etc
    # pwd

15. Exit back to **team01**.

    # exit
    $

16. Check your current directory. Does **su** affect your current directory? _____

    $pwd

17. Now try using the **su** command with the - (dash) option. What is your home directory? If you're not sure, check before performing the **su**. _____

$echo $HOME
$su - or **su - root**

Note: Make sure you include a space before and after the “-” (dash)
root's Password: **ibmaix**
#

18. Determine your current directory and your home directory.

 # pwd
 # echo $HOME

Is there any thing different this time? _____

19. Check /**etc**/**security**/**passwd** to make sure you have root privileges.

 # cat /etc/security/passwd

20. Exit back to **team01** and log out.

 # exit

On the blank area of the screen (not in a window), press and hold down the right mouse button. A drop-down menu should appear. Continue holding the right mouse button and drag the cursor to the bottom of the menu to the **“Log out...”** selection. Then, release the mouse button.

Click **“Continue logout”**

A new log in box should appear.

END

Consider the following questions:

What is the difference between the **su** command used with and without the dash?

What situations would it be helpful to use the dash and not use the dash?

Are there disadvantages of logging in directly as root?

Checkpoint

1. What type of adapter are you likely to require for a single-user graphics workstation?
   a. Asynchronous
   b. Communications
   c. Graphics

2. What is the difference between UP and SMP machines?

3. True or false? The **su** command allows you to get root authority even if you signed on using another user ID.

Figure 1-13. Checkpoint AU1410.0

Notes:

Unit Summary

- **Common Configurations**
  - Single-user graphics workstation
  - Multiuser ASCII
  - Networked system
  - X Window-enabled PC
  - SMP
  - SP
- **System Administrator's Role:**
  - Preinstallation planning
  - Install - hardware, software, network
  - Manage - user accounts, system resources, licenses
  - Backup/recovery
  - Define subsystems
  - Performance monitoring, capacity planning

Figure 1-14. Unit Summary AU1410.0

Notes:

Unit 2. AIX V5.3 Installation

What This Unit Is About

This unit describes the process of installing the AIX 5.3 operating system.

What You Should Be Able to Do

After completing this unit, you should be able to:

- List the different media options available
- List the steps necessary to install the AIX 5.3 base operating system
- Identify the tasks that can be carried out using the Configuration Assistant

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Activity

References

SC23-2550	*AIX Version 4.1 Installation Guide*
SC23-1924	*AIX Version 4.2 Installation Guide*
SC23-4112	*AIX Version 4.3 Installation Guide*
SC23-4374	*AIX 5L Version 5.1 Installation Guide*
SC23-4389	*AIX 5L Version 5.2 Installation Guide*
SC23-4887	*AIX 5L Version 5.3 Installation Guide*

Unit Objectives

After completing this unit, you should be able to:

- List the different installation and media options available
- List the steps necessary to install the AIX V5.3 base operating system
- Identify the tasks that can be carried out using the Configuration Assistant

Figure 2-1. Unit Objectives AU1410.0

Notes:

Installation Methods

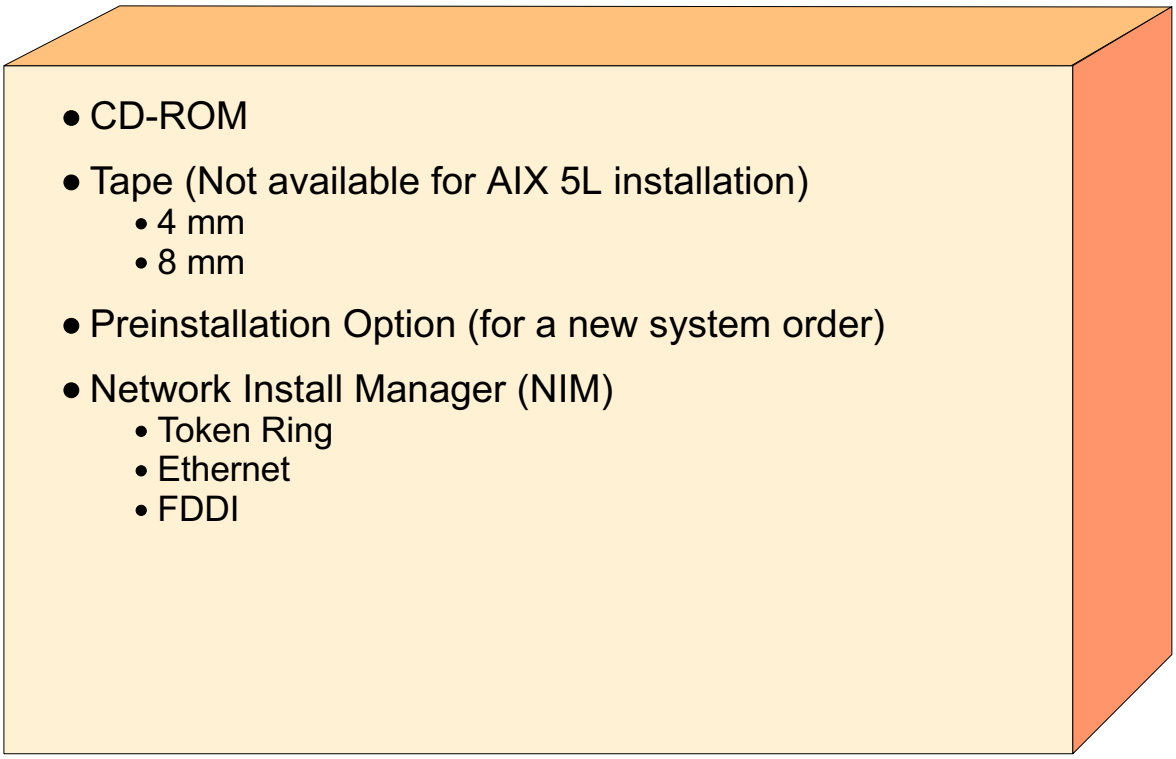


Figure 2-2. Installation Methods AU1410.0

Notes:

In AIX V5.1, 64 MB of RAM is required to install the Base Operating System.

In AIX V5.2 and AIX 5.3, 128 MB of RAM is required to install the Base Operating System and chrp is the only supported platform. Execute **bootinfo -p** to get your hardware platform and **bootinfo -y** to check, if you have a 64 bit or a 32 bit machine. A 64 bit machine can run the 64 bit kernel as well the 32 bit kernel.

The contents of the CD-ROM is packaged in a file system format, thus the installation process from a CD is carried out in a different format than the tape.

The preinstall option is only valid if accompanied by a hardware order that includes the preinstalled AIX.

Network installations are carried out using the AIX Network Install Manager (NIM). This allows the user to manage the installation of the BOS and optional software, on one or more machines in a network environment. The NIM environment is made of client and server machines, where it is the server machine that makes the resources available to the other machines; that is, installation has to be initiated from the server to the client. An

existing pSeries with AIX installed is required to set up a NIM environment. Additional information on how to perform a NIM installation can be found in the *Network Installation Management Guide and Reference*.

Installation Process - from CD

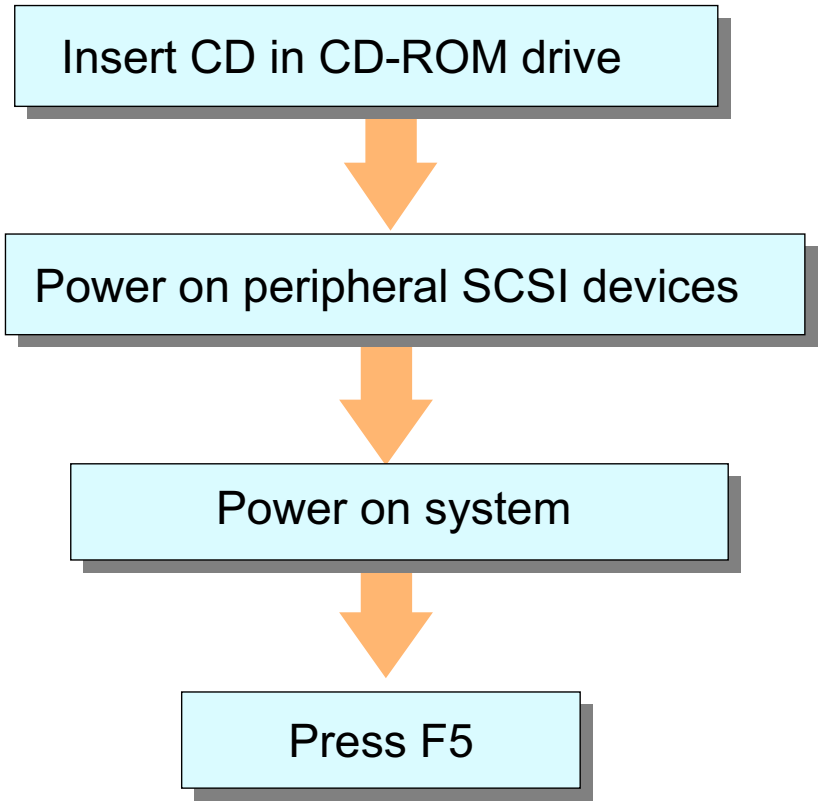


Figure 2-3. Installation Process - from CD AU1410.0

Notes:

The system needs to boot from the installation media. The base operating system (BOS) installation is most commonly performed using a CD.

Insert the installation media into the drive. If it is an external device, you must power it on before powering on the system or the system does not recognize it. It is best to power on all peripheral devices anyway, because during the installation all recognized devices are configured.

Power on the system to start the boot sequence. The LED's will display numbers indicating the system components are being tested. Also, if you are using a graphical display, you see icons of the hardware devices appear on the screen. The machine is completing a power on self test (POST).

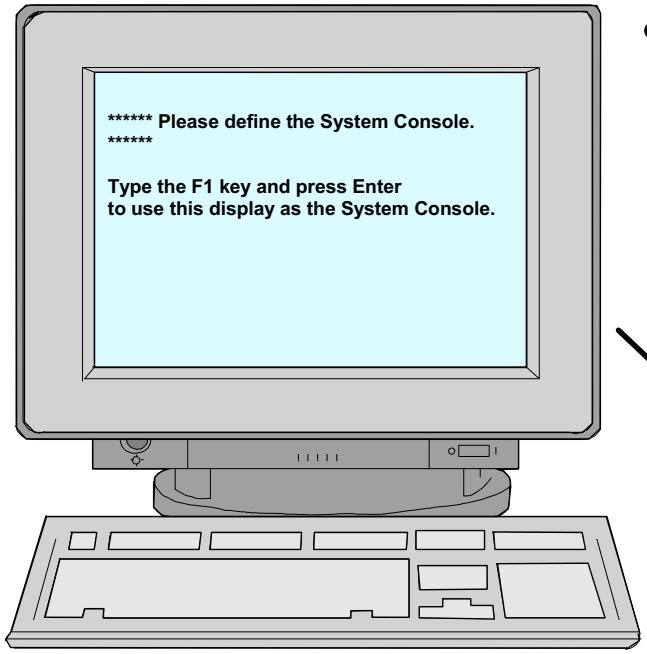
If the machines doesn't reach the installation menu but instead keeps cycling through the POST, it is because the CD (or whatever installation device you are trying to use) is not in the boot list. If this happens and you are installing by CD, during the POST, depress and release the F5 key on the keyboard. This invokes the default service boot list. The CD is on that list. If you are attempting to install by tape, you will need to add the tape to the boot list.

This is done via the System Management Services (SMS) program. This will be discussed later.

The CD and tape devices must be powered on to open the door to the device. If they are internal, you will need to power on the system before inserting the installation media. If you insert the media before the POST is done (about 30 seconds), the machine can still boot from that media.

Once the POST is complete, the system searches the boot list for a bootable image. When it finds the bootable image, you will see menus appear on the screen.

Console and Language Definition



Select your console
- This message will be displayed in different languages to:
  - All native graphics displays
  - Terminal on serial port (S1)

NEXT:

Select the language for installation

Figure 2-4. Console and Language Definition AU1410.0

Notes:

Each native (graphics) display and the ASCII terminal attached to the first built-in serial port (S1) will display the console messages. Whichever display you respond to will become the console display during the installation. The console display can be changed at a later time if required.

Graphic displays request that you press the **F1** key and then **Enter** to make it the system console. If you are using an ASCII terminal as the system console, you will need to press **2** and then **Enter**.

If you are using an ASCII terminal as your console, make sure that it is powered on and correctly configured before you begin the installation. AIX will assume these characteristics for the terminal on S1:

Terminal type=dumb
Speed=9600
Parity=none
Bits per character=8
Stop bits=1

Line Control=IPRTS
Operating mode=echo
Turnaround character=CR

The boot program does not redisplay the message if you missed it the first time. If your terminal was not correctly configured, you can still type **2** and press **Enter** to continue, once you have corrected the problem.

During the installation, you are also prompted to select the language to be used for the messages and the status information during the installation process. This language needs not be the same as the language intended for the primary environment of the system.

Installation and Maintenance Menu

At the Installation and Maintenance menu check all the installation settings.

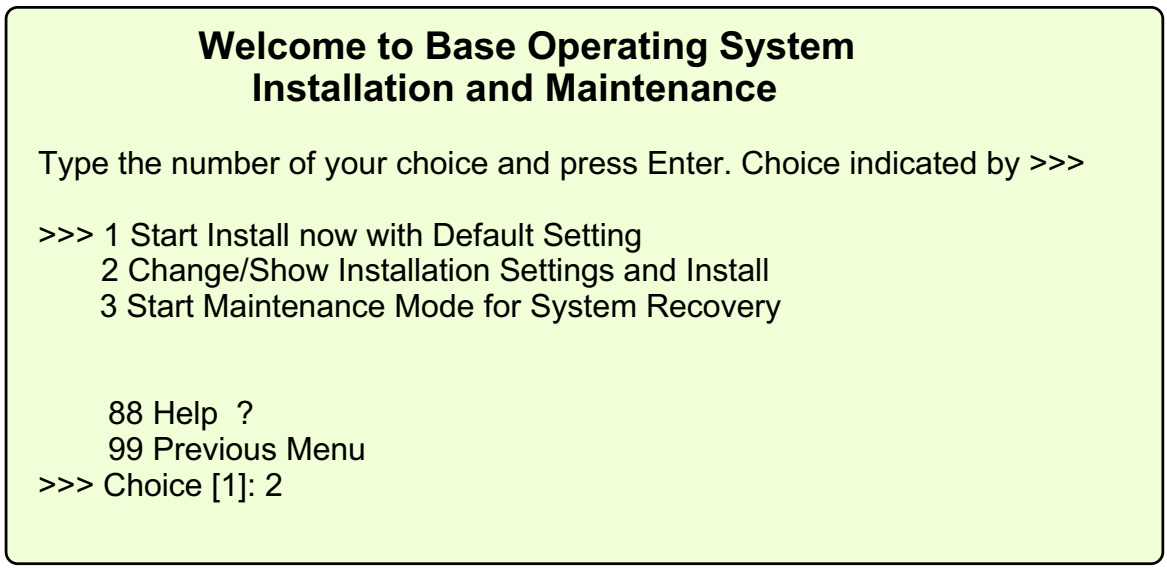


Figure 2-5. Installation and Maintenance Menu AU1410.0

Notes:

To confirm or change the installation and system settings that have been set for this system, type a **2** and press **Enter**. Select **88** to display help on this or any subsequent installation screen.

Installation and Settings

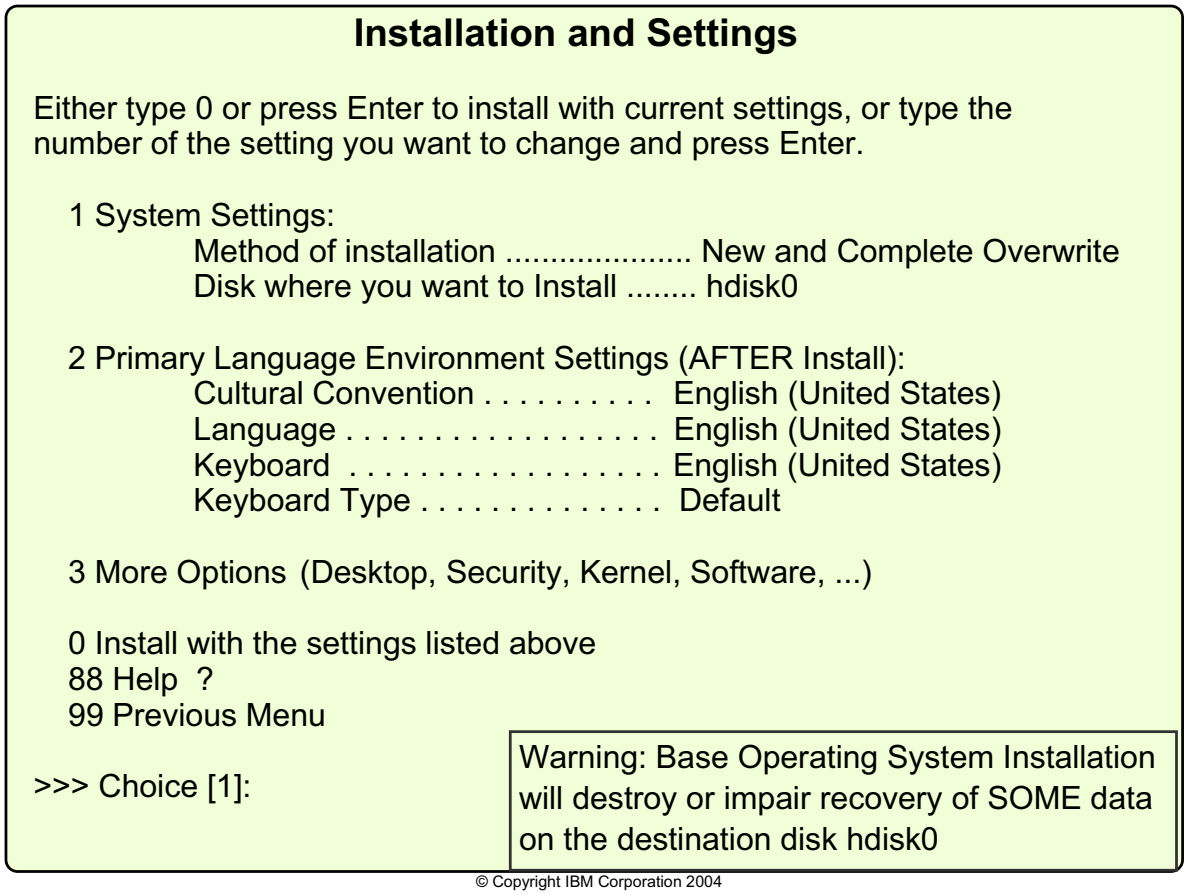


Figure 2-6. Installation and Settings AU1410.0

Notes:

The **Installation Settings** screen allows you to:

- Set the type of installation: Migration, Preservation, or New and Complete Overwrite
- Determine the installation disk
- Set the primary language environment
- Set more options

Method of Installation

Option 1 of the Installation and Settings menu

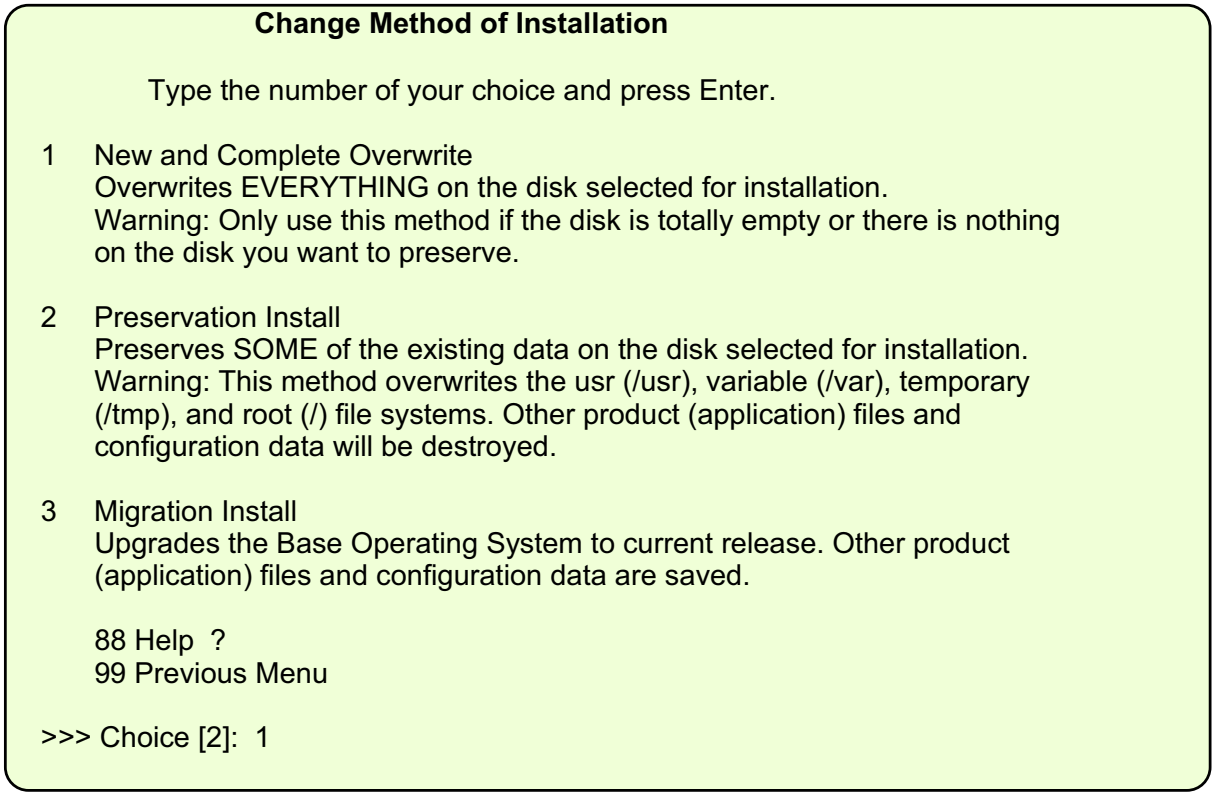


Figure 2-7. Method of Installation AU1410.0

Notes:

When you select option 1 to change the **Method of Installation**, the following submenu is displayed, the contents of which depends on the current state of the machine.

Complete Overwrite Install

On a new machine, New and Complete Overwrite is the only possible method of installation. On an existing machine, if you want to completely overwrite the existing version of BOS, then you should use this method.

Preservation Install

Use this installation method when a previous version of BOS is installed on your system and you want to preserve the user data in the root volume group. This method removes only the contents of /**usr,** / **(root),** /**var** and /**tmp**. The Preservation Install option preserves page and dump devices as well as /**home** and other user-created file systems. System configuration has to be done after doing a preservation installation.

Migration Install

Migration prior to AIX Version 4.2 is not supported. Use this installation method to upgrade an AIX Version 4.2 or later system to AIX Version 5.2, while preserving the existing root volume group. This method preserves all file systems except **tmp**, as well as the logical volumes and system configuration files. Obsolete or selective fix files are removed. Migration is the default installation method for an AIX system running Version 4.x.

The installation process determines which optional software products will be installed.

Installation Disks

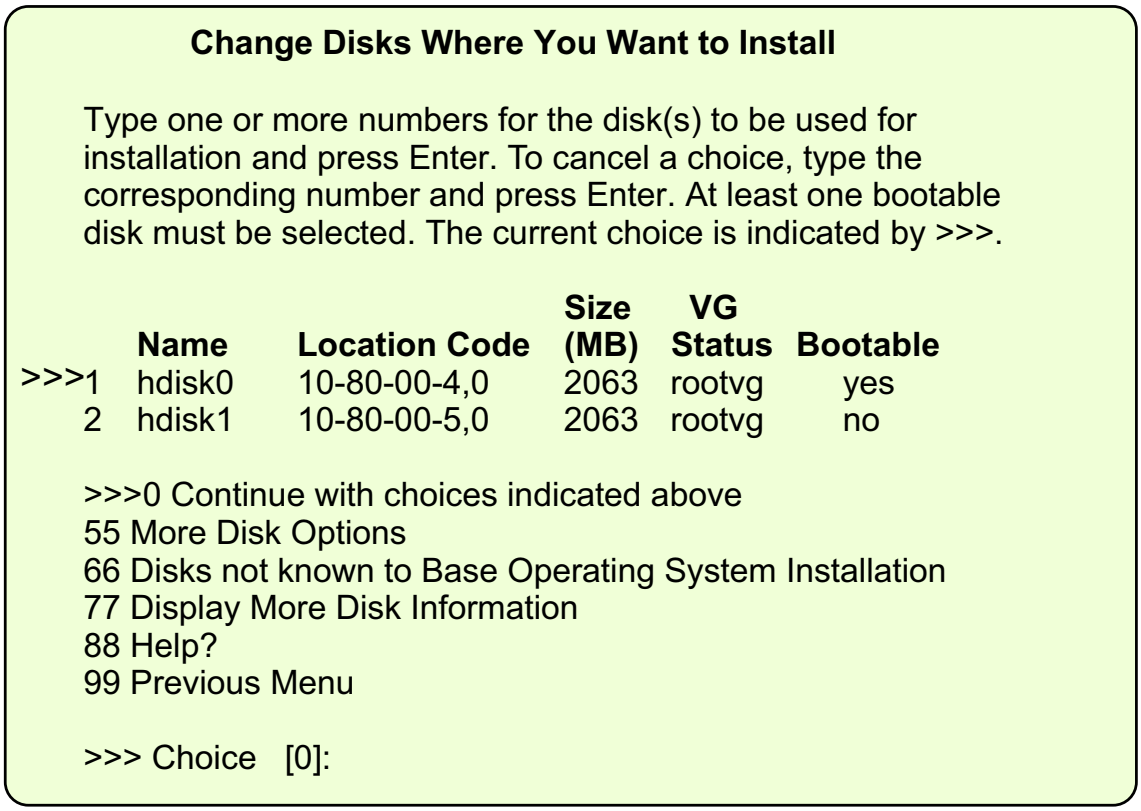


Figure 2-8. Installation Disks AU1410.0

Notes:

Having selected the type of installation, you must then select the disks that are to be used for the installation. A list of all the available disks is displayed, similar to the one shown.

This screen also gives you the option to install to an unsupported disk by adding the code for the device first.

When you have finished selecting the disks, type 0 in the Choice field and press Enter.

Erasure Options for Disks

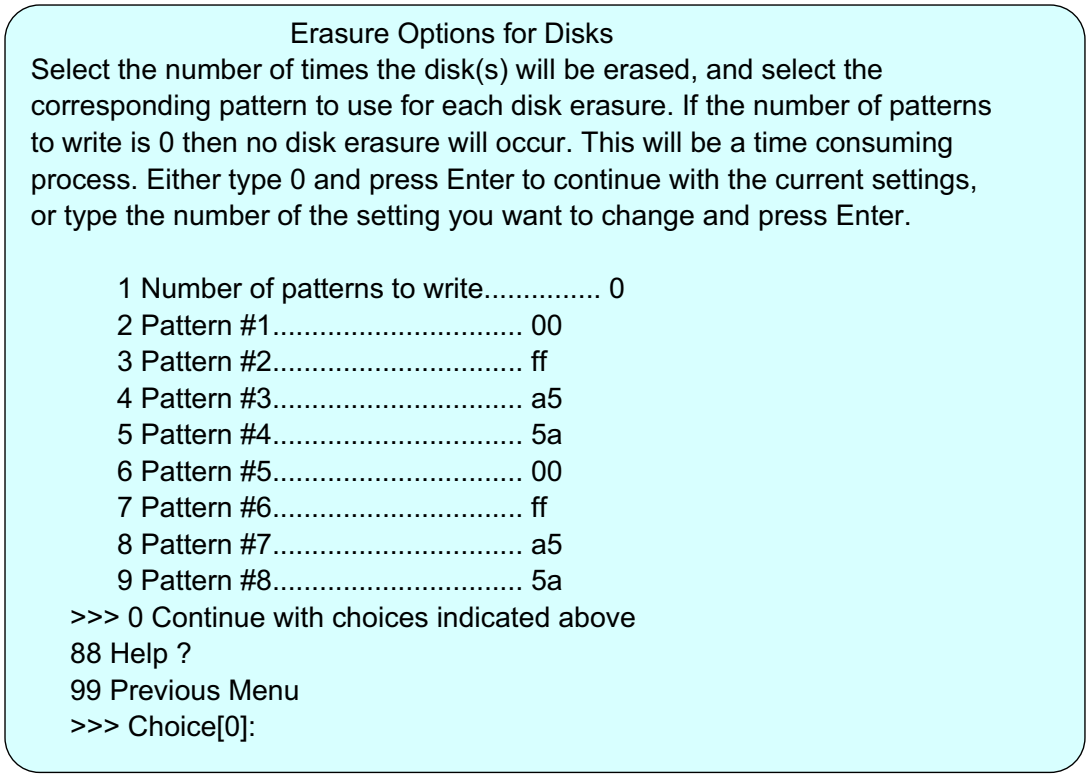


Figure 2-9. Erasure Options for Disks AU1410.0

Notes:

Sometime you are reusing a disk that previous contained some sensitive material and you want to be sure that information is no longer accessible.

If this is an overwrite installation, you can specify to erase the disks chosen to be installed before the installation occurs by typing 55 and pressing the Enter key for the More Disk Options option.

This option opens a new menu that prompts for the number of patterns to write, which is the number of times the drive is overwritten. If you choose 0 for the number of patterns to write, the disks will not be erased prior to installation.

This menu also prompts for the patterns to be used for each disk erasure. The patterns are a choice of the hexadecimal values 00,a5,5a, or ff. For example, a pattern of 00 will write all zeros to the drive. Erasing a drive is a time consuming process and only drive types that are supported by the `diag` command can take advantage of this option (for example, erasure of IDE drives are not supported).

Primary Language Environment

Option 2 of the Installation and Settings menu

Type the number for the Cultural Convention (such as date, time, and money), Language and Keyboard for this system and press Enter, or type 106 and press Enter to create your own combination.

	Cultural Convention	Language	Keyboard
>>	1. C (POSIX)	C (POSIX)	C (POSIX)
	2. Albanian	English (United States)	Albanian
	3. Arabic	Arabic (Bahrain)	Arabic (Bahrain)

... several screens later ...

106. Create your own combination of Cultural Convention, Language and Keyboards.

88 Help ?
99 Previous menu

Choice [1]:

Figure 2-10. Primary Language Environment AU1410.0

Notes:

At this point in the installation process you can change the language and cultural convention that will be used on the system after installation. This screen may actually display a number of language options, such as French, German, Italian, Byelorussian, Ukrainian, and so forth.

It is recommended that if you are going to change the language, change it at this point rather than after the installation is complete. Whatever language is specified at this point is pulled off the installation media.

Cultural convention determines the way numeric, monetary, and date and time characteristics are displayed.

Language field determines the language used to display text and system messages.

Install Options for 32-bit Machines

Option 3 of the Installation and Settings menu

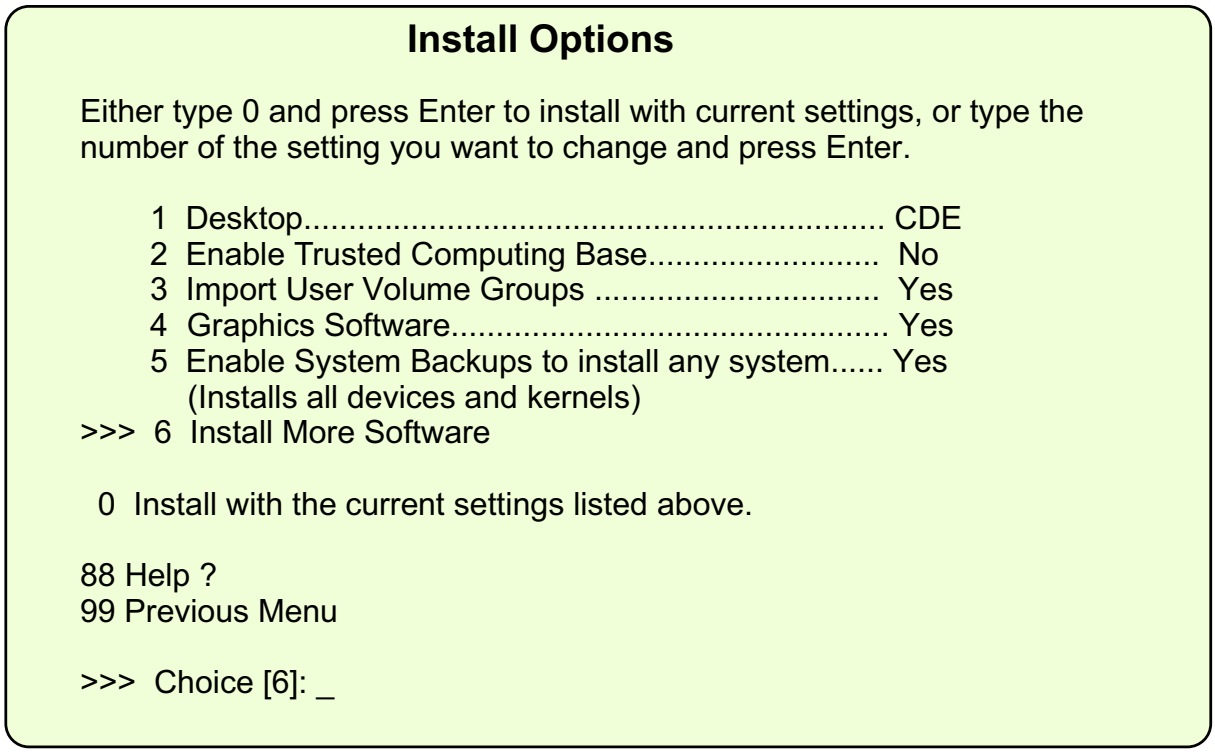


Figure 2-11. Install Options for 32-bit Machines AU1410.0

Notes:

The screen shown is what is presented if running on a 32-bit hardware platform.

Desktop

The first prompt is either:

- Installation Package Set (for ASCII consoles)
  Options are Minimal or Default
- Desktop (for graphical consoles)
  Options are CDE, Gnome, KDE, or NONE

The example shown has a graphical console.

For an ASCII console or a system with a graphical console where the desktop selected is NONE, a *minimal* configuration is installed which includes X11, Java, Perl, SMIT, and the Web-based System Manager.

For a system with a graphical console, if you choose CDE, Gnome, or KDE, the desktop and documentation service libraries are also installed. This is considered a *default* installation configuration. If you choose Gnome or KDE, the interface prompts you for the Toolbox for Linux Applications CD. If this CD is not available, you can type **q** to continue the installation without it.

The default installation configuration may prompt for additional CD volumes during the BOS installation. When prompted, if you decide not to continue with additional volumes or if a volume is not available, you can type **q** and press Enter to continue the installation process. The system has enough of the BOS loaded to be usable.

Migration installations use the Default configuration and update currently installed filesets to the new level.

Install Trusted Computing Base (TCB)

When you install the Trusted Computing Base (TCB), the trusted path, the trusted shell, and system integrity checking are installed. The trusted path protects your system in case a program is masquerading as the program you want to use. The trusted path tries to ensure that the programs you run are trusted programs.

If you want to install the TCB, you must indicate “yes” now. The TCB cannot be installed later.

Install Options for 64-bit Machines

Option 3 of the Installation and Settings menu

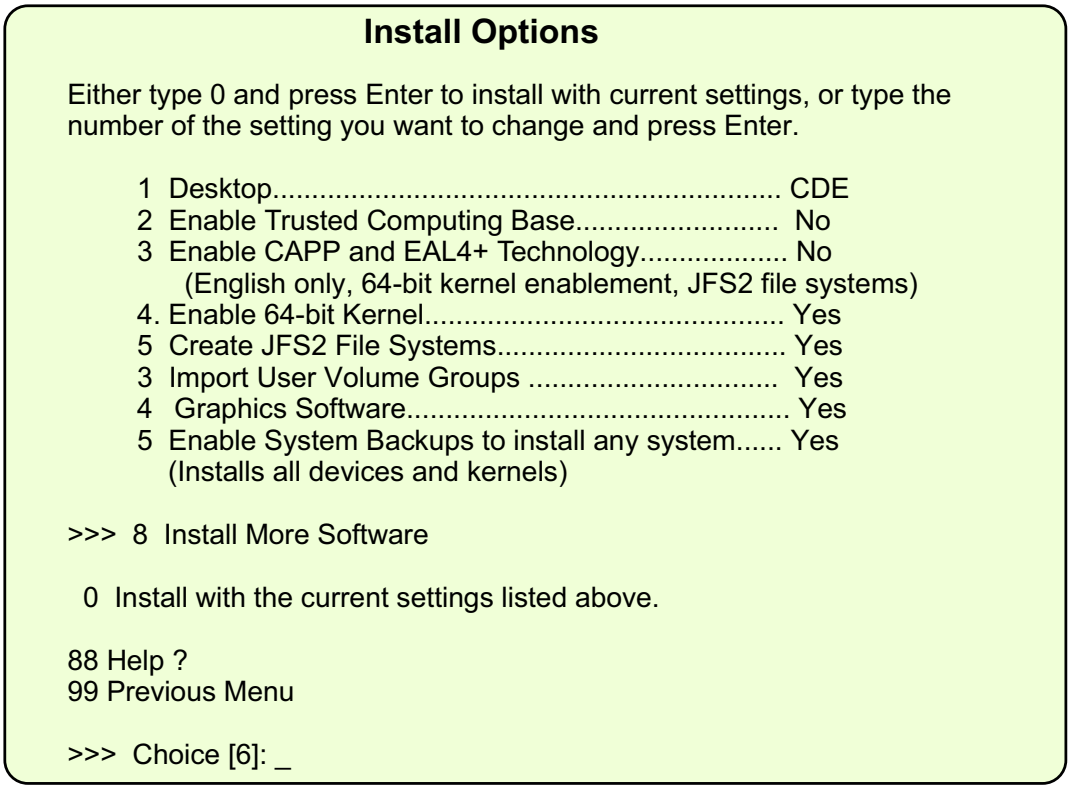


Figure 2-12. Install Options for 64-bit Machines AU1410.0

Notes:

If you are installing on a 64-bit hardware platform, the installation software detects that and presents some additional installation options.

Enable CAPP and EAL4+ Technology

A CAPP system is a system that has been designed and configured to meet the Controlled Access Protection Profile (CAPP) for security evaluation according to the Common Criteria. The CAPP specifies the functional requirements for the system, similar to the earlier TCSEC C2 standard (also known as the *Orange Book*). A Common Criteria (CC) Evaluated System is a system that has been evaluated according to the Common Criteria, an ISO standard (ISO 15408) for the assurance evaluation of IT products. The system configuration that meets these requirements is referred to as a *CAPP/EAL4+ system.*

If When the CAPP/EAL4+ option is selected, the contents of the **/usr/sys/inst.data/sys_bundles/CC_EVAL.BOS.autoi** installation bundle are installed.

For more information on this option see the AIX 5L AIX 5.3 Security Guide.

Install 64-bit Kernel

If you have a 32-bit system you don't get this option. If you have a 64-bit system and select *Yes* for this option, the 64-bit kernel is linked so that it becomes the running kernel on the system after the installation is complete. If you choose *No*, the 64-bit kernel is still installed on the system, but the running kernel after installation is either the **up** or **mp** kernel, depending on the system. To toggle the choice between *no* (the Default) and yes, type 3 and press Enter.

If you want the 64-bit kernel to be the running kernel, but do not select it as part of the initial installation, after the install completes, use the following commands to check which kernel is running and switch to the 64-bit kernel:

getconf KERNEL_BITMODE

ln -fs /usr/lib/boot/unix_64 /unix

ln -fs /usr/lib/boot/unix_64 /usr/lib/boot/unix

bosboot -ad/dev/ipldevice

Reboot your system.

Create JFS2 Filesystems

If you choose Yes and are installing with the New and Complete Overwrite method, the file systems are created with JFS2 (Journaled File System 2), instead of JFS. Prior to AIX 5.3, installing the 64-bit kernel also would create JFS2 filesystems.

Install More Software

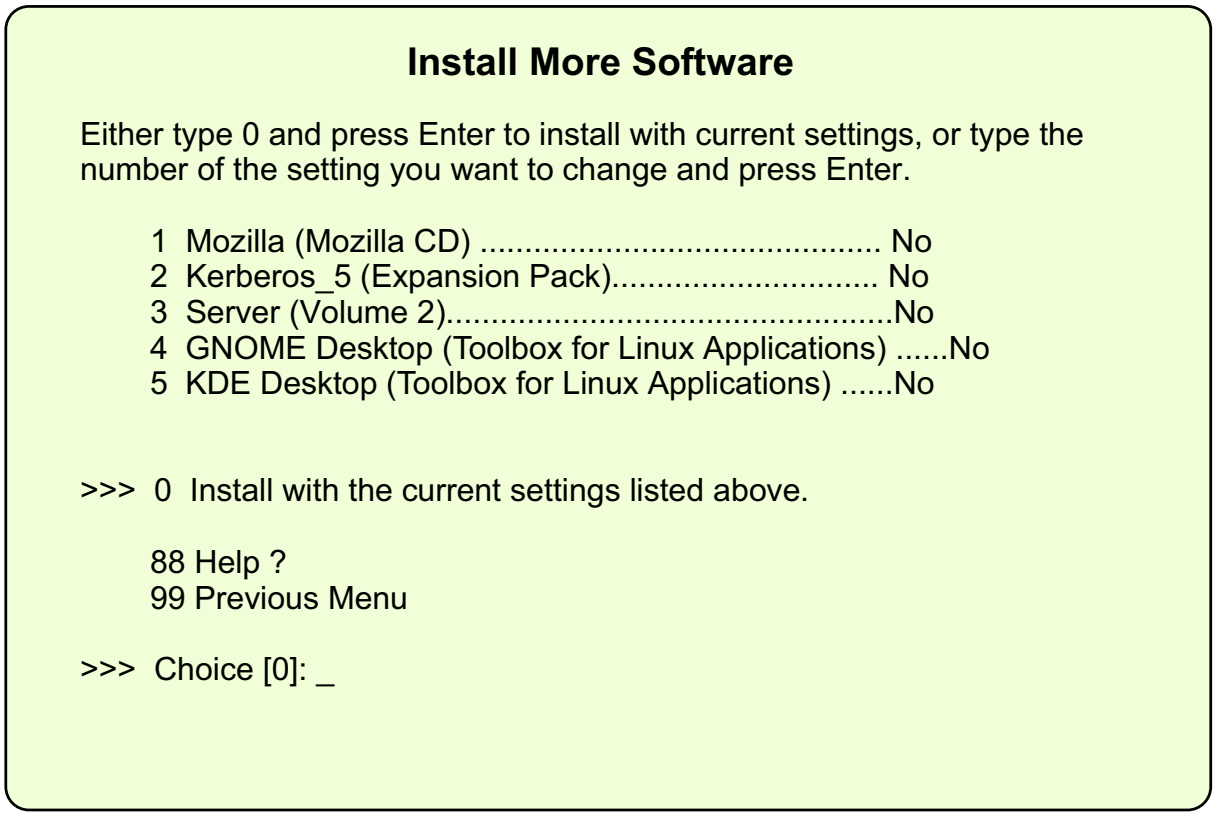
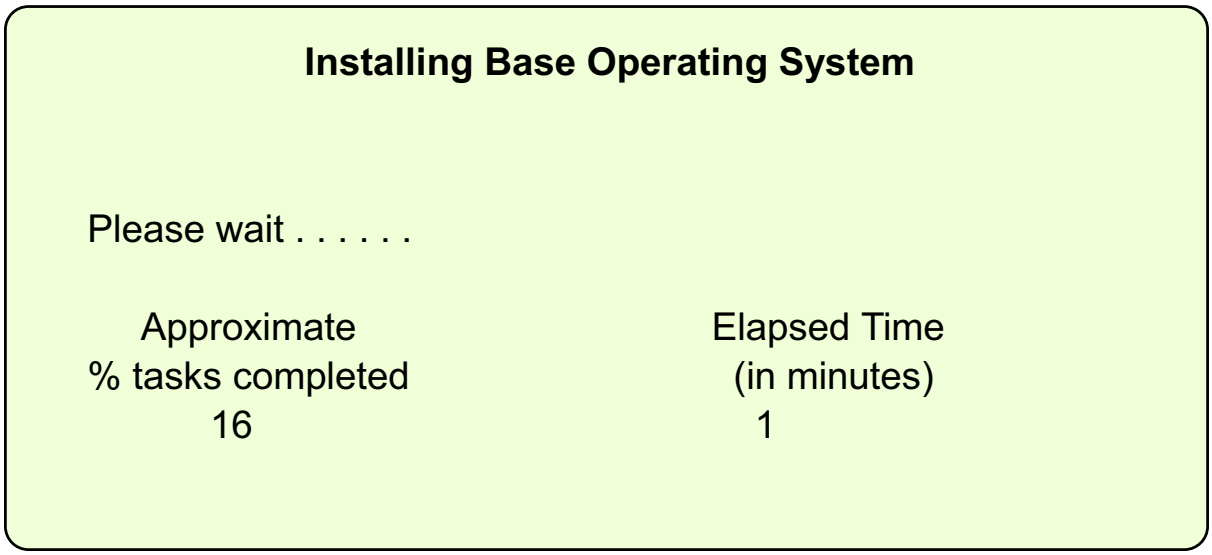


Figure 2-13. Install More Software AU1410.0

Notes:

The **Install More Software** option is available in the new and complete overwrite installation method, as well as the preservation installation method. Select **Install More Software** to choose additional software to install after the BOS installation process finishes. A software bundle file corresponds to each selection that contains the required packages and filesets.

Begin Installation



- Builds AIX directory structure
- Restores BOS, locale and filesets from installation media only
- Installs software for the connected and powered on devices

Figure 2-14. Begin Installation AU1410.0

Notes:

The installation media contains information stored on it to determine the sizes that the standard AIX file systems have. These are set large enough for the installation to succeed but do not leave much free space after installation. You can dynamically increase the size of any of the file systems once AIX has been installed. If you are installing from a system image backup tape, the file systems created are the same sizes and names as those on the system when the tape was created.

The files are restored from the media and then verified. This takes some time but can be left unattended. After the BOS has installed, the appropriate locale optional program will also be installed.

Once the installation has completed, the system automatically reboots from the newly installed operating system on disk.

Installation Flow Chart - All Systems

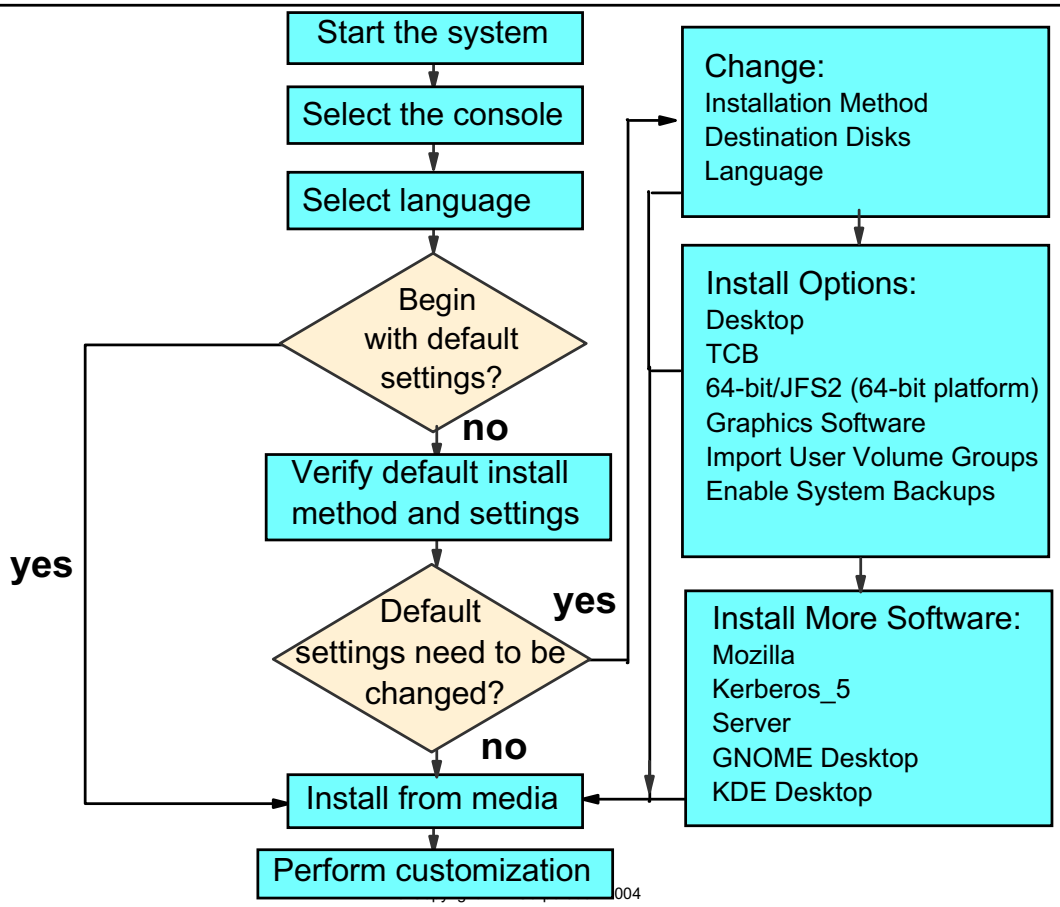


Figure 2-15. Installation Flow Chart - All Systems AU1410.0

Notes:

Configuration Assistant Menu

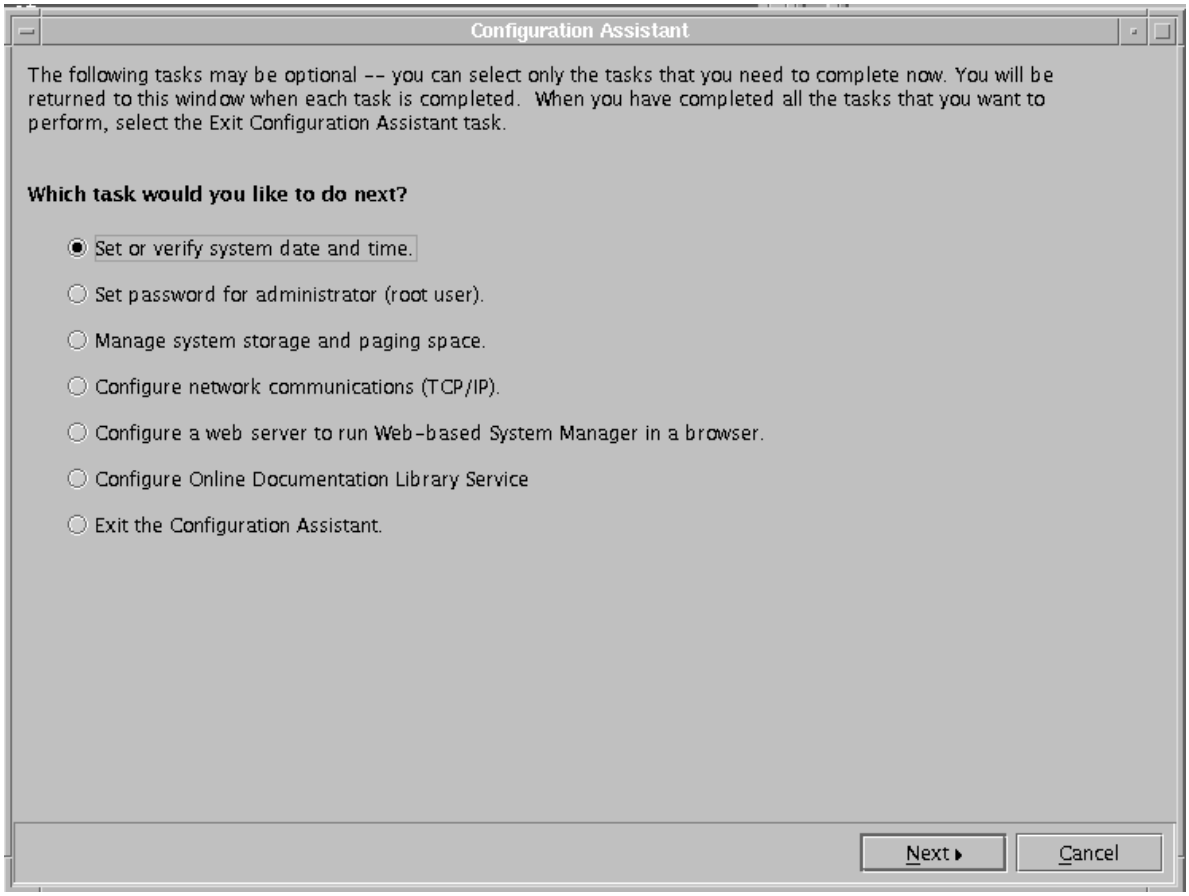


Figure 2-16. Configuration Assistant Menu AU1410.0

Notes:

After installing AIX, the operating system runs with default settings; one user (root), the date and time set for where the system was manufactured, and other very general settings. You probably want to change some or all of these settings. Also, you must provide system and network information if you want to communicate with other systems.

If using a graphics terminal for the installation, the newly installed BOS reboots and starts the **Configuration Assistant**, which guides you through completing customization tasks. When you use the Configuration Assistant immediately after BOS installation, you have at first to accept the license agreement and only the tasks that apply to your type of installation will be shown. If an ASCII terminal was used for the installation, an ASCII-based **Installation Assistant** is displayed instead. Both the graphics-based Configuration Assistant and the ASCII-based Installation Assistant provide comparable support.

When you have completed your work using the Configuration Assistant/Installation Assistant, you can indicate that you are done working with the program. This will prevent this program from being displayed at the next reboot.

The Configuration Assistant and Installation Assistant provide step-by-step instructions for completing each customization task. Examples of tasks that can be performed are setting the system date and time, setting root's password and configuring the network.

Complete the tasks in the order that the Configuration Assistant/Installation Assistant lists them. It is helpful to complete all customization tasks before you use your system.

You must have root user authority to use the Configuration/Installation Assistant. From a graphics terminal, type **install_assist** to access the Configuration Assistant. From AIXWindows, the command **configassist** can also be used to access the Configuration Assistant. From an ASCII terminal, use the **install_assist** command to access the Installation Assistant.

Activity: Configuration Assistant

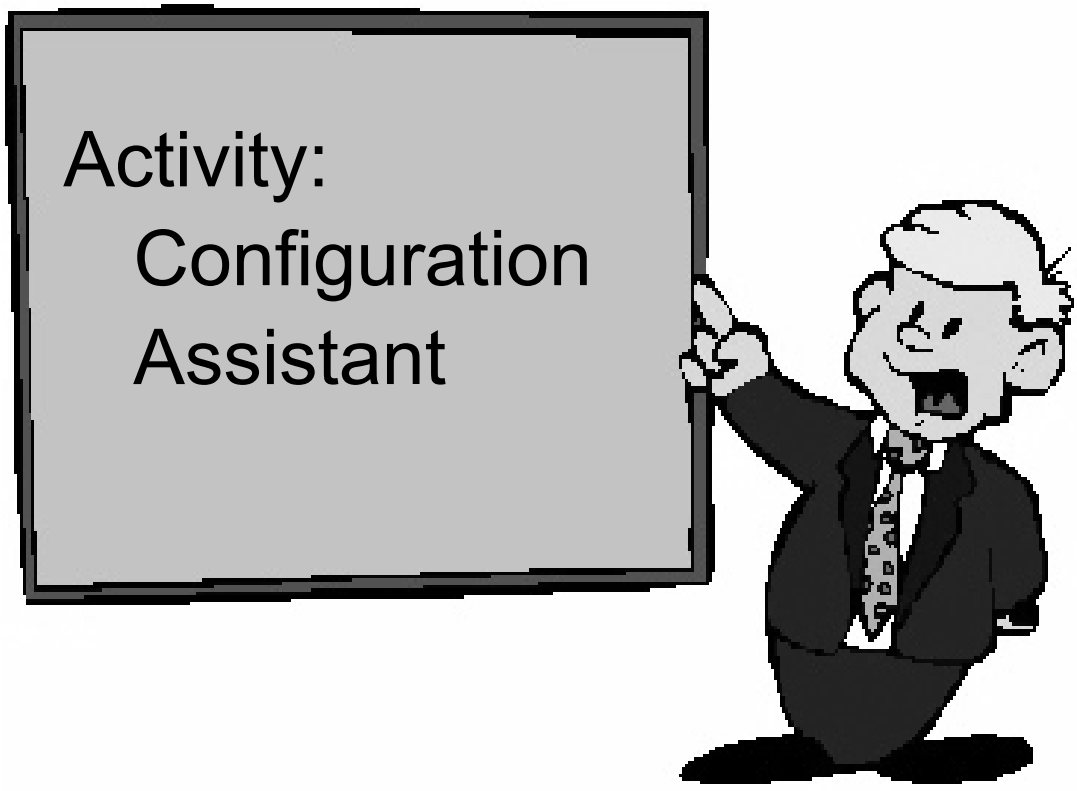


Figure 2-17. Activity: Configuration Assistant AU1410.0

Notes:

Instructions

In this activity, you have the opportunity to work with the Configuration Assistant. The Configuration Assistant is the first screen that you are presented with after a successful installation of the operating system.

1. Log into the system as root.
2. Start Configuration Assistant.
3. Ensure the date and time are set correctly.
4. Familiarize yourself with some of the other options. When you finished, exit from Configuration Assistant and select the option to Finish now, and do not restart Configuration Assistant when restarting AIX.

Instructions with Hints

In this activity, you will have the opportunity to work with the Configuration Assistant. The Configuration Assistant is the first screen that you are presented with after a successful installation of the operating system.

1. Log into the system as root.
2. Start Configuration Assistant.

   If you are using a graphical interface, type:

   # install_assist OR # configassist

   If you are using an ASCII interface, type:

   # install_assist

3. Ensure the date and time are set correctly.

   - Click **Next** on the opening screen.
   - Date and time are already selected. Click **Next**.
   - Make any changes if necessary to the date and time.
   - Click **Next** when finished.

4. Familiarize yourself with some of the other options. When you finished, exit from Configuration Assistant and select the option to “Finish now, and do not restart Configuration Assistant when restarting AIX.”

   - Click **Exit the Configuration Assistant** (Then Click Next)
   - Click **Finish now**, **and do not restart Configuration Assistant when restarting AIX** (Then Click Finish)

Checkpoint

1. AIX 5L can be installed from which of the following: (select all that are correct)
   a. 8 mm tape
   b. CD-ROM
   c. Diskette
   d. 4 mm tape
2. True or false? A Preservation Install preserves all data on the disks.
3. What is the console used for during the installation process?

   _____

Figure 2-18. Checkpoint AU1410.0

Notes:

Unit Summary

- AIX 5L is only distributed on CD-ROM.
- In order to install the base operating system, system specific questions have to be answered before the process can begin.
- The Configuration Assistant is used by the system administrator to further customize the system.

Figure 2-19. Unit Summary AU1410.0

Notes:

Unit 3. System Management Interface Tool (SMIT)

What This Unit Is About

This unit covers the process of installing, configuring and using the AIX Web-based System Manager: WebSM.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Use WebSM to manage AIX
- Install and configure remote client support

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercises

References

SC23-4920 AIX 5L Version 5.3 Web-based System Manager Administration Guide

Unit Objectives

After completing this unit, you should be able to:

- Outline the benefits of the system management tools available with AIX Version 5.3
- Define the functionality of SMIT
- Define how SMIT activity is logged

Figure 3-1. Unit Objectives AU1410.0

Notes:

Early System Administration

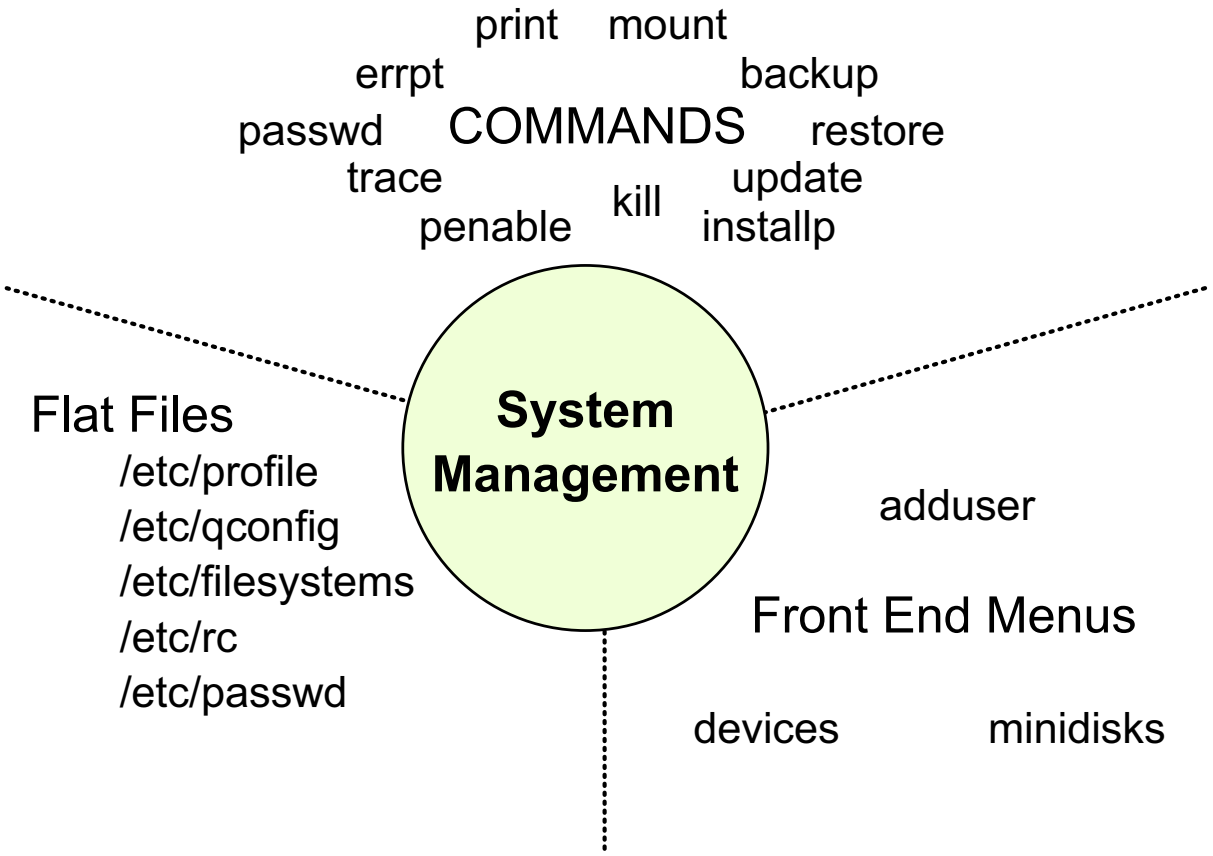


Figure 3-2. Early System Administration AU1410.0

Notes:

The main disadvantages with system administration on UNIX and AIX systems before AIX Version 3 was the fact that there was not a common consistent interface to perform system administration tasks, and the administrator had to be very knowledgeable about how the system worked. The following techniques were used:

- **Commands** — A number of commands were available which performed some system management functions. These had various heritages (for example, from AT&T, Berkeley and IBM) and were not necessarily available on all systems.
- **Front Ends** — A few menu- or command-driven front ends were available to perform some aspects of system management. Unfortunately, these were not consistent with each other, and also could not be used non-interactively (that is, from a shell script.)
- **Flat Files** — Configuration of some aspects of the system was performed by editing files which were in a variety of different formats. This was very prone to typing errors and also required knowledge of one of the system editors.

The first front ends available for the IBM RT systems were for device handling and user creation. Now there are front ends to perform most basic administrative tasks.

System Management Objectives

- Minimize time and resources spent managing systems.
- Maximize productivity, reliability, and performance.
- Provide remote system management solutions.

Figure 3-3. System Management Objectives AU1410.0

Notes:

Minimize time and resource spent managing systems; that is, manage efficiently. AIX helps with tools such as SMIT and the Web-based System Manager.

Maximize productivity, reliability and performance; that is, maximize the productivity of the users. AIX helps with features, such as the logical volume manager, that don't require the system to be brought down for maintenance.

Provide remote system management solutions; AIX supports Web-based technology with the Web-based System Manager. As a result, multiple systems can be managed from one AIX system over the network. This can be done with SMIT using telnet as well.

AIX Administration

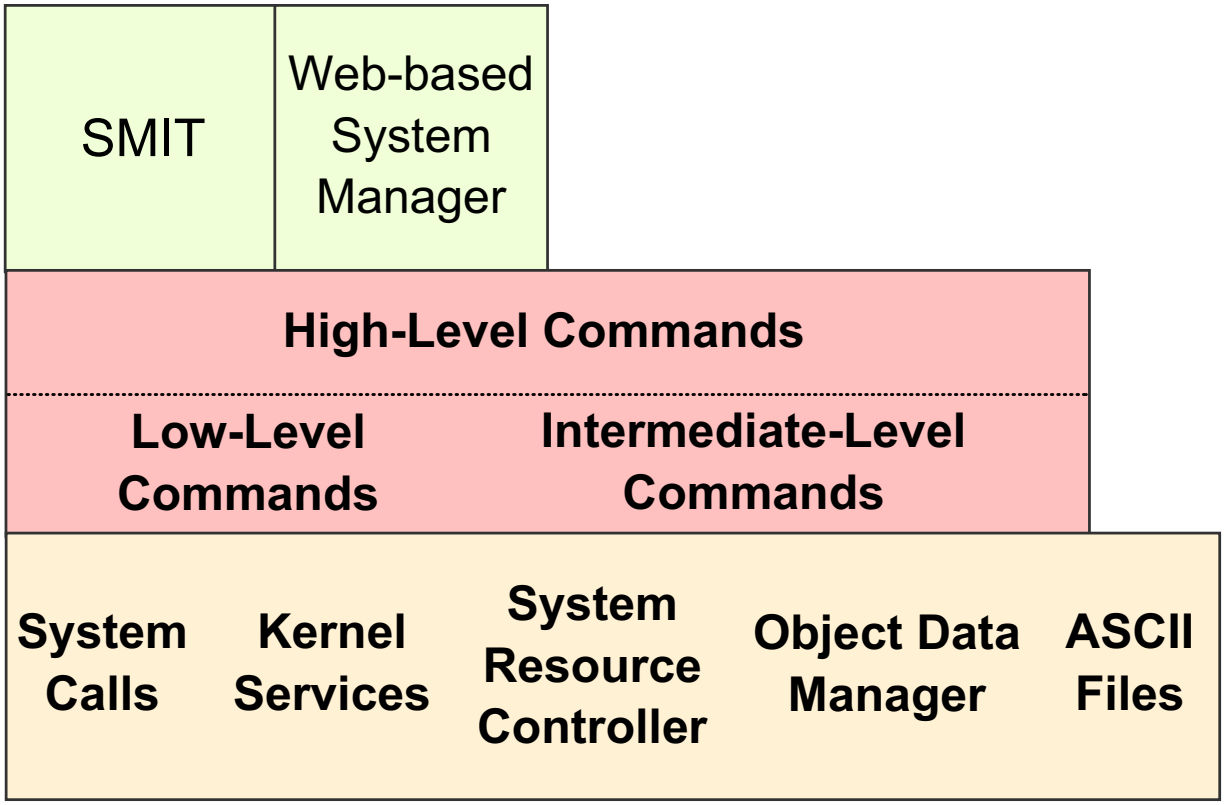


Figure 3-4. AIX Administration AU1410.0

Notes:

The **System Management Interface Tool (SMIT)** provides a menu-driven interface that provides access to most of the common system management functions within one consistent environment.

SMIT does not perform any system management functions directly. It is a user interface that constructs high-level commands from the user's selections and then executes these commands on demand. Those commands could be entered directly by the user to perform the same tasks.

- **High-Level Commands** — These are standard AIX commands (either shell scripts or C programs) which can also be executed by a user. They execute multiple low-level or intermediate-level commands to perform the system administrative functions.
- **Intermediate-Level Commands** — These commands interface with special AIX components such as the System Resource Controller and the Object Data Manager. (These commands are rarely executed directly by a user.)

- **Low-Level Commands**— These are AIX commands which correspond with AIX system calls or kernel services. (They are not normally executed directly by a user.)

SMIT does not cover every possible system management task and occasionally there will be a need to run AIX commands or edit ASCII files directly. However, SMIT does make the most frequent or complex/tedious tasks much easier with a greater degree of reliability.

The **Web-based System Manager** was introduced with AIX V4.3. The Web-based System Manager is an intuitive object-oriented user interface for performing system management tasks. This tool can be run in stand-alone mode or in a client-server environment. The Web-based System Manager will be discussed in further detail later in this unit.

System Management Interface Tool (SMIT)

ASCII or AIXWindows (Motif) User Interface Components

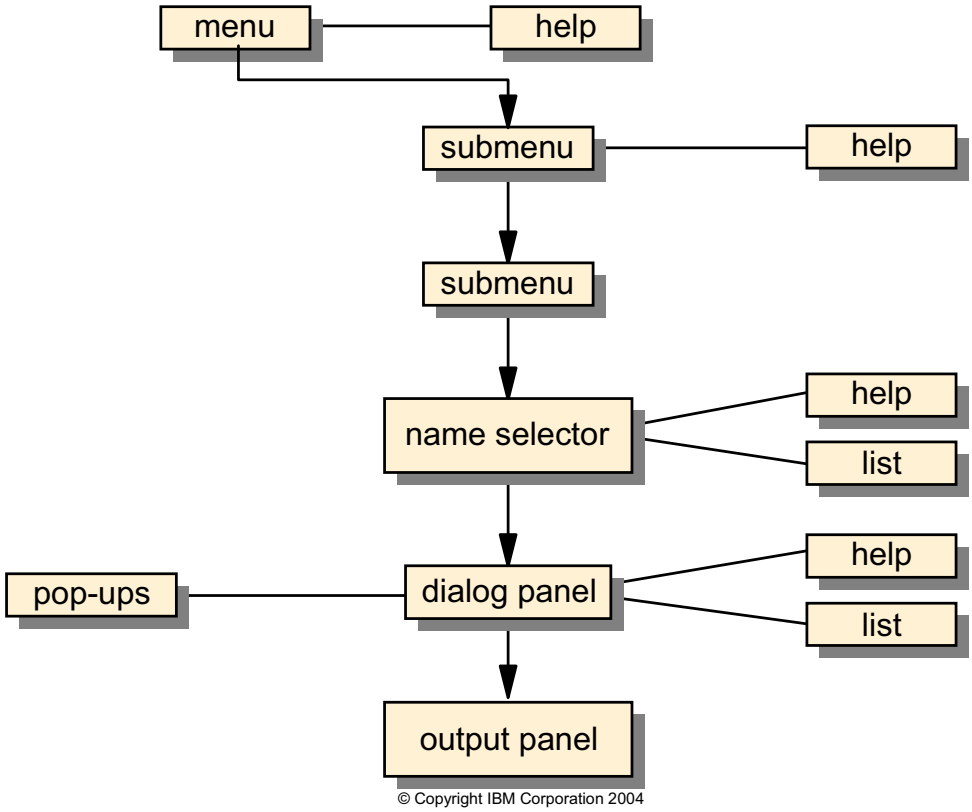


Figure 3-5. System Management Interface Tool (SMIT) AU1410.0

Notes:

SMIT provides a flexible user environment. The user can use an ASCII or AIXWindows-based interface which provides the same facilities but the interaction is slightly different. The user interface consists of a number of components:

- **Menus** - SMIT has a hierarchy of menus which breaks down the typical system management tasks into related areas. Some submenus may appear in multiple places within the hierarchy where appropriate.
- **Selector/Dialog Screens** - A selector screen allows you to select an object on which an action is to be performed (for example a tape drive). Having selected the object, a dialog screen will allow you to control the way in which the task is performed (for example set the attributes for the drive, or install from that drive.)
- **Pop-up Lists** - Where there are a number of possible values for a parameter, you can often request a list of these values and select either a single item or multiple items.

- **Output Panels** - SMIT constructs and runs standard AIX commands. The standard output and standard error from these commands are displayed within a special SMIT output screen, and this output can be reviewed after command completion.
- **Contextual Help** - SMIT provides online help which will guide you through the use of SMIT, and will also provide contextual information about each submenu, dialog screen and also each field within a dialog screen.

SMIT Main Menu (ASCII)

 # smit

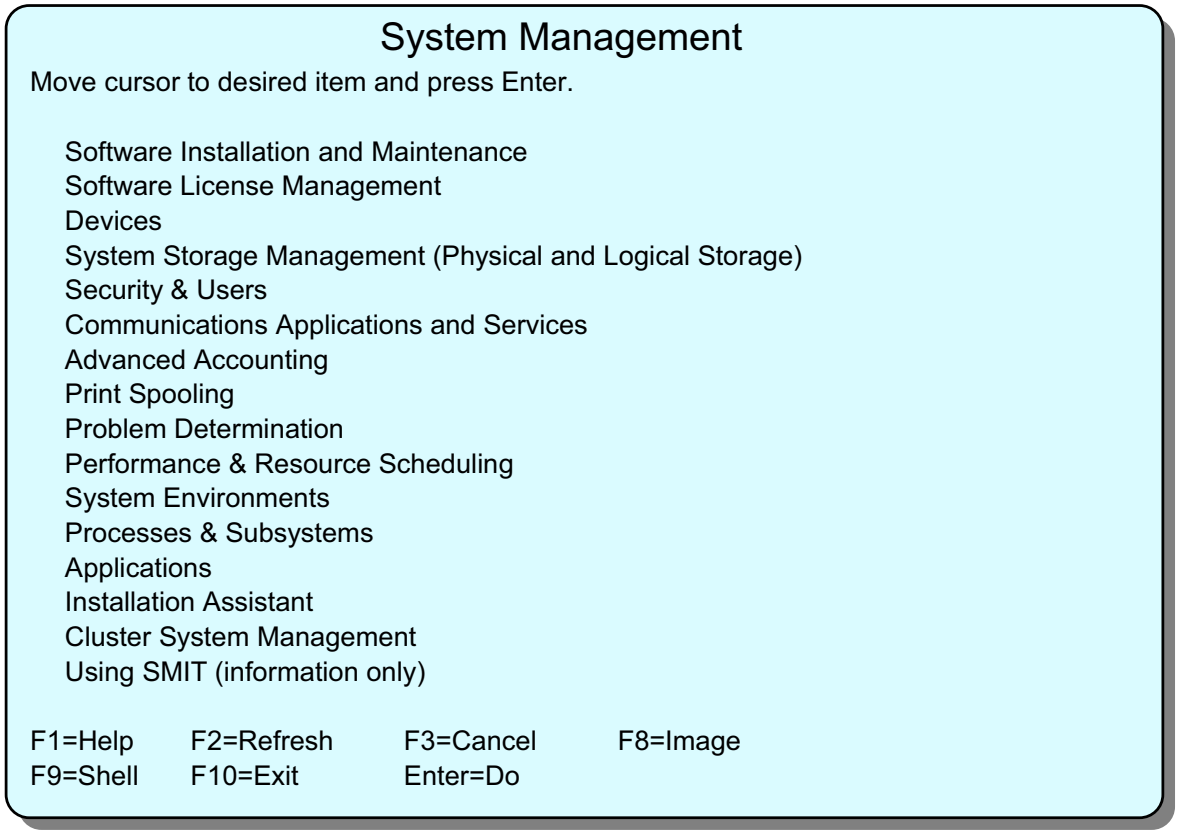


Figure 3-6. SMIT Main Menu (ASCII) AU1410.0

Notes:

The SMIT main menu allows you to select the administrative functions to be performed. You can also select online help on how to use SMIT.

In the ASCII mode, in order to select from the menus, you have to use the up and down arrow keys. This moves a highlighted bar over the menu items. Press **Enter** to select the highlighted item.

You can also use some of the keyboard function keys to perform other functions, such as exiting SMIT or starting a shell.

SMIT Main Menu (Motif)

Figure 3-7. SMIT Main Menu (Motif) AU1410.0

Notes:

The graphical (Motif) version of SMIT must be run using a graphical environment like AIXWindow or Common Desktop Environment (CDE). Typing the command smit in the graphical environment will automatically call graphical SMIT.

To work with graphical SMIT, use the mouse to point and click your way through the menu system. Clicking the Cancel box at the bottom of the screen, moves you back one screen. Or, you can select the screen title in the Return To section of the screen.

A number of functions are available through pull-down menus on the top of the screen. To exit SMIT, for example, click the Exit pull-down.

The function keys used in the ASCII version of SMIT do not correspond to actions in the graphical SMIT.

Dialog Screen

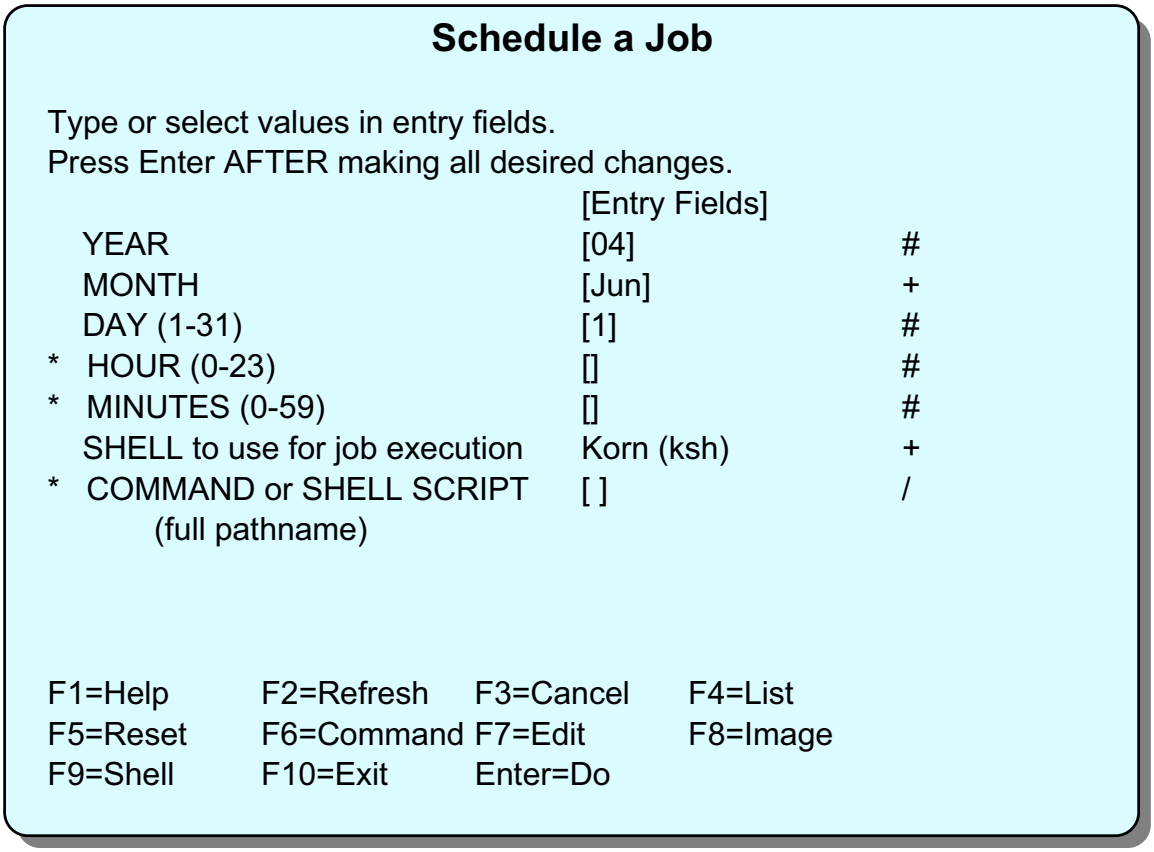


Figure 3-8. Dialog Screen AU1410.0

Notes:

A dialog screen allows you to enter values which determine the operation performed. Some fields will already be filled in from information held in the system. Usually you can change this data from the default values.

A selector screen is a special case of a dialog screen in which there is only one value to change. This usually indicates the object which will be acted upon by the subsequent dialog and AIX command.

To enter data, move the highlighted bar to the value you want to change and then either enter a value or select one from a pop-up list. Fields that you can type in are indicated by square brackets **[]**. Fields that have data that is larger than the space available to display it are indicated by angle brackets **<>**, to indicate that there is data further to the left or right (or both) of the display area.

Special symbols on the screen are used to indicate how data is to be entered:

*	A required field
#	A numeric value is required for this field.

/	A pathname is required for this field.
X	A hexadecimal value is required for this field.
?	The value entered will not be displayed.
+	A pop-up list or ring is available.

An * symbol in the leftmost column of a line indicates that the field is required. A value must be entered here before you can commit the dialog and execute the command.

In the ASCII version, a **+** is used to indicate that a pop-up list or ring is available. To access a pop-up list use the **F4** key. A ring is a special type of list. If a fixed number of options are available, the **Tab** key can be used to cycle through the options.

In the Motif version a **List** button is displayed. Either click the button or press **Ctrl-l** to get a pop-up window to select from.

The following keys can be used while in the menus and dialog screens. Some keys are only valid in particular screens. Those valid only for the ASCII interface are marked (A) and those valid only for the Motif interface are marked (M)

F1 (or ESC-1)	Help - show contextual help information
F2 (or ESC-2)	Refresh - redraw the display (A)
F3 (or ESC-3)	Cancel - return to the previous screen (A)
F4 (or ESC-4)	List - display a pop-up list of possible values (A)
F5 (or ESC-5)	Reset - restore the original value of an entry field
F6 (or ESC-6)	Command - show the AIX command that will be executed
F7 (or ESC-7)	Edit - a field in a pop-up box or select from a multi-selection pop-up list
F8 (or ESC-8)	Image - save the current screen to a file (A) and Show the current fastpath
F9 (or ESC-9)	Shell - start a sub-shell (A)
F9	Reset All Fields (M)
F10 (or ESC-0)	Exit - exit SMIT immediately (A)
F10	Go to command bar (M)
F12	Exit - exit SMIT immediately (M)
Ctrl-l	List - give a pop-up list of possible values (M)
PgDn (or Ctrl-v)	Scroll down one page
PgUp (or ESC-v)	Scroll up one page
Home (or ESC-<)	Go to the top of the scrolling region
End (or ESC->)	Go to the bottom of the scrolling region

Enter	Do the current command or select from a single-selection pop-up list
/text	Finds the text in the output
n	Finds the next occurrence of the text

Output Screen

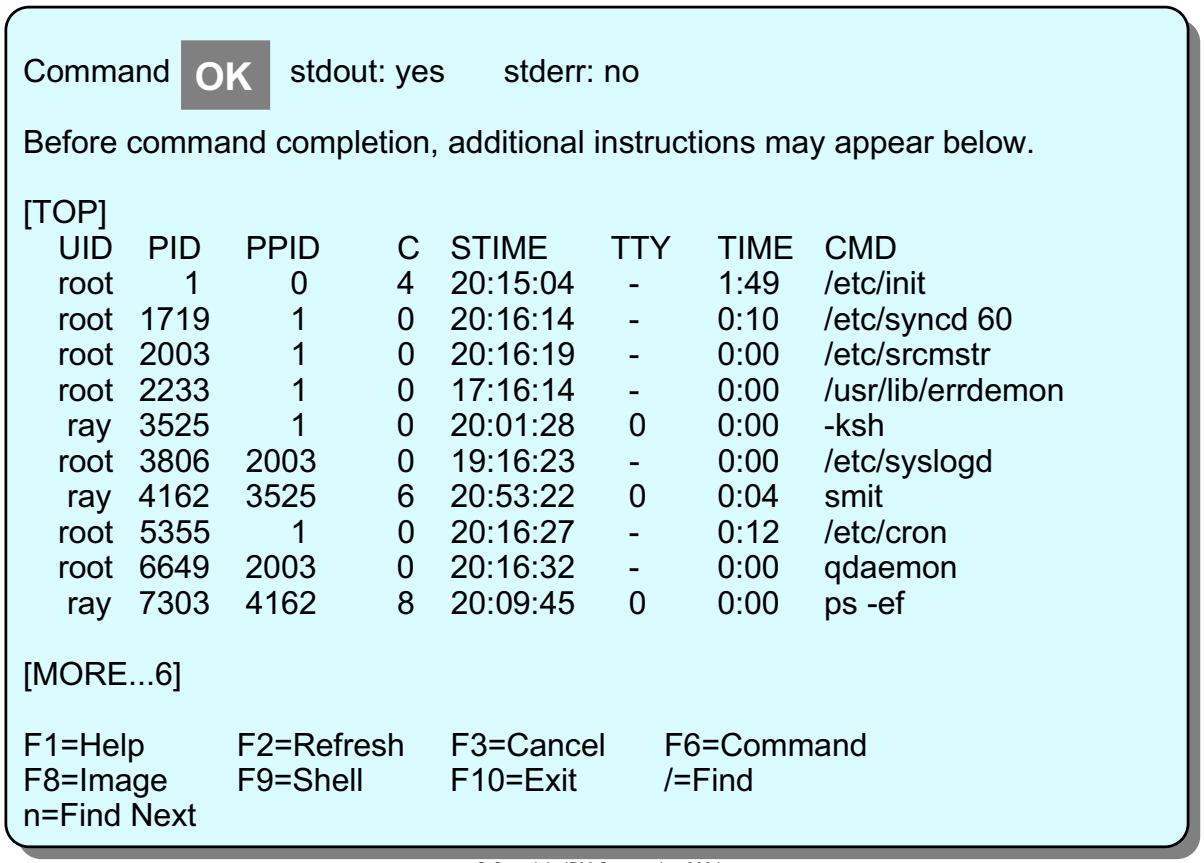


Figure 3-9. Output Screen AU1410.0

Notes:

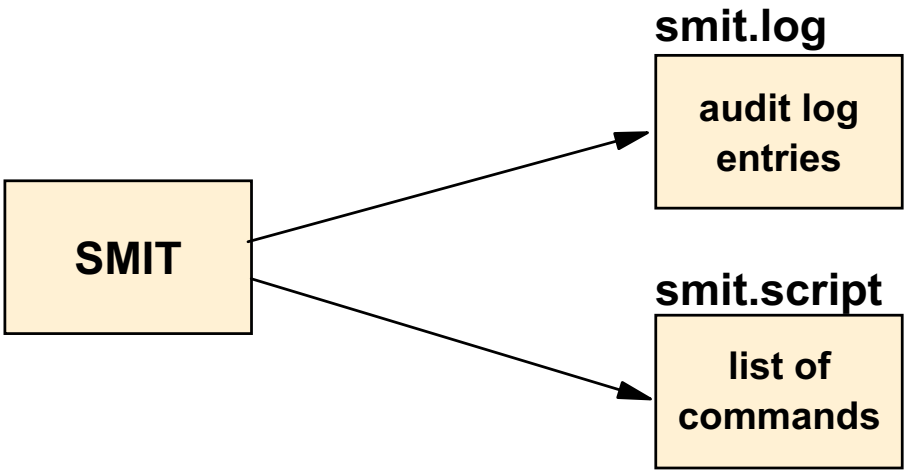
The **Command** field can have the following values: OK, RUNNING and FAILED.

Note that in the Motif version there is a man in the top right-hand corner of the screen which is used to indicate the three values.

- **stdout** is the standard output, that is, there is output produced as a result of running the command. The output will be displayed in the body section of this screen.
- **stderr** is the error messages if there are any. In this case there are no error messages.

The body of the screen holds the output/error messages of the command, in this case output.

SMIT Log and Script Files



- **$HOME/smit.log**
  Keeps a log of all menu and dialog screens visited, all commands executed and their output. Also records any errors during the SMIT session.

- **$HOME/smit.script**
  Shell script containing all AIX commands executed by SMIT.

Figure 3-10. SMIT Log and Script Files AU1410.0

Notes:

SMIT creates two files in the **$HOME** directory of the user running SMIT. If these files already exist, then SMIT will append to them. These files can grow quite large over time, especially during installations, so the user must maintain them and truncate them when appropriate.

The **smit.log** file contains a record of every SMIT screen (menu/selector/dialog) visited, the AIX commands executed, and the output from these commands. When the image key is pressed, the screen image is placed in the smit.log file. If there are any error/warning messages from SMIT or any diagnostic/debugging messages, then these are also appended to the **smit.log** file.

The **smit.script** file just contains the AIX commands executed by SMIT (preceded by the date and time of execution). This file can be used directly as a shell script to perform tasks multiple times, or used as the basis for more complex operations.

smit Command

smit [-*options*] [*FastPath*]

- Invoke ASCII Version

```
# smitty
```

- Run no high-level commands

```
# smit -x
```

- Redirect the log file and script file

```
# smit -s /home/team01/smit.script -l /home/team01/smit.log
```

```
# smit -s /dev/pts/1 -l /dev/pts/2
```


Figure 3-11. smit Command AU1410.0

Notes:

The command **smit** is used to invoke SMIT. It is not common to run smit with any options although a number of them do exist. Here is a sampling of the more commonly used options.

Many administrators prefer the ASCII version of SMIT over the graphical SMIT. If you are working in a graphical environment and want to use the ASCII version of SMIT, use the command **smitty (or smit -C)**. This is commonly used.

Using a SMIT fastpath can be very helpful. Fastpaths are names of individual screens within SMIT. If you want to by-pass the menu system and go straight to a particular screen, use the command smit *fastpath*. When using SMIT, you can view the fastpath screen name by pressing **F8 - Image**.

If you want to explore the menus of SMIT without accidentally running a command, invoke SMIT using **smit -x**. This logs all the normal entries in smit.log and smit.script but does not execute any commands.

Since smit.log and smit.script are created in the user's HOME directory, this can be problem if you log in directly as root. Root's HOME directory is /. Later you learn that filling the root area of you disk can cause your machine to crash. You can tell SMIT to log this information elsewhere using **smit -l** filename for the smit.log and **smit -s** filename for smit.script.

Exercise: Using SMIT

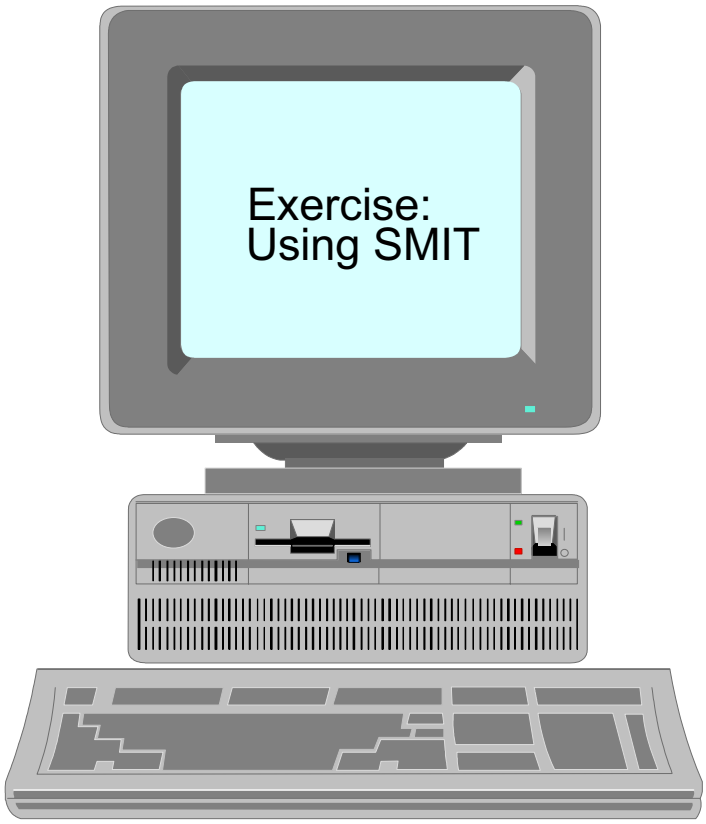


Figure 3-12. Exercise: Using SMIT AU1410.0

Notes:

This lab allows you to get familiar with SMIT. In this exercise, you are also given the chance to use each of the interfaces AIX provides.

The exercise can be found in your Exercise Guide.

Checkpoint Questions

1. Define the SMIT function keys that can be used for the following:
   a. List the command that will be run ____
   b. List the screen name which can be used for the fastpath____
   c. Take a screen image: ___
   d. Break out into a shell: ___
   e. Return to the previous menu: ___
2. How do you request the ASCII character version of SMIT from an XWindows environment command prompt?

Figure 3-13. Checkpoint AU1410.0

Notes:

Unit Summary

- SMIT provides graphics or ASCII support for most system administration tasks.
- SMIT provides logging of activities and generated commands
- SMIT has useful fastpaths for bypassing the menu structures.

Figure 3-14. Unit Summary AU1410.0

Notes:

Unit 4. AIX Software Installation and Maintenance

What This Unit Is About

This unit covers the process of installing and maintaining optional software product and updates.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Define the package definitions and naming conventions
- Identify how software products and updates are installed and managed on the system

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise

References

SC23-2550	*AIX Version 4.1 Installation Guide*
SC23-1924	*AIX Version 4.2 Installation Guide*
SC23-4112	*AIX Version 4.3 Installation Guide*
SC23-4374	*AIX 5L Version 5.1 Installation Guide*
SC23-4389	*AIX 5L Version 5.2 Installation Guide*

Unit Objectives

After completing this unit, you should be able to:

- Define the package definitions and naming conventions
- Identify how software products and updates are installed and managed on the system

Figure 4-1. Unit Objectives AU1410.0

Notes:

AIX Product Offerings

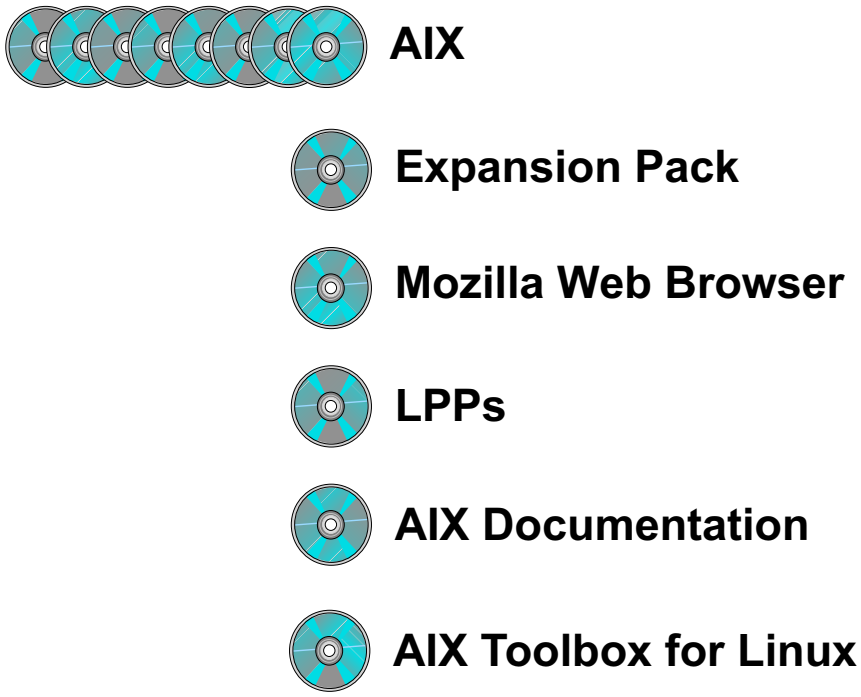


Figure 4-2. AIX Product Offerings AU1410.0

Notes:

The AIX 5L operating systems are delivered on multiple CDs. During the ordering process, it is necessary to indicate the system type.

Licensed Program Products are separately orderable products that will run on the AIX operating system.

The contents of the Expansion and Bonus Packs vary over time. Their purpose is to acquaint users with tools and products that may be valuable in their business environment.

The AIX 5L Expansion Pack extends the base operating system by providing a variety of security software (DES, SSL, Certificates, and so forth), security extensions to base software (RSCT, WebSNM), and other software (HTTPServer, OpenSSH, Java2 Developer Kit, Directory Server). An Expansion Pack is included with every new order of AIX 5.3 at no additional charge when media is selected, or can be ordered separately for existing AIX licenses.

The AIX Bonus Pack compliments AIX by adding tools, utilities, as-is software and try-and-buy applications. Prior to AIX 5.3 this was distributed in the same manner as the

expansion pack. With AIX 5.3 this software is now available as a “Web Download Pack” which is downloaded from the IBM Web site. The AIX 5.3 Web Download Pack currently contains IBM Text-to-Speech, OpenSSH, Mozilla for AIX (web browser), and an evaluation copy of AIX Fast Connect.

For more details on either the Expansion Pack or the Bonus/Web Download Pack go to:

http://www.ibm.com/servers/aix/expansionpack

Fix Repository

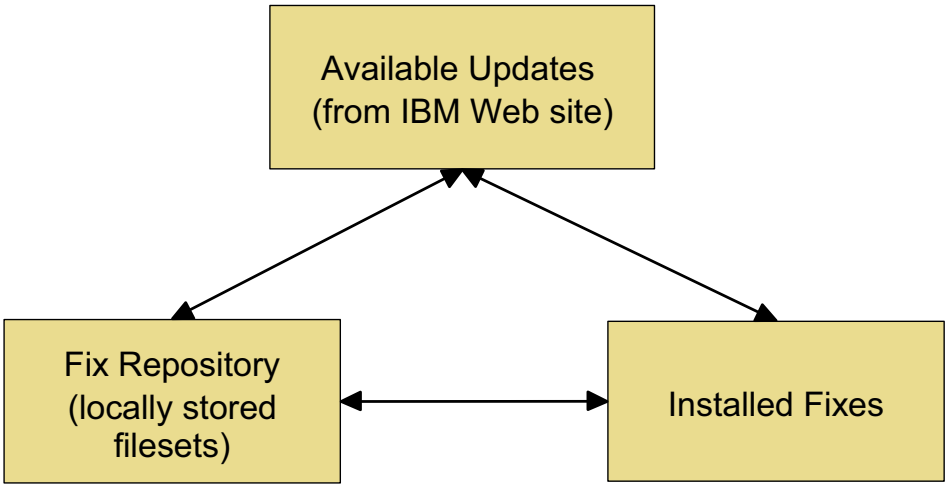


Figure 4-3. Fix Repository AU1410.0

Notes:

When working with modifications or fixes, it is common to download the fixes to a directory on your local hard drive before installation. This location is commonly referred to as the fix repository.

While /**usr**/**sys**/**inst.images** is a standard location for storing software images and will appear in the smit Input Device/Directory F4 list, you may choose to use any directory for this purpose.

Managing the fix repository includes knowing how up to date it is relative to what is available and what in the repository has been installed.

AIX provides a reporting facility to compare the installed software, repository software and IBM web site available software. Any two of these can be compared to obtain a report.

Fix Release Information

Figure 4-4. Fix Release Information AU1410.0

Notes:

IBM @server support provides a web site interface to access fix information.

There are multiple ways to navigate to this web page.

One way is via "Fix Central": **www.ibm.com/eserver/support/fixes**

Identify the server as pSeries, product type as AIX OS, ordering option as Fix Release Information, and finally the OS level as (for example) AIX5.3.

Another way is to go directory to the AIX fixes web page:
www.ibm.com/servers/eserver/support/pseries/aixfixes.html

It lists the various ordering options; next to Fix Release Info click on the level of AIX desired.

You may identify a specific known fix, obtain a list of the most recent fixes, identify critical fixes, list available maintenance levels, of use the Fix Release Information facility (which is shown here).

The Fix Release Information page is designed with work with the AIX comparison reports. The Fix Data File downloaded from here can be used as input to the utility for comparison against either the local Fix Repository or the Installed Software.

The comparison report output can then be used in the bottom half of the Fix Release Information page to create a special anonymous FTP site directory holding all the Fix Images you are missing.

The last step would be to use ftp to download the fix filesets to your Fix Repository Location.

Packaging Definitions

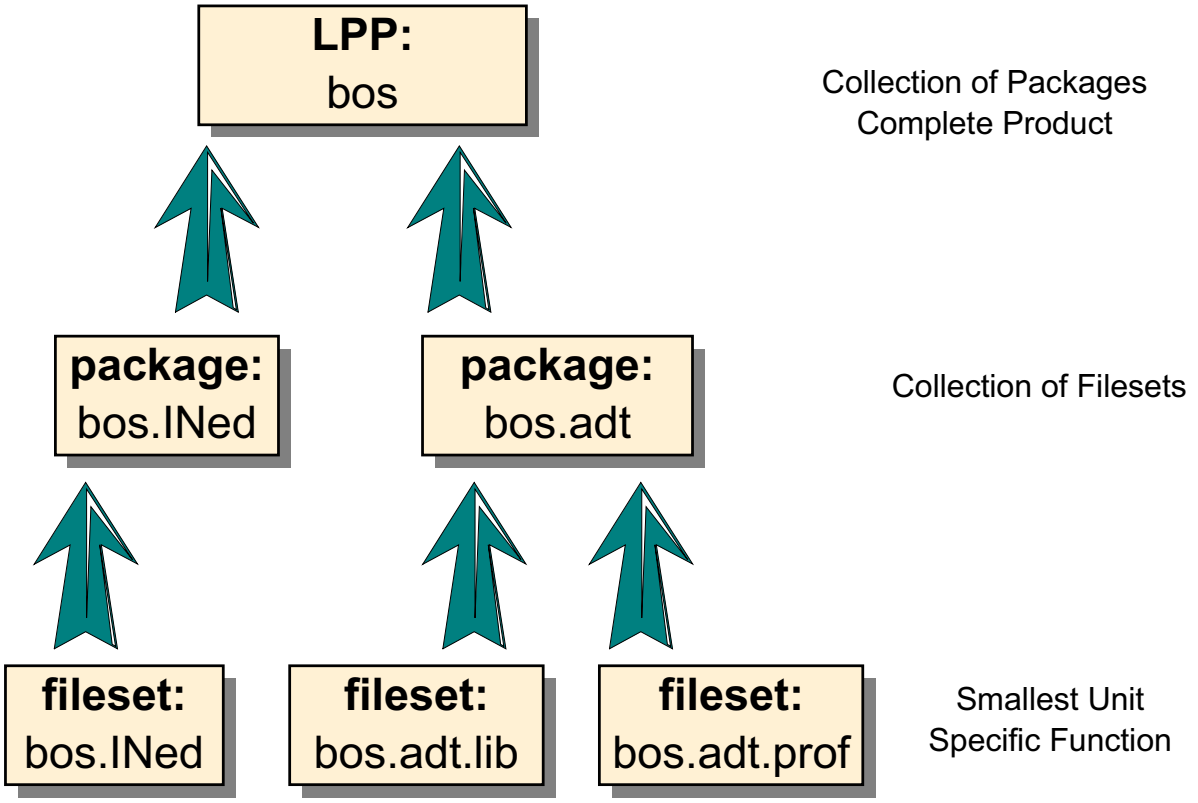


Figure 4-5. Packaging Definitions AU1410.0

Notes:

Licensed **P**rogram **P**roduct (LPP) is a complete software product collection including all packages and filesets required. For example the Base Operating System (bos) itself is a LPP which in turn is a complete collection of packages and filesets.

A package contains a group of filesets with a common function. It is a single, installable image.

A fileset is the smallest individually installable unit. It is a collection of files that provides a specific function. For example, bos.net.tcp.client is a fileset in the bos.net package.

Bundles

- A **Bundle** is a collection of packages and filesets suited for a particular environment
- Predefined system bundles in AIX 5.2 include:
  - AllDevicesKernels
  - Alt_Disk_Install
  - App-Dev
  - CC_Eval.Graphics
  - CDE
  - DocServices
  - GNOME
  - Graphics
  - HTTP_Server
  - KDE
  - Kerberos_5
  - Media-Defined
  - Mozilla
  - PerfTools
  - Server
  - devices
  - openssh_client
  - openssh_server
  - wsm_remote

Figure 4-6. Bundles AU1410.0

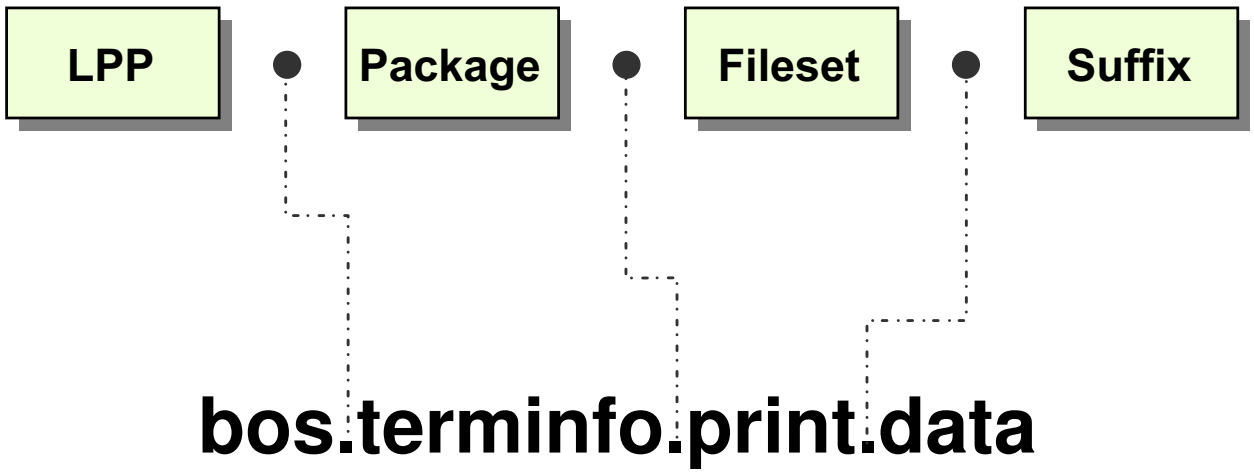
Notes:

Since there are thousands of filesets, having to determine which individual fileset you want on your machine could be a time-consuming task. AIX has bundles which offer a collection of filesets that suit a particular purpose. For example, if you are developing applications, the **App-Dev** bundle would be the logical choice to install.

Some filesets within a bundle will only be installed if the prerequisite hardware is available (for example, a graphic adapter is needed to run AIXWindow).

In some cases, bundles are equivalent to product offerings. Often, however, they are a subset of a product offering or a separate customized bundle. The bundles available may vary from configuration to configuration.

Fileset Naming



Message Convention:

LPP.msg[.lang].package.fileset

Figure 4-7. Fileset Naming AU1410.0

Notes:

Filesets follow a standard naming convention. The Licensed Program Product name will be the first part of every fileset name. The fileset names are meaningful and describe the contents of the fileset. The following are the standard fileset suffixes:

.adt	Application Development Toolkit for the Licensed Program Product
.com	Common code between two like filesets
.compat	Compatibility code that will be removed in a future release of the Licensed Program Product
.data	/usr/share portion of a fileset
.dev	Device support for that Licensed Program Product
.diag	Diagnostics for a fileset
.fnt	Font portion of a fileset
.help[lang]	Translated help files for that Licensed Program Product

.loc	Locale for that Licensed Program Product
.mp	Multi-processor specific code for a fileset
.msg[lang]	Translated messages
.rte	Run time or minimum set
.smit	SMIT tools and dialogs for a fileset
.ucode	Microcode for a fileset
.up	Uni-processor specific code for a fileset

With message libraries associated with LPPs, the language is also part of the naming convention.

Software Updates

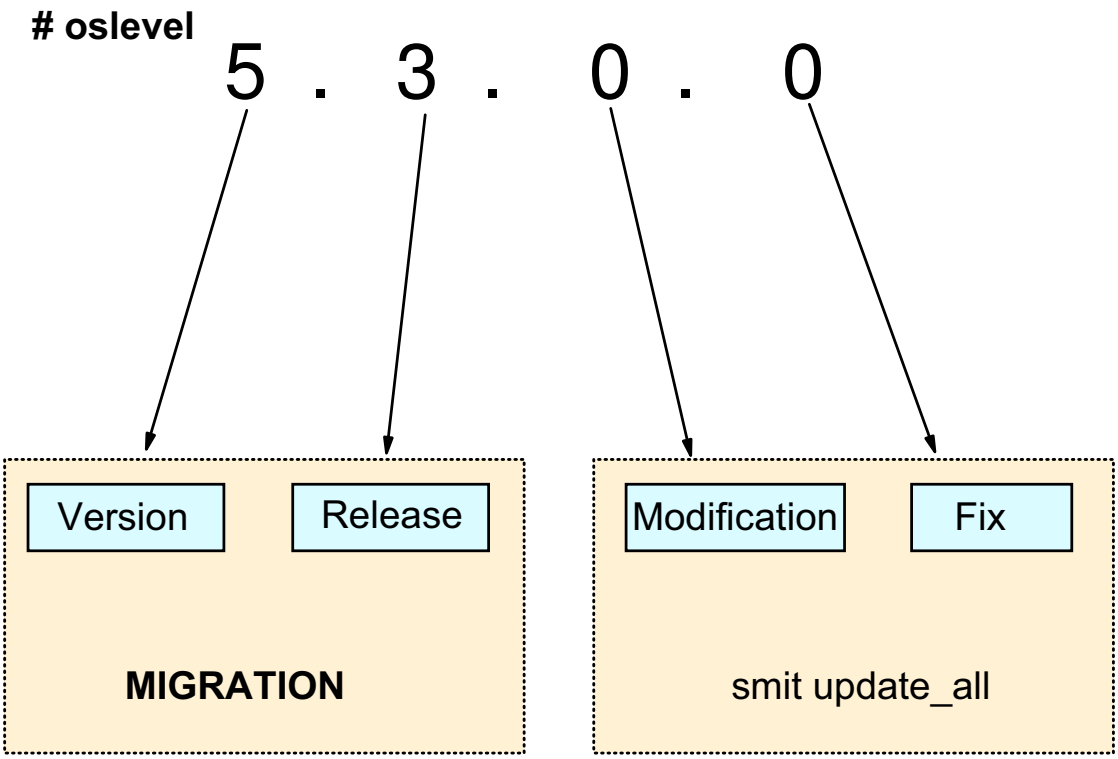


Figure 4-8. Software Updates AU1410.0

Notes:

As new software is created for AIX, you want to upgrade your system to maintain the latest features and functionality.

The numerical information that shows what level of software you currently have installed is broken into 4 parts: Version, Release, Modification, and Fix. You can see this using the command **oslevel**.

When you want to upgrade the system, how you do it depends on what type of upgrade you are performing. Changes to the Version or Release levels require you to perform a migration installation as discussion in the Installation section. If you want to make a change to the Modification or Fix levels, use **smit update_all**. These changes provide fixes to defects or additional functions to the BOS or optional software products.

Version and Release upgrades must be purchased. Modification and fix-level upgrade are available at no charge. They are provided on CD or tape (order via AIX Support Center) or they can be downloaded from the Web. Updates are available at **http://www.ibm.com/servers/eserver/support/pseries/aixfixes.html**

The key added features of this Web site:

Download on demand. No more waiting for e-mail to tell you the fix is ready to pick up. The fixes are immediately available.

Search by fileset name, PTF number, apar number or apar abstract.

One-click downloading of all requisites. Download individually or download-as-a-group. With the download-as-a-group, customers can start a multi-fileset download.

Software States

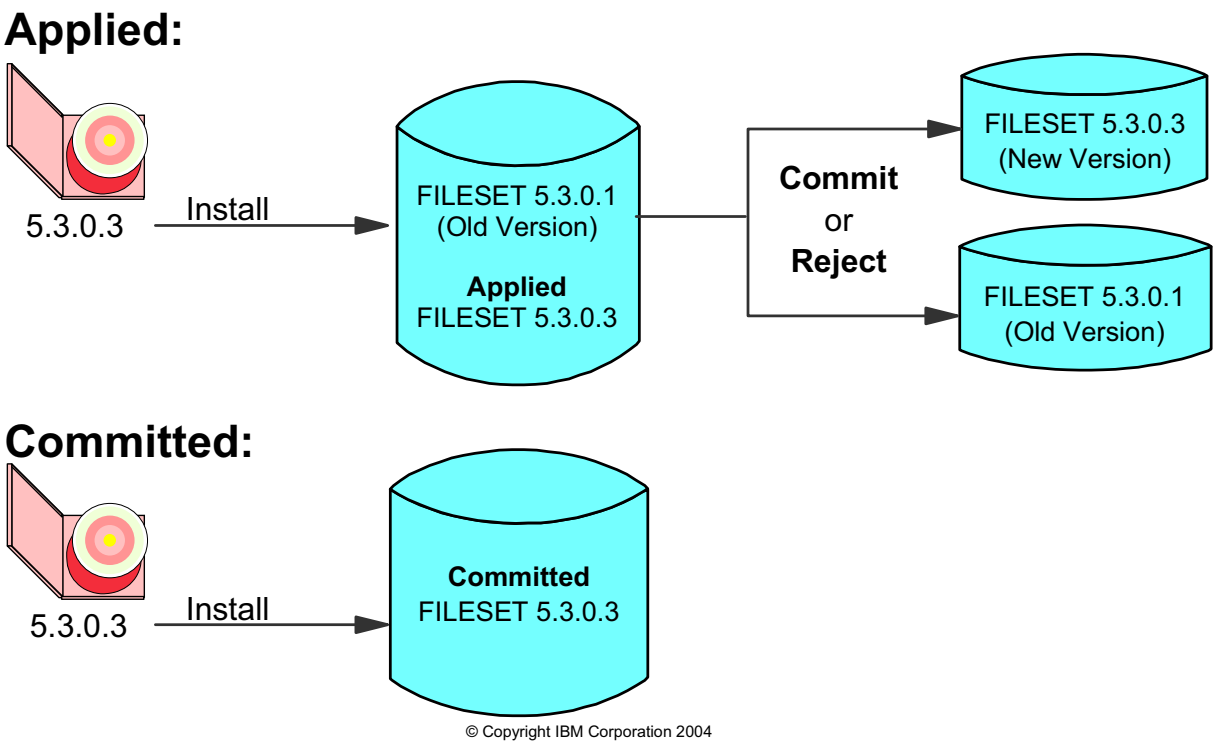


Figure 4-9. Software States AU1410.0

Notes:

AIX has a number of software states. When you are installing software for the first time, the software will automatically install to a committed state. This means there is only one level of that software product installed on your system.

When you are installing a fix- or a maintenance- level upgrade to your system, you have the option of installing the software either in the committed state or the applied state. The applied state allows you to maintain two levels of the software on your system. When software is installed in the applied state, the older version is saved on the disk and is deactivated while the newer version is installed and becomes the active version.

The applied state gives you the opportunity to test the newer software before committing to its use. If it works as expected, then you can commit the software which will remove the old version from the disk.

If the newer version is causing a problem, you can reject it which removes the newer version and recommits the old version.

With committed (or applied) software products, you can also remove them. This causes the product's files to be deleted from the system. Requisite software (software dependent on this product) is also removed unless it is required by some other software product on your system. If you want to use the software again, you would need to reinstall it.

Software Installation and Maintenance

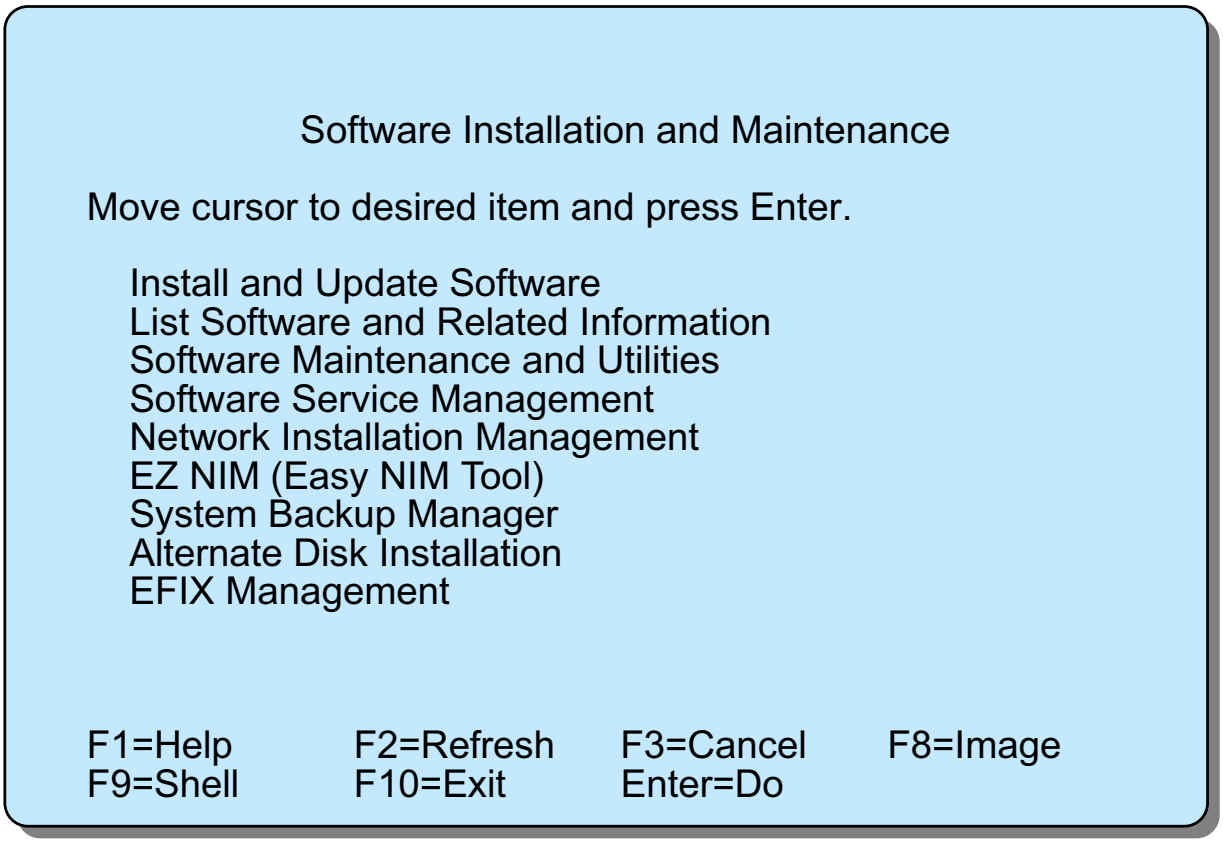


Figure 4-10. Software Installation and Maintenance AU1410.0

Notes:

Use the SMIT fastpath **smit install** to access the **Software Installation and Maintenance** menu.

You can also use the Web-based System manager to install software.

Install and Update Software

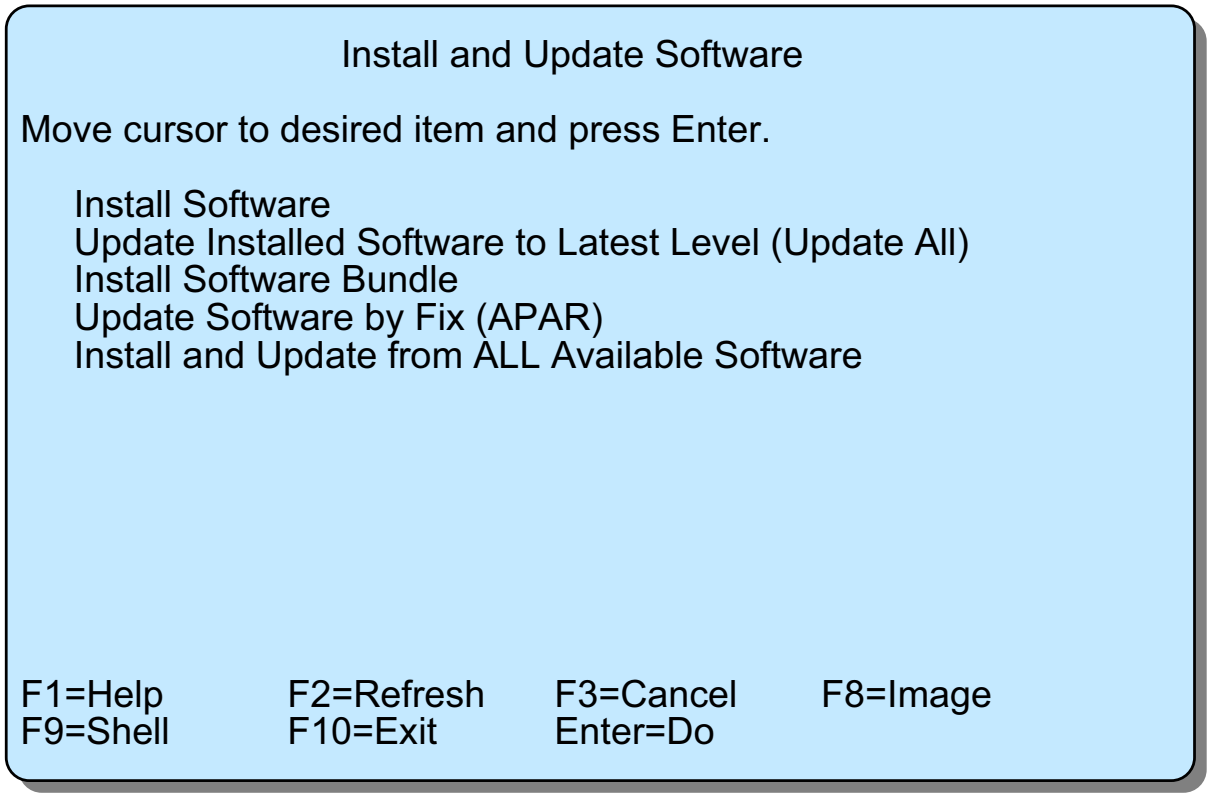


Figure 4-11. Install and Update Software AU1410.0

Notes:

Use the **smit install_update** fastpath to access this menu.

Install Software
This option allows you to install or update to the latest level of software available on the installation media. This allows you to install everything on the installation media if so desired. This is most commonly used to install optional software not currently installed on you system.

Update Installed Software to Latest Level
This option is the **smit update_all** fastpath. It enables you to update all of your currently installed software products. Only the existing installed products are updated; no new optional software will be installed. This is the most commonly used method to install a maintenance level (service) update.

Install Software Bundle
Use this option to install a software grouped into a bundle. For example, if you wish to install the Application Development bundle, choose this option.

Update Software by Fix (APAR)

An APAR is a number used to identify reported problems caused by a suspected defect in a program. A fix to an APAR can be made up of one or more fileset updates. These updates are obtained through the IBM Support Center or by using FixDist. The URL is **http://www.ibm.com/servers/eserver/support/pseries/aixfixes.html**

Install and Update from ALL Available Software

This option enables you to install or update software from all software available on the installation media. Use this option when none of the other menus fit your needs.

Install Software

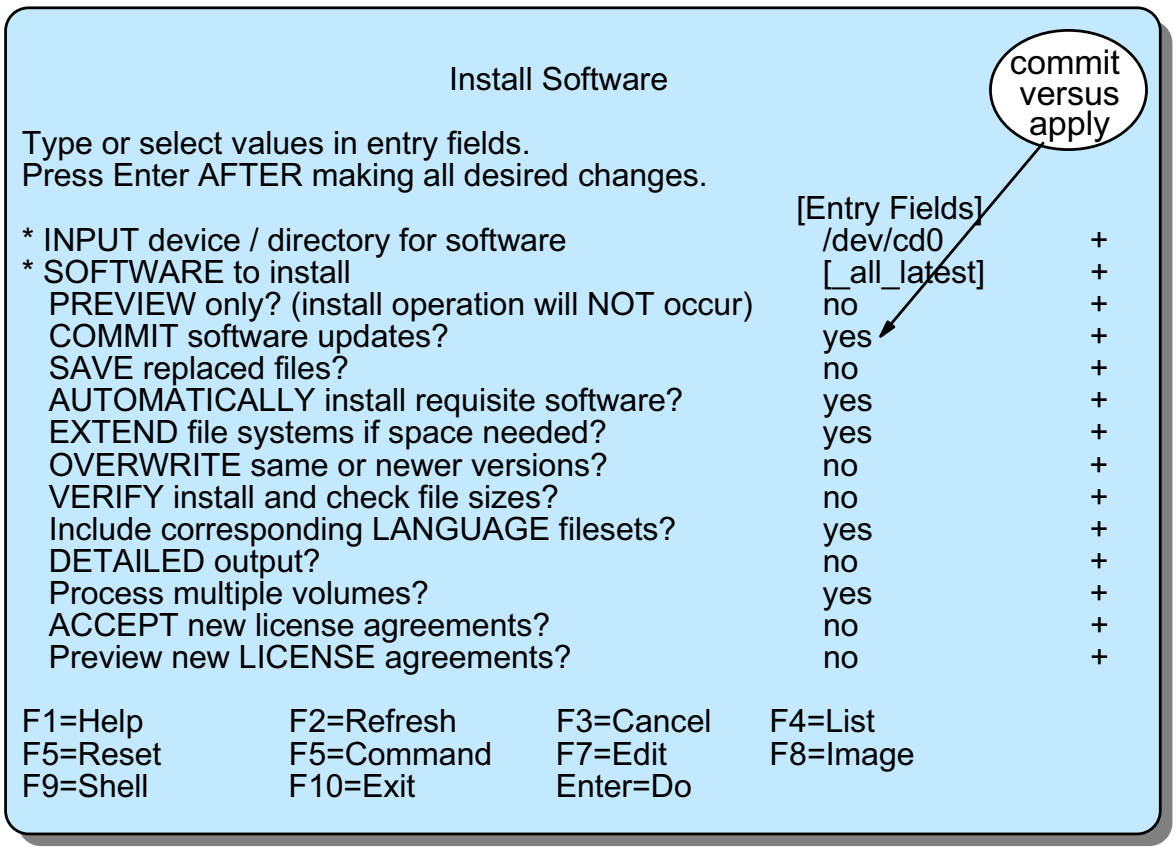


Figure 4-12. Install Software AU1410.0

Notes:

This SMIT dialog screen allows you to install all or selected software from the installation media. If any updates exist for these products, they are also installed.

If **_all_latest** if left in the **SOFTWARE to install** line, everything on the installation media will be installed (except printers and devices). Usually, this line is used to indicate the new software you want to install. Use “list” (F4) to display all filesets on the media. From there, you can select the fileset, package or LPP that you want to install.

Access this menu using the SMIT fastpath **smit install_latest**.

The input device is usually CD-ROM, tape or diskette. However, it is also possible to install software that has already been loaded to disk. The directory /**usr**/**sys**/**inst.images** can be used for this purpose.

The preview option allows you to preview the results of the installation without actually performing the software install. The system displays information on space requirements and a list of software products and updates that are installed.

If you choose no for **COMMIT software updates?**, then you must choose yes to **SAVE replaced files?**.

This is the line where you decide whether you want to **commit** or **apply** the software product. The default is **commit**. To **apply** the install you must change this line.

To perform and **update_all** the SMIT screen will be identical except in the **SOFTWARE to install** line you will see **[update_all]**.

Beginning with AIX 5.1, software license agreements are shipped and displayed electronically, saving paper and allowing for electronic software distribution in the future. If a product has an electronic license agreement, it must be accepted before software installation can continue.

Using **geninstall** is also a way to install AIX LPP packages. The geninstall calls the **installp** command to install additional AIX LPP packages.

#geninstall -d /usr/sys/inst.images/installp/ppc bos.games

Do not specify the version, release, modification or fix level of the fileset, otherwise the installation fails.

Software Inventory

 # smit list_installed

List Installed Software and Related Information

Move cursor to desired item and press Enter.

List Installed Software
List Installed Software by Bundle
List Applied but Not Committed Software Updates
Show Software Installation History
Show Fix (APAR) Installation Status
List Fileset Requisites
List Fileset Dependents
List Files Included in a Fileset
List Fileset Containing File
Show Installed License Agreements

F1=Help F2=Refresh F3=Cancel F8=Image
F9=Shell F10=Exit Enter=Do

lslpp command

-L lists the installed software
-h shows the history of a software product

Figure 4-13. Software Inventory AU1410.0

Notes:

Use the SMIT fastpath **smit list_installed** to access this menu. This menu provides information about the software and fixes installed on a system.

Most of the SMIT options on this menu actually execute the **lslpp** command. The following command options can be used to view specific software information:

- **-l** Displays the name, level, state and description of the fileset.
- **-h** Displays the installation and update history for the fileset.
- **-p** Displays requisite information for the fileset.
- **-d** Displays dependent information for the fileset.
- **-f** Displays the names of the files added to the system during installation of the fileset.
- **-w** Lists the fileset that owns a file.
- **-b** List software for the specified bundle name.

The option **Show Fix (APAR) Installation Status** executes the **instfix** command. This command will be discussed shortly.

List Installed Software

lslpp -l bos.*

```
  Fileset                      Level    State          Description
  ----------------------------------------------------------------------------------------------------
Path: /usr/lib/objrepos
  bos.64bit                    5.3.0.0  COMMITTED  Base Operating System 64-bit Runtime
  bos.adt.base                 5.3.0.0  COMMITTED  Base Application Development
                                                   Toolkit
  bos.adt.include              5.3.0.0  COMMITTED  Base Application Development
                                                    Include Files
  bos.adt.lib                  5.3.0.0  COMMITTED  Base Application Development
                                                    Libraries
  bos.cdmount                  5.3.0.0  COMMITTED  CD/DVD Automount Facility
  bos.content_list             5.3.0.0  COMMITTED  AIX Release Content List
  bos.diag.com                 5.3.0.0  COMMITTED  Common Hardware Diagnostics
  bos.diag.rte                 5.3.0.0  COMMITTED  Hardware Diagnostics
  bos.diag.util                5.3.0.0  COMMITTED  Hardware Diagnostics Utilities
  bos.dosutil                  5.3.0.0  COMMITTED  DOS Utilities
  bos.games                    5.3.0.0  COMMITTED  Games
     :
     :
     :
```


Figure 4-14. List Installed Software AU1410.0

Notes:

The **lslpp** command is used to list the installed software on the system. The various options of the **lslpp** command allow you to view selected information on the software installed.

The output of the **lslpp** command displays the fileset name, the level of the product, its state (applied, committed), and a description of the product.

Other options include:

- -d displays filesets that are dependents on the specified software
- -f displays names of files added to the system during the installation of specified filesets
- -p lists requisite information for a specified fileset

Comparison Reports for LPPs

 # smit compare_software
 # smit compare_report

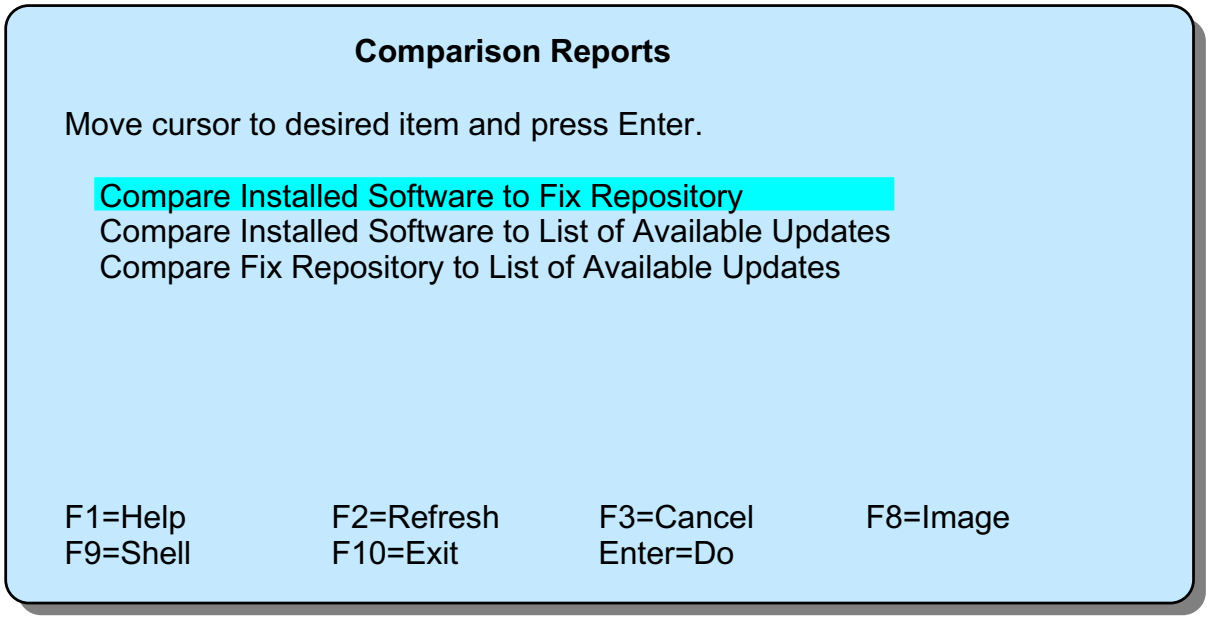


Figure 4-15. Comparison Reports for LPPs AU1410.0

Notes:

Comparison reports are new to AIX V5.2 and an easy way for the customer to manage level of their systems regarding fixes and maintenance levels. It is possible to compare levels of different systems against a base system or a set of fixes.

To compare a base level system (sys1) with an other level system (sys2) and generate a lower level fileset report:

root@sys1# lslpp -Lc > complist_sys1

root@sys2# lslpp -Lc > complist_sys2

root@sys1# compare_report -b complist_sys1 -o complist_sys2 -l

Compare Installed Software to Fix Repository

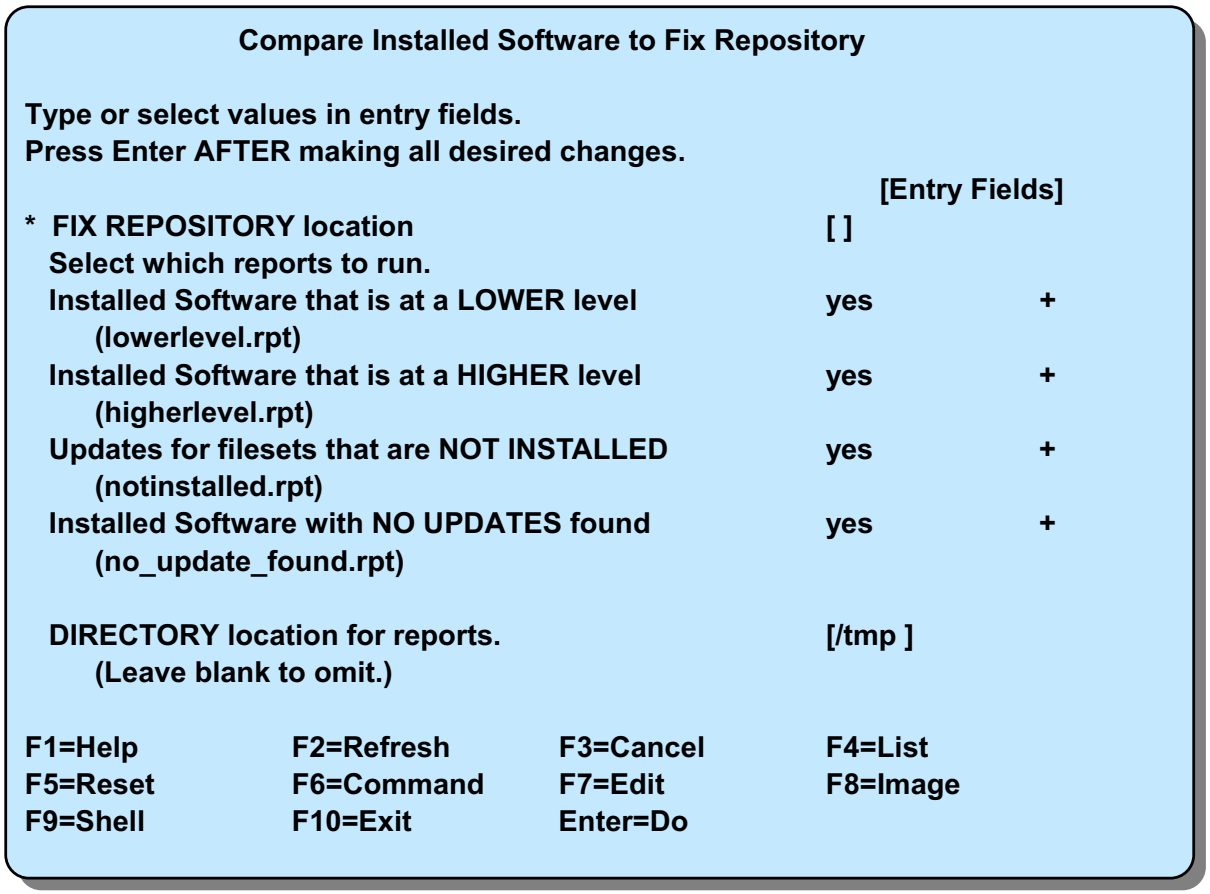


Figure 4-16. Compare Installed Software to Fix Repository AU1410.0

Notes:

To compare filesets installed on a system to filesets contained in a fix repository. Four reports can be generated:

- A list of filesets on the system that are downlevel
- A list of filesets on the system that are uplevel
- A list of filesets in a fix repository that are not installed on the system
- A list of filesets installed on the system that are not in the fix repository

Software Maintenance and Utilities

#smit maintain_software

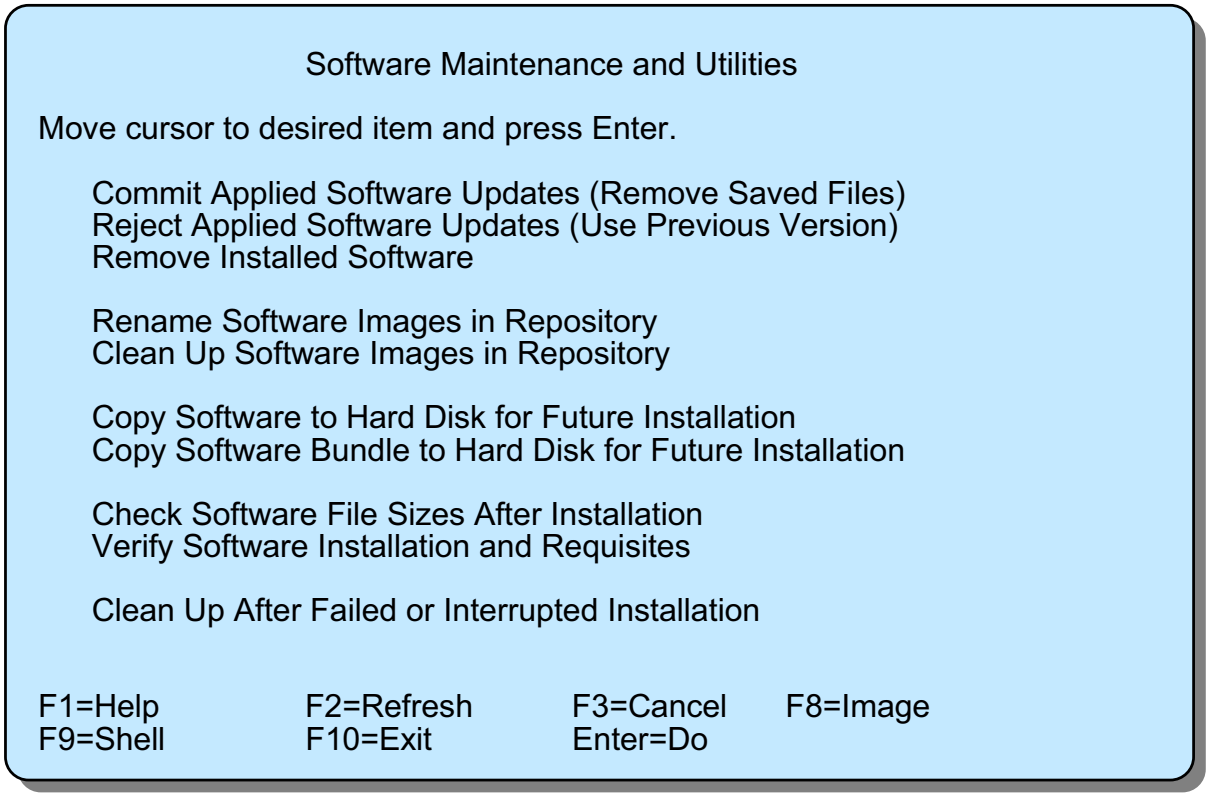


Figure 4-17. Software Maintenance and Utilities AU1410.0

Notes:

The fast path **smit maintain_software** allows you to commit, reject and remove software. You will also find the other menu items useful.

You can copy filesets from the installation media to the hard drive without actually performing an installation. This allows you to install it later without needing the original installation media.

If you are experiencing problems with your software, the check and verify options make the system run an analysis to determine if there is problem. It compares information stored on the disk to the information stored in ODM.

The clean up option resets your software installation back to the beginning after a failed install. A failed install is usually due to a power failure or a system shutdown occurring before the installation is complete. You then need to start your installation/update over.

To 'Copy **all** Software to Hard Disk for Future Installation use the following command:

gencopy -d /dev/cd0 -t /usr/sys/inst.images **all**

oslevel Command

- Command Syntax
  oslevel [-l level | -g | -q] [-r]
  -g filesets later than the current maintenance level
  -l Filesets below that specified maintenance level
  -q all known maintenance levels
  -r highest recommended maintenance level

- Get actual AIX BOS Level

```
# oslevel
5.3.0.0
```

- Get actual AIX BOS Maintenance Level

```
# oslevel -r
5200-03
```


Figure 4-18. oslevel Command AU1410.0

Notes:

instfix Command

- Installs a fix

```
# instfix -k  IX38794 -d /dev/rmt0.1
```

- Searches for a fix

```
# instfix -ik IX38794
All filesets for IX38794 were found.
```

- Searches for a fix by keyword

```
# instfix -s SCSI -d /dev/rmt0.1
```

- Get which AIX BOS Maintenance Levels are partly or full installed

```
# instfix -i | grep ML
All filesets for 5.2.0.0_AIX_ML were found.
Not all filesets for 5200-01_AIX_ML installed.
Not all filesets for 5200-02_AIX_ML installed.
```

- Get which filesets are missing in a partly installed AIX BOS Maintenance level

```
# instfix -ciqk 5200-02_AIX_ML | grep :-:
```


Figure 4-19. instfix Command AU1410.0

Notes:

The **instfix** command allows you to install a fix or a set of fixes without knowing any information other than the Authorized Program Analysis Report (APAR) number (which is given to you by your Support Center) or other unique keywords identifying the fix.

The **instfix** command can also be used to determine if a fix is installed on your system.

Valid options with the command:

-T	Displays entire table of contents.
-s	Search for and display table of contents entries containing the string.
-k	Install filesets for a keyword or fix.
-f	Install filesets for multiple keywords or fixes using an input file. Note that the output of the **-T** option produces a suitable input file format. **-f** results in instfix using standard input.

-i Use with **-k** or **-f** option to display whether fixes or keywords are installed. This option is for information only. Installation is not attempted when this option is used.

-a Use only with **-i** to optionally display the symptom text associated with a fix.

-d Specify the input device (required for all but **-i**).

-c output should be in colon delimited format

The examples on the foil do the following:

1. Install all filesets associated with fix IX38794 from the tape in the /dev/rmt0.1 drive.
2. Inform the user on whether fix IX38794 is installed.
3. List all keyword entries on the tape containing the string SCSI.
4. Get which AIX BOS Maintenance levels are partly or full installed.
5. Get which filesets are missing in a partly installed AIX BOS Maintenance level.

Exercise: AIX Software Installation

Figure 4-20. Exercise: AIX Software Installation AU1410.0

Notes:

This lab gives you the opportunity to install filesets and show software installation history.

This exercise can be found in your Exercise Guide.

Checkpoint

1. Which of the following states can your software be in, in order for you to be able to use it? (select all that apply)

   a. Applied state
   b. Removed state
   c. Install state
   d. Commit state

2. What command is used to list all installed software on your system?

   _____

3. Which of the following can you install as an entity? (select all that apply)

   a. Fileset
   b. LPP
   c. Package
   d. Bundle

4. What is the difference between the SMIT menus: **Install Software** and **Update Installed Software to Latest Level (Update All)**?

   _____

Figure 4-21. Checkpoint AU1410.0

Notes:

Unit Summary

- AIX package naming conventions include the following terms:
  - LPP
  - Package
  - fileset
  - suffix
- Use the **lslpp** command, SMIT or the Web-based System Manager to list all software products installed on the system.

Figure 4-22. Unit Summary AU1410.0

Notes:

Unit 5. Configuring AIX Documentation

What This Unit Is About

This unit covers the process of installing, configuring and using the AIX Documentation Server: the Information Center.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Install the infocenter software and desired documentation
- Configure infocenter
- Use infocenter to access documentation

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercises

References

SC23-4887 AIX 5L Version 5.3 Installation Guide and Reference

Unit Objectives

After completing this unit, you should be able to:

- Use Infocenter to browse and search AIX documentation
- Install infocenter
- Install documentation

Figure 5-1. Unit Objectives AU1410.0

Notes:

Configuring AIX V5.3 Documentation

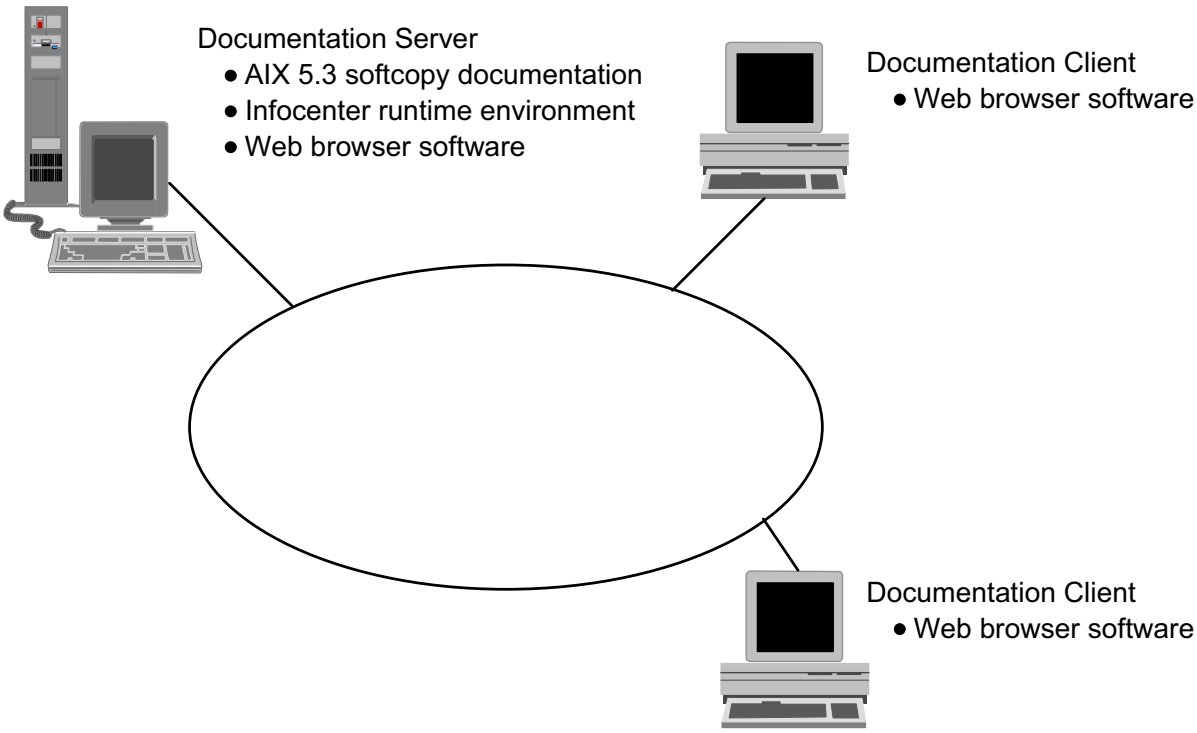


Figure 5-2. Configuring AIX V5.3 Documentation AU1410.0

Notes:

In addition to providing SMIT to make system administration tasks easy, beginning with AIX V4.3, softcopy documentation is loaded on a *documentation server*. Any other computer in the network with appropriate Web-browser software (for example, the Netscape Navigator) can then become a *documentation client*.

When users on a client computer request an AIX document, the request is sent to the Web server on a documentation server which then sends back the requested item. When searches are performed, they are done on the server computer and the results are then sent back to the user on the client computer.

Configuring AIX V5.3 Online Documentation

- Configure TCP/IP
- Install the Web browser software
  - Mozilla 1.4 Web Browser and Application Suite for AIX
  - Prerequisite libraries on AIX Toolbox for Linux Applications
- Install the AIX documentation
  - AIX 5L V5.3 Documentation CD
  - infocenter.aix.[lang]
- Install the infocenter run time environment
  - AIX 5L V5.3 Documentation CD
  - Includes internal eclipse Web server
  - infocenter.aix.rte
- Configure Documentation Services
  - smit change_documentation_services

Figure 5-3. Configuring AIX V5.3 Online Documentation AU1410.0

Notes:

The steps outlined above are used to configure an AIX V5.3 documentation server or online documentation for a stand-alone pSeries system.

1. Configure TCP/IP on the AIX system. This is discussed later in the course.
2. Install the Web browser software. Mozilla web browser fro AIX is available on a CD that can be ordered with AIX. It is Mozilla 1.4 Web Browser and Application Suite fro AIX (LCD4-1173). It can also be downloaded from the Web site: http://www.ibm.com/servers/aix/browsers
3. Install the AIX documentation. AIX provides a separate 2-CD set AIX 5L V5.3 Documentation (5765-G03). It contains the full AIX documentation library in many different languages. The package names are of the format: infocenter.aix.[lang]. For example you may choose to install: infocenter.aix.EN_US. You may choose between several categories of documentation within the package.

4. Install the infocenter run-time environment. On the same AIX 5L V5.3 Documentation CD, there is a fileset: infocenter.aix.rte. This will provide the eclipse based web server engine and documentation access application.
5. Configure the Documentation Services. This typically done through a smit panel that is covered next.
6. The AIX V5.3 Documentation includes *System User's Guides*, Installation Guides, *System Management Guides*, *Programming Guides*, *Product and Application Doumentation, and References and Technical References*. This documentation can be installed to disk.

Installation of the documentation client involves a subset of the steps outlined above:

1. Install and configure TCP/IP.
2. Install the Web browser software.
3. Optional (if you wish to use the infocenter command rather than typing the URL into your browser panel): Configure Documentation Services but indicate some other machine as the documentation server machine name.

Most of the documentation configuration can be done with the Configuration Assistant. The Configuration Assistant is discussed in the AIX Installation unit.

Change/Show Documentation Services

smit change_documentation_services

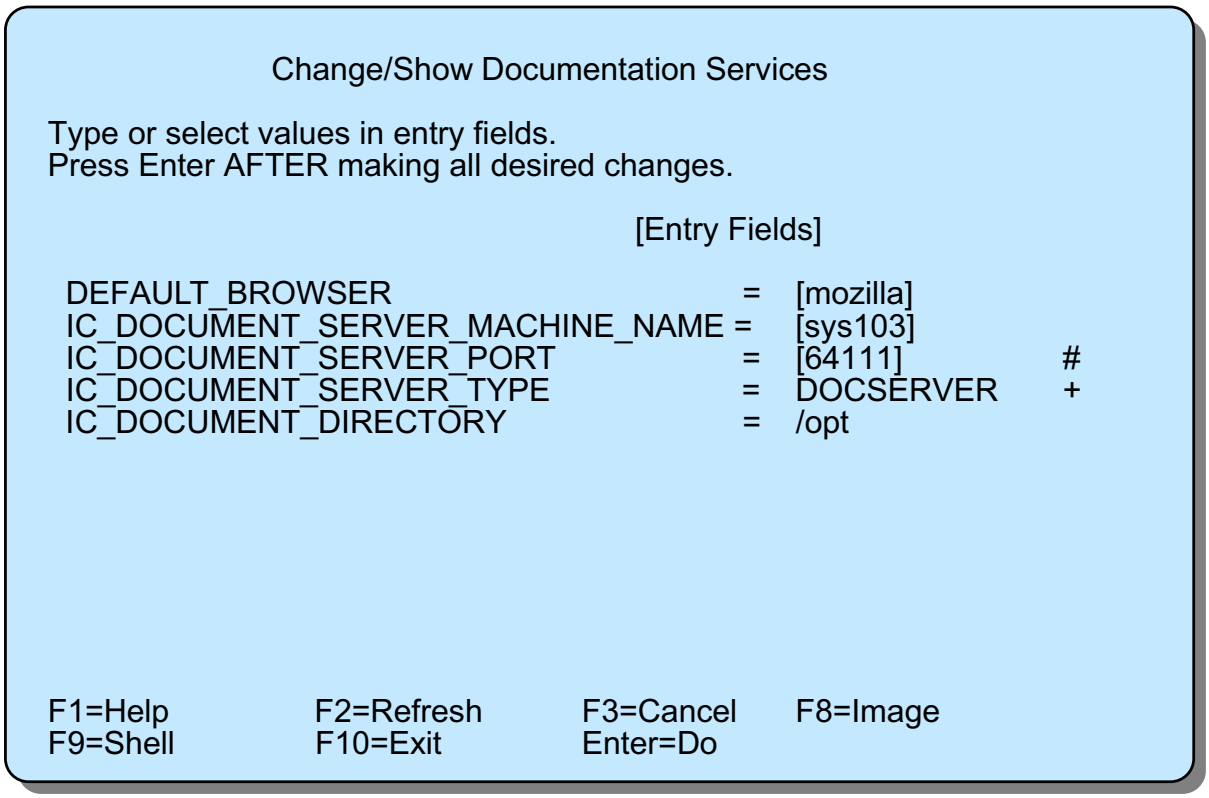


Figure 5-4. Internet and Documentation Services AU1410.0

Notes:

Use the SMIT fastpath **smit change_documentation_services** to access this menu.

This menu is also accessed via the **System Environments** option on the main SMIT menu. Choose the option **Change/Show Documentation Services**

The server machine name should be set to the host name of the documentation server machine. If acting as both the client and the server, this would be set to your own hostname.

The server port defaults to 64111, but can be changed if there are port conflicts. Be sure to report any change in port number to all clients that use you as a server.

The Server type can be NONE, STANDALONE, REMOTE, or DOCSERVER.

The document directory defaults to /opt, though you may choose to change this.

The Web-based System Manager can also be used to configure the AIX V5.3 online documentation.

IBM pSeries Information Center

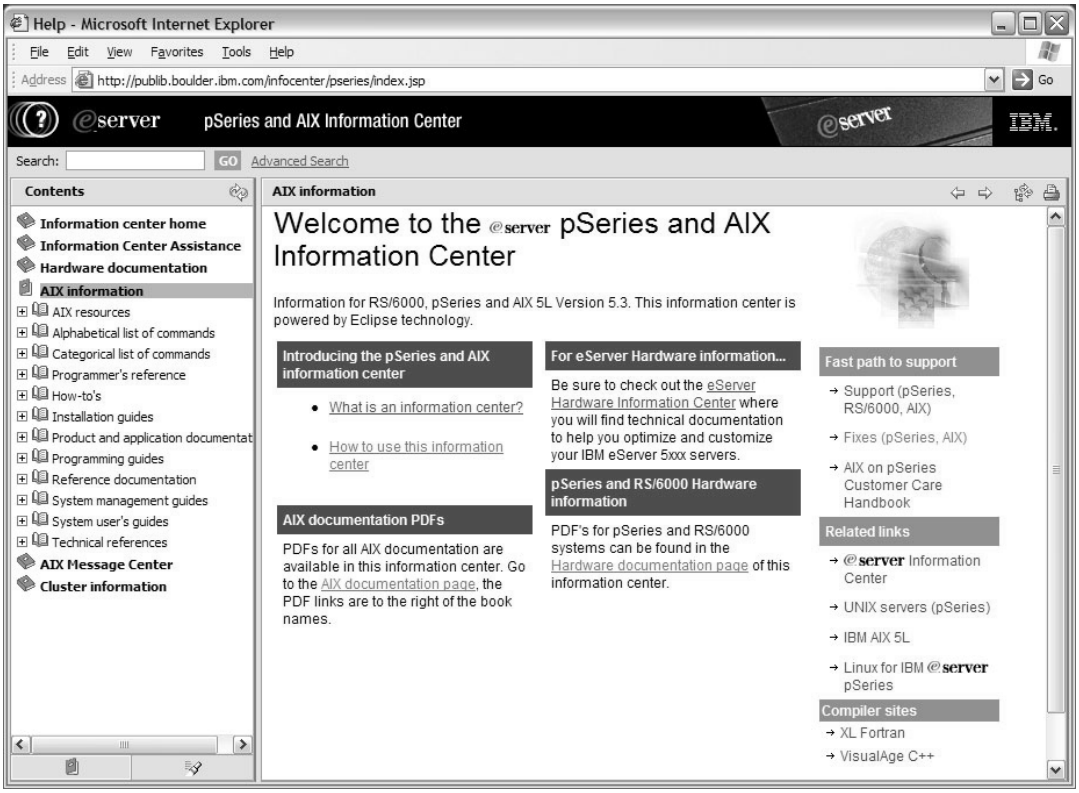


Figure 5-5. IBM pSeries Information Center AU1410.0

Notes:

The IBM @server pSeries Information Center is a Web application that serves as a focal point for all information pertaining to pSeries and AIX. It provides access to the with AIX 5.3 documentation, as well as access to a message database to search on error numbers, identifiers and LED's. FAQs, How-To's, and many more features are provided.

- In AIX 5.3, you may use your own pSeries as an Information Center Server. From any browser (ex. IE on a PC) you may access the server.
  http://yourservername:64111
- You can also access the central IBM Information Center Server by using the URL:
  http://publib16.boulder.ibm.com/pseries/en_US/infocenter/base
- On any AIX 5.3 system with infocenter installed and configured, run the command **infocenter** from the command line. This command starts the default browser with the URL defined by your configuration.
- Or, start the Information Center with the **Information Center icon** located on the Help panel of the CDE desktop.

- Once in the infocenter you are presented with a main Web page which has a variety of hyperlinks to get to the many sources of information. Some links are to Web sites on the Internet (in the main panel). Others are to the documentation installed on the infocenter server (in the Contents panel on the left).

Information Center Documents

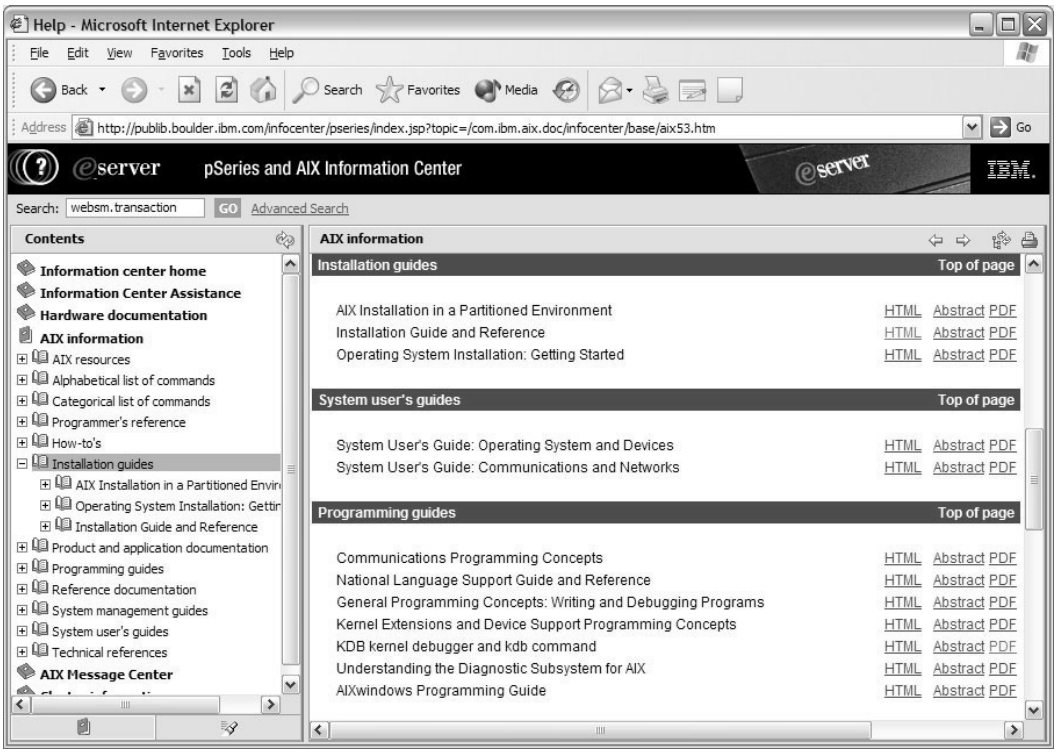


Figure 5-6. Information Center Documents AU1410.0

Notes:

The contents list on the left of the Web page has categories of documents that you may wish to access. You may repeated click on these to drill down to the individual document you are interested in reading. As you narrow it down the appropriate collection of documents or manuals appears in the main panel.

The main panel has three documents you may access for each manual. The html Web pages, an abstract, and the PDF file. Use the PDF file if you wish to either print all or some of the manual or if you wish to download it to your PC for future offline access.

Information Center Search

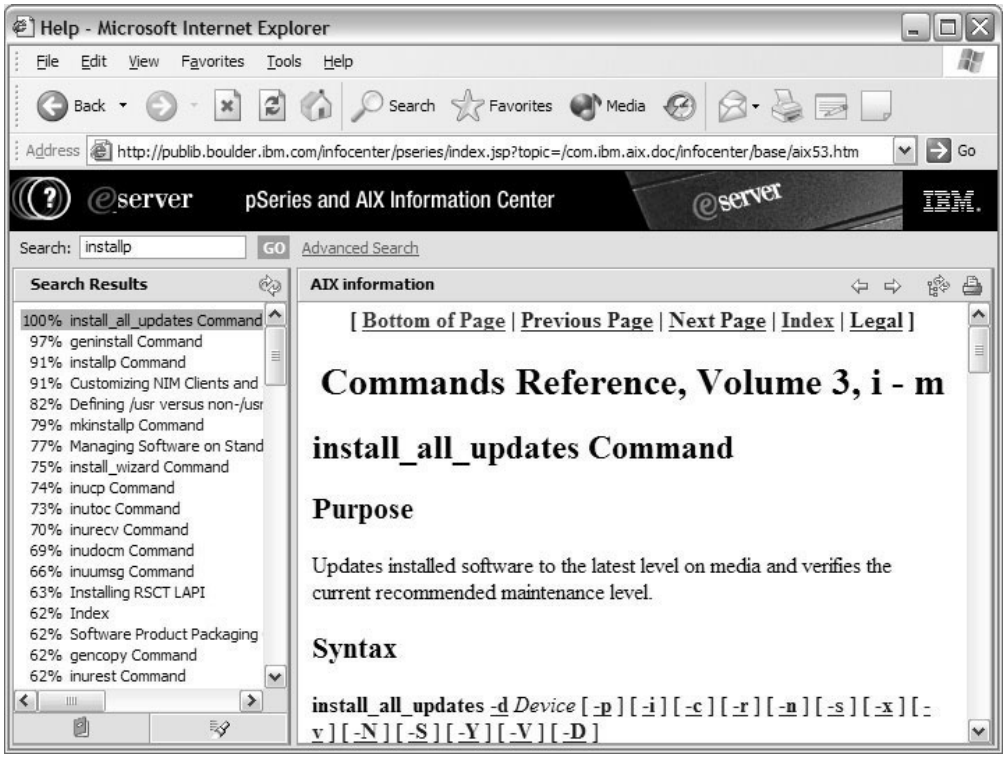


Figure 5-7. Information Center Search AU1410.0

Notes:

The information center has a search engine which examines the documents to find the one with information you seek. Entering a search string in the Search field and clicking GO generates a list of search results ordered by relevance. Clicking the item you think is the best selection causes the Web page for that section to appear in the main window.

Checkpoint

1. **T/F:** AIX Web-based documentation can be used to reference information in different ways, such as searching for a command, searching for a task or viewing information in a book like manner.
2. **T/F:** The AIX V5L documentation is viewed using a Web browser.
3. **T/F:** The Information Center requires the prior installation of Web Server software (such as HTTPServer) in order to provide remote client access.

Figure 5-8. Checkpoint AU1410.0

Notes:

Unit Summary

- Web-based documentation may be installed locally
- The infocenter interface provides a way to read, search or print the installed manuals
- The infocenter interface provides links to useful IBM support sites.
- Remote access to an infocenter server is possible via any Web browser

Figure 5-9. Unit Summary AU1410.0

Notes:

Unit 6. Web-based System Management

What This Unit Is About

This unit covers the process of installing, configuring and using the AIX Web-based System Manager: WebSM.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Use WebSM to manage AIX
- Install and configure remote client support

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercises

References

SC23-4920 *AIX 5L Version 5.3 Web-based System Manager Administration Guide*

Unit Objectives

After completing this unit, you should be able to:

- Define the use of the Web-based System Manager
- Set up and use AIX Web-based documentation
- Identify how to enable remote WebSM access

Figure 6-1. Unit Objectives AU1410.0

Notes:

Web-based System Manager

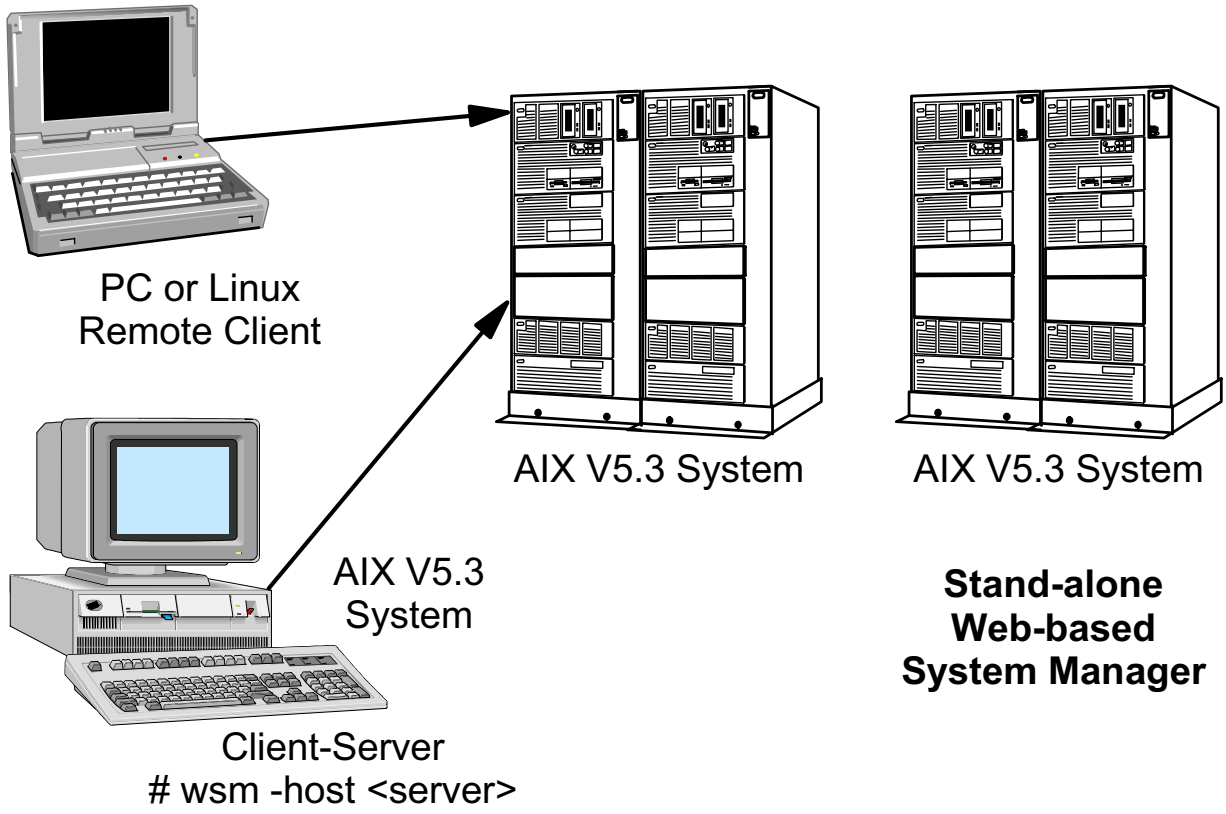


Figure 6-2. Web-based System Manager AU1410.0

Notes:

AIX V4.3 introduced the Web-based System Manager, which is the next step in the evolution of AIX system administration tools. There are a lot of enhancements to the Web-based System Manager and since AIX V5.1 it was called the default system administration tool for AIX. The Web-based System Manager can be run in stand-alone mode, that is, you can use this tool to perform system administration functions on the AIX system you are currently running on. However, the Web-based System Manager also supports a remote management. In this environment, it is possible to administer an AIX system from a remote PC or from another AIX system using a graphics terminal. In this environment, the AIX system being administered is the *server* and the system you are performing the administration functions from is the *client*.

The client can operate in either client-server mode running the wsm command on an AIX client, in applet mode using a web browser on a platform that support Java 1.3, or remote client mode on either Windows or Linux clients.

Note: Client-server mode administration is not compatible between WebSM on AIX 5.1.0.30 and earlier and WebSM on AIX 5.3.

The objectives of the Web-based System Manager are:

- Simplification of AIX administration by a single interface
- Enable AIX systems to be administered from almost any client platform with a browser that supports Java 1.3 or use downloaded client code from an AIX V5.3 code
- Enable AIX systems to be administered remotely
- Provide a system administration environment that provides a similar look and feel to the Windows NT/2000/XP, LINUX and AIX CDE environments

The Web-based System Manager provides a comprehensive system management environment and covers most of the tasks in the SMIT user interface. The Web-based System Manager can only be run from a graphics terminal so SMIT will need to be used in the ASCII environment.

To download Web-based System Manager Client code from an AIX host use the address
http://<hostname>/remote_client.html

Supported Microsoft Windows clients for AIX 5.3 are Windows 2000 Professional version, Windows XP Professional version, or Windows Server 2003.

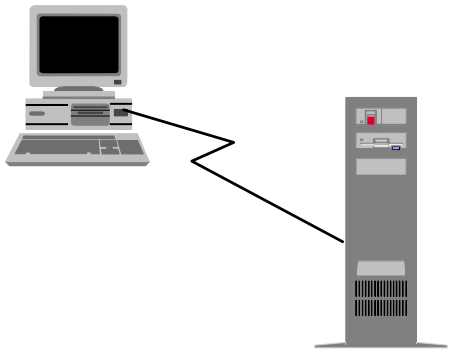
Supported Linux clients are PCs running: Red Hat Enterprise Version 3, SLES 8, SLES 9, Suse 8.0, Suse 8.1, Suse 8.2, and Suse 9.0 using desktops KDE or GNOME only.

The PC Web-based System Manager Client installation needs a minimum of 300 MB free disk space, 512 MB memory (1GB preferred) and a 1 GHZ cpu.

Accessing the Web-based System Manager

Stand-Alone
wsm

Remote Client:
From Windows or Linux desktop,
Double-click on the
Web-based System Manager
Remote Client icon



Client/Server:
From AIX 5.3 client:
wsm -host <hostname>

Figure 6-3. Accessing the Web-based System Manager AU1410.0

Notes:

In stand-alone mode, to access the Web-based System Manager use the command **wsm**.

- From the CDE Application Manager, you can also access by icons if you are using CDE. Open the **System Admin** folder and double-click **Management Console** to view icons for each of the Web-based System Manager applications.

If using the Web-based System Manager in client-server mode:

- If the WebSM remote client software has been installed on the PC, click the Web-Based System Manager Icon on the desk top for your platform. This is the preferred way to do remote access from a PC.
- If the Web-based System Manager client is running as a Java applet in a browser use the appropriate URL to access the tool. The default URL is **http://<hostname>/wsm.html**. Be aware that AIX V5.1 is using Java 1.3.0 and AIX V5.2 is using Java 1.3.1,and AIX V5.3 is using Java 1.4.2 that your browser plug-in-version must be compatible to the Java version on the AIX server.

- If the Web-based System Manager client is running as a stand-alone Java application, double-click the Web-based System Manager remote client icon.
- From an AIX V5.3 client, use the command **wsm -host <hostname>**. This brings up a login box where you enter your ID and password for the remote AIX system.

Using the Web-based System Manager (1 of 3)

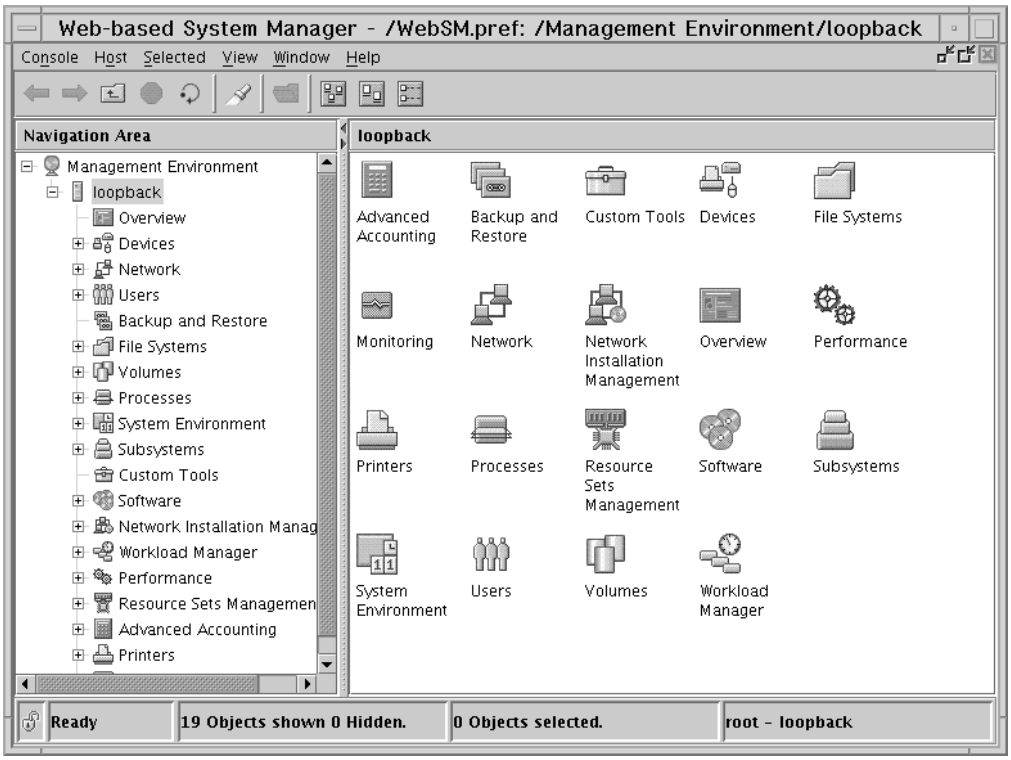


Figure 6-4. Using the Web-based System Manager (1 of 3) AU1410.0

Notes:

The graphic above shows the Web-based System Manager Console Window containing two primary panels. The panel on the left displays the machines that you can manage from the Console Window. This panel is referred to as the *Navigation Area*. The panel on the right (the *Contents Area*) displays results based on the item selected in the Navigation Area. You select the machine to perform management operations from the Navigation Area. As you navigate to the desired operation in the Navigation Area, the Contents Area is updated to show the allowable choices.

There is a session log that is a facility of the console. It keeps track of changes made on managed hosts during a Web-based System Manager session.

Using the Web-based System Manager (2 of 3)

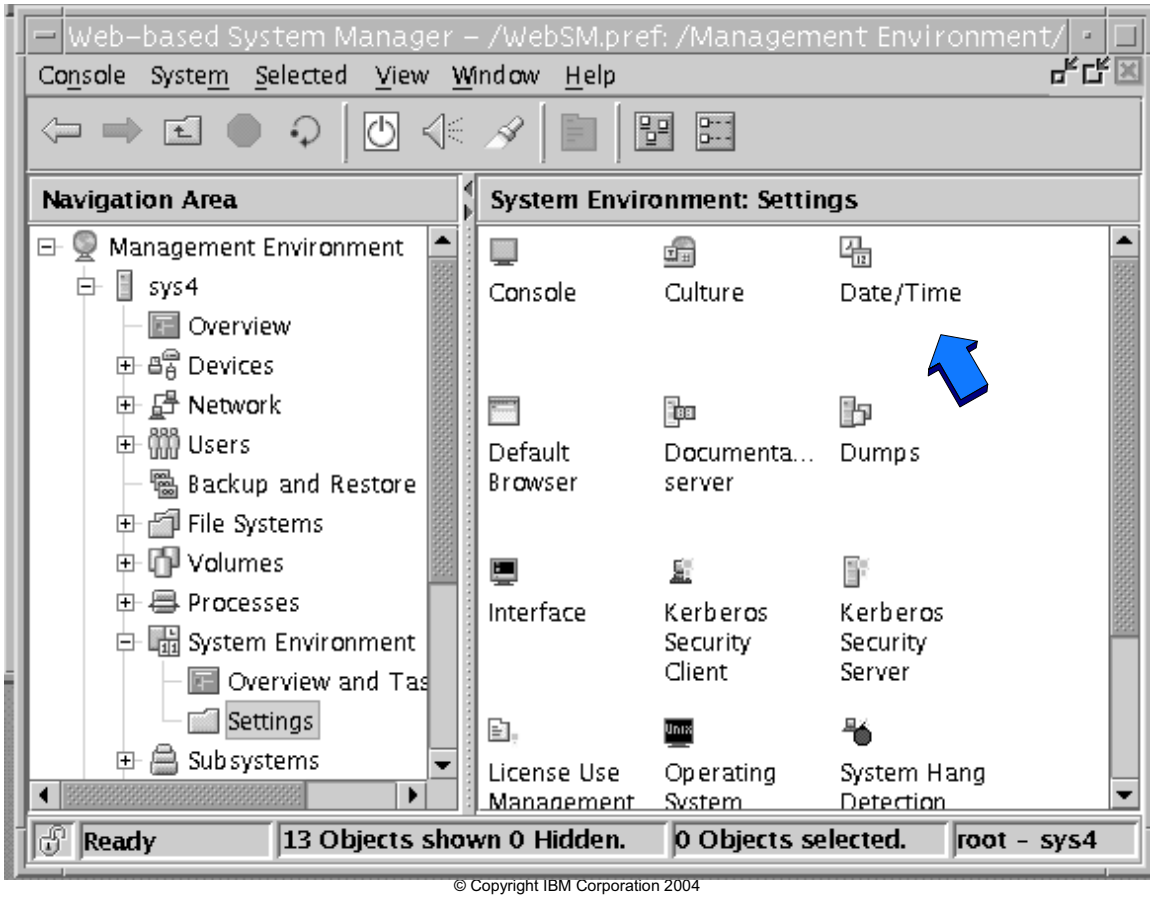


Figure 6-5. Using the Web-based System Manager (2 of 3) AU1410.0

Notes:

The graphic shows the **System Environment: Settings** window of the Web-based System Manager. This window contains a toolbar. From left to right, the symbols support the following functions: Back to previous screen, Forward to next screen, Up one level, Stop reloading, Reload now, Shutdown, Broadcast message, Find, Show properties of highlighted object, Icon (to return to icon mode if currently viewing details), Details (which lists each icon and provides an explanation of each). Most of these functions can also be accessed via the **View** option on the menu bar.

If you select the Date and Time icon, this allows you to set the date and time on the system.

Using the Web-based System Manager (3 of 3)

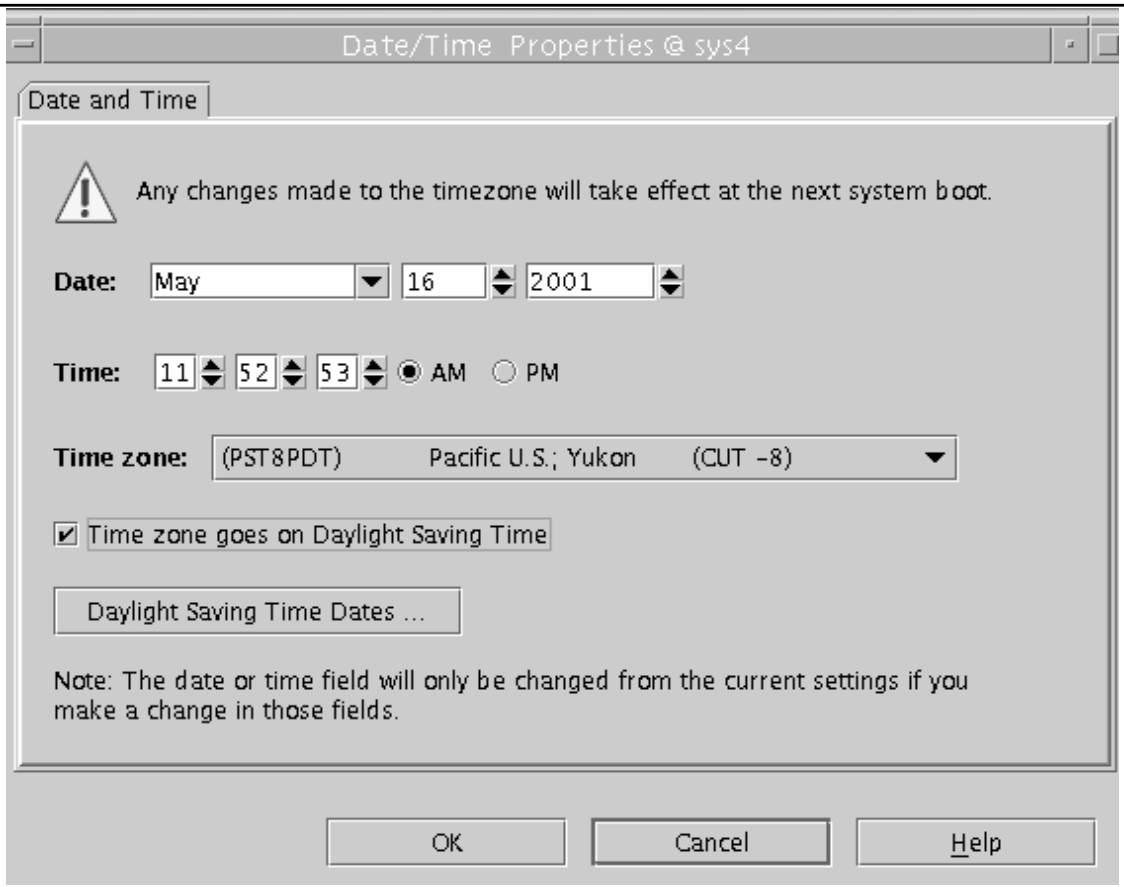


Figure 6-6. Using the Web-based System Manager (3 of 3) AU1410.0

Notes:

Note that the Web-based System Manager supports an easy-to-use point-and-click environment where information can be entered. Use this window to set the system date and time (only the root user can perform this function). When finished, click **OK** to apply your change.

Additional information on the Web-based System Manager can be accessed through the Internet using the URL:

http://www-1.ibm.com/servers/aix/wsm/

Configuring Remote WebSM

- Install the Web server
  - IHS2 on AIX 5L V5.3 Expansion Pack
- Configure the Web Server
  - configassist
- Test the Web server with browser
- Install WebSM (usually done by default with the base)
- Enable WebSM server

```
# /usr/websm/bin/wsmserver  -enable
```

- Install WebSM Client on Windows or Linux platform

Figure 6-7. Configuring Client/Server WebSM AU1410.0

Notes:

These are the steps needed to set up the Web server from scratch.

WebSM is installed by default in AIX V5L. The following filesets are installed from the AIX 5.3 Base Installation media:

sysmgt.help.en_US.websm
sysmgt.help.msg.en_US.websm
sysmgt.msg.en_US.websm.apps
sysmgt.msg.en_US.sguide.rte
sysmgt.websm.apps
sysmgt.websm.diag
sysmgt.websm.framework
sysmgt.websm.icons
sysmgt.websm.rte
sysmgt.websm.security
sysmgt.websm.webaccess

To set up the documentation directory, you need to know the location of the document directory for the Web server you are using. We will be using the IBM HTTP Server Web server in the classroom. The path needed is **/usr/HTTPServer/htdocs.** The CGI directory is **/usr/HTTPServer/cgi-bin**.

The **apachectl** command can be used to manage the HTTP Server. For example it can be used to stop and start the HTTP daemons.

Enable the WebSM server
/usr/websm/bin/wsmserver -enable

This can also be done through smit using the fastpath
smit web_based_system_manager

Which automatically runs
/usr/websm/bin/wsmserver -enable

To accessing WebSM from the client machine, use the URL:
http://<*hostname*>/wsm.html

You can also configure the Web_based System Manager from SMIT. The fastpath is: smit web_based_system_manager

Configure the Web Server

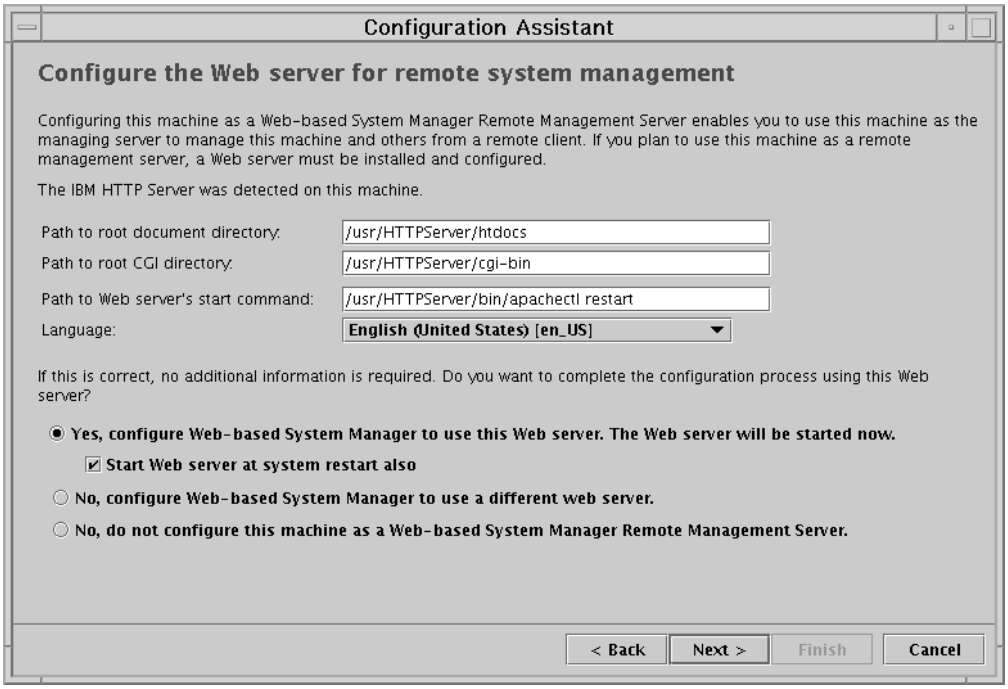


Figure 6-8. Configure the Web Server AU1410.0

Notes:

The configassist facility has a button which assists you in Configuring the Web Server for remote system management. The default values that you see are generally good, but if you are using some Web Server software other than the HTTPServer you may wish to change the directories and start commands. In the latter case, click on the second button on the bottom of the page to configure WebSM to use a different Web server.

You may also select what language you use on the interface.

If you wish to always have the Web server ready for use, select the "Start Web server at system restart also" button to have the start command placed in the inittab.

WebSM Remote Client Install

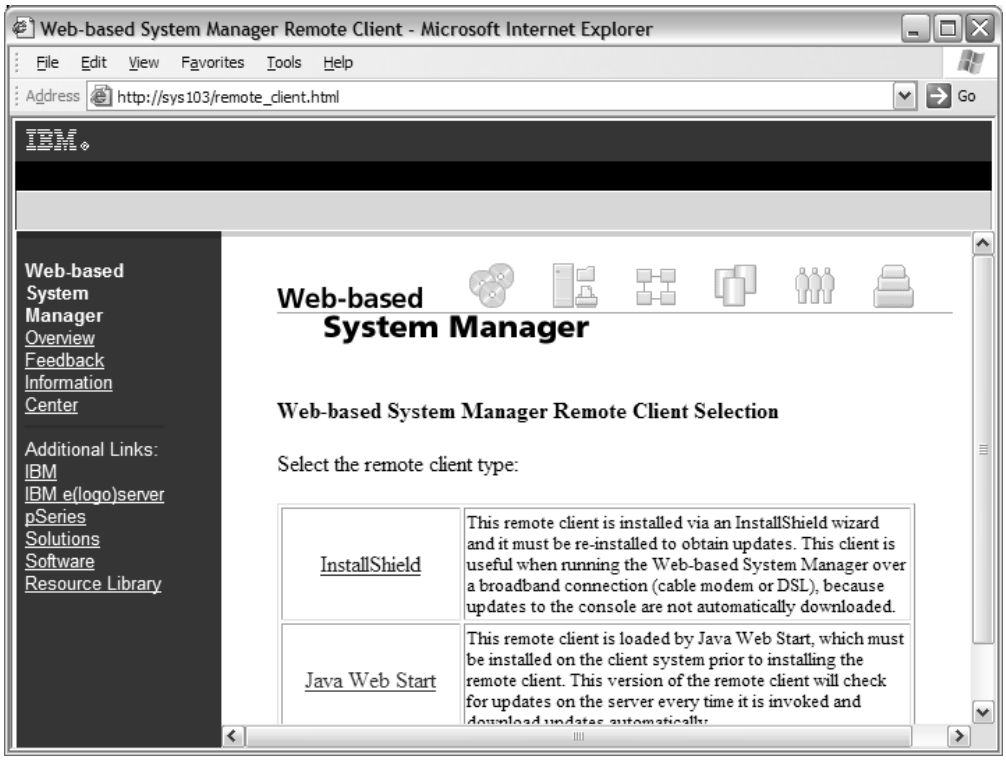


Figure 6-9. WebSM Remote Client Install AU1410.0

Notes:

To install on the WebSM remote client on a PC running Windows or Linux, just access the AIX Web Server from the client's browser, with the URL of:

http://<hostname of server>/remote_client.html

The Web page provides two options for installation of remote client software. Either InstallShield or Java Web Start.

The InstallShield is pretty straight forward. It downloads the code and installs using the InstallShield standard.

The advantage of Java Web Start is that everytime the client application runs, it checks to see if there is a remote server application software update and automatically downloads the changes.

If you are going to use Java Web Start, then you must install and configure the security package which otherwise would be an option in using the remote client. You would first have to install the security package on the AIX server. The AIX 5.3 Expansion Pack has the server filesets:

sysmgmt.websm.security (regular strength)
sysmgmt.websm.security-us (stronger encryption)

The URL for installing the client part of the security package is:

http://hostname/remote_client_security.html

HMC: Management

- Partition configuration and control
  - Dynamic partitioning for LPARs (AIX 5.2 and later)
- Capacity Upgrade on Demand (CUoD)
- Diagnostics
- Operational management
- Remote HMC control

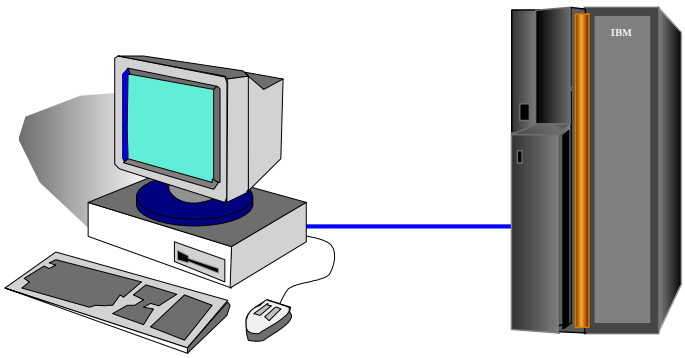


Figure 6-10. HMC: Management AU1410.0

Notes:

Partition configuration and control

The HMC provides the external platform to configure partitions.

Capacity Upgrade on Demand

Capacity Upgrade on Demand (CUoD) allows you use the HMC to non-disruptively activate extra resources while the system is operating. If you ordered a CUoD-capable system, additional resources were shipped with the system and can be enabled by using special CUoD activation codes.

Note: CUoD is not supported on systems running Linux in the full system partition.

You can use the HMC to perform the following Capacity Upgrade on Demand functions:

- Display license agreements
- Display the extra resources preinstalled on your managed system
- Type a resource activation code

- Activate extra resources
- Display CUoD status messages

Diagnostics

A challenge faced with the pSeries system running LPARs is standard AIX error handling. The HMC interacts with each active partition to handle problem determination functions.

Operational management

Once your partitions are active, the HMC continues to function as a management platform, handling operational tasks.

Remote HMC control

Remote access to HMC functions is provided via two paths:

a. Remote WebSM GUI
   - From AIX 5L with the WebSM client installed
   - From a Microsoft Windows or Linux workstation with the WebSM client installed
   - From another HMC

b. High-level commands

These give you the ability to issue HMC commands remotely. We discuss these in greater detail in a later visual.

Remote HMC Functions

- Access HMC remotely via:
  - Another HMC on the network
  - Any workstation on the network running WebSM client application
  - Secure Shell (SSH) session to HMC
    - Most LPAR functions can be performed with HMC command-line commands

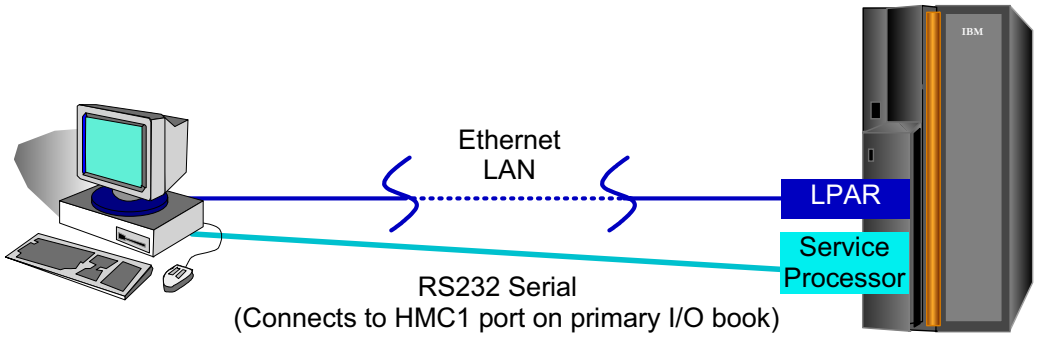


Figure 6-11. Remote HMC Functions AU1410.0

Notes:

From another HMC machine on the network

The WebSM client application is built-in to the HMC Graphical User Interface (GUI). Via the control panel, you are able to access controls to another HMC on your network. Authorized users may be defined for each HMC independently, so you must decide whether the users of one HMC should be authorized on the other. If so, the user authorization must be set up on both HMCs.

To set up remote control, Select the console menu, then select add host. Add the hostname or IP address of the HMC that you want to access remotely. Once added, it appears in the console navigation area (left side).

From any workstation on the network running Web-based System Manager client application

The HMC tools are built from the Web Based System Manager (WebSM) application. You will have remote functionality from a system running the WebSM application. This is NOT accomplished via a browser. You can download the WebSM client from the HMC for Microsoft Windows and Linux workstations. The WebSM client is also available as part of AIX 5.1 and following AIX versions. It is important for the WebSM client to be compatible with the version of HMC software, so if you can, you should download the WebSM client from the HMC.

See the *HMC for pSeries Installation and Operations Guide* for specific procedures to install the WebSM client on different types of client platforms.

Run commands via SSH session to HMC

The command line option gives you a simple way to perform HMC functions. This connectivity solution provides secure access to a most of the LPAR functions in the HMC applications.

HMC Application Groups

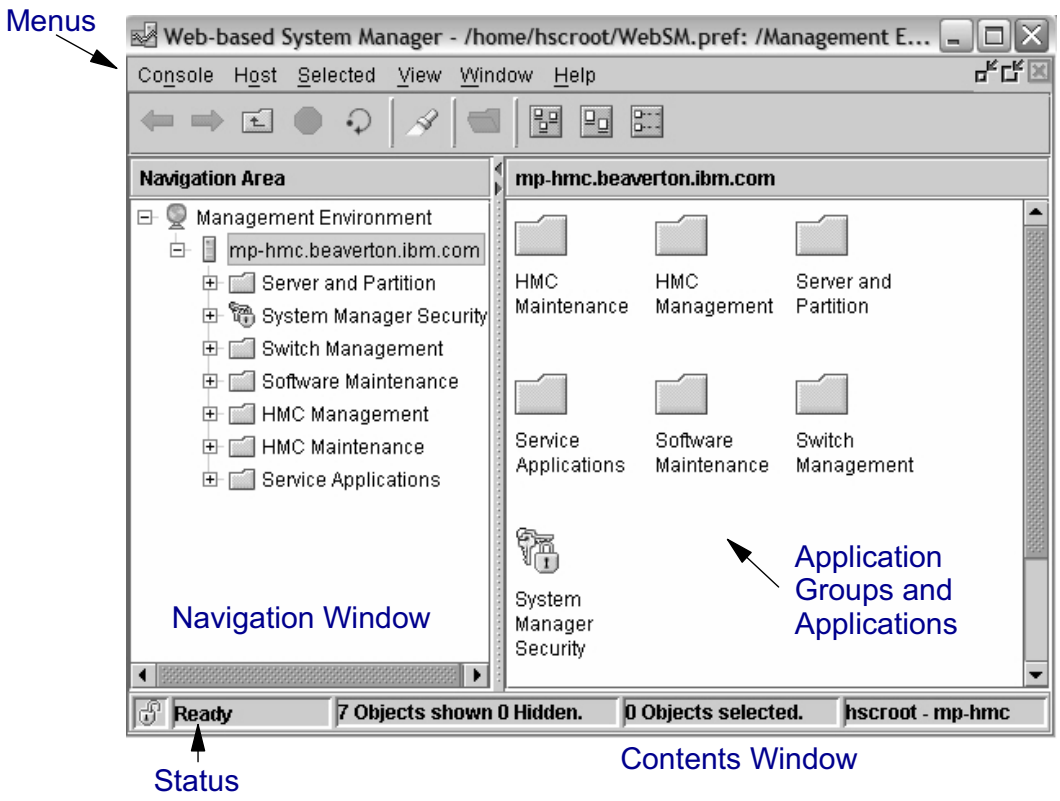


Figure 6-12. HMC Application Groups AU1410.0

Notes:

Default HMC console view

When you log in to the HMC, the HMC Graphical User Interface (GUI) management window opens and selects the management environment automatically. This window is divided into two main areas: the Navigation area and the Contents area.

The panel on the left (the Navigation Area) displays a hierarchy of icons that represent collections of computers, individual computers, managed resources, and tasks. Each Navigation area icon identifies a tool. At the highest point, or root of the tree, is the Management Environment. The Management Environment tool contains one or more host computer tools that are managed by the console. Each computer tool contains multiple application tools that contain managed objects, tasks, and actions for a related set of system entities or resources.

Exercise: Configuring WebSM Server

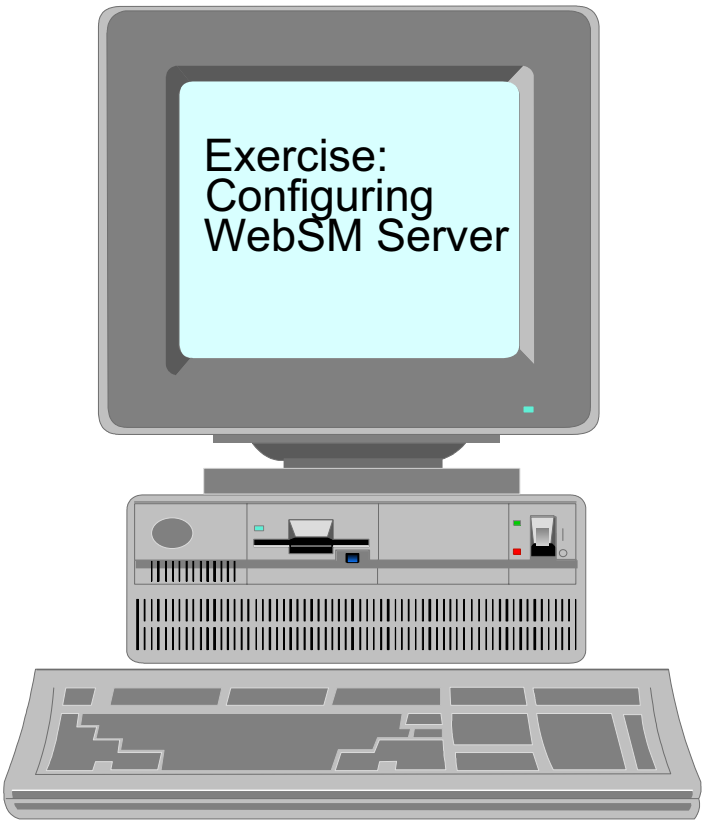


Figure 6-13. Exercise: Configuring WebSM Server AU1410.0

Notes:

This lab allows you to set up WebSM and learn how to use this interface. If you have other machines in your classroom that are networked together, you can also try to perform remote administration using WebSM.

The exercise can be found in your Exercise Guide.

Checkpoint

1. **T/F:** WebSM is available for client access automatically after the BOS is installed.
2. Which of the statements are true regarding the Web-based System Manager?
   a. An AIX 5L system can be managed from a remote PC with appropriate JAVA and Web-browser code installed.
   b. In stand-alone mode use the wsm command to access the Web-based system manager.
   c. It is possible to manage an AIX 5L system from a remote AIX 5L system using an ascii terminal.
   d. The Web-based System Manager includes TaskGuides that direct the user through complex tasks.

Figure 6-14. Checkpoint AU1410.0

Notes:

Unit Summary

- The Web-based System Manager supports system administration tasks in a stand-alone or client-server environment
- WebSM may be used either locally or remotely from either another WSM installed AIX platform or a PC with the WebSM application
- Remote access may enable or disabled

Figure 6-15. Unit Summary AU1410.0

Notes:

Unit 7. System Startup and Shutdown

What This Unit Is About

This unit discusses how the system environment should be managed.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Describe the system startup process
- Describe how to shut down the system
- Describe the contents of the /**etc**/**inittab** file
- Manage the system environment

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise

References

Online	*System Management Guide: Operating System and Devices*

Unit Objectives

After completing this unit, you should be able to:

- Describe the system startup process
- Describe how to shut down the system
- Describe the contents of the /etc/inittab file
- Manage the system environment

Figure 7-1. Unit Objectives AU1410.0

Notes:

Startup Modes

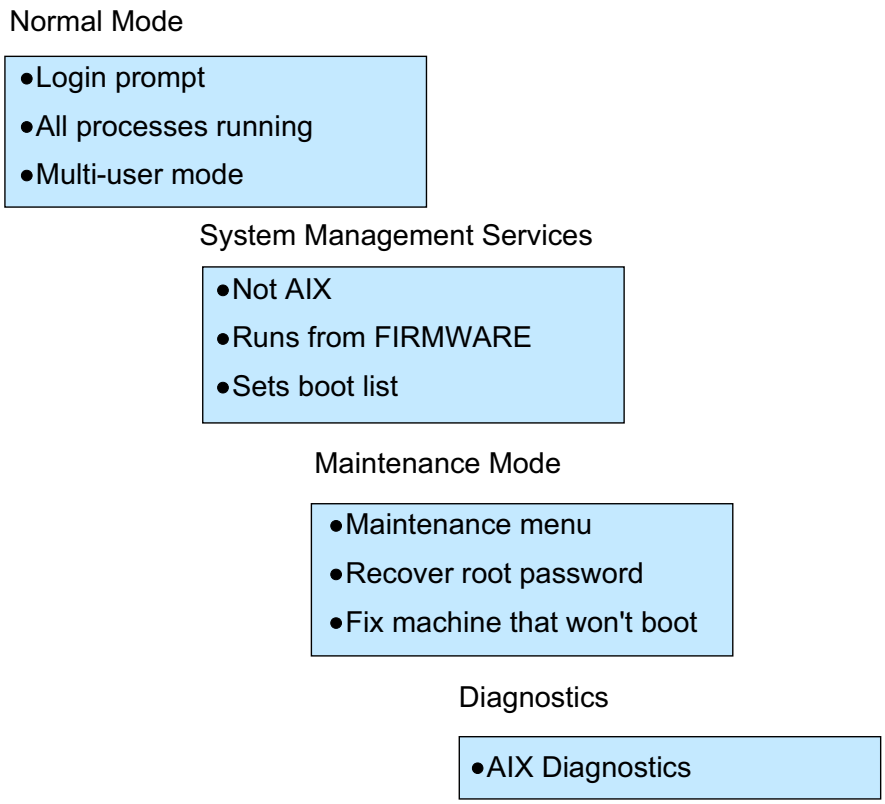


Figure 7-2. Startup Modes AU1410.0

Notes:

When you power on your RS/6000, one of the first things it does is determine which device it should use to boot the machine. By default, the machine uses the normal boot list which usually contains one or more hard drives. When the machine does a normal boot, it will complete the full AIX boot sequence and start processes, enable terminals and generate a login prompt to make it available for multi-user access. It also activates the disks, sets up access to the files and directories, starts networking and completes other machine specific configurations.

Another boot option for the RS/6000 is to boot machine specific code called the System Management Services (SMS) programs. These programs are not part of AIX. This code is shipped with the hardware and is built-in to the firmware. This can be used to examine the system configuration and set boot lists without dependency on an operating system. It is invoked during the initial stages of the boot sequence using the **F1** key.

If your system does not boot or you have lost the root password, you need to boot your machine using bootable media other than the hard drive (like an installation CD or bootable backup - mksysb tape). This boots you into maintenance mode. To do this, you need to

ensure that the device that contains your alternate boot media (CD or tape) is in the boot list. When you boot from the new media, you are given backdoor access to your system.

By pressing the **F5** key you use the default firmware bootlist which always contains the CD as boot media.

There is one other boot option - that is to boot into diagnostics. This can be accomplished by using bootable media specifically designed for diagnostics or the diagnostic mode is invoke when the hard drive is the boot device during a service boot. Diagnostics is discussed in the System Administration II class.

All machines have a normal boot list and one or more service boot lists. The normal boot list is the default boot list. The service boot list is invoked (like SMS) during the initial stages of the boot sequence using function key **F6**. We discuss the service boot list more in a later unit.

When connecting to systems via TTYs and with certain newer models, you have to use the 1, 5, and 6 keys as there are no **F**-keys.

Starting System Management Services

- Power on the system
- Press F1 when icons appear and tones sound

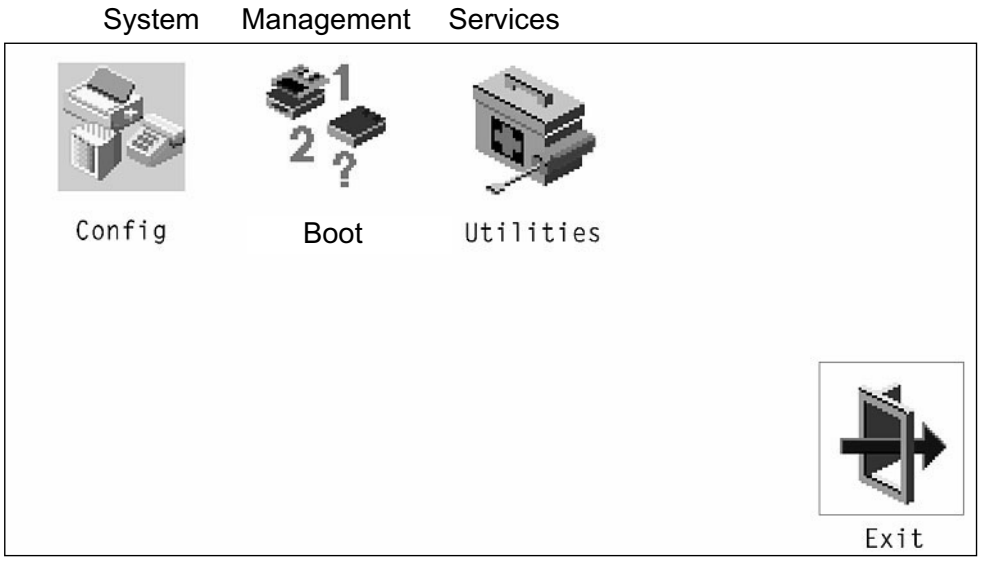


Figure 7-3. Starting System Management Services AU1410.0

Notes:

If you want to set the boot lists or view the system hardware configurations without the aid of AIX, you can use the **System Management Services (SMS) programs**.

To invoke SMS, power on (or reboot) the system. You hear one beep when the machine first powers on. About 30 to 45 seconds later, you hear a different tone. This is what you are listening for. Also, you probably hear the monitor activate. You have about a 15 second time frame to press **F1**. If you hear the music play, you've waited too long. As the monitor warms up, you might see hardware icons appear on the screen. You want to press the **F1** key before it reaches the last hardware device (speaker). Don't wait for the screen to warm up however, because many times as the icons are beginning to appear, the music is sounding and it is too late.

Timing is everything!

Above is an example of a System Management Service main menu. The exact configuration of the menu will vary depending on the model of PCI RS/6000 system being used. The four main services in this example include:

Config - View the hardware configuration of the system.

Boot - View or change the boot device order list.

Utilities - Set power-on and supervisory passwords, and enabling unattended start mode, view vital product data, view the error log, select active console, and updating the firmware.

Exit - Return to previous screen.

PCI RS/6000 Start Up Process Overview

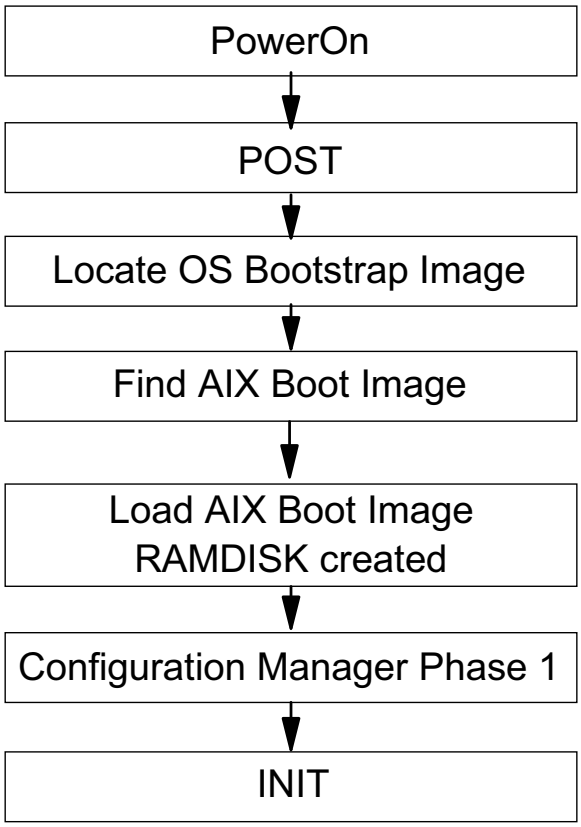


Figure 7-4. PCI RS/6000 Start Up Process Overview AU1410.0

Notes:

During the boot process a number of steps must be completed. The LED panel will provide information on the boot progress. Some values displayed are model specific. These values can be found in the Service Guide for that specific model.

The initial step in booting a machine completes a Power-on Self Test (POST). This step initialized memory, the keyboard, communication adapters, and audio components. The icon related to each device is displayed on the screen. This is the same point where you would press a function key to choose a different boot list. The LED values display during this part are model specific.

Once the POST is completed, the system locates and loads bootstrap code. This part is completed by System ROS (Read Only Storage) stored in the firmware. The bootstrap code, sometimes referred to as Software ROS or level 2 firmware, takes control and builds AIX specific boot information, then locates, loads and turns control over to the AIX boot logical volume (BLV). Because these machines can run different operating systems, the System ROS is generic boot information for the machine and is operating system

independent. The Software ROS is AIX information created based on the machine type and is responsible for completing machine preparation to enable it to start an AIX kernel.

The AIX kernel is then loaded and takes control. The kernel completes the boot process by configuring devices and starting the **init** process. LED codes during this part are generic AIX codes. These are the same on all AIX systems.

bootinfo

- To view the architecture type:

```
# bootinfo -p
```

rs6k MCA model
rspc PCI model (POWER Reference Platform)
chrp PCI model (Common Hardware Reference)

- To view the bit addressing:

```
# bootinfo -y
```

32 32-bit
64 64-bit

Figure 7-5. bootinfo AU1410.0

Notes:

Architecture types

AIX V5.1 supports rs6k, rspc and chrp and AIX V5.2 and AIX V5.3 support only chrp.

Architecture	Processor	Description
rs6k	POWER	This is the original or classic RS/6000 workstation based on the microchannel bus
rspc	POWER	POWER Reference Platform, based on the PCI bus
chrp	POWER	Common Hardware Reference Platform, based on the PCI bus

alog

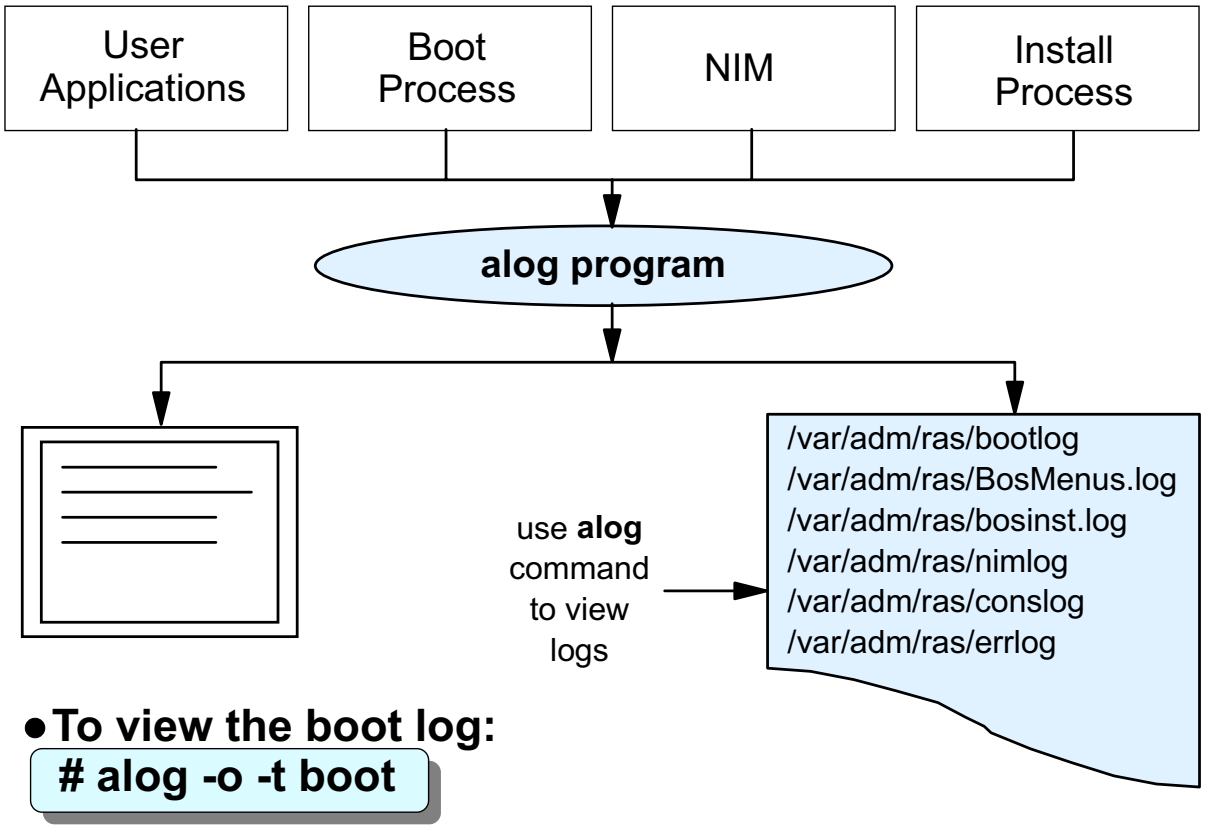


Figure 7-6. alog AU1410.0

Notes:

The **alog** command is a BOS feature that provides a general-purpose logging program that can be used by any application or user to manage a log. The **alog** command reads standard input and writes the output to standard out and copies it to a fixed size file at the same time. The file is treated as a circular log. That means when it is filled, new entries are written over the oldest entries. Log files used by **alog** are specified on the command line or defined in the **alog** configuration database maintained by the ODM. The system-supported log types are **boot, bosinst, nim** and **console**.

Many users start the boot process and then go and get a cup of coffee. Unfortunately, boot messages may appear on the screen, only to be scrolled and lost, never to be seen by the user. In some instances, these messages may be important, particularly if the system did not boot properly. Fortunately, **alog** is used by the **rc.boot** script and the configuration manager during the boot process to log important events. To view the boot information, the command **alog -o -t boot** may be used. If the machine will not boot, boot the machine into maintenance mode and view the **boot** log contents.

You can as well use SMIT by using **smit alog** to view the different system-supported logs.

/etc/inittab

Format of the line: id:runlevel:action:command

```
init:2:initdefault:
brc::sysinit:/sbin/rc.boot 3 >/dev/console 2>&1 # Phase 3 of system boot
powerfail::powerfail:/etc/rc.powerfail 2>&1 | alog -tboot > /dev/console # Power Failure Detection
mkatmpvc:2:once:/usr/sbin/mkatmpvc >/dev/console 2>&1
atmsvcd:2:once:/usr/sbin/atmsvcd >/dev/console 2>&1
load64bit:2:wait:/etc/methods/cfg64 >/dev/console 2>&1 # Enable 64-bit execs
tunables:23456789:wait:/usr/sbin/tunrestore -R > /dev/console 2>&1 # Set tunables
rc:23456789:wait:/etc/rc 2>&1 | alog -tboot > /dev/console # Multi-User checks
fbcheck:23456789:wait:/usr/sbin/fbcheck 2>&1 | alog -tboot > /dev/console # run /etc/firstboot
srcmstr:23456789:respawn:/usr/sbin/srcmstr # System Resource Controller
rctcpip:23456789:wait:/etc/rc.tcpip > /dev/console 2>&1 # Start TCP/IP daemons
rcnfs:23456789:wait:/etc/rc.nfs > /dev/console 2>&1 # Start NFS Daemons
cron:23456789:respawn:/usr/sbin/cron
piobe:2:wait:/usr/lib/lpd/pio/etc/pioinit >/dev/null 2>&1  # pb cleanup
qdaemon:23456789:wait:/usr/bin/startsrc -sqdaemon
writesrv:23456789:wait:/usr/bin/startsrc -swritesrv
uprintfd:23456789:respawn:/usr/sbin/uprintfd
shdaemon:2:off:/usr/sbin/shdaemon >/dev/console 2>&1 # High availability daemon
l2:2:wait:/etc/rc.d/rc 2
l3:3:wait:/etc/rc.d/rc 3
l4:4:wait:/etc/rc.d/rc 4
    .
    .
    .
```


Figure 7-7. /etc/inittab AU1410.0

Notes:

The **/etc/inittab** file lists the processes that **init** will start, and it also specifies when to start them. If this file gets corrupted, the system will not boot properly. It is useful to keep a backup of this file.

The fields are:

- **identifier** - Up to 14 characters that identify the process. Terminals use their logical device name as an identifier.
- **runlevel** - Defines what run levels the process is valid for. AIX uses run levels of 0-9. If the **telinit** command is used to change the runlevel, a SIGTERM signal will be sent to all processes that are not defined for the new run level. If after 20 seconds a process hasn't terminated, a SIGKILL signal is sent. The default run level for the system is **2**, which is AIX multiuser mode.
- **action** - How to treat the process. Valid actions are:
  - respawn: If the process does not exist, start it
  - wait: Start the process and wait for it to finish before reading the next line

  - once: Start the process and do not restart it if it stops
  - sysinit: Commands to be run before trying to access the console
  - off: Do not run the command

- **command** - The AIX command to run to start the process.

The **telinit** command can be used to cause init to re-read the /**etc**/**inittab file**. You may need to do this if **init** stops respawning the getty process on a TTY due to line errors.

AIX uses a default run level of 2. This is the normal multi-user mode. You may want to perform maintenance on your system without having other users logged in. The command **shutdown -m** places your machine into a single user mode terminating all logins. Once the machine reaches the single user mode, you will be prompted to enter root password. When you are ready to return to normal mode, type **telinit 2**.

Because this file controls part of the boot process, great care should be taken to prevent it from becoming corrupt. Not using **vi** to edit this file is a good place to start. AIX provides several commands to add, change and remove entries from /**etc**/**inittab**. They are **mkitab**, **chitab**, and **rmitab**. These commands perform syntax checking to ensure there are no invalid lines in this file.

After editing the /etc/inittab file, force the system to reread the file by using the **telinit q** command.

System Resource Controller

- Provides a single interface to control subsystems
- Controls individual or groups of subsystems

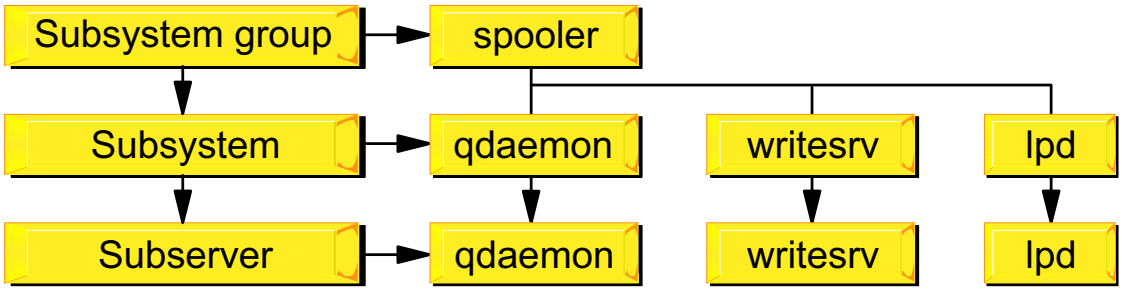


Figure 7-8. System Resource Controller AU1410.0

Notes:

The **System Resource Controller (SRC)** provides a set of commands to make it easier for the administrator to control subsystems. A subsystem is a program (or a set of related programs) designed to perform a function. This can be further divided into subservers. Subservers are similar to daemons. SRC was designed to minimize the need for user intervention since it provides control of individual subsystem or groups of subsystems with a few commands.

The relationship between the group and subsystem is easily seen from the output of **lssrc -a**. The graphic shows the relationship between the spooler subsystem group and its subsystems qdaemon, writesrv, and lpd. Some subsystem have subservers. For example, the tcpip group contains a subsystem, inetd, that has several subservers, for example ftp and telnet.

System Resource Controller Syntax

List SRC Status

```
# lssrc -g spooler
subsystem    Group        PID      Status
qdaemon      spooler      8022     active
writesrv     spooler      9558     active
lpd          spooler               inoperative
```

Start a Subsystem

```
# startsrc -s lpd
0513-059 The lpd Subsystem has been started. Subsystem PID is 12472.
```

Refresh a Subsystem

```
# refresh -s lpd
0513-095 The request for subsystem refresh was completed successfully.
```

Stop a Subsystem

```
# stopsrc -s lpd

0513-044 The lpd Subsystem was requested to stop.
```


Figure 7-9. System Resource Controller Syntax AU1410.0

Notes:

These are examples of SRC commands.

The lssrc command is used to show the status of SRC. In the example, we are checking the status of the spooler group using **-g**. To list the status of all processes, the **-a** should be used (**lssrc -a**).

-s and **-g** are options that control subsystems or subsystem groups respectively. These can be used with the SRC commands.

In the remaining examples, we are controlling one subsystem, lpd - the daemon that controls the print server. Use **startsrc** to start subsystems or groups. Use **stopsrc** to stop subsystems or groups. The **refresh** command forces the subsystem to reread any of its configuration files.

Stopping Processes

ps -ef

```
UID   PID   PPID     C     STIME  TTY  TIME  CMD
root  1        0     0     May 04   -  0:11  /etc/init
root  2626     1     0     May 04   -  1:17  /usr/sbin/syncd 60
root  4136     1     0     May 04   -  0:00  /usr/sbin/srcmstr
root  4964     4136  0     May 04   -  0:00  /usr/sbin/inetd
root  6734     1     0     May 04   -  0:02  /usr/sbin/cron
root  8022     4136  0     May 04   -  0:00  /usr/sbin/qdaemon
root  9036     1     0     May 04   -  0:00  /usr/sbin/uprintfd
root  9345     1     0     May 04   -  0:02  /usr/bin/program
```

For process not started by srcmstr

```
# kill 9345
```

For processes started by SRC

```
# stopsrc -s qdaemon
```


Figure 7-10. Stopping Processes AU1410.0

Notes:

Because some processes are started using SRC, they should be stopped using SRC. If you are not sure how it was started, you can run **lssrc** to view what is controlled by SRC. Or, by examining the output from **ps -ef**, you can determine the same information.

In the output above, **srcmstr** has a PID of 4136. Any processes with PPID of 4136 is controlled by SRC. These should be stopped using **stopsrc** - as is the case with qdaemon. Processes that do not have a PPID of 4136 are not controlled by SRC and can be stopped with the **kill** command - as is the case with program /usr/bin/program.

System Shutdown

shutdown command

- Gracefully stops all activity on the system and advises all logged on users.
- Warns users of an impending shutdown

```
# shutdown +2 The system will be down until 3AM

Broadcast message from root@localhost (tty) at 1:30:20...

The system will be down until 3AM

shutdown: PLEASE LOG OFF NOW!!!
All processes will be killed in 2 minutes
```


Figure 7-11. System Shutdown AU1410.0

Notes:

The SMIT **shutdown** fastpath or the **shutdown** command is used to shut the system down cleanly.

If used with no options, it displays a message on all enabled terminals (using the **wall** command), then after one minute disables all terminals, kills all processes on the system, sync the disks, unmounts all file systems, and then halts the system.

You can also use shutdown with the **-F** option for a fast immediate shutdown (no warning), **-r** to reboot after the shutdown or **-m** to bring the system down into maintenance mode. The **-k** is a pretend shutdown. It will appear to all users that the machine is about to shutdown, but no shutdown actually occurs.

To shut down the system to single-user mode:

cd /

shutdown -m

If you need a customized shutdown sequence, you can create a file called /**etc**/**rc.shutdown**. If this file exists, it is called by the shutdown command and is executed

first. For example, this is useful if you need to close a database prior to a shutdown. If **rc.shutdown** fails (non-zero return code value) the shutdown is terminated.

Flags

-d	Brings the system down from a distributed mode to a multiuser mode.
-F	Does a fast shutdown, bypassing the messages to other users and bringing the system down as quickly as possible.
-h	Halts the operating system completely; same as the -v flag.
-i	Specifies interactive mode. Displays interactive messages to guide the user through the shutdown.
-k	Avoids shutting down the system.
-m	Brings the system down to maintenance (single user) mode.
-r	Restarts the system after being shutdown with the reboot command.
-t	Restarts the system on the date specified by mmddHHMM [yy] where:
mm	Specifies the month.
dd	Specifies the day.
HH	Specifies the hour.
MM	Specifies the minute.
-l	Since AIX V5.1 this option creates a new file (/etc/shutdown.log) and appends log output to it. This may be helpful in resolving problems with the shutdown procedure. While the output is generally not extensive, if the root file system is full, the log output will not be captured.

The **-t** option is only supported on systems that have a power supply which automatically turns power off at shutdown and an alarm to allow reboot at a later time. Systems without this capability may hang or may reboot immediately after shutdown.

Manage the System Environment

smit system

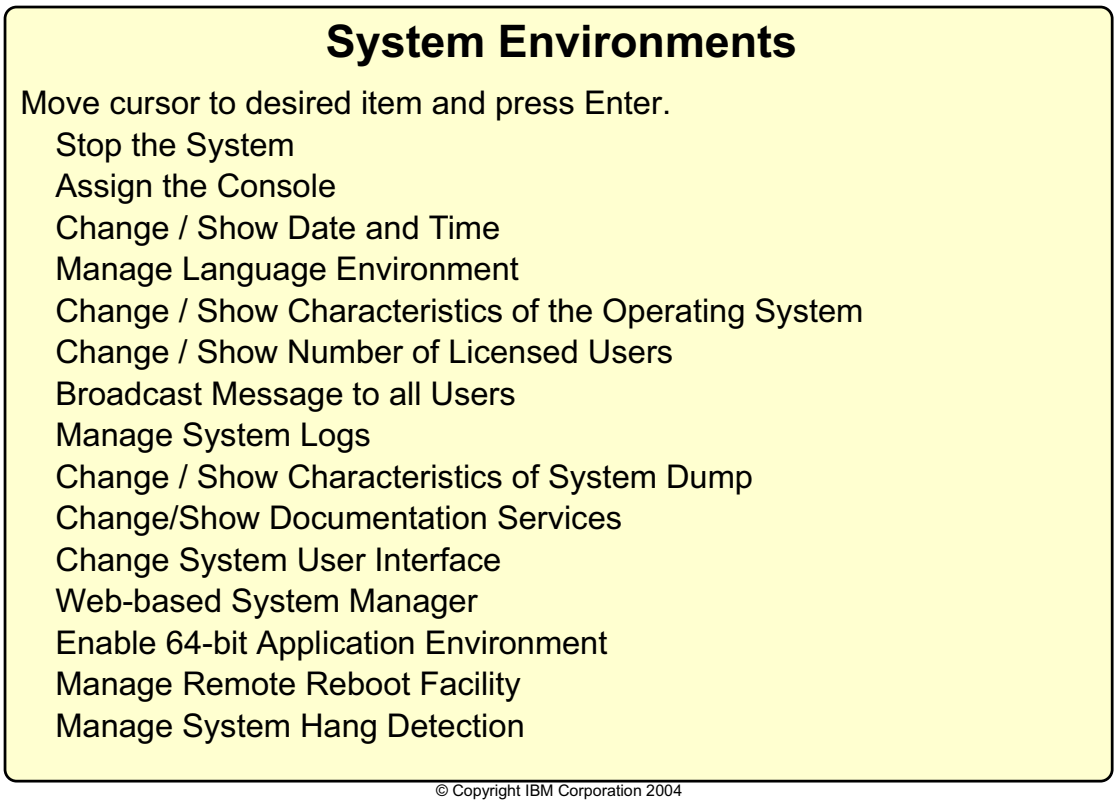


Figure 7-12. Manage the System Environment AU1410.0

Notes:

The System Environment selection in SMIT controls many different aspects of the system.

Stop the System - runs the shutdown command.

Assign the Console - allows assignment or reassignment of the system console. A reboot is required for it to take effect.

Change/Show Date and Time - runs the date command to set the date and time. Time zones are also controlled here. Time in AIX is kept in CUT (GMT) time and is converted and displayed using the local time zone.

Manage Language Environments - sets up the language information on your system.

Change/Show Characteristics of the Operating System - allows dynamic setting of kernel parameters.

Change/Show Number of Licensed Users - shows status of fixed and floating licenses.

Broadcast Message to all Users - issues the wall command.

Manage System Logs - displays and cleans up various system logs.

Change/Show Characteristics of System Dump - manages what happens when your system panics, crashes and dumps system data.

Change/Show Documentation Services - Allows the root user to specify values for the environment variable which configure the infocenter documentation services.

Change System User Interface - determines whether CDE or command-line login is used.

Internet and Documentation Services - controls setting up the Web-based documentation.

Change/Show Default Documentation Language - allows the user to change/show the default language of the documentation and search server.

Web-based System Manager - configures the Web-based System Manger to work in a remote mode.

Enable 64-bit Application Environment - allows the 64-bit application environment to be enabled either immediately or at system restart.

Manage Remote Reboot - identifies a serial port and special string to invoke remote reboot

Manage System Hang Detection - configures automated action for when a defined set of processes get no cycles

Manage System Language Environment

- # smit mlang

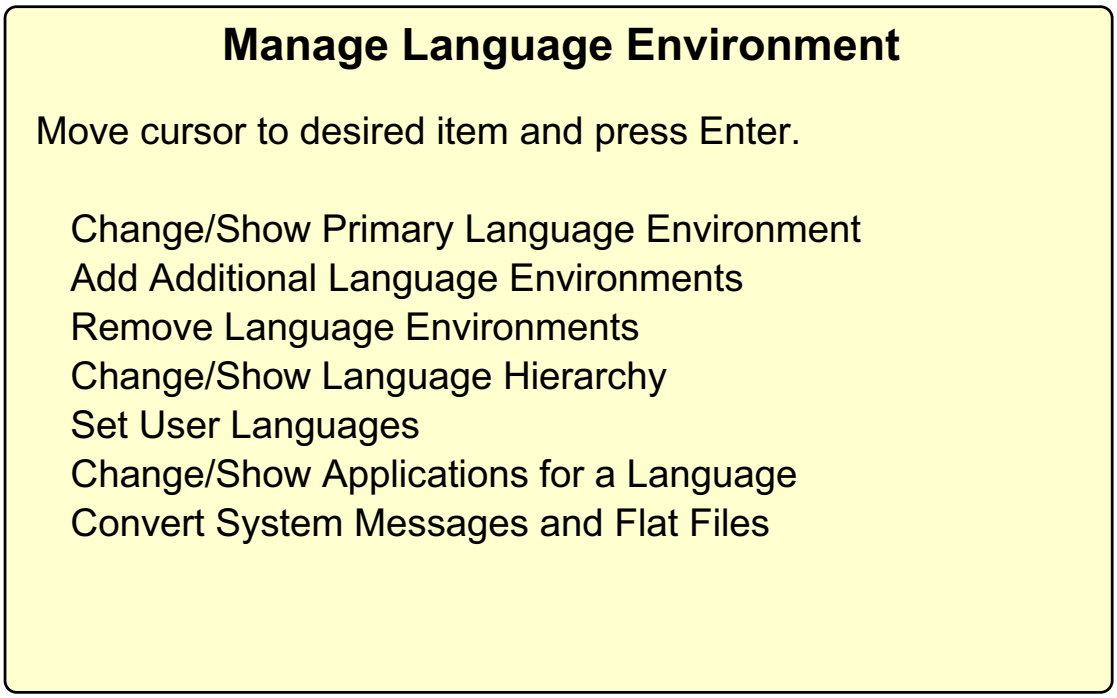


Figure 7-13. Manage System Language Environment AU1410.0

Notes:

The LANG variable specifies the installation default locale. The LANG value is set in the **/etc/environment** file at installation time by the system, based on the information given by the user.

The choice of the language environment affects the means of handling collation, character classification, case conversion, numeric and monetary formatting, date and time formatting, and so forth.

Many language-territory combinations are supported by more than one code set. Be careful when changing the LANG environments to assure the locale chosen matches the user's needs, the keyboard mapping, and font selection.

To change the system National Language (used for accessing online documentation, online help in SMIT and all error messages) use the **chlang** command. For example, **chlang En_GB** for PC850 code pages or **en_GB** for ISO 8859.1 code pages or **chlang C** for POSIX messages. This updates the default setting of the LANG environment variable in **/etc/environment**. You must log off and log in again to the system, for the change to the language environment to become effective.

Industry-standard code sets are provided by means of the ISO8859 family of code sets, which provide a range of single-byte code set support. The Personal Computer (PC) based code sets IBM-850 and IBM-932 are also supported. IBM-850 is a single-byte code set while IBM-932 is a multibyte code set used to support the Japanese locale.

The installation default locale refers to the locale selected at installation. For example, when prompted, a user can specify the English language as spoken in Great Britain during the installation. The code set automatically defaults to the ISO8859-1 code set.

To convert ASCII text files or message catalogs from one code page to another, the **iconv** command or SMIT can be used.

The Euro currency symbol "**€**" is supported in the ISO.8859-15, UTF-8 and IBM-1252 codesets.

Exercise: System Startup and Shutdown

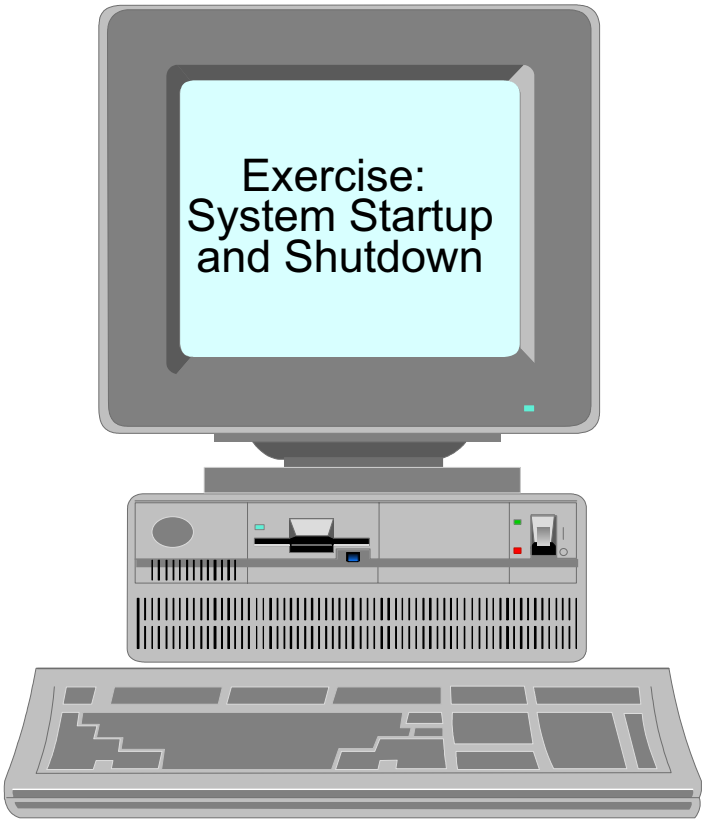


Figure 7-14. Exercise: System Startup and Shutdown AU1410.0

Notes:

This lab allows you to become familiar with the startup and shutdown sequences for AIX.

The exercise can be found in your Exercise Guide.

Checkpoint

1. What is the first process that is created on the system and which file does it reference to initiate all the other processes that have to be started?

_____

_____

2. Which AIX feature can be used to stop and start groups of daemons or programs?

_____

3. True or false? You can only execute the **shutdown** command from the console.

Figure 7-15. Checkpoint AU1410.0

Notes:

Unit Summary

- When the system boots up it first runs through a number of hardware checks before starting the processes defined in the /etc/inittab file
- The LED codes produced during the boot process can be used to identify problems. Alternatively, the boot log file can be accessed to obtain the system messages produced during the boot phase
- Once the system is up, it can be shut down by an authorized user from any terminal
- SMIT can be used to change common system settings such as the language used, and the date and time used by the system

Figure 7-16. Unit Summary AU1410.0

Notes:

Unit 8. Devices

What This Unit Is About

This unit introduces the concepts of devices, their different states, and their location codes.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Describe the difference between logical and physical devices
- Describe the purpose of the ODM predefined and customized databases
- Describe different states of a device
- Describe the format of device location codes
- Use SMIT to Add/Show/Change/Delete devices

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise

References

Online	*System Management Guide: Operating System and Devices*

Unit Objectives

After completing this unit, you should be able to:

- Describe the difference between logical and physical devices
- Describe the purpose of the predefined and customized databases
- Describe different states of a device
- Describe the format of device location codes
- Use SMIT to Add/Show/Change/Delete devices

Figure 8-1. Unit Objectives AU1410.0

Notes:

Device Terminology

- Physical Devices
- Ports
- Device Drivers
- Logical Devices
- /dev Directory

Figure 8-2. Device Terminology AU1410.0

Notes:

In order to attach peripherals such as terminals and printers to an AIX system, we must tell AIX the characteristics of these devices so that the operating system can send the correct signals to the adapter to which the device is connected. A number of pieces of hardware and software must interact correctly for the device to function correctly.

- **Physical Devices** - Actual hardware that is connected in some way to the system.
- **Ports** - The physical connectors/adapters in the system where physical devices are attached. Most ports are programmable by the system software to allow attachment of many different types of devices.
- **Device Drivers** - Software in the kernel that controls the activity on a port and the format of the data that is sent to the device.
- **Logical Devices** - Software interfaces (special files) that present a means of accessing a physical device to the users and application programs. Data appended to logical devices will be sent to the appropriate device driver. Data read from logical devices will be read from the appropriate device driver.

- /**dev** - The directory which contains all of the logical devices that can be directly accessed by the user. (Some of the logical devices defined are only referenced in the ODM customized database and cannot be accessed by users.)

Listing of /dev Directory

```
# ls -l /dev
brw-rw--rw    1   root    system   20,0     Oct 29 02:25    fd0
brw-rw--rw    1   root    system   20,64    Oct 29 02:26    fd1
crw-rw--rw    1   root    system   20,0     Oct 29 02:25    rfd0
crw-rw--rw    1   root    system   20,64    Oct 29 02:26    rfd1
:
:
crw-r--r--    1   root    system   22,0     Oct 29 02:25    rmt0
crw-r--r--    1   root    system   22,1     Oct 29 02:25    rmt0.1
:
:
crw-------    1   root    system   14,1     Oct 29 02:44    hdisk0
crw-------    1   root    system   14,2     Nov  1 05:31    hdisk1
crw-------    2   root    system   14,1     Oct 29 02:44    rhdisk0
crw-------    1   root    system   14,2     Nov  1 05:31    rhdisk1
```

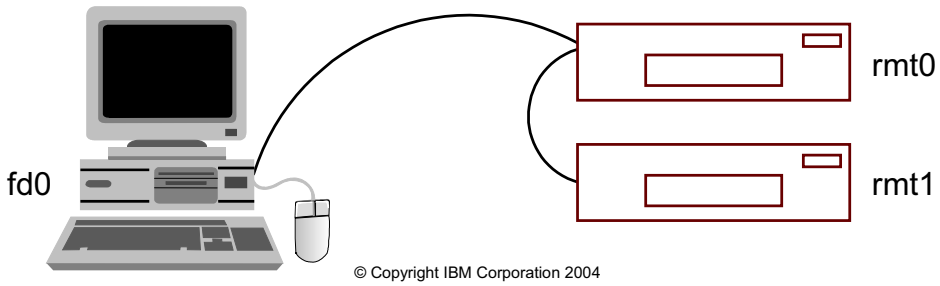


Figure 8-3. Listing of /dev Directory AU1410.0

Notes:

There are a large number of devices that can be configured in the system. Devices can be one of two types:

- Block device is a structured random access device. Buffering is used to provide a block-at-a-time method of access. Usually only disk file systems.
- Character (raw) device is a sequential, stream-oriented device which provides no buffering.

Most block devices also have an equivalent character device. For example, /**dev**/**hd1** provides buffered access to a logical volume whereas /**dev**/**rhd1** provides raw access to the same logical volume.

The **ls -l** command allows you to see the type of a file. A special file (in the /**dev** directory) will be indicated by a **b** in the first column for a block device or a **c** for a character device.

Normally the fifth field contains a numeric value indicating the number of bytes in the file. For devices, it shows the major and minor device numbers. The device rmt0 shown in the listing has a major device number of 22 and a minor device number of 1. This indicates that

the code to handle major device 22 must already be in the kernel, and it must handle device number 1 correctly. While not shown here, there would be files for rmt0 with minor numbers of 0 through 7, each of which must be handled correctly by the device driver. More precisely, the major number refers to the software section of code in the kernel which handles that type of device, and the minor number to the particular device of that type or the operation mode of a device of that type.

Examples of block devices:

cd0	CD-ROM
fd0, fd0l, fd0h	Diskette
hd1, lv00	Logical Volume
hdisk0	Physical Volume

Examples of character (raw) devices:

console, lft, tty0	Terminal
lp0	Printer
rmt0	Tape Drive
tok0, ent0	Adapter
kmem, mem, null	Memory
rfd0, rfd0l, rfd0h	Diskette
rhd1, rlv00	Logical Volume
rhdisk0	Physical Volume

Device Configuration Database

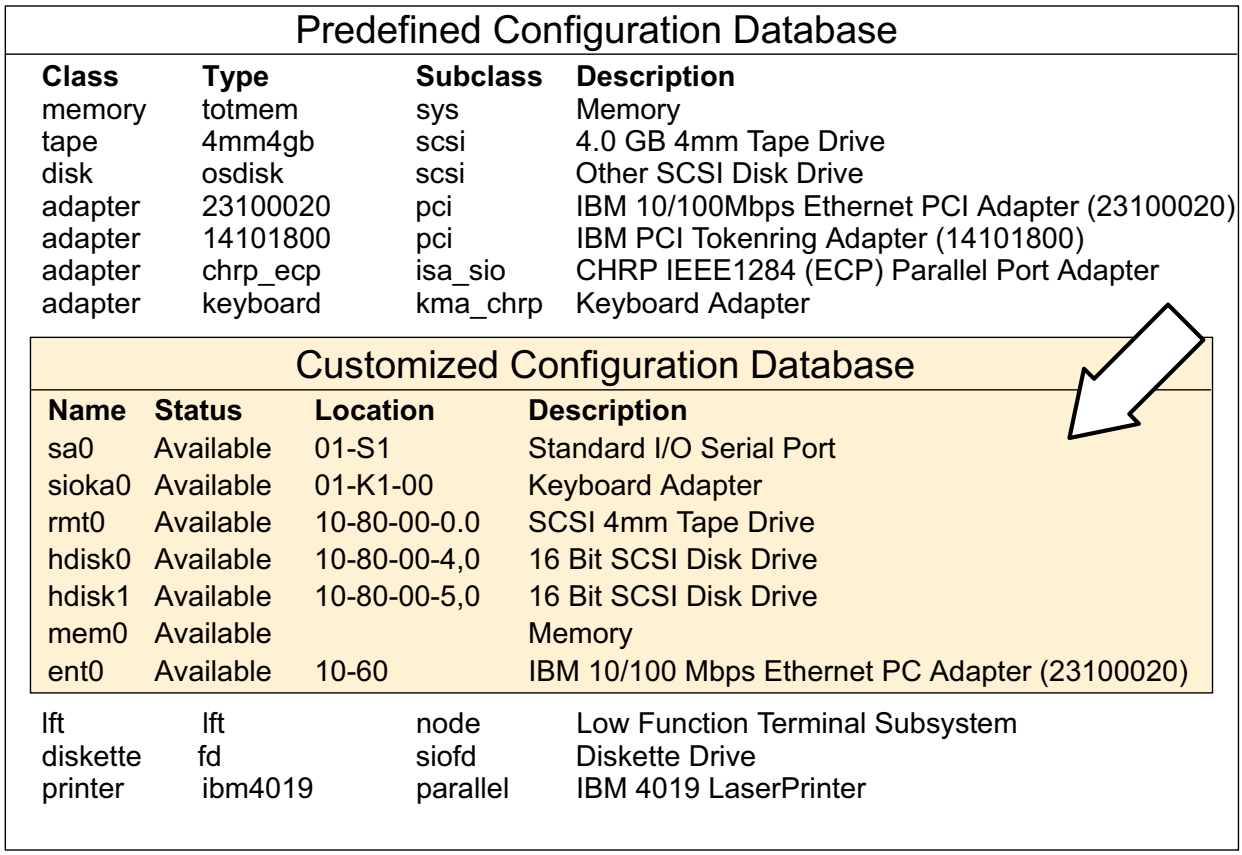


Figure 8-4. Device Configuration Database AU1410.0

Notes:

The predefined and customized databases store information about all of the logical devices in the system and their attributes managed by the ODM (Object Data Manager).

The predefined database contains configuration data for all possible devices supported by the system. The SMIT menus have options to install non-supported drivers. The contents of the predefined database is largely defined at installation time, ensuring that you always have support for devices in your system.

The customized database contains configuration data for all currently defined and configured (available) devices.

The Configuration Manager is a program that automatically configures devices on your system during system boot and run time. The Configuration Manager uses the information from the predefined and customized databases during this process, and updates the customized database afterwards.

List All Supported Devices

PdDv (Predefined Devices)
 # lsdev -P -H

class	type	subclass	description
memory	totmem	sys	Memory
tape	4mm4gb	scsi	4.0 GB 4mm Tape Drive
disk	osdisk	scsi	Other SCSI Disk Drive
adapter	22100020	pci	IBM PCI Ethernet Adapter (22100020)
adapter	14101800	pci	IBM PCI Tokenring Adapter (14101800)
adapter	ppa	isa_sio	Standard I/O Parallel Port Adapter
adapter	isa_keyboard	isa_sio	Keyboard Adapter
.	.		
.	.		

lsdev -Pc tape

tape	1200mb-c	scsi	1.2 GB 1/4-Inch Tape Drive
tape	150mb	scsi	150 MB 1/4-Inch Tape Drive
tape	3490e	scsi	3490E Autoloading Tape Drive
tape	4mm2gb	scsi	2.0 GB 4mm Tape Drive
.	.		
.	.		

Figure 8-5. List All Supported Devices AU1410.0

Notes:

Default characteristics for known device types are stored in the ODM predefined database.

Devices are classified by Class, Type and Subclass where Class indicates what the device does, Type indicates what model it is and Subclass indicates how it can be attached to the system.

There are also definitions for some unknown devices which can be attached to the system (for example, non-IBM serial or parallel printers or SCSI disk drives). These devices are either intelligent and need little configuration, or the device attachment method is standard (for example, parallel or RS232) and no features of the device are assumed when it is added.

To find out what devices are listed in the predefined database, use the SMIT option **List All Supported Devices** which runs the command **lsdev -P**

To find out the attributes of a predefined device, use the SMIT option **Show Characteristics of a Supported Device** which runs the command **lsattr -D**

The **-P** option pulls information from the predefined database in the ODM.

The **-H** option shows the headers for the output.

The **-c** option specifies the class of device.

SMIT is the best way to obtain a listing of currently supported devices for the system:

smit devices -> List Devices -> List All Supported Devices

The devices listed may not physically exist on the system, but device support for them has been installed.

List All Defined Devices

name	status	physloc	location	description
sys0	Available			System Object
pci0	Available	P1		PCI Bus
isa0	Available	P1	10-58	ISA Bus
sa0	Available	P1/S1	01-S1	Standard I/O Serial Port
scsi0	Available	P1/Z1	10-80	Wide/Fast-20 SCSI I/O Controller
cd0	Available	P1/Z1-A3	10-80-00-3,0	SCSI Multimedia CD-ROM Drive
rmt0	Defined	P1/Z1-A6	10-80-00-6,0	4.0 GB 4mm Tape Drive
hdisk0	Available	P1/Z1-A4	10-80-00-4,0	16 Bit SCSI Disk Drive
hdisk1	Available	P1/Z1-A5	10-80-00-5,0	16 Bit SCSI Disk Drive
mem0	Available			Memory
ent0	Available	P1/E1	10-60	IBM 10/100 Mbps Ethernet PCI
tok0	Available	P1.1-I1/T1	1P-08	IBM PCI Tokenring Adapter

 # lsattr -EH -l sys0

attribute	value	description	user_settable
keylock	normal	State of system keylock at boot time	False
realmem	131072	Amount of usable physical memory Kbytes	False
iostat	true	Continuously maintain DISK I/O history	True

 # lsattr -E -l sys0 -a realmem

realmem	131072	Amount of usable physical memory in Kbytes	False

Figure 8-6. List All Defined Devices AU1410.0

Notes:

The devices that have been customized in the system are described in the ODM customized database. Each device has a logical device name, a status, a location and various attributes.

The **lsdev -CH** command provides information on the resource name, its status (or state), the address or location, and a brief description of all devices in the customized database.

This list contains those devices that are found on the system. The status column will contain:

Available: The device is ready and can be used
Defined: The device is unavailable

Devices may appear in a defined state after a restart. If this is the case, it may be due to the fact that the device is powered off or the fact that the device no longer exists on the system.

Devices with a location code are physical devices. Devices without a location code are logical devices. Location codes depend on the type of device and the adapter to which the device is connected.

The **lsattr -E -l [resource name]** command provides detailed information on the effective attributes currently configured for specified devices. In the example, it provides configuration information on the system itself.

The **-C** option for **lsdev** pulls the customized information from the ODM.

The **-E** option for **lsattr** shows the effective attributes.

The **-l** option for both commands is the logical device name.

The **-c** option for both commands is the class of device.

The **-a *attribute*** option for the lsattr command displays information for a specific attribute.

Another command that can be used to list information about devices found in the ODM customized database is **lscfg -v**. The listing is sorted by parent, child and device location. Specific hardware information about devices will be listed such as EC level, FRU number, part number, and so forth. The output also displays the model architecture and bus type.

Device States

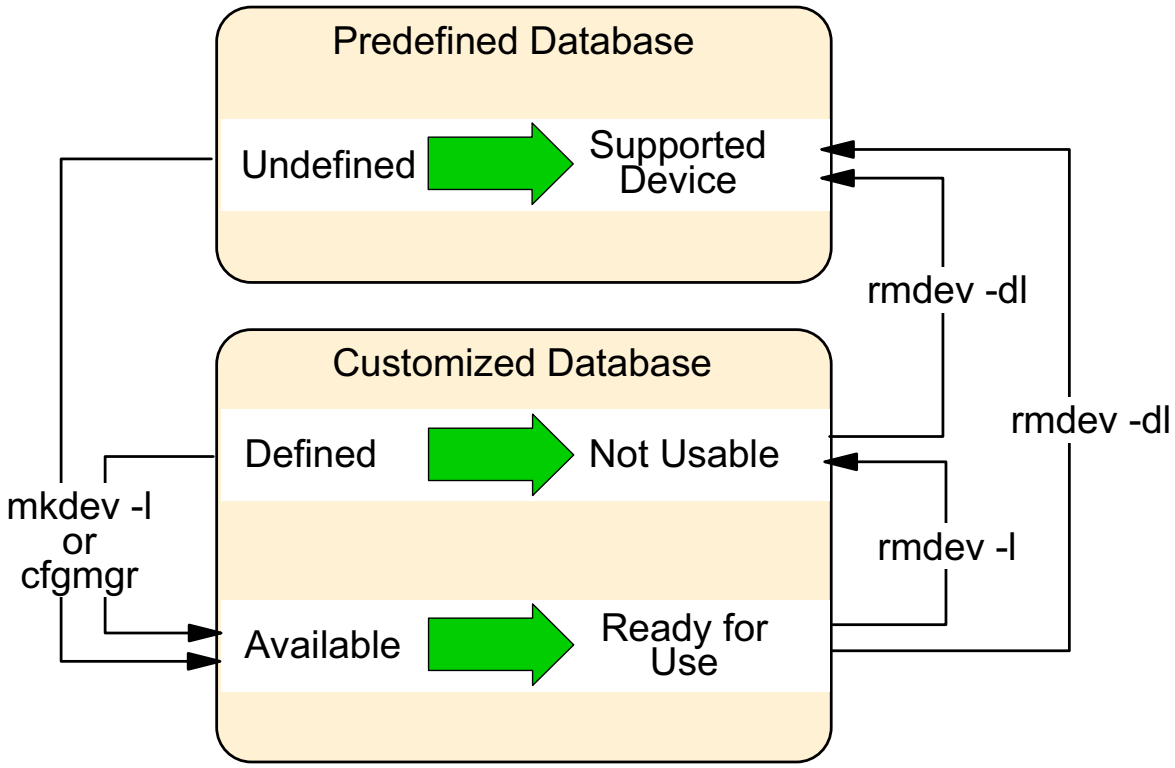


Figure 8-7. Device States AU1410.0

Notes:

The most common device states are:

Undefined - The device is a supported device but is not configured. It does not reside in the customized database.

Defined - The device has been added to the customized database. It has been allocated a logical device name, a location code and attributes have been assigned to it. But, it is still unavailable for use.

Available - The device resides in the customized database. The device is fully configured and is ready for use.

When a device is first identified, it is configured and put into the **Available** state.

If a device that has been configured in the past is powered off and the machine is rebooted, the device will appear in the **Defined** state. This indicates that the system knows it is supposed to be there, but because it was not powered on, it cannot be used.

You can control the device states by using **smit** or the commands **mkdev** and **rmdev**.

To put a defined tape device into an available state:
In the smit devices area, use Configure a Defined Tape Device -or-
 # mkdev -l rmt0

To move an available tape device to defined:
In the smit devices area, use Remove a Tape Device and set Delete from Database to no
-or-
 # rmdev -l rmt0

To permanently remove an available or define tape device:
In the smit devices area, use Remove a Tape Device and set Delete from Database to yes
-or-
 # rmdev -dl rmt0

Remember, most **Defined** devices are the result of not powering on the device before booting. Or, it could be the device was physically removed, but you never ran **rmdev -dl xxxx** to remove the device from the ODM.

Self-Configuring Devices

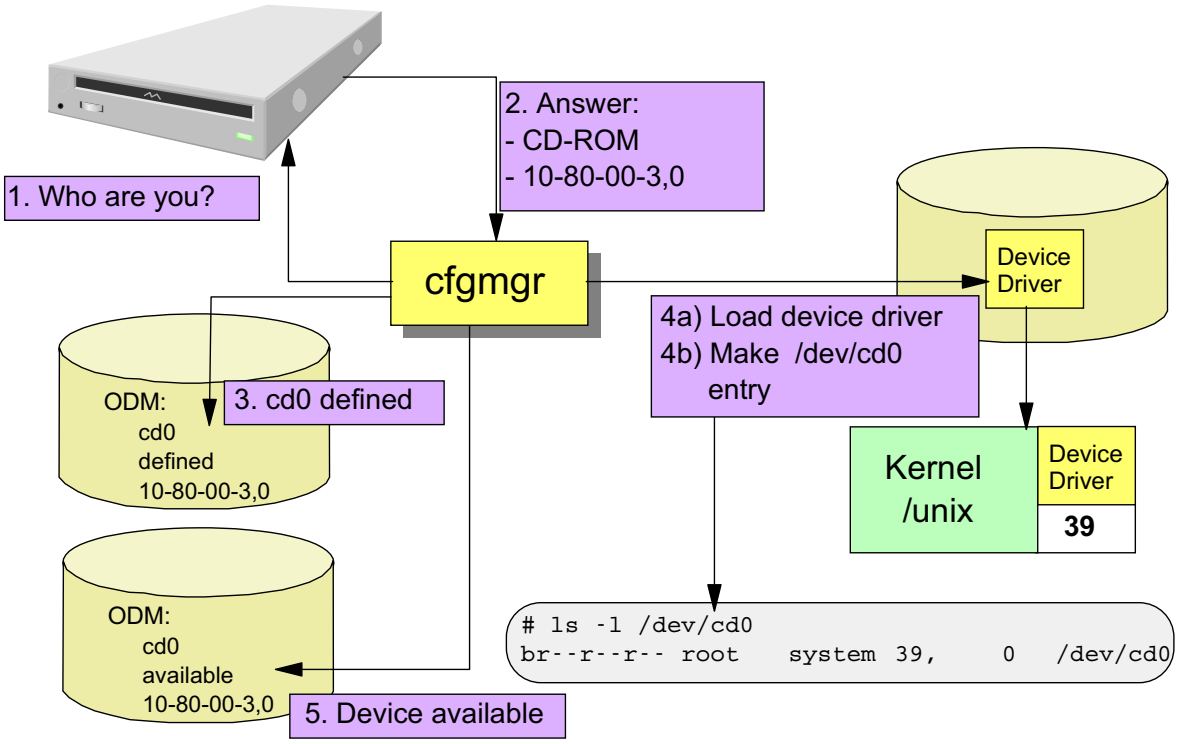


Figure 8-8. Self-Configuring Devices AU1410.0

Notes:

cfgmgr is a program that runs during boot that configures devices. It can also be run safely from the command line on a system that is up and running. **cfgmgr** identifies all self-configuring devices as long as they are powered on and matches them to the information in the predefined database. It then uses the predefined information to complete a customized database entry for the device.

All devices are self-configuring except for parallel and serial devices. So except for things like printers and ASCII terminals, configuring a device requires only attaching it and power it on before booting the machine. Since **cfgmgr** runs during the boot process, no more intervention is required by the administrator.

You see that for SCSI devices, you need to set a unique SCSI ID on the device before attaching it. Once that is done, configuration of the device is handled by AIX.

SMIT Devices Menu

 # smit devices

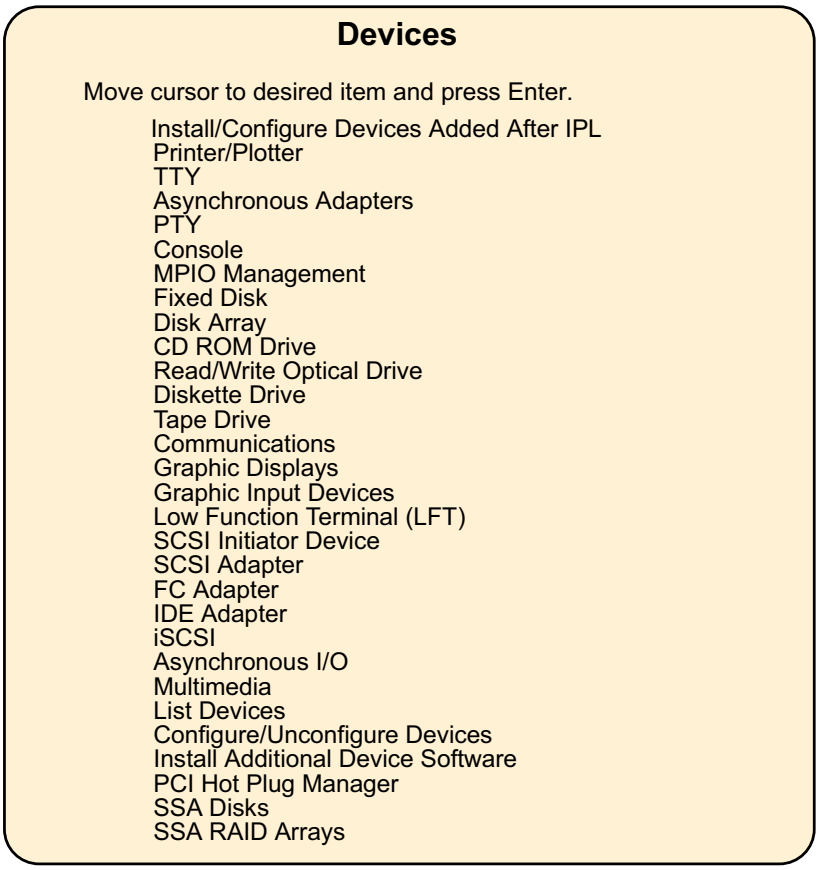


Figure 8-9. SMIT Devices Menu AU1410.0

Notes:

The SMIT Devices menu (fastpath: **# smit devices**) is used to manage the configuration information about the devices in the system. This information controls the way the kernel and applications behave towards the physical devices attached. The list of devices varies depending on what you have configured or installed on your system.

Some of the options are submenus which provide the functions to add, change and delete the configuration information, report any errors and trace activity, for specific device types.

- **Install/Configure Devices Added After IPL**

  Runs cfgmgr

- **Printer/Plotter**

  This submenu allows you to configure printer devices and also queues for local printers and remote printers.

- **TTY**

  Any non-printer device attached to a serial port. (For example: terminal, modem, direct connection.)

- **PTY**

  A pseudo-terminal device. It provides the appearance of a real ASCII terminal to the application, but does not have any physical port attachment. Used for applications such as AIXWindows and TCP/IP communications.

- **Communication**

  Adapters for various types of communications. (For example: Token Ring, Ethernet, MultiProtocol, X.25, 3270, Fiber Optic.)

- **Display Power Management**

  For power management, displays power off (to conserve power) or dim to preserve the display tube. This option is available when accessing Low Function Terminal (LFT) or Graphic Displays.

Devices can also be managed using the Web-based System Manager. To do so, use the fastpath **wsm devices**.

Device Addressing

- Location codes are used for device addressing
- The location code for a device is a path from the adapter in the CPU drawer or system unit, through the signal cables and the asynchronous distribution box (if there is one) to the device
- Location codes consist of up to four fields of information depending on the type of device
- Location codes differ based on model type

Figure 8-10. Device Addressing AU1410.0

Notes:

Every logical device is assigned a location code when it is attached to the system. Location codes depend on the type of device and the adapter to which it connects.

The location code is another way of identifying the physical device.

The location codes exist to provide the system with a method of locating the device and establishing relationships between devices and their adapters. If a hardware failure occurs, the location code is often displayed or referred to in the LED.

The format for location codes is:

AB-CD-EF-GH

The length of the location code depends on the type of device. Two pairs indicate an adapter. Four pairs indicates a device attached to an adapter.

Location Code Format for PCI Devices

AB-CD-EF-GH

AB	00	Resources attached to the processor
	01	Resources attached to the ISA bus
	04	Resources attached to the PCI bus (only)
	XY	Resources attached to the XY PCI bus (For example - 10 or 1P)
CD	01-99	For pluggable adapters/cards
	A-Z,0	As position 1 and 2 respectively for integrated adapters
EF		The connector ID
GH		Port identifier, address, memory modules, device, FRU for the device

Figure 8-11. Location Code Format for PCI Devices AU1410.0

Notes:

Knowing how to interpret location codes allows you to quickly locate a device based on the software definition. If you have several of the same type of devices, like hard disk for example, it allows you to easily identify the exact disk that is having the problem.

The actual values used in the location codes vary from model to model. For specific values, you need to reference the *Service Guides* for your model. These can be found online at the IBM Information Center:
http://publib16.boulder.ibm.com/pseries/en_US/infocenter/base/

In this unit, we provide a general overview of location codes and specific examples for machine types found in the classrooms.

The location code format above is an example of what you might find on a 43P Model 150 pSeries system.

In older machines there was only a single PCI bus which used an AB value of 04. In current machines these are multiple PCI buses which are assigned AB values which identify the bus, such as 10 or IP.

The first set of digits, AB, defines the bus type that devices are attached to:

- **00** defines resources attached to the processor bus, such as the system planar, the processor, memory and the primary PCI bus
- **01** defines resources attached to the ISA bus such as the diskette drive, mouse and keyboard adapters
- **04** defines resources attached to the PCI bus where either there is only one PCI bus or where the PCI bus can not be determined.
- **XY** defines resources attached to the XY parent PCI bus, where XY is a two character identify for the bus determined by the machine designer. For example, a machine may have several PCI buses each numbered 10, 20, etc.

The second set of digits, CD, identify a slot or adapter number. Again, how this position is used may vary from machine/model to machine/model.

The integrated devices are on the primary PCI bus (start with 10) or on the ISA bus (01). Their CD positions are fixed unlike on the Model 140 where the letters are assigned in the order of discover. So, for example, **01-D1** is always the integrated diskette drive and is attached on the ISA bus. **10-80** is always the integrated SCSI controller (adapter).

Pluggable cards will be attached to one of the two PCI buses. Slots 2 and 3 are on the primary bus and will start with **10**. Cards in Slots 1, 4 or 5 are on the secondary bus and start with **1P**. Each slot has an assigned location code number. To see the assigned numbers you need to reference the *Service Guide*. To give one example, a card in slot 1 will have an address of **1P-08**.

When you are looking at the location codes on a Model 150, use this chart taken from the *Service Guides* to interpret their meaning:

1P-08 Slot 1
10-b0 Slot 2
10-90 Slot 3
1P-18 Slot 4

1P-10 Slot 5

For integrated devices, like the build in keyboard port, the C position will be a letter A-Z and the D position will be a 0. For example 01-**F0** shows the keyboard adapter is on the ISA bus (01) and is an integrated adapter (F0). The letters are assigned in the order in which they are discovered during configuration. Each integrated device is assured a unique value.

EF is usually 00. We show an example of an 128-port async adapter shortly that shows a non-00 EF position.

GH is usually 00 for non-SCSI devices. Multiple diskette drives is one exception. And, 128-port async adapter will also give non-00 GH positions.

*Additional information for classroom machines
As mentioned above, each model has unique location code numbers. You may be using a machine/model other than the 43P Model 150 in your classroom. If so, your machine has different numbers than those discussed in the lecture.

Location Code Example: Non-SCSI

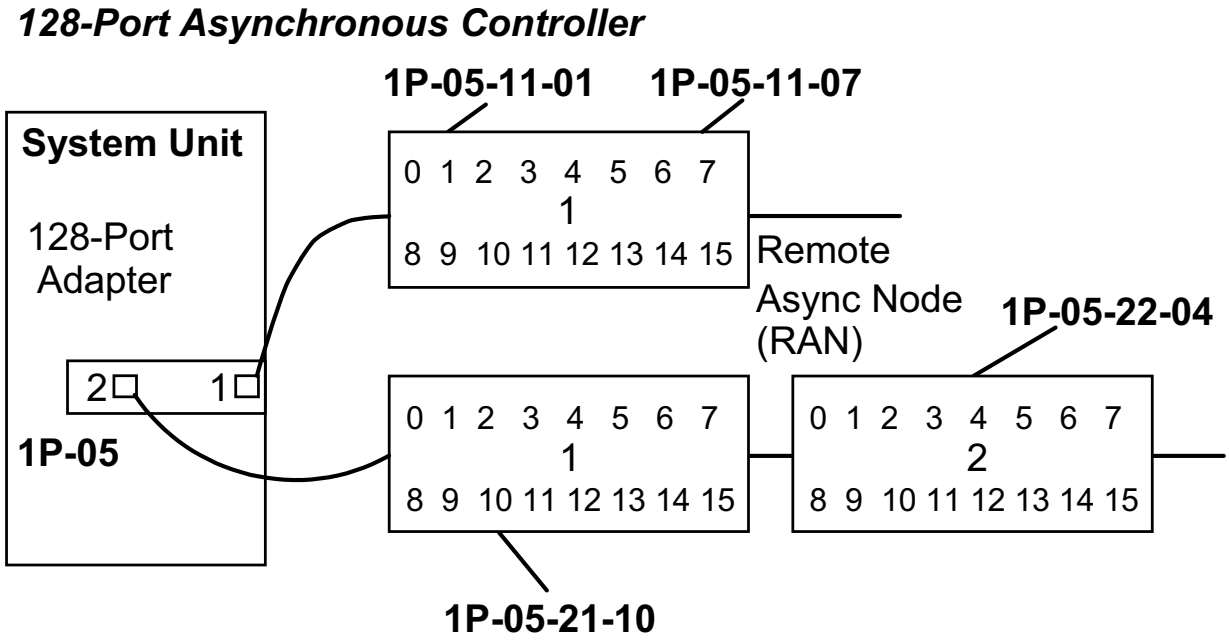


Figure 8-12. Location Code Example: Non-SCSI AU1410.0

Notes:

The above example illustrates non-SCSI device location codes for a pSeries.

A 128-port asynchronous adapter allows 128 serial devices (like ASCII terminals) to be attached to the adapter. The adapter has two connectors (or ports) on the card. Each connector can support a serial bus.

On each bus, boxes that contain ports are connected to each other. These boxes are called Remote Asynchronous Nodes (RANs). Each of the two connectors can support four RANs. Four RANs on two connectors give a total of eight RANs. Each RAN has 16 ports. That gives a total of 128 ports.

The location code must account for each piece of the puzzle.

AB-CD is the same as previous examples. It provides the adapter card address. In our example, the adapter card is plugged into slot 5 on the PCI bus.

E identifies the connector on the adapter card, 1 or 2.

F identifies the RAN. RANs are numbered in ascending order going away from the adapter, 1-4.

GH is the two-digit port number. For example, port 7 is 07. The range of numbers is 00-15.

Location Code Format for SCSI Devices

AB-CD-EF-G,H

AB-CD — Identifies the bus and the adapter location
Same as with non-SCSI devices

EF — For a single SCSI bus - 00
For a dual SCSI bus:
- Internal bus - 00
- External bus - 01

G,H — G = SCSI address (SCSI ID) of the device
H = Logical unit number of the device

Figure 8-13. Location Code Format for SCSI Devices AU1410.0

Notes:

The above shows an example of location codes for SCSI devices.

The location code format is slightly different. You notice in this format the G and H positions are separated by a comma.

The AB-CD positions contain the same information we have already covered. It indicates where the adapter card (SCSI controller) is attached - the bus and slot number.

The EF position identifies the SCSI bus. If the controller provides only a single SCSI bus, the EF position is **00**. If the controller provides for dual SCSI buses, each bus must be identified by a unique address. With dual SCSI, the card's internal bus is identified with **00** and the card's external bus is identified with **01**.

The G,H position provides two pieces of information. The G position is the SCSI address or SCSI ID of the device. The SCSI ID is set on the device itself. It is usually accomplished by setting jumpers or switches on the device. Some devices have dials or push buttons that are external that allow an easy method to set the ID. Set the SCSI ID so that it doesn't

conflict with another device on that bus. When **cfgmgr** runs it will recognize the ID that is set on the hardware and set the G position accordingly.

The H is usually a 0. If the SCSI devices has multiple devices within it, then the logical unit number (LUN) is used to uniquely identify each device. Non-zero numbers are used with RAID arrays or some CD jukeboxes.

Location Code Example for SCSI Device

SCSI Devices (Disk, Tape, CD-ROM)

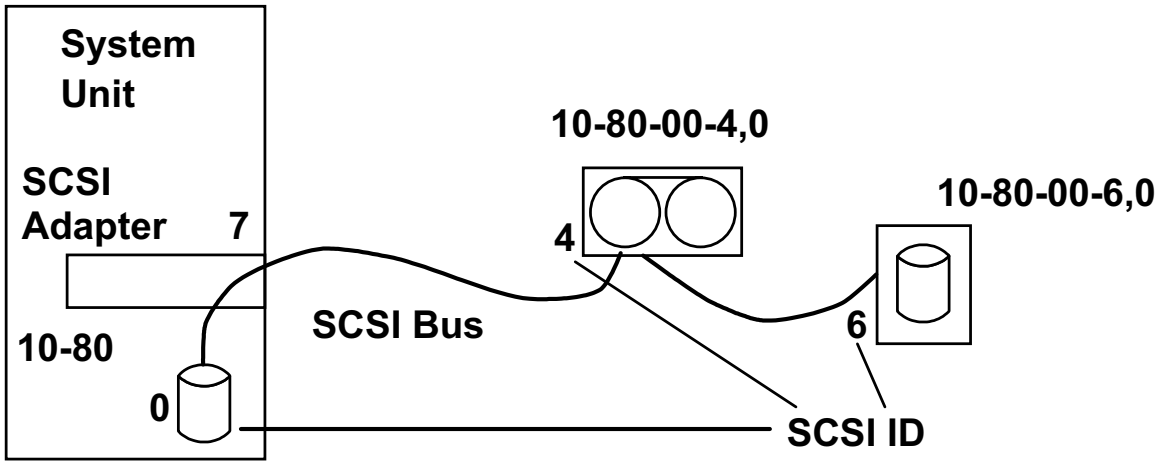


Figure 8-14. Location Code Example for SCSI Device AU1410.0

Notes:

This example shows several SCSI devices attached to a single SCSI bus on a 43P Model 150. This is not a dual SCSI. This is a single bus that has devices that are housed inside and outside the cabinet.

From the device addressing, the adapter is located on slot 1 on the PCI bus. The external disk has a SCSI ID of 6 and the tape device has a SCSI ID of 4.

What would the location code be for the disk with SCSI ID of 0? _____-_____-_____-___,___

The SCSI adapter uses a SCSI ID of 7 by default. Normally, you should not set a device to a SCSI ID of 7 for that reason.

Location Code Example: PCI

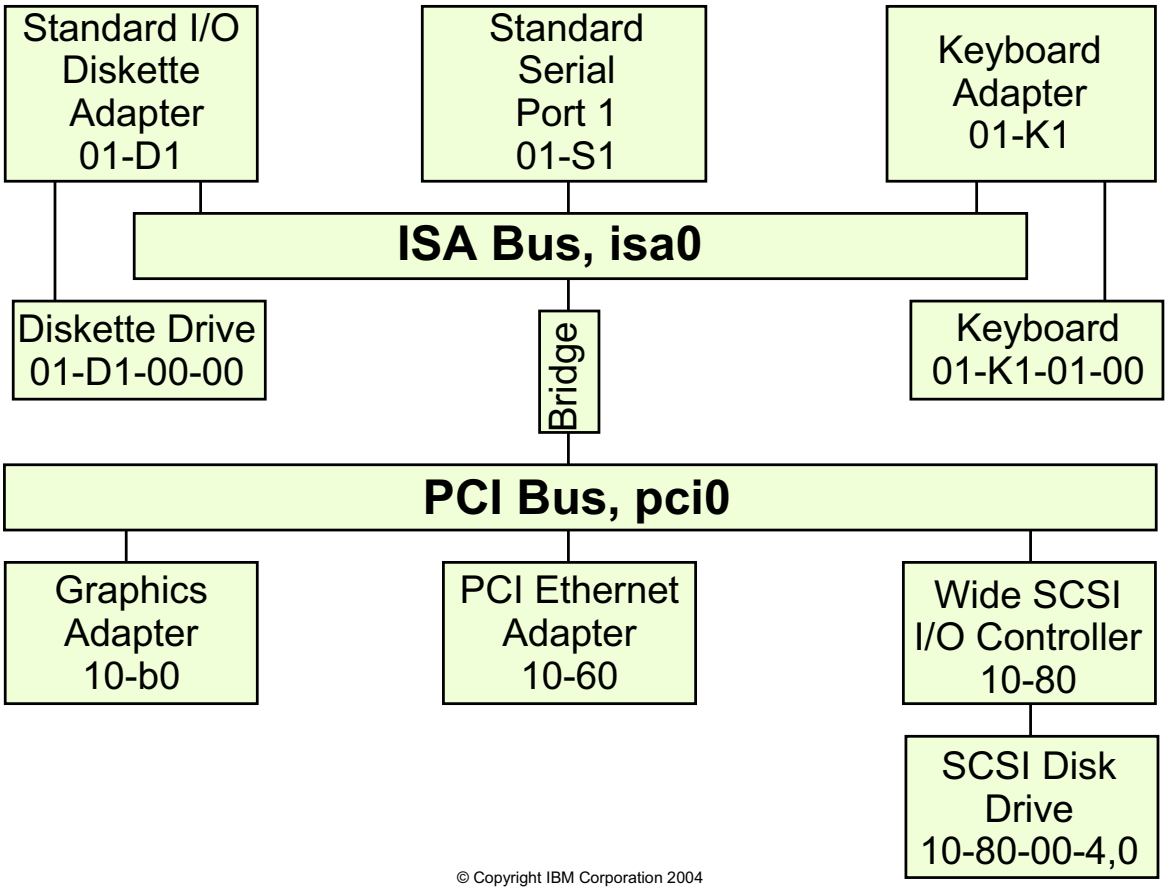


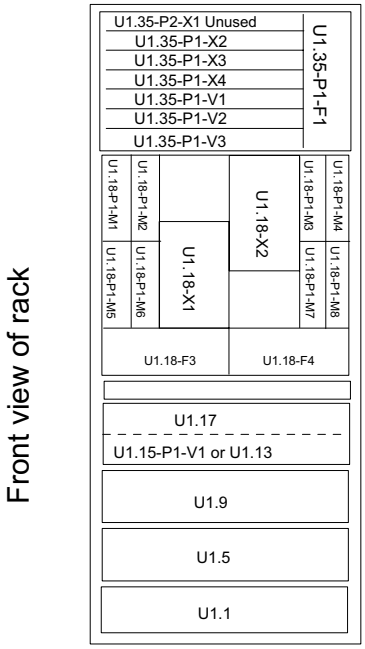
Figure 8-15. Location Code Example: PCI AU1410.0

Notes:

The example shown in the visual is a partial view of a 43p Model 150 system with an attached ISA bus.

All devices attached to the ISA bus are identified with a prefix location code of 01 and the PCI devices in this example are attached with a prefix location code of 10.

pSeries 670 and 690 Location Codes



Example of hardware location code format

```
U1.5-P1-I1/Z1
 | | |    |
 | | |    subassembly/connector
 | | | Major assembly
 | | EIA
 | Position
Unit number
Rack #
```

pSeries 690 Service Guide:
Reference Information Example

FRU Name	Location Code	AIX Location Code	Physical Connection	Logical Connection
Media Drawer - DVD RAM/CD-ROM	**U1.17-P1-I10/Z1-A1**	**3A-08-00-5,0**		
I/O Subsystem SCSI controller 1 on P1	**U1.9-P1/Z1**	**2s-08-00-8,0**		

Figure 8-16. pSeries 670 and 690 Location Codes AU1410.0

Notes:

Introduction

Physical addressing has been in place throughout the history of the RS/6000 and pSeries family of products. An important change with the pSeries 670 and 690 servers is that the I/O drawers are installed at specific locations within the rack. We include the visual above primarily as reference. Your focus is on I/O drawer addressing.

The example in the visual above shows location codes for the pSeries 670 and 690. The *Service Guide* for each type of system contains charts to look up the location codes.

Rack addressing scheme

The physical address of a component is defined in the visual above. You do not have any say in this value. These addresses are documented in the *pSeries 690 Service Guide.*

Location codes outline

The AIX location code is presented within AIX as before, as a four field entry. The AIX location code is case sensitive as of AIX 5.1, a departure from previous versions of AIX.

Location code to AIX code table

As the previous visuals have shown, rack positioning is a key component of device addressing, unlike previous pSeries and RS/6000 products.

The address diagram shown in the visual is an example of this addressing scheme.

U1.5

The rack position is denoted here, with the 1 referring to the first rack, and the 5 referring to the EIA position in the rack.

P1

Major Assembly here refers to Planar 1 in the I/O drawer in the given rack position.

I1/Z1

Either a PCI slot, or SCSI controller in a I/O drawer.

Important AIX commands

List all adapters and their AIX location codes:

```
lsdev -Cc adapter
```

List all slots and what is in them:

```
lsslot -c pci
```

Show information about device including physical location code and the AIX location code:

```
lscfg -vl xyz
```

where *xyz* is the name of a device such as ent0 or ssa0.

Listing Device Physical Locations

CuDv (Customized Devices)

 # lsdev -C -H -F "name status physloc location description"

name	status	physloc	location	description
sys0	Available			System Object
pci0	Available	P1		PCI Bus
pci1	Available	P1.1	10-b8	PCI Bus
isa0	Available	P1	10-58	ISA Bus
sa0	Available	P1/S1	01-S1	Standard I/O Serial Port
scsi0	Available	P1/Z1	10-80	Wide/Fast-20 SCSI I/O Controller
cd0	Available	P1/Z1-A3	10-80-00-3,0	SCSI Multimedia CD-ROM Drive
rmt0	Defined	P1/Z1-A0	10-80-00-0,0	4.0 GB 4mm Tape Drive
hdisk0	Available	P1/Z1-A4	10-80-00-4,0	16 Bit SCSI Disk Drive
hdisk1	Available	P1/Z1-A5	10-80-00-5,0	16 Bit SCSI Disk Drive
mem0	Available			Memory
ent0	Available	P1/E1	10-60	IBM 10/100 Mbps Ethernet PCI
tok0	Available	P1.1-I3/T1	10-90	IBM PCI Tokenring Adapter

Figure 8-17. Listing Device Physical Locations AU1410.0

Notes:

The use of physical location codes is becoming more and more common, especially in working on problem determination involving the physical devices in a pSeries.

By default the **lsdev** command only shows the traditional AIX locations codes, but it does allow us to ask for additional information.

The **lsdev -CHF "name status physloc location description"** displays the output in a user-specified format. The **physloc** format option provides the physical location of a device and the **location** format option provides the logical location of a device.

Adding an ASCII Terminal

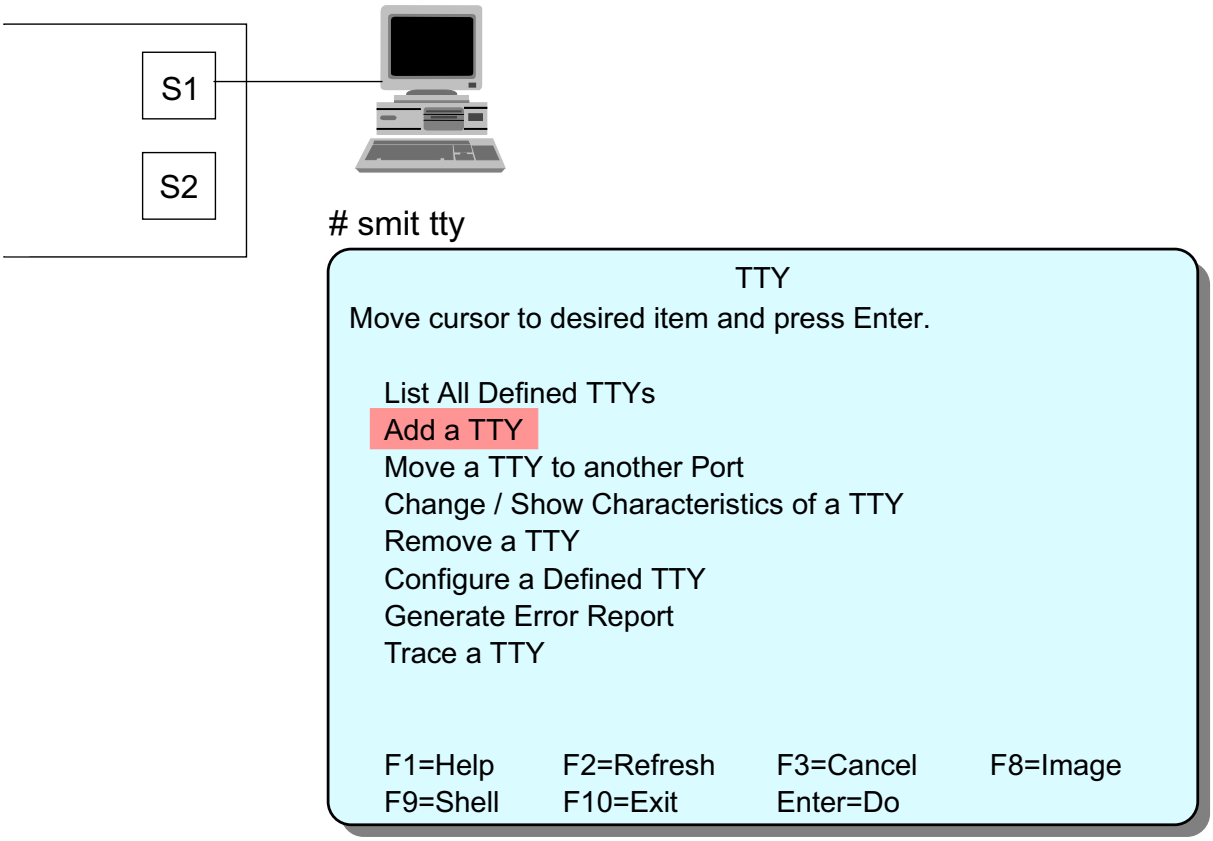


Figure 8-18. Adding an ASCII Terminal AU1410.0

Notes:

Most devices self-configure using **cfgmgr**. One type of device that does not is an ASCII terminal. We go through the process of adding an ASCII terminal to provide an example of what is required to manually configure a device.

First, physically attach the terminal to the serial port. Be sure to note which serial port it is attached to. We need that information as we complete this process.

To begin the configuration, use **smit tty**.

This screen is used to manage the configuration of asynchronous devices.

To add the terminal, select **Add a TTY**.

Attachment

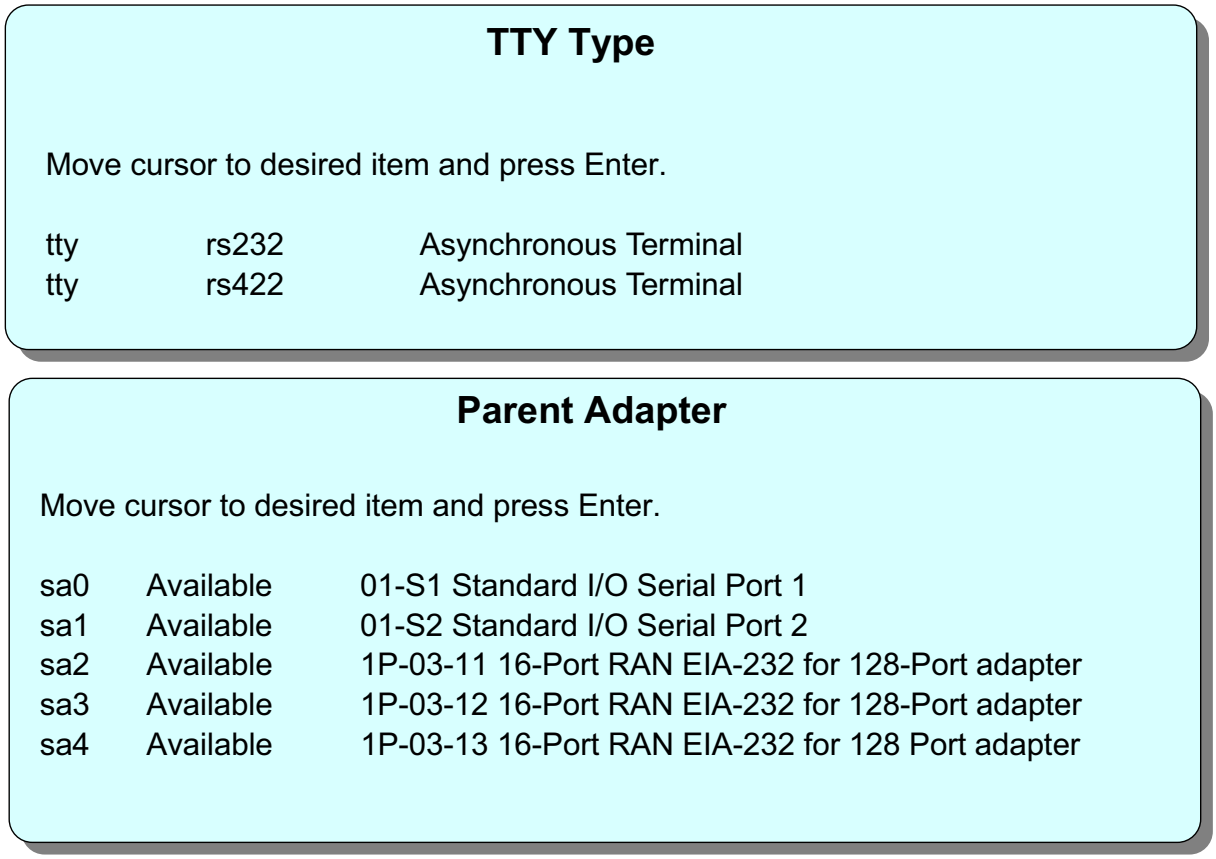


Figure 8-19. Attachment AU1410.0

Notes:

Once you select **Add a TTY**, you will then be asked the **TTY Type** and which **Parent Adapter** the terminal is attached to.

The choices for TTY type are **rs232** and **rs422**. rs232 is the most common TTY type.

To select the correct parent adapter, you need to know where the device is physically attached. This is where the serial port is important.

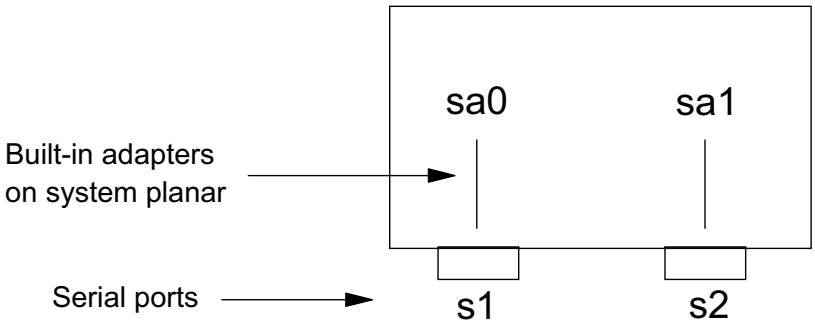
In our example from the previous page, the terminal was attached to serial port 1. Therefore, we select **sa0 - Standard I/O Serial Port 1**.

The location code is also displayed. **01-S1** is, in fact, the location code of serial port 1.

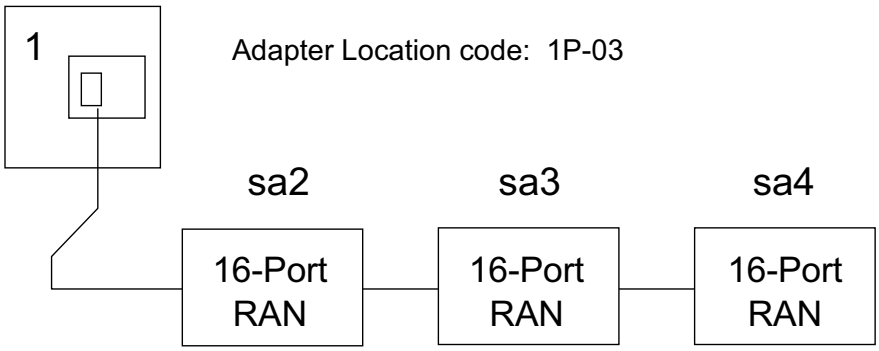
sa2, **sa3**, and **sa4** are remote asynchronous nodes used in conjunction with the 128-port async adapter.

Be careful with the numbering scheme. **sa0** is serial port 1. **sa1** is serial port 2. The **sa** stands for serial adapter. The adapters are devices and device names are numbered starting at 0.

For the built-in serial connection the nomenclature looks like this:



For the 128-port adapter the nomenclature looks like this:



Add a TTY

smit mktty

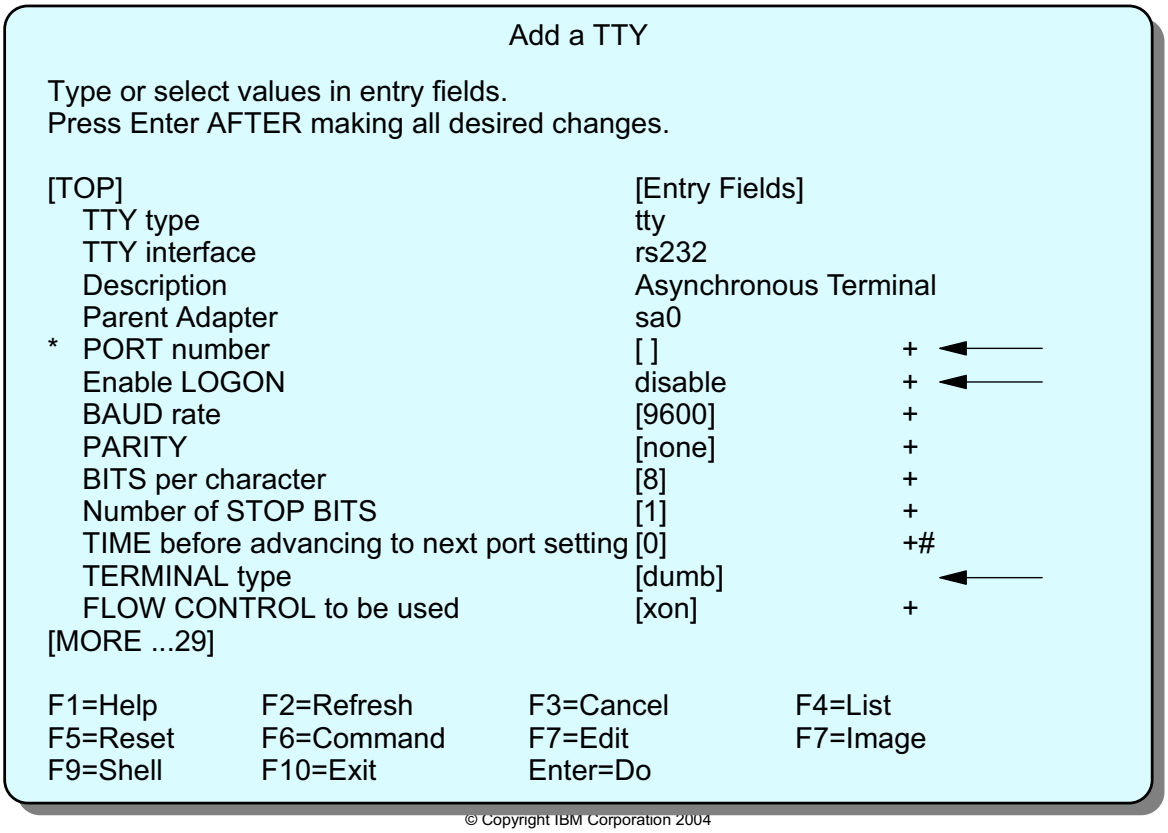


Figure 8-20. Add a TTY AU1410.0

Notes:

There is only one mandatory field on this screen and that is the PORT number. The F4 key will provide a list of possible port numbers. For the first built-in serial port it is **s1**, for the second it is **s2**. On a 16-port RAN, the choices are **0-15**. Select the one to which the terminal is connected. The combination of the appropriate RAN selected on the Parent Adapter selector screen and the port number shown here provides the system with the correct location code.

You must supply the port number to uniquely locate the device. The value required depends upon the adapter specified. For example:

Built-in serial port S1	s1
Built-in serial port S2	s2
8-Port Adapter	0-7
16-Port Adapter	0-15
Each 16-PORT RAN	0-15

The Enable LOGIN attribute will be set to disable by default. If you are adding a terminal that should have a login prompt, you should change this to enable.

The asynchronous line characteristics must be specified: baud rate, parity, bits per character, stop bits. In a national language environment you must use eight bits with no parity (the default). Set the speed appropriately for the terminal device or modem you are using, up to 38400.

The TERMINAL type attribute is used to assign the TERM environment variable when a user logs in on the device. You must set this to the name of a supported terminal type. The list of supported terminals can be found in directories located in /usr/share/lib/terminfo.

Documenting Hardware Configuration

- **lsdev -CH**
  Provides name, status, location, and description of devices
- **lscfg -v**
  Provides details of all devices including manufacturer, type and model number and part numbers
- **lsattr -El sys0**
  Provides attributes for the name device (for example, sys0)
  Run command for all devices
- **getconf -a**
  Provides the values of all system configuration variables

Figure 8-21. Documenting Hardware Configuration AU1410.0

Notes:

Documentation is an important part of the system administrators job. Be sure to document all device configurations for your machines.

lsdev -CH provides a listing all from the customized database. The **H** option supplies headers to the output for easier interpretation.

lscfg -v provides a verbose detailed output of all of the devices on the machines. It includes vital product data (VPD) which has information like manufacturer, type and model, and part numbers. Not all devices have VPD.

lsattr -El sys0 provides attributes for the device. In this example, it is providing the attributes for the kernel. **sys0** is the device name of the kernel. To fully document your system you need to run this command against all devices configured on your machine. For example, to get the attributes of a hard drive, you need to run **lsattr -El hdisk0**. It would probably be helpful to create a shell script to complete this process for you.

getconf -a writes the values of all system configuration variables to standard output.

Some examples:

```
#getconf BOOT_DEVICE
hdisk0
#getconf MACHINE_ARCHITECTURE
chrp
#getconf KERNEL_BITMODE
32
#getconf HARDWARE_BITMODE
32
#getconf REAL_MEMORY
131072
#getconf DISK_PARTITION /dev/hdisk0
16
#getconf DISK_SIZE /dev/hdisk0
8678
```

Exercise: Devices

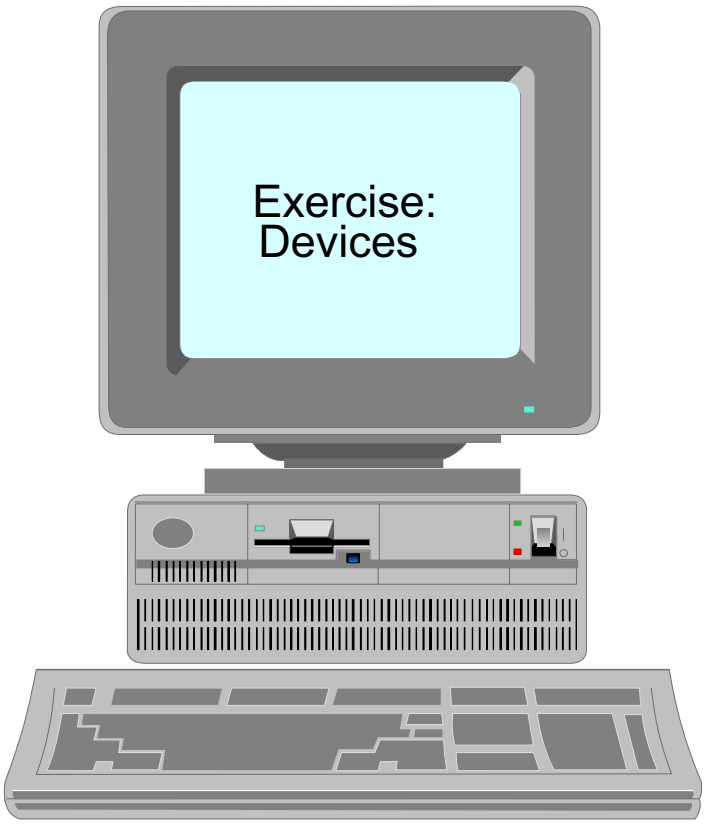


Figure 8-22. Exercise: Devices AU1410.0

Notes:

This lab gives you an opportunity to examine the device configuration of the classroom system.

The exercise can be found in your Exercise Guide.

Checkpoint (1 of 2)

 # lsdev -C -H

name	status	location	description
sys0	Available		System Object
pci0	Available		PCI Bus
isa0	Available	10-58	ISA Bus
ppa0	Available	01-R1	Standard I/O Parallel Port Adapter
lp0	Available	01-R1-00-00	IBM 4039 LaserPrinter
sa0	Available	01-S1	Standard I/O Serial Port 1
tty0	Available	01-S1-00-00	Asynchronous Terminal
mem0	Available		Memory
scsi0	Available	10-80	Wide SCSI I/O Controller
rmt0	Defined	10-80-00-3,0	5.0 GB 8mm Tape Drive
hdisk0	Available	10-80-00-4,0	SCSI Disk Drive
ent0	Available	10-60	IBM PCI 10/100 Ethernet Adapter

Figure 8-23. Checkpoint (1 of 2) AU1410.0

Notes:

Checkpoint (2 of 2)

1. Is it possible to use SCSI ID 7 for a new tape drive?

   Use the output on the previous slide (**lsdev -C -H**) to answer the following four questions.

2. What will happen if we attempt to add another device with the SCSI address set to 4?

3. Can the 8 mm tape drive be currently used? Why?

4. Where is the printer connected?

5. The token-ring adapter is installed in what slot?

Figure 8-24. Checkpoint (2 of 2) AU1410.0

Notes:

Unit Summary

- A physical device is the actual hardware attached to the system. A logical device is the software interface used by programs and users to access a physical device.
- Device information is stored in the ODM in two databases: customized and predefined.
- Devices can exist in a number of different states: unavailable, defined, available and stopped.
- Location codes are used to describe exactly where a device is connected into the system.
- Device attributes can be modified through SMIT.
- To create, modify, or remove device definitions, it is sometimes necessary to use commands such as **mkdev, chdev** and **rmdev.**

Figure 8-25. Unit Summary AU1410.0

Notes:

Unit 9. System Storage Overview

What This Unit Is About

This unit is an overview of AIX system storage.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Describe the terminology and the concepts associated with:
  Physical Volumes
  Volume Groups
  Logical Volumes
  Physical Partitions
  Logical Partitions
- Describe how file systems and logical volumes are related

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Activity

References

Online *System Management: Operating System and Devices*

Unit Objectives

After completing this unit, you should be able to:

- Describe the terminology and concepts associated with:
  - Physical Volumes
  - Volume Groups
  - Logical Volumes
  - Physical Partitions
  - Logical Partitions
- Describe how file systems and logical volumes are related

Figure 9-1. Unit Objectives AU1410.0

Notes:

Components of AIX Storage

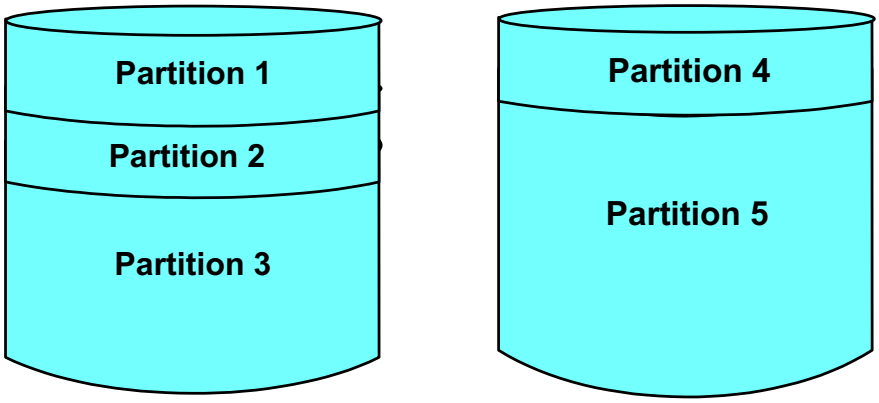
- Files
- Directories
- File Systems
- Logical Storage
- Physical Storage
- Logical Volume Manager

Figure 9-2. Components of AIX Storage AU1410.0

Notes:

These are the basic components or building blocks of AIX storage. As a user you work with files and directories. As a system administrator you work with the others as well.

Traditional UNIX Disk Storage



PROBLEMS:

- Fixed partitions
- Expanding size of the partition
- Limitation on size of a file system and a file
- Contiguous data requirement
- Time and effort required in planning ahead

Figure 9-3. Traditional UNIX Disk Storage AU1410.0

Notes:

Traditionally, disk partitioning has been implemented via partitions. Customers had to select the correct size for each partition before the system could be installed.

Each file system sits on a partition on the hard disk.

Changing the size of the partition and thus the file system is no easy task. It involves backing up the file system, removing the partition, creating new ones and restoring the file system.

A major limitation to partitions is that each partition has to consist of contiguous disk space. This characteristic limits the partition to reside on a single physical drive. It cannot span multiple hard disks. Since file systems are always contained within a partition, no file system can be defined larger than the largest physical drive. This means that no single file can exist larger than the largest physical drive.

Benefits of the LVM

- Logical volumes solve noncontiguous space problems
- Logical volumes can span disks
- Dynamically increase logical volume size
- Logical volumes can be mirrored
- Hard disks easily added to a system
- Logical volumes can be relocated
- Volume group and logical volume statistics can be collected

These tasks can be performed dynamically!

Figure 9-4. Benefits of the LVM AU1410.0

Notes:

The constraints with traditional UNIX disk storage have been virtually eliminated in AIX with the addition of the Logical Volume Manager.

Note that the tasks listed above can be performed while users are on the system.

Physical Storage

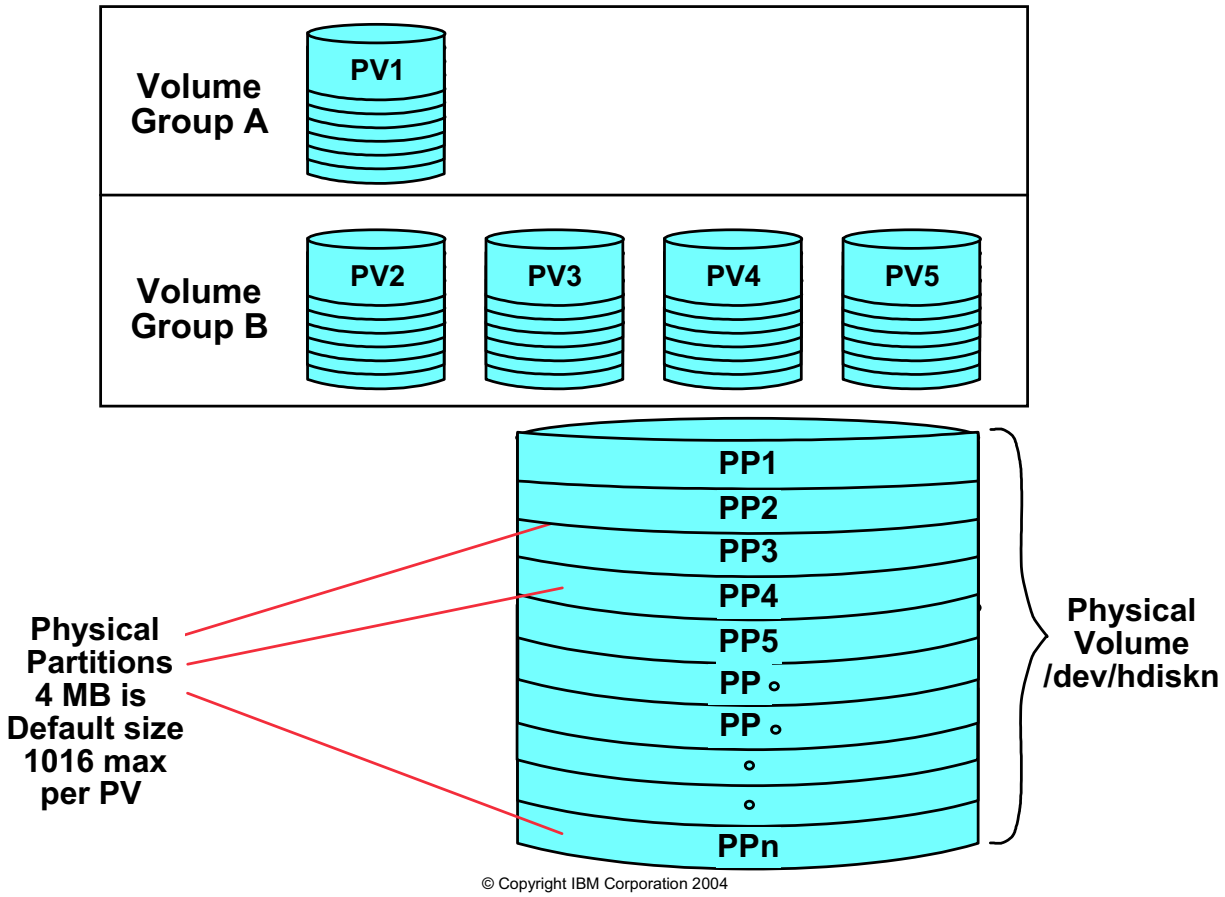


Figure 9-5. Physical Storage AU1410.0

Notes:

Physical Volumes

A physical volume (PV) is the name for an actual disk or hard drive. A PV can be internally attached or externally attached.

When a physical volume is added to a system, a file called hdisk*n* is added to the /dev directory. *n* is a number allocated by the operating system. It is usually the next available number. This file may be used to access the device directly but this is not often done.

For a disk to be used by logical volume manager, the disks must be added to a volume group or a new volume group must be set up for it.

A PV can only belong to one VG.

Volume Group

A volume group (VG) is the largest unit of storage allocation. A VG consists of a group of one or more physical volumes (disks) all of which are accessed under one VG name. The combined storage of all the physical volumes make up the total size of the VG. This space can be used by other storage entities like file systems and logical volumes.

Volume groups are portable and can be disconnected from one system and connected to another system. All disks in the VG must move together.

A volume group is broken down and manipulated as a collection of physical partitions (PP) which lie on the physical volumes within the volume group. The size of the PP's within a VG is constant.

Physical Partitions

A physical partition (PP) is a division of a physical volume. It is the basic unit of disk space allocation.

Since most disks are larger than 4 GB, the default PP size of 4 MB normally needs to be changed. PP size can be changed in increments of the power of 2 up to 1024 MB. In AIX 5.2 and later, LVM will default the PP size of a new VG to the smallest PP size (equal or greater than 4MB) which will allow full addressing of the largest disk in the VG given the selected maximum number of PPs per PV (defaults to 1016). The smallest PP size is 1 MB, which is supported by using a larger number of PPs per PV.

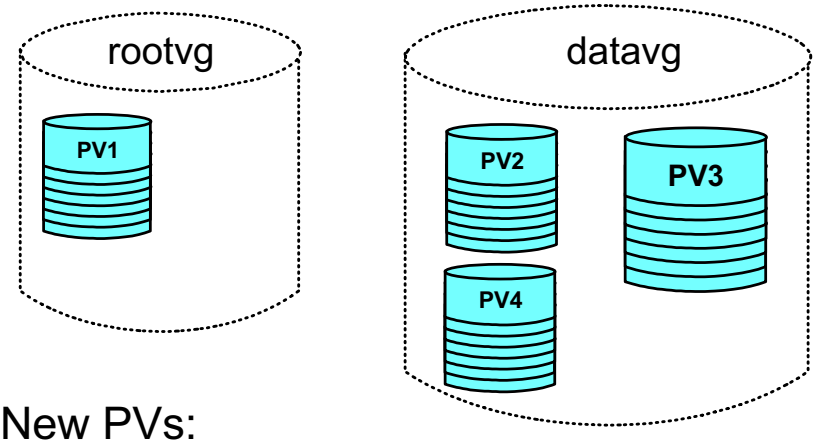
In AIX 5.3, a Scalable VG can have a maximum PP size of 128GB.

All PPs within a volume group are the same size and cannot be changed dynamically. The default size of the PPs is 4 MB. The default maximum number of PPs per PV is 1016. A volume group that contains a physical volume larger than 4.064 GB needs either a physical partition size greater than 4 MB or the physical volume must be allocated more physical partitions. The physical partition size cannot be changed dynamically. However, the number of physical partitions per physical volume can be changed dynamically in multiples of 1016 (that is 1016, 2032, 3048, 4064 and so forth up to a maximum of 130,048).

In AIX 5.3, a Scalable VG can have a maximum number of PPs per PV of 2,097,152.

Be aware that if you choose to have more than 1016 PPs per PV, in a non-scalable VG you will decrease the maximum number of 32 physical volumes supported in the volume group. Details on this will be discussed shortly.

Volume Groups



New PVs:
- Add to existing VGs
- Create new VG

Why create new volume groups?
- Separate user data from operating system files
- Disaster recovery
- Data portability
- Data integrity and security

Figure 9-6. Volume Groups AU1410.0

Notes:

When the system is installed, the root volume group (**rootvg**) is created. This is where the AIX operating system files are contained.

Additional disks can either be added to **rootvg** or a new volume group can be created for them. There can be up to 255 VGs per system.

If you have external disks, it is recommended that they be placed in a separate volume group. By maintaining the user file systems and the operating system files in distinct volume groups, the user files are not jeopardized during operating system updates, reinstallations, and crash recoveries.

Maintenance is easier because you can update or reinstall the operating system without having to restore user data.

For security, you can make the volume group unavailable using **varyoffvg**.

Volume Group Descriptor Area

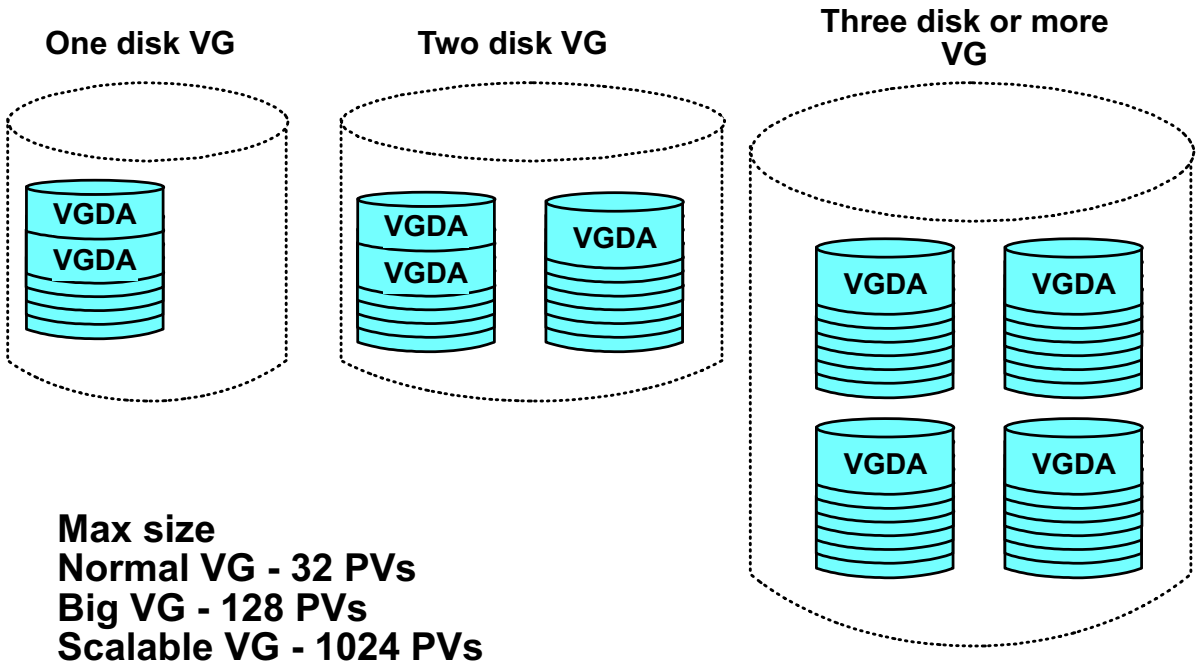


Figure 9-7. Volume Group Descriptor Area AU1410.0

Notes:

VGDA The Volume Group Descriptor Area (VGDA) is an area of disk, at least one per PV, containing information for the entire VG. It contains administrative information about the volume group (for example, a list of all logical volume entries, a list of all the physical volume entries and so forth). There is usually one VGDA per physical volume. The exceptions are when there is a volume group of either one or two disks (illustrated).

Quorum There must be a quorum of VGDAs available to activate the volume group and make it available for use (**varyonvg**). A quorum of VGDA copies is needed to ensure the data integrity of management data that describes the logical and physical volumes in the volume group. A quorum is equal to 51% or more of the VGDAs available.

A system administrator can force a volume group to varyon without a quorum. This is not recommended and should only be done in an emergency.

Volume Group Limits (1 of 2)

VG Type	Maximum PVs	Maximum LVs	Maximum PPs per VG	Maximum PP size
Normal VG	32	256	32,512 (1016 * 32)	1 GB
Big VG	128	512	130,048 (1016 * 128)	1 GB
Scalable VG	1024	4096	2,097,152	128 GB

Figure 9-8. Volume Group Limits (1 of 2) AU1410.0

Notes:

This table illustrates the differences in limits between different types of volume groups.

Beginning with AIX 5.3, LVM supports scalable volume groups which are the most flexible. Not only are the limits much more scalable, but one does not need to make trade off as is sometimes necessary with normal or big volume groups.

Volume Group Limits (2 of 2)

- Normal Volume Groups (mkvg)

Number of disks:	Max. number of partitions/disk:
1	32512
2	16256
4	8128
8	4064
16	2032
32	**1016**

- Big Volume Groups (mkvg -B)

Number of disks:	Max. number of partitions/disk:
1	130048
2	65024
4	32512
8	16256
16	8128
32	4064
64	2032
128	**1016**

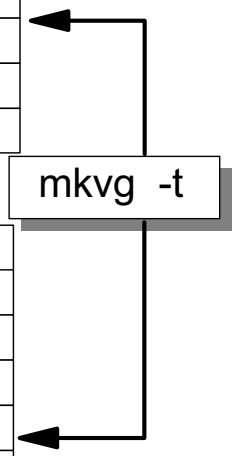


Figure 9-9. Volume Group Limits (2 of 2) AU1410.0

Notes:

With successive versions of AIX, new type of volume groups have been introduced which allow for greater capacities and greater flexibility:

- **Normal volume groups:** When creating a volume group with SMIT or using the **mkvg** command, normal volume groups are the default.
- **Big volume groups:** This volume group was introduced with AIX 4.3.2. A big volume group must be created using the command line command **mkvg -B**. Beside increasing the number of PVs per VG, the big volume group also doubled the maximum number of LVs per VG from 255 to 512. Support for creating Big volume groups via SMIT was introduced in AIX 5.3.
- **Scalable volume groups**: This volume group was introduced with AIX 5.3. A scalable volume group is be created using the line command **mkvg -S**.

The other physical limitation on the volume group is the number of physical partitions on a physical volume within the volume group. In AIX 4.3.1, the ability to increase the number of physical partitions (known as factor) was added. This is done using the command **mkvg -t**

where the “#” is a multiplier for the number of PPs desired. The number is multiplied by 1016 and that becomes the new limit for PPs on PVs with a VG. For example, **mkvg -t 2** would allow 2032 (1016*2) PPs per PV.

Changing the factor will affect the number of PVs in a volume group. The above charts show the relationship between the factor and the number of PVs in both types of VGs. If in our example of **mkvg -t 2**, this would allow us 2032 PPs per PV and the maximum number of PVs is 16 (normal VG) or 64 (big VG). To modify an existing VG, the command is **chvg** instead of **mkvg**.

The t factor is not needed or supported for the Scalable VGs.

Logical Storage

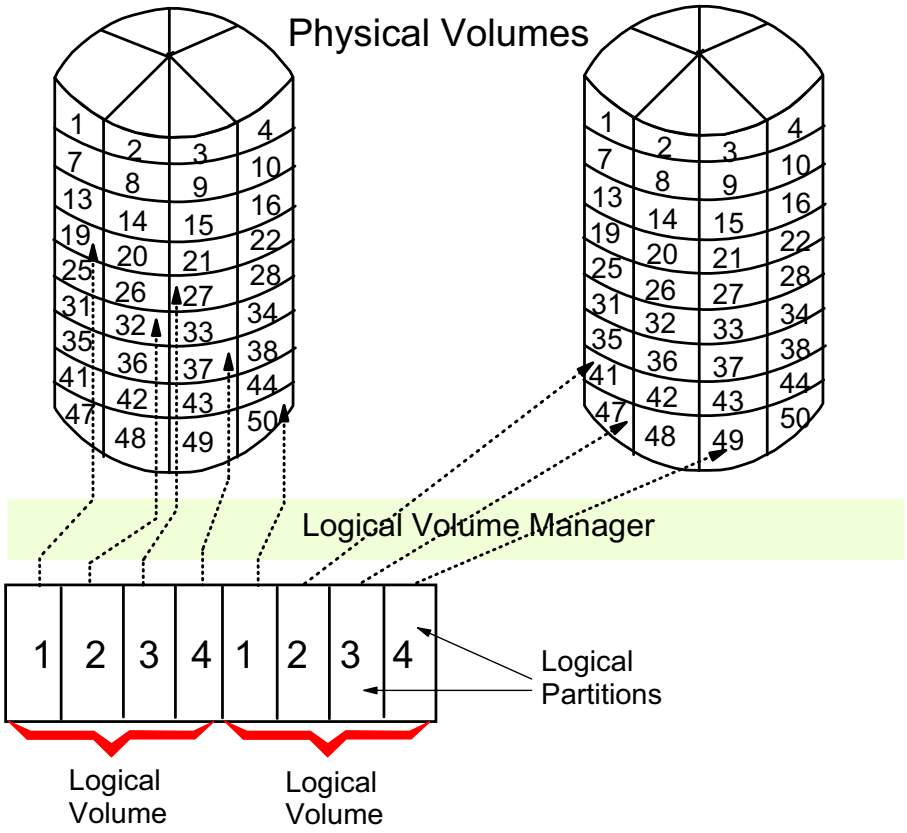


Figure 9-10. Logical Storage AU1410.0

Notes:

A **physical partition** is the smallest unit of allocation of disk. Each logical partition maps to a physical partition which physically stores the data.

Obviously, the logical partitions within a volume group are the same size as the physical partitions within that volume group.

A **logical volume** consists of one or more logical partitions within a volume group.

Logical volumes may span physical volumes if the volume group consists of more than one physical volume. Logical volumes do not need to be contiguous within a physical volume because the logical partitions within the logical volume are maintained to be contiguous. The view the system sees is the logical one. Thus, the physical partitions they point to can reside anywhere on the physical volumes in the volume group.

Logical volumes may be increased in size at any time, assuming that there are sufficient free physical partitions within the volume group. This can be done dynamically through SMIT even when users are doing work in that logical volume. However, logical volumes

cannot easily be decreased and require a file system backup and restore to a recreated smaller logical volume.

Logical volumes consist of a number of logical partitions, so when a logical volume is being created the size requested is increased to the next logical partition boundary. Typically, the logical/physical partition size is 4 MB so a logical volume is a multiple of 4 MB in size. Logical/physical partition sizes range from 1 MB - 1024 MB.

A volume group is where the physical and logical views of storage meet. It is both a physical view and a logical view.

The **Logical Volume Manager** (LVM) consists of the logical volume device driver (LVDD) and the LVM subroutine interface library. The LVM controls disk resources by mapping data between a more simple and flexible logical view of storage space and the actual physical disks. The LVM does this using a layer of device driver code that runs above traditional disk device drivers.

Uses of Logical Volumes

A logical volume may contain one of the following, and only one at a time:

- Paging space (/dev/hd6)
- Journal log (/dev/hd8)
- Boot Logical Volume (/dev/hd5)
- Nothing (raw logical volume)
- Journaled or Enhanced journaled file system
  (for example:

/dev/hd1	/home
/dev/hd2	/usr
/dev/hd3	/tmp
/dev/hd4	/
/dev/hd9var	/var
/dev/hd10opt	/opt
/dev/lv00	/myfilesystem)

Figure 9-11. Uses of Logical Volumes AU1410.0

Notes:

When you install the system, you automatically create one volume group (**rootvg**) which consists of a base set of logical volumes required to start the system. **rootvg** contains such things as paging space, the journal log, and boot data, each usually in its own separate logical volume.

You can create additional logical volumes with the **mklv** command or go through the SMIT menus. This command allows you to specify the name of the logical volume and to define its characteristics.

The theoretical maximum number of user-defined logical volumes per volume group is 255 (512 for big volume groups), but the true limit is determined by the total size of the combined physical volumes assigned to the volume group.

The native file system on AIX is the journaled file system (JFS), or the enhanced journaled file system (JFS2). They use database journaling techniques to maintain consistency. It is through the file system's directory structure that users access files, commands, applications, and so forth.

Paging space is fixed disk storage for information that is resident in virtual memory but is not currently being accessed.

The journal log is the logical volume where changes made to the file system structure are written until such time as the structures are updated on disk. Journaled file systems and enhanced journaled file systems is discussed in greater detail later in the course.

The boot logical volume is a physically contiguous area on the disk which contains the boot image.

A raw device is simply an empty logical volume. Sometimes an application, for example a database package, may require a raw device.

When you install the operating system, the dump device is automatically configured for you. By default, the primary device is /**dev**/**hd6**, which is the paging logical volume, and the secondary device is /**dev**/**sysdumpnull**. For systems migrated from versions of AIX earlier than 4.1, the primary dump device is what it formerly was, /**dev**/**hd7**.

What Is a File System?

- A file system is:
  - Method of storing data
  - Hierarchy of directories
- Seven types supported:
  - Journaled File System (jfs)
  - Enhanced Journaled File System (jfs2)
  - CD-ROM File System (cdrfs)
  - DVD-ROM File System (udfs)
  - Network File System (nfs)
  - Common Internet Filesystem (cifs)
  - Proc File System (procfs)
- Different file systems are connected together via directories to form the view of files users see.

Figure 9-12. What Is a File System? AU1410.0

Notes:

AIX supports seven file system types:

jfs	Journaled File System which exists within a Logical Volume on disk
jfs2	Enhanced Journaled File System which exists within a Logical Volume on disk
cdrfs	CD-ROM File System on a Compact Disc
udfs	Universal Disk Format (UDF) file system on DVD
cifs>	Common Internet File System accessed across a network (via AIX Fast Connect)
nfs	Network File System accessed across a network
procfs	Proc File System maps processes and kernel data structures to corresponding files

Although these are physically different, they appear the same to users and applications.

A file system is a directory hierarchy for storing files. It has a root directory and subdirectories. In an AIX system, the various file systems are joined together so that they appear as a single file tree with one root. Many file systems of each type can be created.

Because the available storage is divided into multiple file systems, data in one file system could be on a different area of the disk than data of another file system. Because file systems are of a fixed size, file system full errors can occur when that file system has become full. Free space in one file system cannot automatically be used by an alternate file system that resides on the same physical volume.

Why Have Multiple File Systems

- Can strategically place it on disk for improved performance
- Some tasks are performed more efficiently on a file system than on each directory within the file system, for example, back up, move, secure an entire file system
- Can limit disk usage of users by file system (quotas)
- Maintain integrity of the entire file system structure, for example, if one file system is corrupted, the others are not affected
- Special security situations
- Organize data and programs into groups for ease of file management and better performance

Figure 9-13. Why Have File Systems AU1410.0

Notes:

A file system is a structure that allows you to organize your data. It is one level in the hierarchy of you data. By placing data in separate file systems, it allows for ease of control and management of the data.

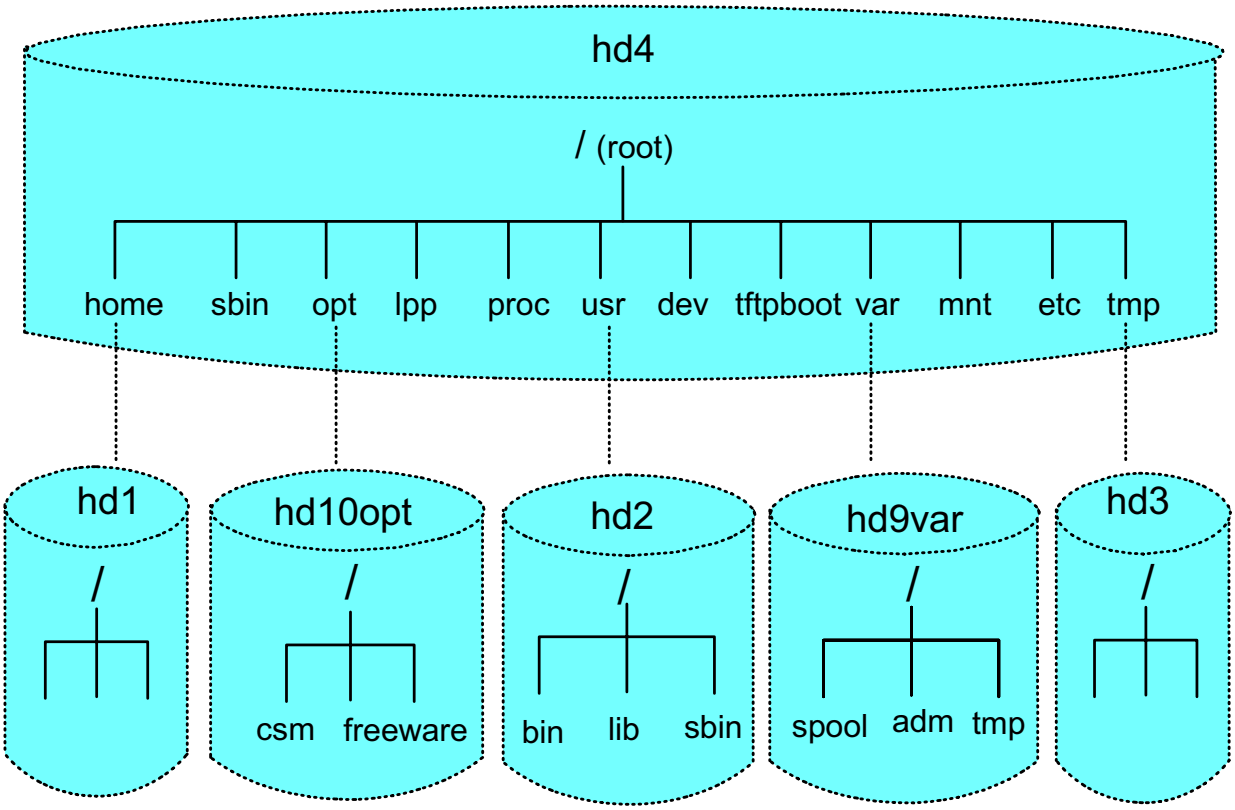
File systems can be placed on the disk in areas that provide the best performance.

Many times, backups and recoveries are done at a file system level.

Since the administrator determines the size of the file system, users are allocated only a certain amount of shared disk space. This helps to control disk usage. The administrator can also impose more granular control over that disk space by limiting how much space an individual user can use in a file system. This is known as file system quotas.

By having several different file systems, all of your data is not in one place. If a file system ever becomes corrupted, the other file systems will not be affected. Also, administrators can take a file system offline without affecting other file systems. This is helpful when performing back ups or when limiting user's access to the file system for security reasons.

Standard File Systems in AIX



NOTE: The drawing depicts logical not physical devices

Figure 9-14. Standard File Systems in AIX AU1410.0

Notes:

When AIX is first installed on a stand-alone system there are only six journaled file systems in existence:

- / (root) = /dev/hd4
  At the top of the hierarchical file tree. It contains the files and directories critical for system operations including the device directory and programs that complete the boot process.
- /usr = /dev/hd2
  Operating system commands, libraries and application programs. Can be shared across the network.
- /var = /dev/hd9var
  Variable spool and log files. The files in this file system vary considerably depending on system activity.

- /home = /dev/hd1
  Users' home directories (was /u in earlier versions of AIX). This is traditionally where user data files are stored.
- /tmp = /dev/hd3
  Space accessible to all users for temporary files and work space. Should be cleared out frequently.
- /opt = /hd10opt
  Special file system to store freeware files.
- /proc = /proc
  Special file system kept in memory to support threads, or light weight processes. This file system is not designed to store user files and is not from type journaled file system.

Let's Review

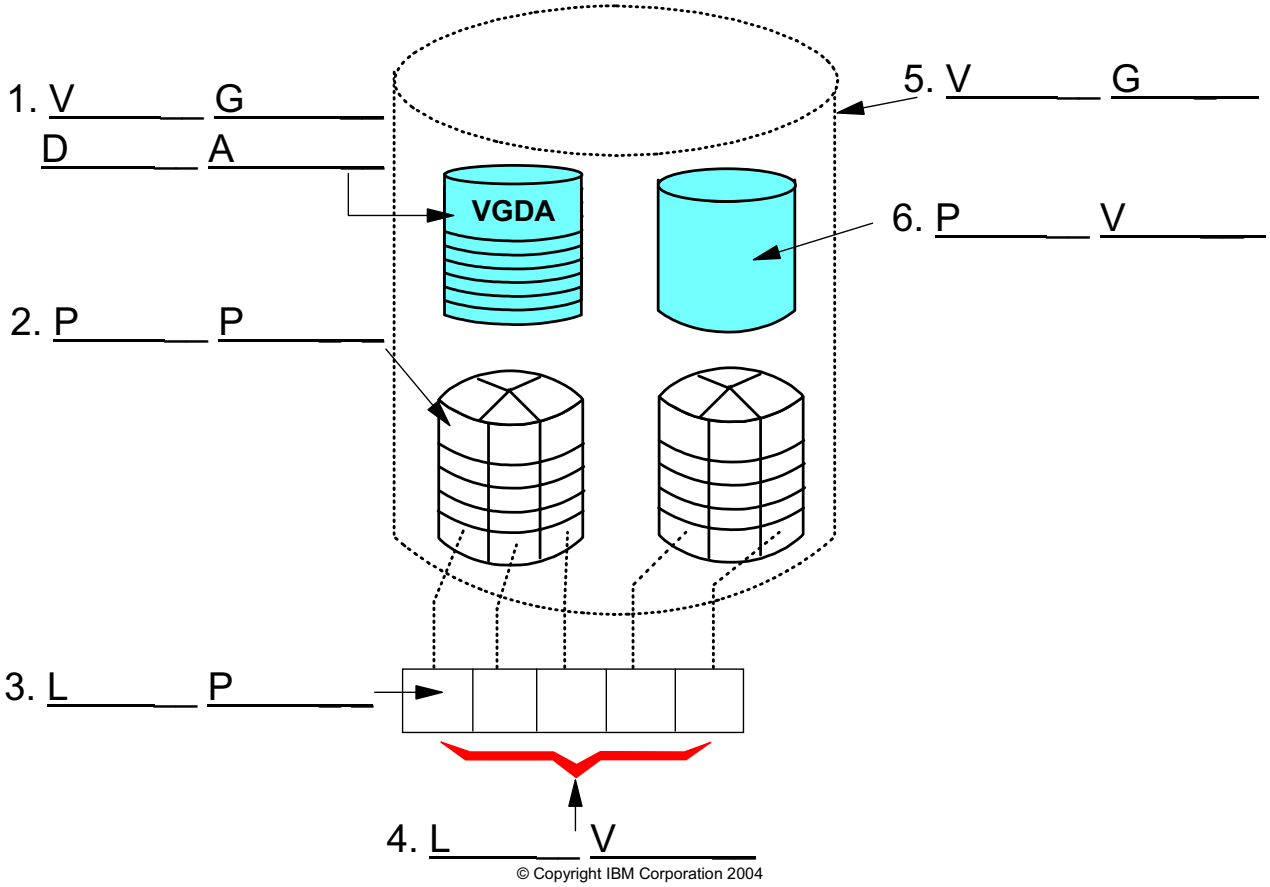


Figure 9-15. Let's Review AU1410.0

Notes:

Label the items shown in the picture above.

/etc/filesystems

```
/:
        dev       = /dev/hd4
        vol       = root
        mount     = automatic
        check     = false
        vfs       = jfs
        log       = /dev/hd8
        type      = bootfs

/home:
        dev       = /dev/hd1
        vol       = /home
        mount     = true
        check     = true
        vfs       = jfs
        log       = /dev/hd8

/home/team01:
        dev       = /dev/fslv00
        vfs       = jfs2
        log       = /dev/loglv00
        mount     = true
        options   = rw
        account   = false
```


Figure 9-16. /etc/filesystems AU1410.0

Notes:

The **/etc/filesystems** file documents the layout characteristics, or attributes of file systems. It is in a stanza format which means a resource is named followed by a colon and a listing of its attributes in the form of attributes = value.

Each stanza in the **/etc/filesystems** file names the directory where the file system is normally mounted.

The file system attributes specify all the parameters of the file system. They are as follows:

check used by the **fsck** command to determine the default file systems to be checked. **True** enables checking

dev for local mounts identifies either the block special file where the file system resides, or the file or directory to be mounted

mount used by the **mount** command to determine whether a file system should be mounted by default

Possible values are:

automatic file system mounted automatically at system startup

true file system mounted by the **mount all** command. This command is issued during system initialization to automatically mount such file systems

false file system will not be automatically mounted

type used to group together related file systems which can all be mounted with the **mount -t** command

vfs specifies the type of mount. For example, vfs=jfs2

vol used by the **mkfs** command when initiating the label on a new file system

log the device to which log data is written, as this file system is modified. (This option is only valid for journaled file systems)

account used to determine the filesystems to be processed by the accounting system.

Mount

- **mount:** the glue that logically connects file systems to the directory hierarchy.
- File systems are associated with devices represented by special files in /dev - the logical volume.
- When a file system is mounted, the logical volume and its contents are connected to a directory in the hierarchical tree structure.

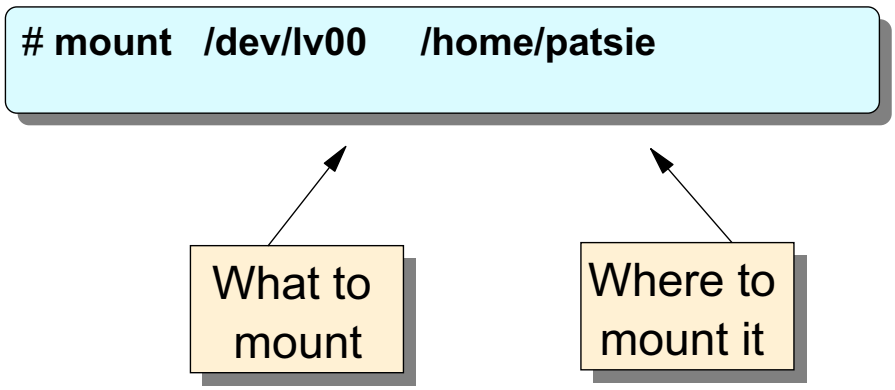


Figure 9-17. Mount AU1410.0

Notes:

A file system has to be mounted in order for it to be available for use. Use the **mount** command or SMIT to do this. The file system can also be umounted using the **umount** or unmount command, or SMIT. These commands can be executed by either the root user or a member of the system group.

Full path names must be used when specifying the mount point.

It is possible to have file systems automatically mounted at boot time. This can be specified in the /**etc**/**filesystems** file using the **mount=automatic** or **mount=true** parameters.

If SMIT is used to create the file system, the mount point is created automatically.

Mounting over an Empty Directory

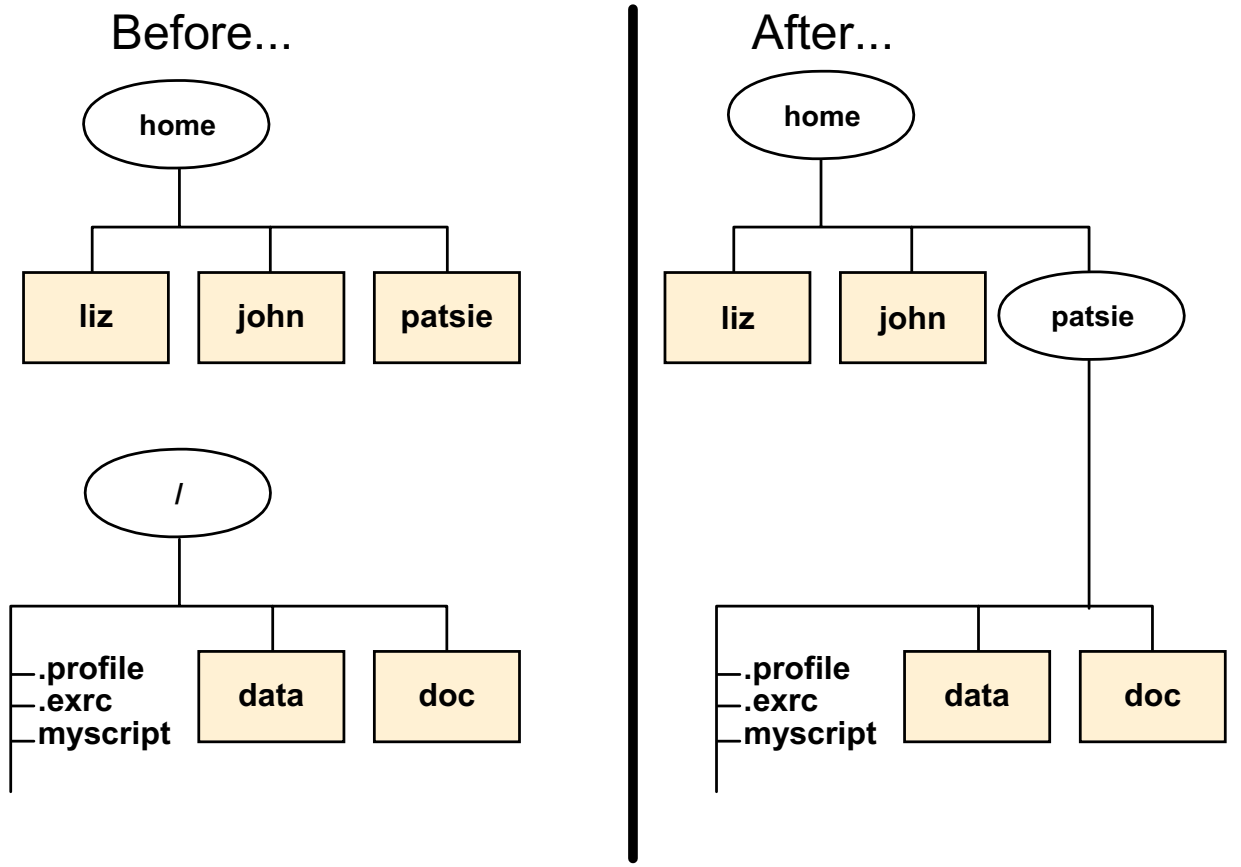


Figure 9-18. Mounting over an Empty Directory AU1410.0

Notes:

In order for users to get access to the data contained in a file system, it must be mounted. When the file system is mounted, it becomes a part of the hierarchical tree structure of files and directories. From the users perspective, there is no way to tell where one file system ends and another begins.

Mounting over Files

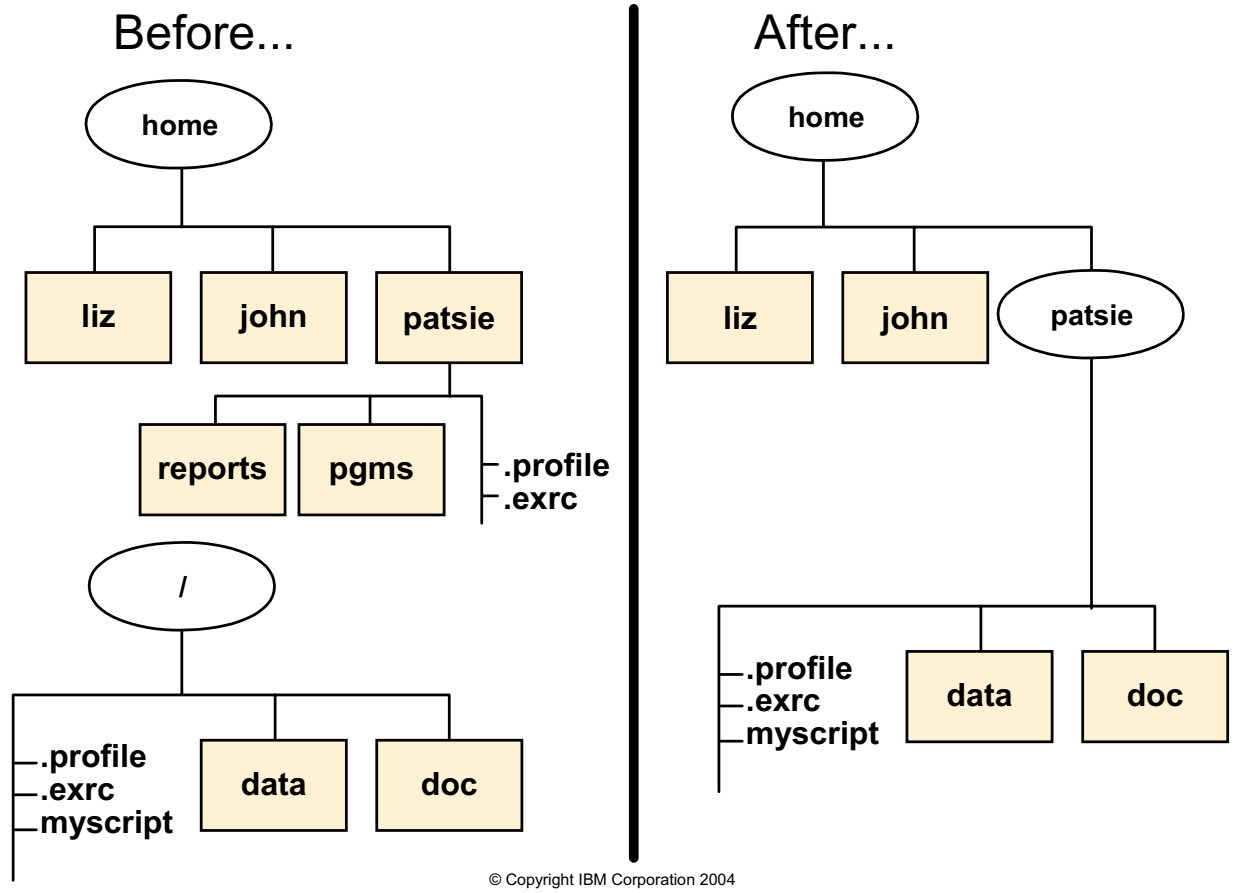


Figure 9-19. Mounting over Files AU1410.0

Notes:

It is possible to mount over files and subdirectories. The result is that the files and subdirectories that have been mounted over are now hidden from the users, that is, inaccessible. They have not been lost though. They are again accessible when the **unmount** command has been executed on the covering file system.

Not everyone has the authority to mount file systems randomly. Authority is based on two things: what the default mount point is, as specified in the file **/etc/filesystems**, and whether the user has write authority to that mount point. Users can issue file or directory mounts provided they belong to the system group and have write access to the mount point. They can do device mounts only to the default mount points mentioned in the file /etc/filesystems. **root** can mount anywhere under any set of permissions.

Listing File Systems

lsfs

Name	Nodename	Mount Pt	VFS	Size	Options	Auto	Account
/dev/hd4	-----	/	jfs	32768	-----	yes	no
/dev/hd1	-----	/home	jfs2	90112	-----	yes	no
/dev/hd2	-----	/usr	jfs	1277952	-----	yes	no
/dev/hd9var	-----	/var	jfs	65536	-----	yes	no
/dev/hd3	-----	/tmp	jfs	65536	-----	yes	no
/dev/cd0	-----	/infocd	cdrfs	-----	ro	yes	no
/dev/lv00	-----	/home/john	jfs2	32768	rw	yes	no
/proc	-----	/proc	procfs	-----	-----	yes	no
/dev/hd10opt	-----	/opt	jfs	65536	-----	yes	no

Figure 9-20. Listing File Systems AU1410.0

Notes:

You can list the various file systems that are defined using the **lsfs** command. This command displays information from /**etc**/**filesystems** and from the logical volumes in a more readable format.

lsfs also display information about CD-ROM file systems and remote NFS file systems.

lsfs [-q] [-c | **-l] [-v vfstype** | **-u mountgrp][file system]**

The data may be presented in line and colon (**-c**) or stanza (**-l**) format. It is possible to list only the file systems of a particular virtual file system type (**-v**), or within a particular mount group (**-u**). The **-q** option queries the superblock for the fragment size information, compression algorithm and the number of bytes per inode.

The SMIT fastpath to get to the screen which will accomplish the same task as the **lsfs** command is: **# smit fs**.

Listing Logical Volume Information

- List all Logical Volumes by Volume Group:

 # lsvg -l rootvg

```
LVNAME   TYPE    LPs    PPs   PVs LV STATE      MOUNT POINT
hd6      paging   64    64    1   open/syncd    N/A
hd5      boot      1     1    1   closed/syncd  N/A
hd8      jfslog    1     1    1   open/syncd    N/A
hd4      jfs       2     2    1   open/syncd    /
hd2      jfs     156   156    1   open/syncd    /usr
hd9var   jfs       1     1    1   open/syncd    /var
hd3      jfs       3     3    1   open/syncd    /tmp
hd1      jfs2      1     1    1   open/syncd    /home
hd10opt  jfs       2     2    1   open/syncd    /opt
lv00     jfs2      2     2    1   open/syncd    /home/john
```


Figure 9-21. Listing Logical Volume Information AU1410.0

Notes:

lsvg -l rootvg

Provides information about the logical volumes in the rootvg volume group.

lslv lvname

This provides status information about the selected logical volume within the volume group. For example, **lslv hd6.**

Checkpoint (1 of 3)

1. How many different PP sizes can be set within a single VG?

   _____

2. By default, how big are PPs?

   _____

3. How many VGs can a PV belong to?
   a. Depends on what you specify through SMIT
   b. Only one
   c. As many VGs as exist on the system

4. T/F All VGDA information on your system is identical, regardless of how many VGs exist.

Using the output listing the file systems shown below, answer the questions on the next page:

 # lsfs

```
  Name        Nodename   Mount Pt    VFS       Size      Options   Auto
/dev/hd4         --      /           jfs       8192         --     yes
/dev/hd1         --      /home       jfs       90112        --     yes
/dev/hd2         --      /usr        jfs       507904       --     yes
/dev/hd9var      --      /var        jfs       8192         --     yes
/dev/hd3         --      /tmp        jfs       16384        --     yes
/dev/hd10opt     --      /opt        jfs       65536        --     yes
/dev/cd0         --      /infocd     cdrfs                  ro     yes
/dev/lv00        --      /home/john  jfs       8192         rw     yes
```


Figure 9-22. Checkpoint (1 of 3) AU1410.0

Notes:

Checkpoint (2 of 3)

5. With which logical volume is the /home file system associated?

   _____

6. What type of file systems are being displayed?

   _____

7. What is the mount point for the file system located on the /dev/lv00 logical volume?

   _____

8. Which are the system supplied logical volumes and their associated file systems?

   _____
   _____
   _____
   _____
   _____

9. Which file system is used primarily to hold user data and home directories?

   _____

Figure 9-23. Checkpoint (2 of 3) AU1410.0

Notes:

Checkpoint (3 of 3)

 # lsvg -l rootvg

```
LVNAME    TYPE      LPs  PPs  PVs   LV State        MOUNT POINT
hd6       paging    8    8    1     open/syncd      N/A
hd5       boot      1    1    1     closed/syncd    N/A
hd8       jfslog    1    1    1     open/syncd      N/A
hd9var    jfs       1    1    1     open/syncd      /var
hd3       jfs       2    2    1     open/syncd      /tmp
lv00      jfs2      1    1    1     closed/syncd    /home/john
```

Using the output listing of logical systems above, answer the following:

10. Which of the logical volumes above are examples of logical volumes with journaled file systems on them?

    _____

Figure 9-24. Checkpoint (3 of 3) AU1410.0

Notes:

Activity: LVM Commands

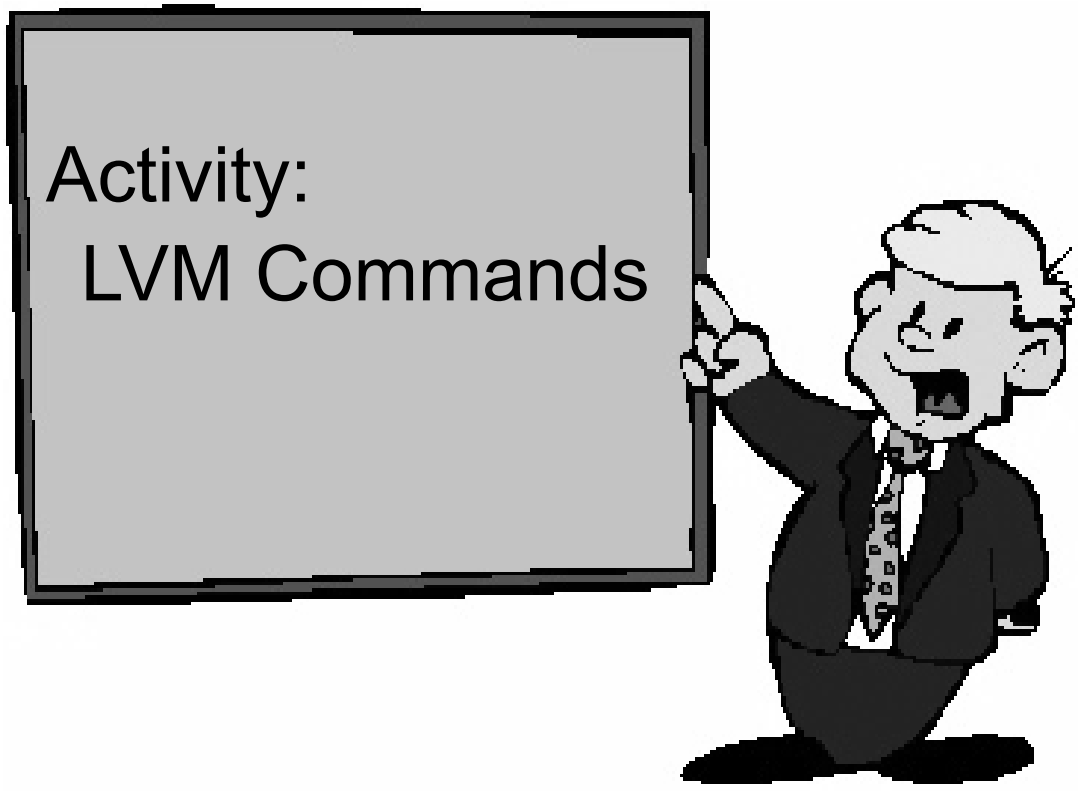


Figure 9-25. Activity: LVM Commands AU1410.0

System Storage Overview Activity

This activity gives you a chance to look at the file system configuration on your machine and introduce you to some commands that will be covered in depth during the lecture.

1. Log in as **team01** and **su** to **root**.

   $ su
   password: **ibmaix**

2. View the contents of /**etc/filesystems** and list the file systems on your machine.

   # more /etc/filesystems

3. Try running the **lsfs** command. What does it show? _____

   # lsfs

4. Try running **lsvg**. What does it show? _____

lsvg

5. Try running **lspv**. What does it show? _____

lspv

6. Try running **lsvg -l rootvg**. What does it show? _____

lsvg -l rootvg

END

All of the above commands, plus lots more, will be covered later in the course.

Unit Summary

- The LVM is organized as follows:
  - A **VG** consists of one or more **PVs**
  - Each **PV** is divided into **PPs**
  - A **LV** is made up of **LPs**
  - **LPs** are mapped to **PPs**
- Logical Volumes are used to contain:

JFS or JFS2	Paging Spaces
Dump Space	Journal Log
Boot Logical Volume	Raw Space

- The most common use of logical volumes is to contain JFS or JFS2.

Figure 9-26. Unit Summary AU1410.0

Notes:

Unit 10. Working with the Logical Volume Manager

What This Unit Is About

This unit provides information on how to work with logical volumes, physical volumes, and volume groups.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Add/Change/Delete Volume Groups
- Add/Change/Delete Logical Volumes
- Add/Change/Delete Physical Volumes
- Describe mirroring
- Describe striping

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise
- Activity

References

Online	*System Management Guide: Operating System and Devices*
GG24-4484	*AIX Storage Management*
	downloadable IBM Redbooks (published 2000):
	Logical Volume Manager from A to Z: Introduction and Concepts
	Logical Volume Manager from A to Z: Troubleshooting and Commands

Unit Objectives

After completing this unit, you should be able to:

- Add, Change, or Delete Volume Groups
- Add, Change, or Delete Logical Volumes
- Add, Change, or Delete Physical Volumes
- Describe mirroring
- Describe striping

Figure 10-1. Unit Objectives AU1410.0

Notes:

Logical Volume Manager

 # smit lvm

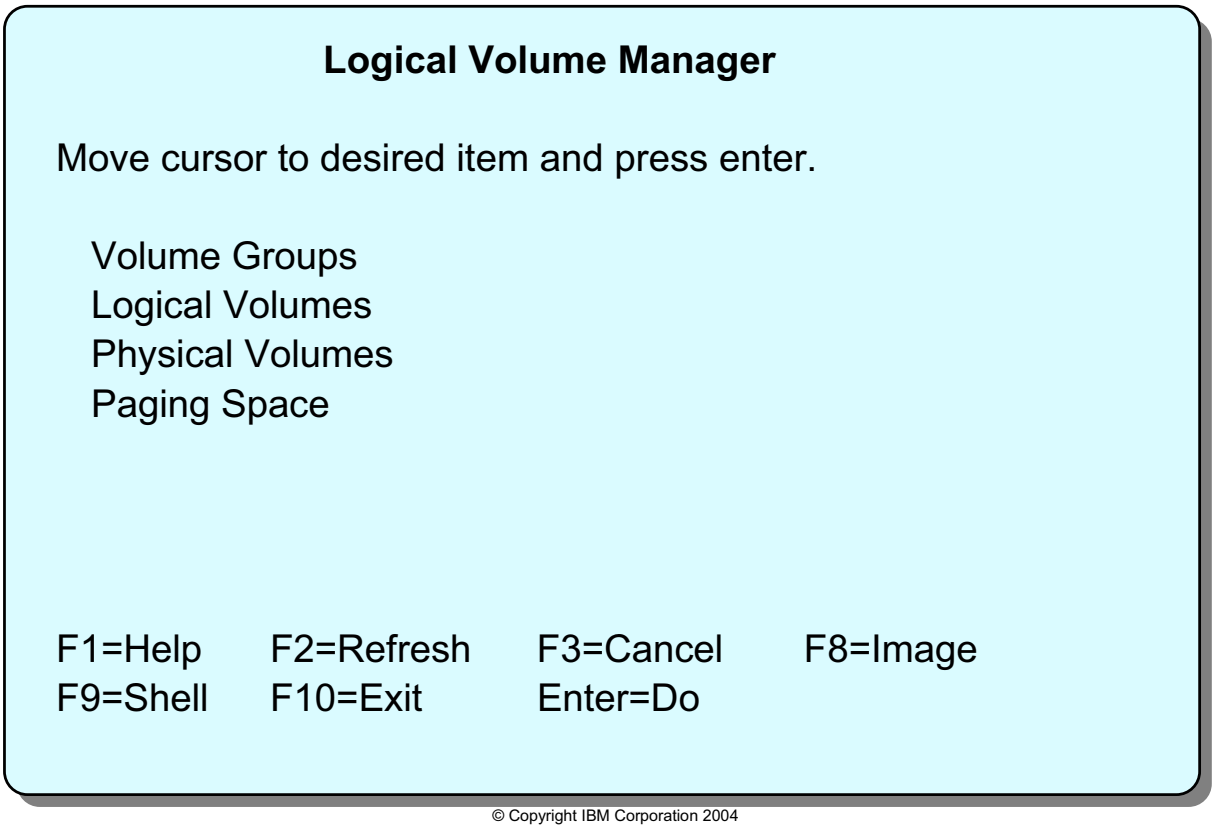


Figure 10-2. Logical Volume Manager AU1410.0

Notes:

The Logical Volume Manager menu is used to manage many aspects of the system's storage.

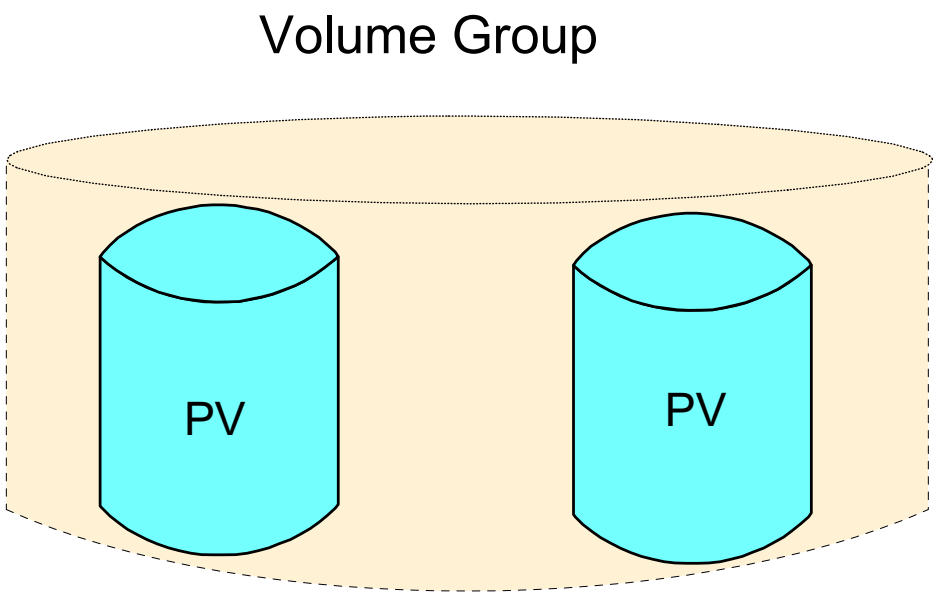
- **Volume Groups -** This menu provides facilities to manipulate the volume groups in the system. The Define a Fixed Disk to the Operating System menu duplicates some items on this menu.
- **Logical Volumes -** This menu provides facilities to manipulate the logical volumes in the system. Logical volumes which contain journaled file systems, paging space or dump volumes can also be manipulated from their respective menus. However, the facilities on this menu give a much lower level of control over the characteristics of the logical volume. For example, features such as partition allocation policy and mirroring for a logical volume, can only be set using this menu. This menu is also used when a logical volume which does not contain an AIX file system, and so forth, is being manipulated.

- **Physical Volumes** - This option allows the user to configure the physical volumes (fixed disks) in the system. This menu duplicates options on the Fixed Disks menu of Devices.
- **Paging Space -** This option allows a user to add, delete, activate and list the paging spaces available.

The Web-based System Manager can also be used to manage the Logical Volume Manager.

10.1 Volume Groups

Volume Groups



- Physical Volume (PV) — hard disk
- Volume Group (VG) — collection of related disks (PVs)

Figure 10-3. Volume Groups AU1410.0

Notes:

Physical Volume - hard disk. There is a limit of up to 128 PVs per volume group.

A **Volume Group** is a collection of related PVs on a processor that:

- Are not members of another VG
- Share a single physical partition size

When you install your AIX system, one volume group called **rootvg** is automatically created.

There can be a maximum of 255 VGs per system.

A PV that supports removable media should be assigned to a VG containing itself and no other members.

SMIT Volume Groups Menu

 # smit vg

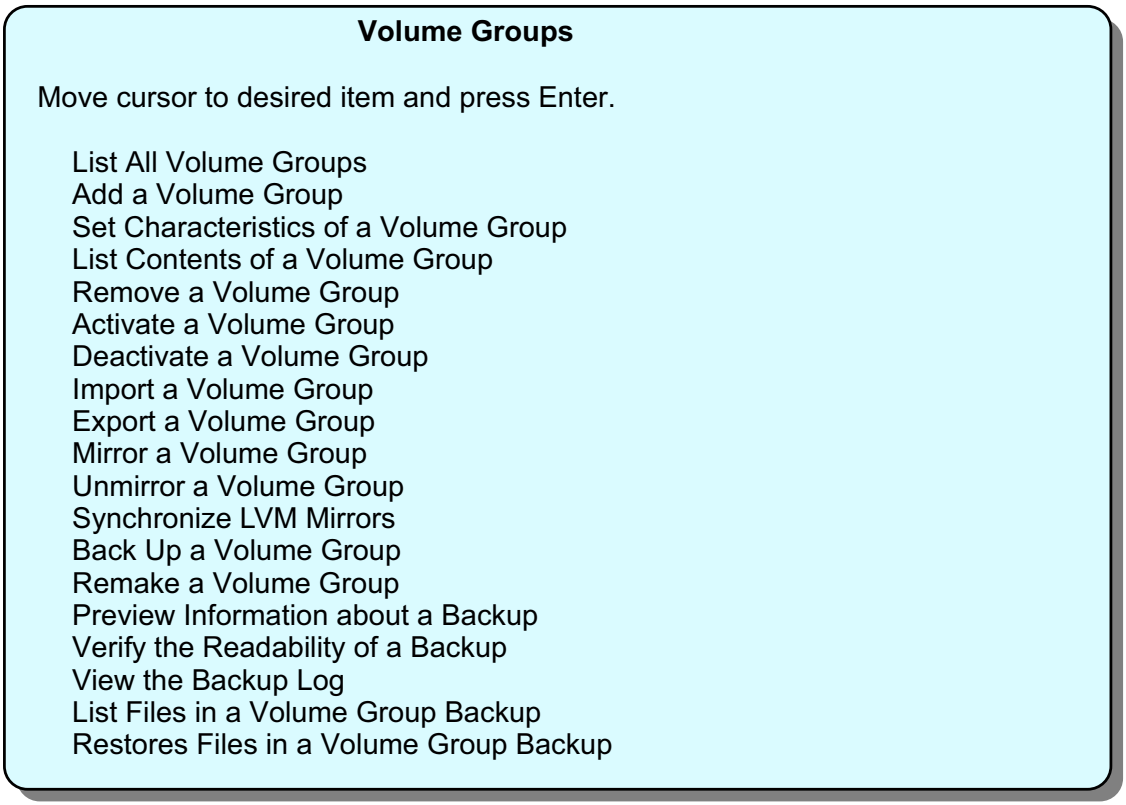


Figure 10-4. SMIT Volume Groups Menu AU1410.0

Notes:

This is the SMIT screen that allows for the configuration of volume groups. We describe these items throughout the course.

Listing Volume Group Information (1 of 4)

List All Volume Groups

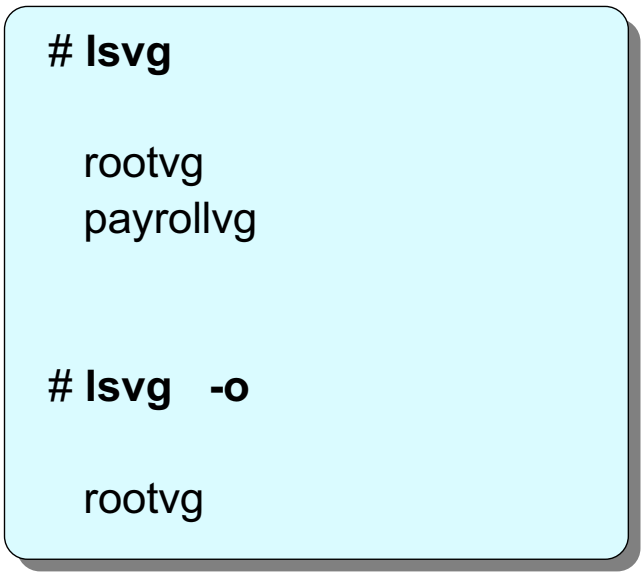


Figure 10-5. Listing Volume Group Information (1 of 4) AU1410.0

Notes:

The **lsvg** command is used to list the volume groups in the system.

It can be used to list the names of all volume groups (default) or only those that are varied on/active (**-o**).

Listing Volume Group Information (2 of 4)

List Contents of a Volume Group

```
# lsvg rootvg
VOLUME GROUP:       rootvg          VGIDENTIFIER:   000bc6fd00004c00000000e10fdd7f52
VG STATE:           active          PP SIZE:        16 megabyte(s)
VG PERM:            read/write      TOTAL PPs:      1084    (17344 megabytes)
MAX LVs:            256             FREE PPs:       1032    (16512 megabytes)
LVs:                11              USED PPs:       52      (832 megabytes)
OPEN LVs:           10              QUORUM:         2
TOTAL PVs:          2               VG DESCRIPTORS: 3
STALE PVs:          0               STALE PPs:      0
ACTIVE PVs:         2               AUTO ON:        yes
Max PPs per VG      32512
MAX PPs per PV:     1016            MAX PVs:        32
LTG size:           128 kbytes      AUTO SYNC:      no
HOT SPARE:          no              BB Policy:      relocatable
```


Figure 10-6. Listing Volume Group Information (2 of 4) AU1410.0

Notes:

The **lsvg** command can be used to list information about the status and content of a particular volume group, for example **lsvg** *Volumegroup*.

The output provides status information about the volume group. The most useful information here is:

State (active or inactive/complete if all PVs are active)
PP size (4 MB by default)
Total number of PPs
Number of free PPs

Listing Volume Group Information (3 of 4)

Physical Volumes

```
# lsvg -p rootvg

rootvg:
PV_NAME     PV_STATE   TOTAL PPs  FREE PPs   FREE DISTRIBUTION
hdisk0      active     159        52         24..00..00..00..28
hdisk1      active     159        78         32..02..00..12..32
```


Figure 10-7. Listing Volume Group Information (3 of 4) AU1410.0

Notes:

lsvg -p *Volumegroup*

This gives information about all of the physical volumes within the volume group. The information given is: PV Name, PV State (active or inactive), Total number of PPs, Number of free PPs and how the free space is distributed across the disk (outer edge..outer middle..center..inner middle..inner edge).

Free distribution is the number of physical partitions allocated within each section of the physical volume: outer edge, outer middle, center, inner middle, inner edge.

Listing Volume Group Information (4 of 4)

Logical Volumes

```
# lsvg -l rootvg

rootvg:
LVNAME      TYPE    LPs   PPs   PVs   LV STATE      MOUNT POINT

hd6         paging  8     8     1     open/syncd    N/A
hd5         boot    1     1     1     closed/syncd  N/A
hd8         jfslog  1     1     1     open/syncd    N/A
hd9var      jfs     1     1     1     open/syncd    /var
hd4         jfs     1     1     1     open/syncd    /
hd2         jfs     77    77    1     open/syncd    /usr
hd3         jfs     3     3     1     open/syncd    /tmp
hd1         jfs     11    11    1     open/syncd    /home
hd10opt     jfs     2     2     1     open/syncd    /opt
lv00        jfs2    1     2     2     open/syncd    /home/john
lv01        jfs2    4     4     2     open/syncd    /home/fred
```


Figure 10-8. Listing Volume Group Information (4 of 4) AU1410.0

Notes:

lsvg -l *Volumegroup*

This gives information about all of the logical volumes within the volume group. The details given are: LV name, Type of LV (for example, file system, paging), number of LPs, number of PPs, number of PVs, LV state and, if the LV contains a journaled file system the mount point is also given.

Adding Volume Groups

 # smit mkvg

Add a Volume Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

	[Entry Fields]	
Volume GROUP name	[ ]	+
Physical partition SIZE in megabytes	4	+
* PHYSICAL VOLUME names	[ ]	+
Force the creation of a volume group?	no	+
Activate Volume group AUTOMATICALLY at system restart	yes	
Volume Group MAJOR NUMBER	[ ]	+#
Create VG Concurrent Capable?	no	+

F1=Help F2=Refresh F3=Cancel F4=List
F5=Reset F6=Command F7=Edit F8=Image
F9=Shell F10=Exit Enter=Do

Figure 10-9. Adding Volume Groups AU1410.0

Notes:

The **mkvg** command is used to create a volume group. A new volume group must contain at least one physical volume. The **-y** option is used to indicate the name for the new volume group. If this is not specified, a system generated name is used. The **-s** option is used to specify the physical partition size in MB which must be a power of 2. The default is the smallest PP size consistent with the Max PP/PV and the largest PV in the VG.

The **-n** option means that the volume group is not automatically activated at system startup. This should be done for external disks that may not always be available to the system.

Example of the **mkvg** command: to create a volume group named *newvg* created with a physical partition size of 2 MB:

mkvg -s 2 -y newvg hdisk1

The Volume Group MAJOR NUMBER on the SMIT dialog screen is used by the kernel to access that volume group. This field is most often used for High Availability Network File System (HANFS) and High Availability Cluster Multi-Processing (HACMP) applications.

The two items on the SMIT dialog screen referring to concurrent mode operation have no meaning on systems without HACMP installed. These items are valid on AIX V4.2 and later.

There is a separate smit panel for adding a Big Volume Group which is identical to this panel.

Adding Scalable Volume Groups

 # smit mkvg

Add a Scalable Volume Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

	[Entry Fields]	
Volume GROUP name	[ ]	+
Physical partition SIZE in megabytes	4	+
* PHYSICAL VOLUME names	[ ]	+
Force the creation of a volume group?	no	+
Activate Volume group AUTOMATICALLY at system restart	yes	
Volume Group MAJOR NUMBER	[ ]	+#
Create VG Concurrent Capable?	no	+
Max PPs per VG in kilobytes?	32	+
Max Logical Volumes	256	+

F1=Help F2=Refresh F3=Cancel F4=List
F5=Reset F6=Command F7=Edit F8=Image
F9=Shell F10=Exit Enter=Do

Figure 10-10. Adding Scalable Volume Groups AU1410.0

Notes:

There is a separate smit panel for Adding Scalable VGs. Besides creating a different format VGDA, the administrator has the option to set the Maximum PPs per VG and the Maximum LV for the VG.

Note that in non-scalable VGs, LVM allows tuning of the number of PP for each PV via the t factor. In scalable VGs the PPs are managed on a VG wide basis.

The max number of LVs was fixed depending upon the type of VG. Now in the Scalable VG the maximum is tunable.

Set Characteristics of a Volume Group

 # smit vgsc

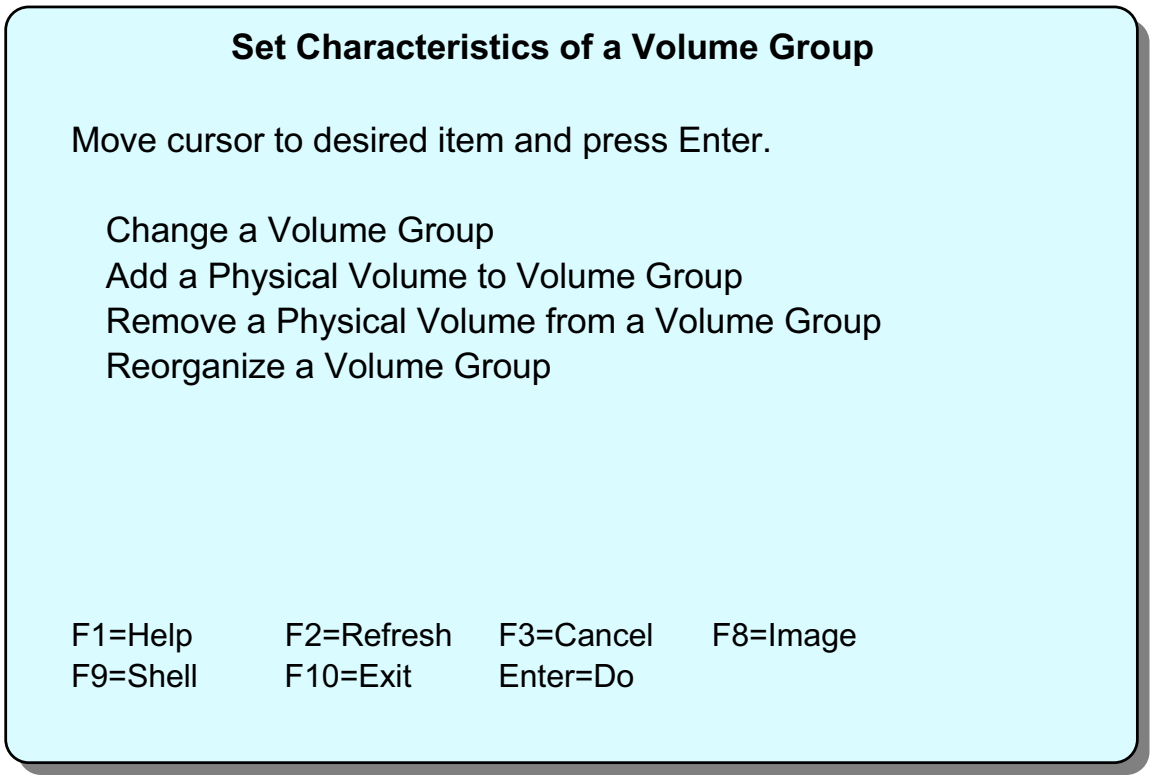


Figure 10-11. Set Characteristics of a Volume Group AU1410.0

Notes:

Once the VG has been created we can do four operations on the VG.

We can modify the attributes of the VG. We can increase or decrease the size of the VG by adding or removing physical volumes. And we can reorganize the VG.

Change a Volume Group

 # smit chvg

Change a Volume Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

	[Entry Fields]	
* VOLUME GROUP name	rootvg	
* Activate Volume group AUTOMATICALLY at system restart?	yes	+
* A QUORUM of disks required to keep the Volume group on-line?	yes	+
Convert this VG to Concurrent Capable?	no	+
Change to big VG format?	no	+
Change to Scalable VG format	no	+
LTG Size in kbytes	128	+
Set hotspare characteristics	no	+
Set synchronization characteristics of stale partitions	no	+
Max PPs per VG in kilobytes	32	+
Max Logical Volumes	256	+

Figure 10-12. Change a Volume Group AU1410.0

Notes:

The **chvg** command is used to change the startup characteristics of a volume group. The **-a y** option sets the volume group to be used at startup. The **-a n** option resets this characteristic to no.

Logical Track Group Size (LTG)

Flexible LTG size for better performance

- Find the maximum LTG size:

```
# lquerypv -M hdisk0
   256
```

- Set the LTG size per volume group using **mkvg** or **chvg**

```
# chvg -L 256 testvg
```


Figure 10-13. Logical Track Group Size (LTG) AU1410.0

Notes:

Logical track group size

The logical track group size corresponds to the maximum allowed transfer size for disk I/O. In previous versions of AIX, the only supported logical track group size was 128 KB. Many disks today support sizes larger than 128 KB. To take advantage of these larger transfer sizes and achieve better disk I/O performance, AIX V5.1 and later accepts the following values for the logical track group size:

- 128 KB (Default)
- 256 KB
- 512 KB
- 1024 KB

In addition to the above values, AIX 5.3 accepts the values for LTG Size: 2 MB, 4 MB, 8 MB, 16 MB, 32 MB, 64 MB, 128 MB.

Find the LTG size

You can find the maximum supported logical track size for each physical disk. Use the `lquerypv` command with the `-M` argument. The output gives the maximum logical track group size in KB. Here is an example:

```
# lquerypv -M hdisk0
256
```

In AIX 5.3 this information is automatically included in the lsp command output that we will discuss later.

Set the LTG size

The default logical track group size is 128 KB. The maximum allowed value is the smallest maximum transfer size supported by all disks in a volume group. This value can be changed by using either of the following commands:

SMIT Fastpath	Description
`mkvg`	Shows all four values (128 KB, 256 KB, 512 KB, and 1024 KB) in the selection dialog for the logical track group size. The `mkvg` command will fail with an appropriate error message if you try to create a volume group with a LTG size larger than the physical volume will support.
`chvg`	Shows only the values for the logical track group size supported by the member disks in the volume group.

To change the LTG size, the volume group must be varied on, the logical volumes must be closed, and file systems must be unmounted.

```
# chvg -L 256 testvg
```

Variable LTG Size

- AIX 5.3 dynamically sets LTGsize
- Calculated at each VG activation
- Largest size supported by all PVs
- mkvg -L no longer supported
- Override: varyonvg -M <LTGsize>
- Enable of old VGs using chvg -L 0

Figure 10-14. Variable LTGsize AU1410.0

Notes:

Before AIX 5.3, one would either let the system default the Logical Track Group Size to 128KB or would have to set it ones self using the -L option on either the mkvg or the chvg commands. One would have to use the lquerypv command to discover the largest LTGsize supported by all the disks in the VG.

In AIX 5.3, LVM dynamically discovers the optimal LTGsize at each varyonvg of the VG.

The -L option is no longer supported on the mkvg, though the defined LTGsize of previously created VGs stay in effect and you may change those with the chvg -L option.

If you would like those previously created VGs to use the new dynamic LTG capability, just set the LTGsize to zero. That allows LVM to determine the best size the next time the VG is activated.

Hot Spare

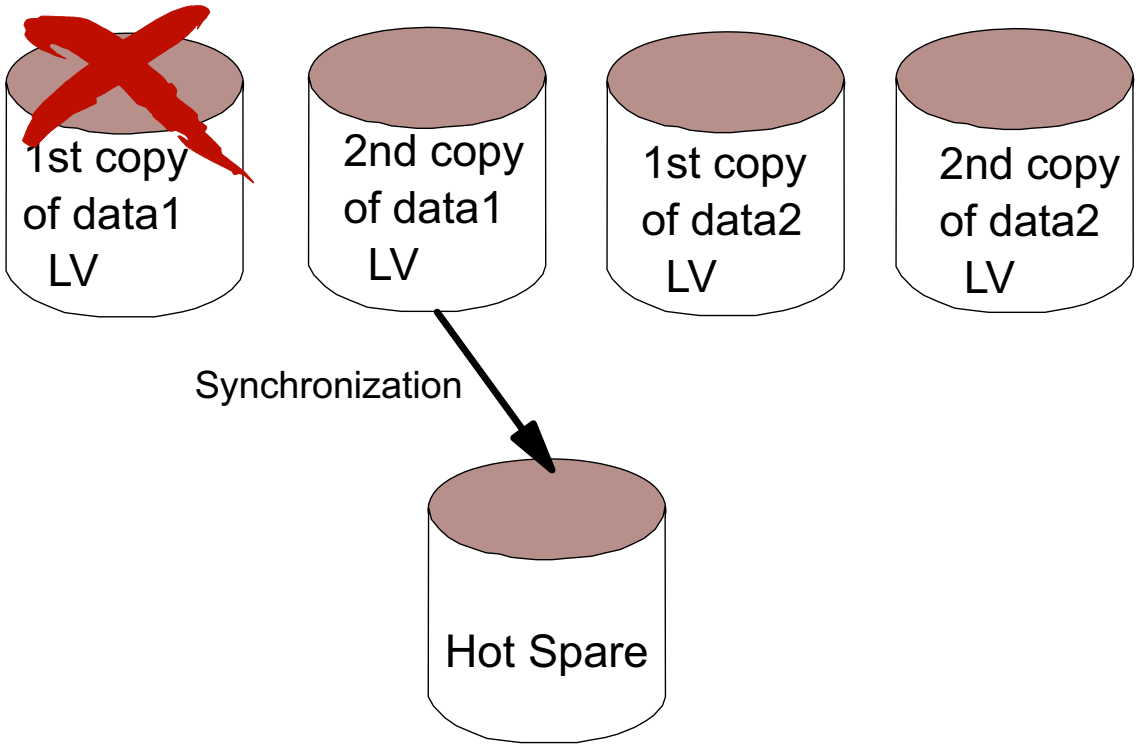


Figure 10-15. Hot Spare AU1410.0

Notes:

What is an LVM hot spare?

A hot spare is a disk or group of disks used to replace a failing disk. LVM marks a physical volume missing due to write failures. It then starts the migration of data to the hot spare disk.

Minimum hot spare requirements

The following is a list of minimal hot sparing requirements enforced by the operating system.

- Spares are allocated and used by volume group
- Logical volumes must be mirrored
- All logical partitions on hot spare disks must be unallocated

- Hot spare disks must have at least equal capacity to the smallest disk already in the volume group. Good practice dictates having enough hot spares to cover your largest mirrored disk.

Hot spare policy

The **chpv** and the **chvg** commands are enhanced with a new **-h** argument. This allows you to designate disks as hot spares in a volume group and to specify a policy to be used in the case of failing disks.

The following four values are valid for the hot spare policy argument (**-h**):

Argument	Description
y (lower case)	Automatically migrates partitions from one failing disk to one spare disk. From the pool of hot spare disks, the smallest one which is big enough to substitute for the failing disk will be used.
Y (upper case)	Automatically migrates partitions from a failing disk, but might use the complete pool of hot spare disks.
n	No automatic migration will take place. This is the default value for a volume group.
r	Removes all disks from the pool of hot spare disks for this volume group.

Synchronization policy

There is a new **-s** argument for the **chvg** command that is used to specify synchronization characteristics.

The following two values are valid for the synchronization argument (**-s**):

Argument	Description
y	Automatically attempts to synchronize stale partitions.
n	Will not automatically attempt to synchronize stale partitions. This is the default value.

Examples

The following command marks hdisk1 as a hot spare disk:

```
# chpv -hy hdisk1
```

The following command sets an automatic migration policy which uses the smallest hot spare that is large enough to replace the failing disk, and automatically tries to synchronize stale partitions:

```
# chvg -hy -sy testvg
```

How to set up hot sparing

The following table summarizes the steps required to set up hot sparing.

Step	Command	Action
1	-	Decide which volume groups with mirrored logical volumes require high availability
2	-	Decide how many hot spare disks are required, and how large the hot spare disks must be, based on the existing disks in the volume group
3	`extendvg`	Add the hot spares to the volume groups which they are to protect
4	-	Decide which hot spare policy will be most effective for your volume groups
5	`chpv`	Designate the selected disks as hot spares
6	`chvg`	Decide which synchronization policy meets the business needs, and set the policy
7	-	Sleep well at night!

Instead of using the command line interface you can use as well the websm to make the changes on the hot spare information.

Extending and Reducing Volume Groups

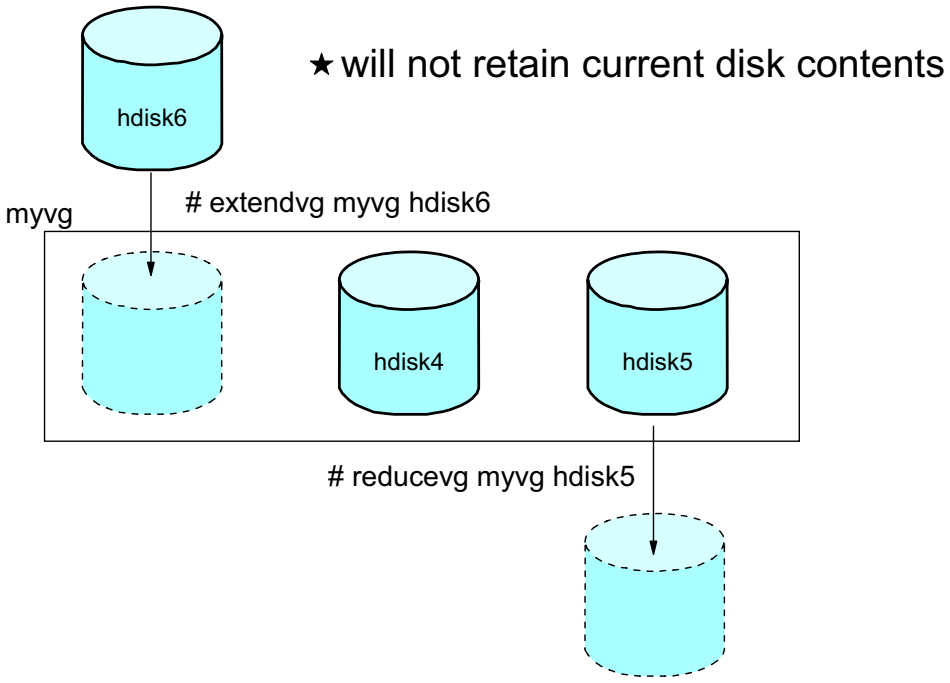


Figure 10-16. Extending and Reducing Volume Groups AU1410.0

Notes:

To add a disk to the volume group, use the extendvg command or smit panel. This will format the disk into Physical Partitions and then add these to the PP mapping maintained in the VGDA for the Volume Group. The space on the new disk will now be available to be allocated to Logical Volumes in the is Volume Group. Note that using extendvg to add a disk implies that you do not want to keep any information that was previously stored on that disk.

To remove a disk from the volume group, first be sure to free up all the storage on the disk by either deleting the logical volumes or migrating them to some other disk in the VG. Once there are no logical volumes on the disk we can remove that disk from the VG by using the reducevg command.

Add a Physical Volume to a Volume Group

extendvg -f Volumegroup hdiskn

The **extendvg** command is used to add a new physical volume to an existing volume group. The fixed disk must be installed in the system or connected to it externally, and must be powered on.

If the existing data on the disk shows that it is part of another volume group, the **-f** option forces the addition of the disk to the volume group without requesting confirmation. Use this option when adding a disk which has been previously used but which contains no data that is required any further.

Remove a Physical Volume from a Volume Group

reducevg [-d] Volumegroup hdiskn

The **reducevg** command is used to remove a physical volume from a volume group. If it is the last physical volume, the volume group is removed.

Removing Volume Groups

 # smit reducevg2

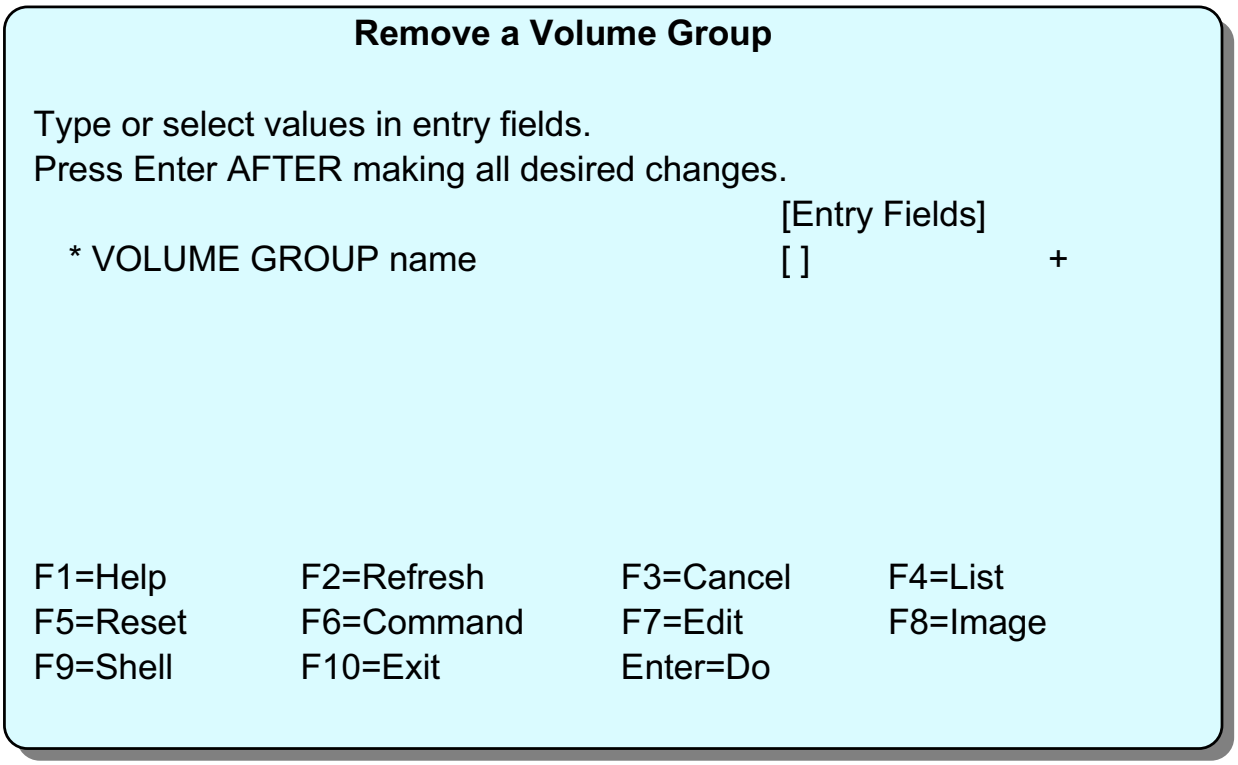


Figure 10-17. Removing Volume Groups AU1410.0

Notes:

If there are no physical volumes in a volume group, you can use the **smit reducevg2** fastpath to remove the volume group.

The **Remove a Volume Group** menu item does not have a corresponding high-level command. The correct way to remove a volume group is to use the **Remove a Physical Volume from a Volume Group** option (**reducevg** command). This removes the volume group when you remove the last physical volume within it.

The syntax of the **reducevg** command is:

reducevg [-d] [-f] ***VolumeGroup PhysicalVolume***

Activate/Deactivate a Volume Group

- **Activate a Volume Group (make it available for use)**

  varyonvg [-f] *Volumegroup*

  # varyonvg datavg

- **Deactivate a Volume Group (make it unavailable for use)**

  varyoffvg *Volumegroup*

  # varyoffvg datavg

Figure 10-18. Activate/Deactivate a Volume Group AU1410.0

Notes:

The **varyonvg** command is used to activate a volume group that is not activated at system startup (or has been added to the system since startup.)

The **-f** option is used to force a volume group online. This is needed if you have lost quorum but still want to varyon the VG. If you are using no quorum, then it is needed to bring the VG online if any VGDA is lost.

The **varyoffvg** command is used to deactivate a volume group. No logical volumes should be open when this command is issued. Removing a disk without deactivating the volume group could cause errors and loss of data in the volume group descriptor areas and the logical volumes within that volume group.

In AIX 5.3 a new option -M was added to allow the specification of a Logical Track Group size for the VG, instead of allowing LVM to determine it dynamically.

Import/Export a Volume Group

 # smit importvg

Import a Volume Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

		[Entry Fields]	
	VOLUME GROUP name	[ ]	
*	PHYSICAL VOLUME name	[ ]	+
	Volume Group MAJOR NUMBER	[ ]	+#

F1=Help	F2=Refresh	F3=Cancel	F4=List
F5=Reset	F6=Command	F7=Edit	F8=Image
F9=Shell	F10=Exit	Enter=Do	

Figure 10-19. Import/Export a Volume Group AU1410.0

Notes:

If you have a volume group on one or more removable disks that you want to access on another system, you must first export the volume group from the current system using the **exportvg** command. This removes any information about the volume group from the system. To export a volume group it must be inactive.

To access an exported volume group on a system, it must be imported to the system using the **importvg** command. Do not attempt to import a rootvg. Also, unless instructed to do so by support personnel, never interrupt an LVM command.

Advanced RAID Support

- **Checks all disks in a Volume Group if they have grown in size**

  chvg -g *Volumegroup*

  # chvg -g datavg

- **Turns on bad block relocation policy of a Volume Group**

  chvg -b *[y/n] Volumegroup*

  # chvg -b y datavg

- **Turns off bad block relocation policy of a Volume Group**

  # chvg -b n datavg

Figure 10-20. Advanced RAID Support AU1410.0

Notes:

Modern storage subsystems have the ability to increase the size, that is, RAID arrays. The following command examines all the disks in the volume group to see if they have grown in size. If any disks have grown in size it attempts to add **dynamically** additional PPs to the PVs. If necessary, the proper **t-factor** is applied or the volume group is converted to a **big** VG.

```
# chvg -g testvg
```

The following command turns on the bad block relocation policy of a volume group.

```
# chvg -b y testvg
```

The following command turns off the bad block relocation policy of a volume group.

```
# chvg -b n testvg
```

Bad block relocation policy should be turned off for RAID devices and storage subsystems unless the manufacturer tells you otherwise.

Activity: Volume Groups

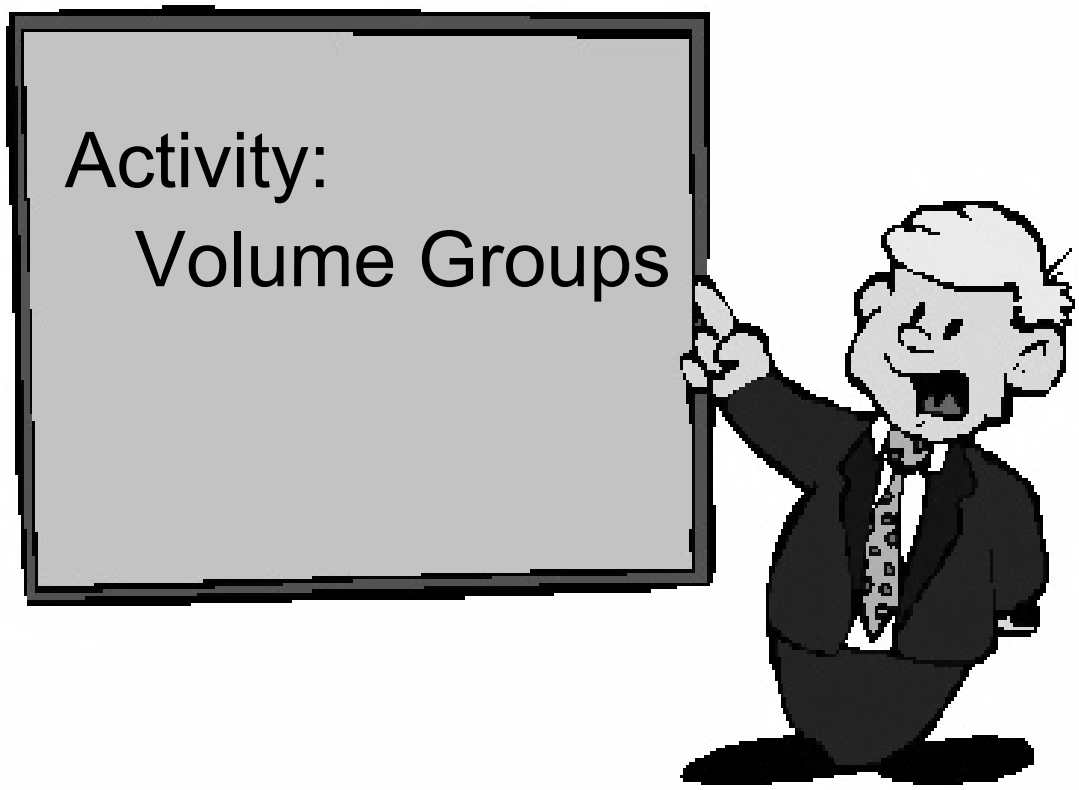


Figure 10-21. Activity: Volume Groups AU1410.0

Working with the Logical Volume Manager - Activity

In this activity, you add/remove a disk from a volume group and create/remove a new volume group. If you are sharing the machine with someone, only one of you can perform these steps!

Instructions

1. Log in as team01 and switch to the root user account.
2. Ensure you have a hard disk available to create a new volume group. What is the name of the disk that is currently available? _____
3. From the disk information that you determined in the step above, add the free disk into **rootvg**.
4. Check to see if the disk is now associated with **rootvg**.
5. Take the same disk, out of **rootvg**. Make sure you remove the correct disk.
6. Verify that the disk is no longer associated with **rootvg**.
7. Using the free disk, create a new volume group called **newvg**.

8. Verify that the new volume group was created. What are the maximum number of PVs that can be added to this VG?
9. Convert **newvg** into a Big Volume Group.
10. What is the maximum number of PVs that can be added to the converted **newvg**?
11. Remove **newvg**.
12. Verify that **hdiskn** is not associated with any volume group. If it is not, repeat the steps above. You need to have this disk free for a later exercise.

END

Working with the Logical Volume Manager Activity with Hints

1. Log in as team01 and switch to the root user account.

   $ su

2. Ensure you have a hard disk available to create a new volume group. What is the name of the disk that is currently available? _____

   # lspv

3. From the disk information that you determined in the step above, add the free disk into **rootvg**.

   Note: You need to substitute your free disk name when **hdiskn** is referenced.

   # smit vg
   Select **Set Characteristics of a Volume Group**.
   Select **Add a Physical Volume to a Volume Group**.

   * VOLUME GROUP name [**rootvg**] +
   * PHYSICAL VOLUME names [**hdiskn**] +
   OK or ENTER

   Then use <F10> to exit from SMIT.

   OR

   # extendvg -f rootvg hdiskn

4. Check to see if the disk is now associated with rootvg.

   # lspv

5. Take the same disk, out of **rootvg**. Make sure you remove the correct disk.

   # smit vg
   Select **Set Characteristics of a Volume Group**.
   Select **Remove a Physical Volume from a Volume Group**.

   * VOLUME GROUP names [**rootvg**] +
   * PHYSICAL VOLUME names [**hdiskn**] +
   FORCE deallocation of all partitions on **no** + this physical volume?
   OK or ENTER

   Then use <F10> to exit from SMIT.

   OR

   # reducevg rootvg hdiskn

6. Verify that the disk is no longer associated with **rootvg**.

   # lspv

7. Using the free disk, create a new volume group called **newvg**.

 # smit vg
Select **Add a Volume Group**

VOLUME GROUP name [**newvg]**
Physical partition SIZE in megabytes **16** +
* PHYSICAL VOLUME names [**hdiskn]** +
Force the creation of a volume group **Yes**
OK or ENTER

Then, use <F3> to return to the Volume Group menu.

OR

 # mkvg -f -y "newvg" -s 16 hdiskn

8. Verify that the new volume group was created. What are the maximum number of PVs that can be added to this VG?

Select **List All Volume Groups**

List only the ACTIVE volume groups? **no** +
OK or ENTER

Then, use <F3> to return to the Volume Group menu.

Select **List Contents of a Volume Group**

* VOLUME GROUP name [**newvg]** +
List OPTIONS status +
OK or ENTER
Then, use <F10> to exit SMIT.

OR

 # lsvg
 # lspv
 # lsvg newvg

9. Convert **newvg** into a Big Volume Group.

 # chvg -B newvg
Answer y to the prompt.

10. What is the maximum number of PVs that can be added to the converted **newvg**?

 # smit vg
Select **List Contents of a Volume Group**

* VOLUME GROUP name [**newvg]** +
List OPTIONS status +

OK or ENTER

Then, use <F3> to return to the Volume Group menu.

OR

 # lsvg newvg

11. Remove **newvg**.

    There are two Volume Group menu items in SMIT that let you remove a volume group. You can select **Set Characteristics of a Volume Group** and remove the disk from the volume group. This is the same method to remove a disk from a volume group. Since there is only one disk in the volume group, the VG is automatically deleted at the same time the last disk is removed.

    The other menu choice is the obvious choice. Let's pick that item.
    Select **Remove a Volume Group**

    * VOLUME GROUP name [**newvg]** +

    OK or ENTER

    Then, use <F10> to exit SMIT.

    OR

    # reducevg newvg hdiskn

    Note: There is no such command as **rmvg**.

12. Verify that **hdiskn** is not associated with any volume group. If it is not, repeat the steps above. You need to have this disk free for a later exercise.

    # lspv

END

10.2 Logical Volumes

Logical Storage

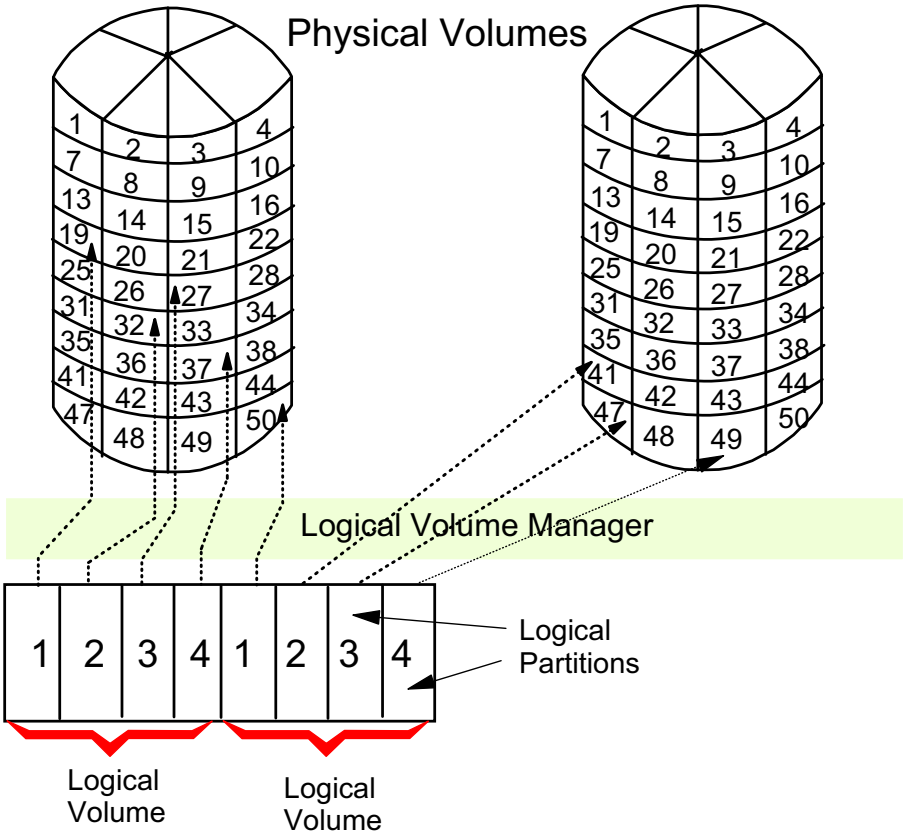


Figure 10-22. Logical Storage AU1410.0

Notes:

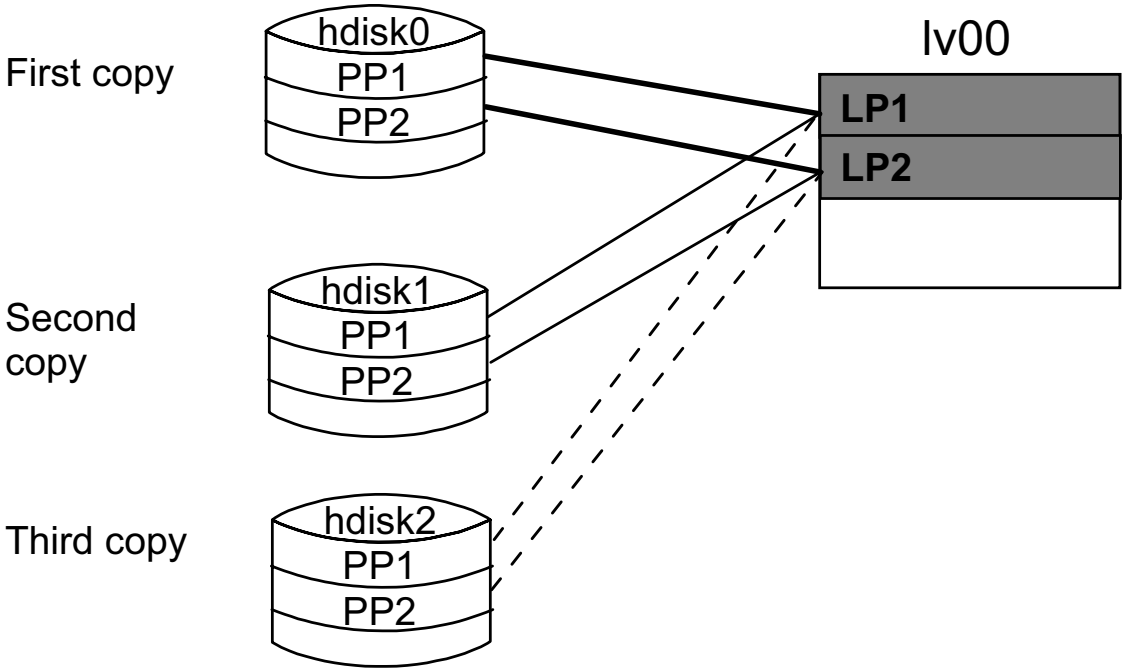
Logical Volumes

A logical volume is a set of logical partitions which may span physical volumes (as long as the physical volumes are in the same volume group). A file system sits on top of a logical volume (LV). A logical volume can be dynamically extended.

Logical Partitions

Logical partitions are mapped one-to-one to physical partitions unless there is mirroring.

Mirroring



- Mirroring is when a logical partition maps to more than one physical partition of the same volume group
- Scheduling Policy:
  Parallel PPs written simultaneously
  Sequential PPs written in sequence

Figure 10-23. Mirroring AU1410.0

Notes:

When creating a logical volume you can implement mirroring of the logical partitions of the logical volume. This means that either two or three copies are kept on the disk of the logical partitions so that the data is still intact and available in the event of a disk failure. Normally, each copy must reside on a separate disk, but this restriction can be removed if required. Physical partitions do not need to be contiguous.

Implementing mirroring inhibits the performance of the logical volume. However, this can be partly overcome by setting the scheduling policy for logical partition copies. The scheduling policy determines how reads and writes are conducted to a mirrored logical volume. The following table describes the four possible scheduling policies.

Policy	Reads	Writes
Parallel	On each read, the system checks whether the primary is busy. If it is not busy, the read is initiated on the primary. If the primary is busy, the system checks the secondary. If it is not busy, the read is initiated on the secondary. If the secondary is busy, the read is initiated on the copy with the least number of outstanding I/Os.	Initiated concurrently the write request returns when the copy that takes the longest time to update completes. Control is passed back to the application after the slowest disk has completed its write. This means there is a chance that the data integrity could be lost if a disk failure occurred while the copies were being updated. To overcome this problem, the mirror write consistency option can be set on.
Parallel/sequential	Always initiates reads on the primary copy.	Initiated concurrently
Parallel/round robin	Alternates between the copies. This results in equal utilization for reads even when there is more than one I/O outstanding at a time.	Initiated concurrently
Sequential	Always initiates reads on the primary copy.	Initiated serially, first to the primary disk; only when that is completed is the second write initiated to the secondary disk.

Mirroring scheduling policies, such as parallel and parallel/round-robin, can allow performance on read-intensive mirrored configurations to be equivalent to non mirrored ones.

The sequential policy is used to make certain no writes are lost.

Typically, performance on write-intensive mirrored configurations is less than non-mirrored.

When turning on mirroring for an existing logical volume, the copies have to be synchronized so the new copy contains a perfect image of the existing copy at that point in time. This can be done by using the **-k** option on the **mklvcopy** command at the time mirroring is turned on or with the **syncvg** command at a later time. Until the copies are synchronized, the new copy is marked stale.

Mirror Write Consistency

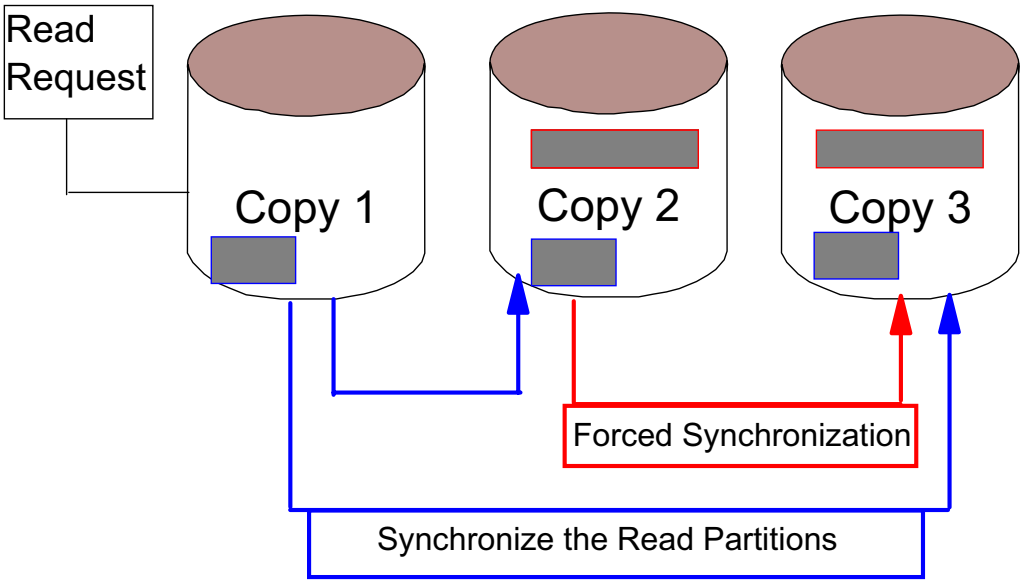


Figure 10-24. Mirror Write Consistency AU1410.0

Notes:

Introduction

Mirror Write Consistency (MWC) ensures data consistency on logical volumes in case a system crash occurs during mirrored writes. The active method achieves this by logging when a write occurs. LVM makes an update to the MWC log that identifies what areas of the disk are being updated before performing the write of the data. Records of the last 62 distinct logical transfer groups (LTG) written to disk are kept in memory and also written to a separate checkpoint area on disk (MWC log). This results in a performance degradation during random writes.

With AIX V5.1 and later, there are now two ways of handling MWC:

- Active, the existing method
- Passive, the new method

The purpose of the passive method

Passive MWC reduces the problem of having to update the MWC log on the disk. This method logs that the logical volume has been opened but does not log writes. If the system crashes, then the LVM starts a forced synchronization of the entire logical volume when the system restarts.

Using MWC

The following syntax is used with either the **mklv** or **chlv** command to set MWC options:

```
mklv -w y|a|p|n
```

```
chlv -w y|a|p|n
```

Here is a description of the MWC arguments:

Argument	Meaning	Description
y or **a**	Yes or Active	Each write is logged to the MWC log. When the volume group is varied back online, the log is used to make logical partitions consistent. This is the default for mirrored logical volumes.
p	Passive	The volume group logs that the logical volume has been opened. After a crash when the volume group is varied on, an automatic forced synchronization of the logical volume is started. Consistency is maintained while the synchronization is in progress by propagating the blocks being read to the other mirrors in the logical volume.
n	No	The mirrors of a mirrored logical volume can be left in an inconsistent state in the event of a system or volume group crash. There is no automatic protection of mirror consistency.

Support for the passive option

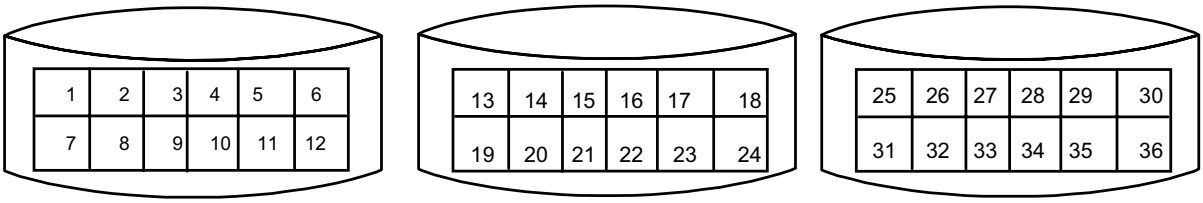
The passive method is only available on volume groups with the big volume group format since they have space to store a flag for each logical volume. Big volume groups allow up to 512 logical volumes and 128 physical volumes per volume group.

Purpose of the MWC

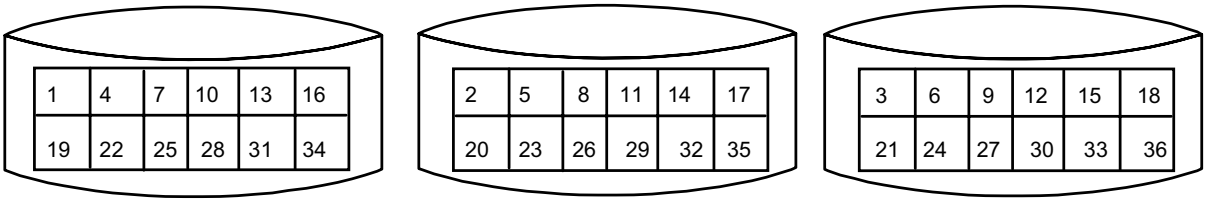
The purpose of the MWC is to guarantee the consistency of the mirrored logical volumes in case of a crash. The consistency of the filesystems is guaranteed by the JFS logs.

Striping

Normal flow of data blocks when a logical volume is spread across physical volumes.



The layout of stripe units when a logical volume is set up to stripe.



- Consecutive stripe units are created on different physical volumes
- Striping increases read/write sequential throughput by evenly distributing partitions among disks
- Stripe unit size is specified at creation time

Figure 10-25. Striping AU1410.0

Notes:

Striping is a technique for spreading the data in a logical volume across several disks such that the I/O capacity of the disk drives can be used in parallel to access data on the logical volume. The primary objective of striping is geared toward enabling very high-performance reading and writing of large sequential files.

In non-striped logical volumes, data is accessed using addresses to data blocks within physical partitions. In a striped logical volume, data is accessed using addresses to stripe units. The size of the stripe unit is specified at creation time. It is specified as a power of two in the range of 4 KB to 128 KB.

The limitations are as follows:

- The number of physical partitions allocated to a striped logical volume must be able to be evenly distributed among the disks
- At least two physical volumes are required
- Use as many adapters as possible
- Create on a volume group dedicated to striped logical volumes

Striped Columns

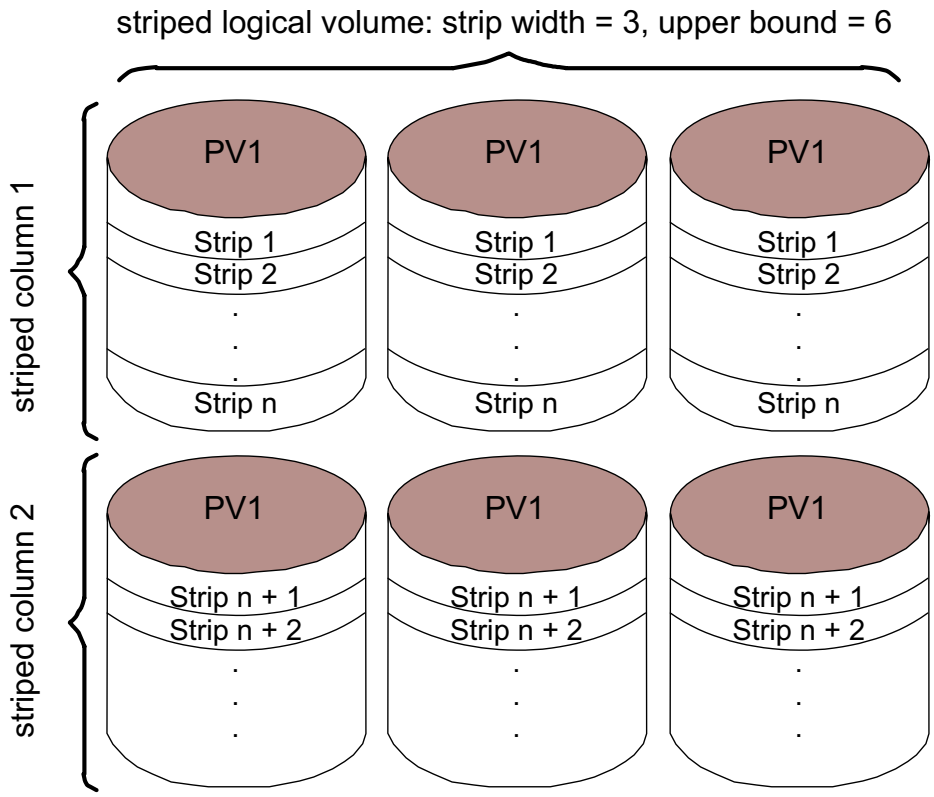


Figure 10-26. Striped Columns AU1410.0

Notes:

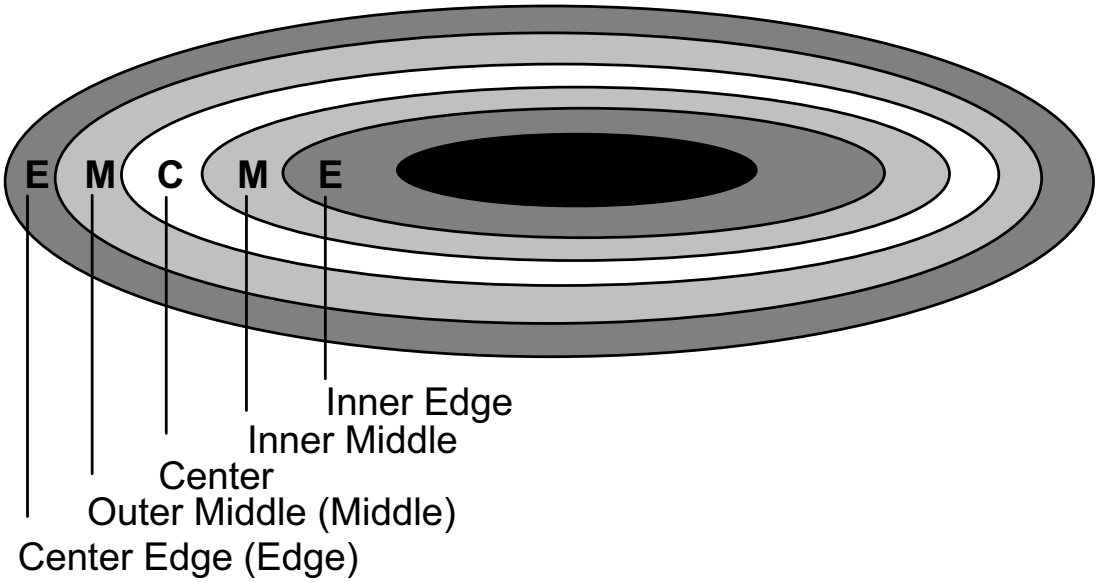
Prior to AIX 5.3, if you had a striped LV that completely filled the capacity of the disks that formed its stripe width and you needed more room to grow the logical volume it was not easy. You needed to back up all the data, re-create the VG with a larger strip (more disks), and then recover the data.

In AIX 5.3, you are allowed to increase the Logical Volume by growing the LV onto another set of disks equal to the existing stripe width. There is no need to back up, redefine, and then restore the data. It is done dynamically.

In this environment each additional stripe width of disks is called a striped column.

Logical Volume Policies

Intra-physical volume allocation policy:



Inter-physical volume allocation policy:

- Maximum number of PVs to use
- Range of PVs to use

Figure 10-27. Logical Volume Policies AU1410.0

Notes:

When creating or changing a logical volume you can set the way the Logical Volume Manager decides on which physical partitions to allocate to the logical volume. This affects the performance of the logical volume.

The **intra-physical** volume allocation policy indicates where on the physical volume partitions will be allocated to the logical volume. The choices are: center, middle, edge, inner edge, and inner middle. Location of the data can impact performance. To determine the area with the best performance, you need to check the documentation with your disks. The center area generally was the area with the best performance on older disks. But, that may not be true with newer disks.

The **inter-physical** volume allocation policy indicates how many physical volumes can be used to contain the physical partitions of the logical volume. The maximum number of physical volumes that can be used by the logical volume can be specified (this is normally set to the number of physical volumes in the volume group). The range of volumes used can be: minimum (only allocate partitions on one physical volume, or as many as there are

copies) or maximum, (allocate partitions across all physical volumes up to the maximum number of physical volumes.)

SMIT Logical Volumes Menu

 # smit lv

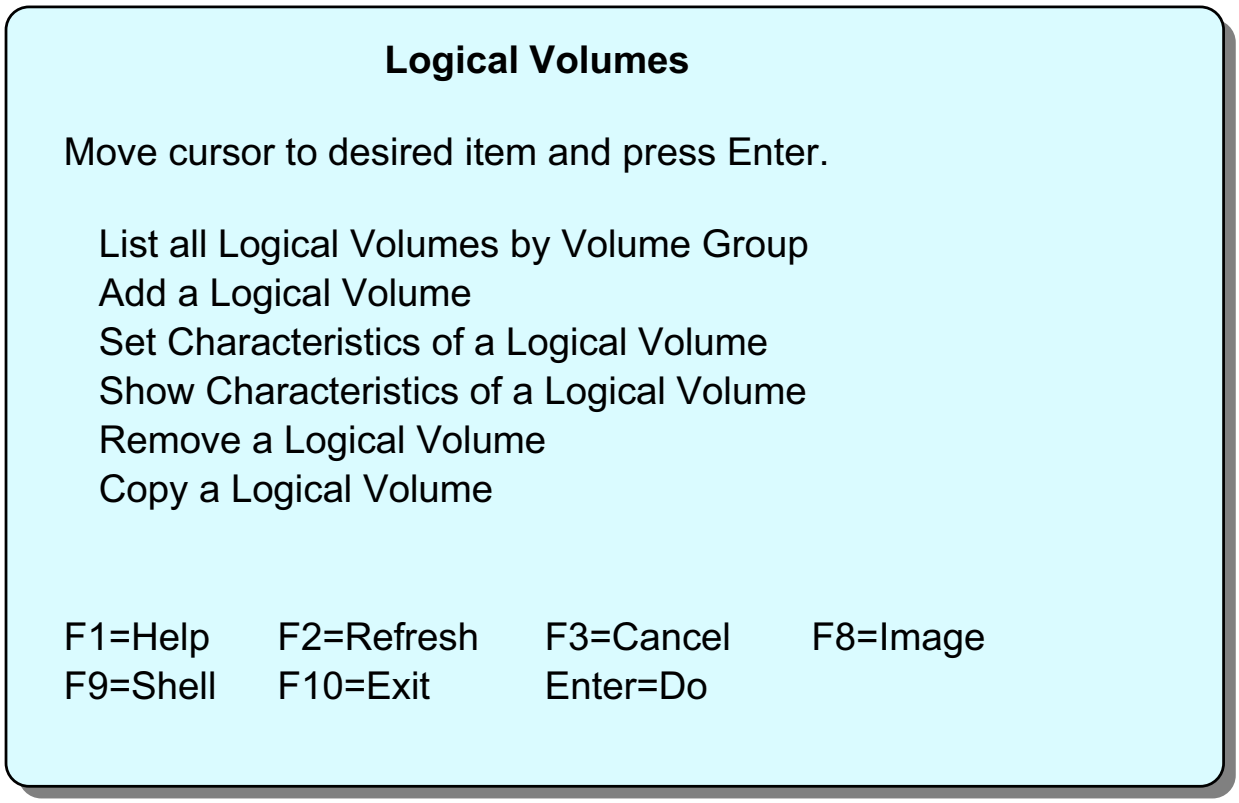


Figure 10-28. SMIT Logical Volumes Menu AU1410.0

Notes:

This is the top-level SMIT menu for logical volumes. The next few pages discuss these items.

Showing Logical Volume Characteristics

- Show Characteristics of a Logical Volume:

Physical Volume map:

```
# lslv -l lv00

lv00:/home/john
PV      COPIES        IN BAND       DISTRIBUTION
hdisk0  010:000:000      70%        000:000:007:003:000
```

Logical Partition map:

```
# lslv -m lv00

lv00:/home/john
LP      PP1   PV1        PP2   PV2        PP3   PV3
0001    0134  hdisk0
0002    0135  hdisk0
0003    0136  hdisk0
```

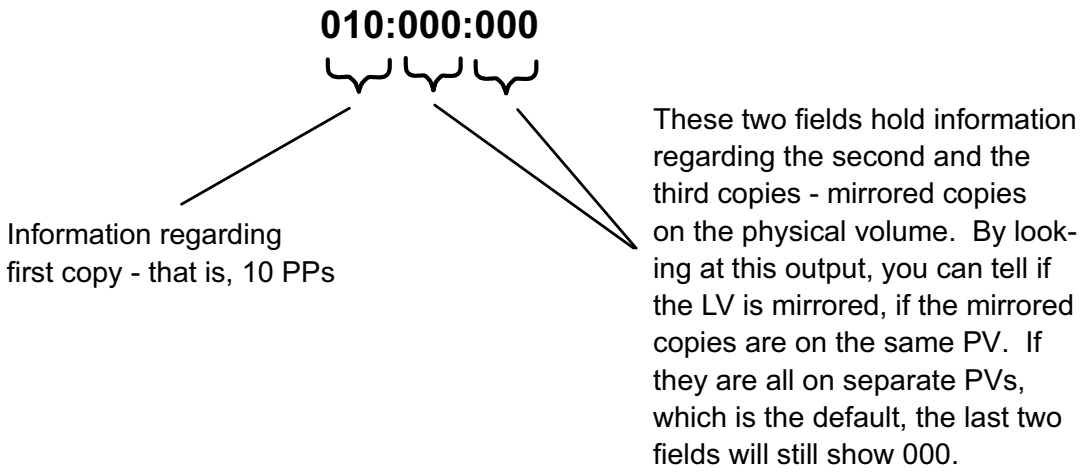

Figure 10-29. Showing Logical Volume Characteristics AU1410.0

Notes:

lslv -l lvname

This gives information about the distribution of a particular logical volume's logical partitions for each physical volume. The information includes the number of logical partitions on the disk and its copies, if any, on that disk; the percentage of physical partitions which match the intra-physical volume allocation policy; the distribution of physical partitions on the physical volume (outer edge, outer middle, center, inner middle, inner edge).

Copies can be interpreted as:



The **IN BAND** attribute shows the percentage of the physical partitions on the physical volume that belong to the logical volume and were allocated within the region specified by the intra-allocation policy.

Distribution

There is a relationship between the numbers 000:000:007:003:000 and 010:000:000 whereby the 007:003 numbers indicate the distribution of the 010. The interpretation is: of the 10 PPs, 7 PPs are located in the center and 3 PPs in the inner-middle of the disk, respectively.

lslv -m lvname

This gives a map of which physical volumes contain which physical partitions for the logical partitions of the logical volume. Three columns are given, one for each copy of a logical partition.

Add a Logical Volume

 # smit mklv

Add a Logical Volume

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

		[Entry Fields]	
	Logical Volume NAME	[ ]	
*	Volume GROUP name	rootvg	
*	Number of LOGICAL PARTITIONS	[ ]	#
	PHYSICAL VOLUME names	[ ]	+
	Logical Volume TYPE	[ ]	
	POSITION on physical volume	middle	+
	RANGE of physical volumes	minimum	+
	MAXIMUM NUMBER of PHYSICAL VOLUMES to use for allocation	[ ]	#
	Number of COPIES of each logical partition	1	+
	Mirror Write Consistency	yes	+
	Allocate each logical partition copy on a SEPARATE physical volume?	active	+

[MORE... 10]

Figure 10-30. Add a Logical Volume AU1410.0

Notes:

The **mklv** command creates a logical volume. The name of the logical volume can be specified or alternatively a system-generated name will be used. The volume group the logical volume will belong to and size (in logical partitions) must be specified. Other characteristics that can be set are the allocation policy, copies (mirroring), scheduling policy and striping. Using **mklv** from the command line you can now specify blocks (b,B), KB (k,K), MB (m,M) and GB (g,G) rather than number of partitions.

 # mklv -y newlv1 datavg 1

 # mklv -y newlv2 datavg 1b

 # mklv -y newlv3 datavg 1k

 # mklv -y newlv4 datavg 1m

 # mklv -y newlv5 datavg 1g

The system does a rounding to the PP size of the volume group.

Remove a Logical Volume

 # smit rmlv

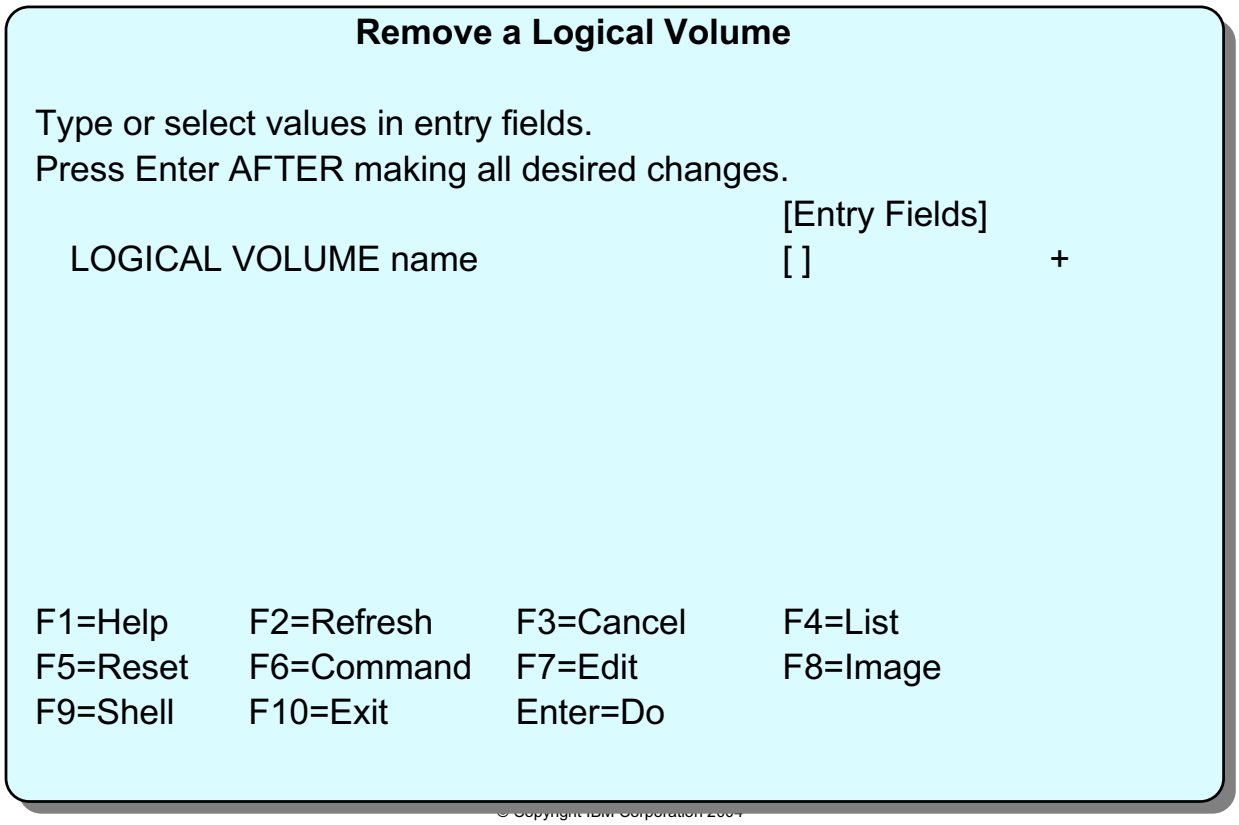


Figure 10-31. Remove a Logical Volume AU1410.0

Notes:

The **rmlv** command removes a logical volume. The **-f** option prevents the command from prompting for confirmation.

Do not use **rmlv** to remove journaled file systems or paging space volumes. These high-level structures have information relating to them saved in the ODM database and in files such as the /**etc/filesystems** file. This information is not removed by the **rmlv** command. You should used the appropriate command for that type of data structure.

Set Characteristics of a Logical Volume

 # smit lvsc

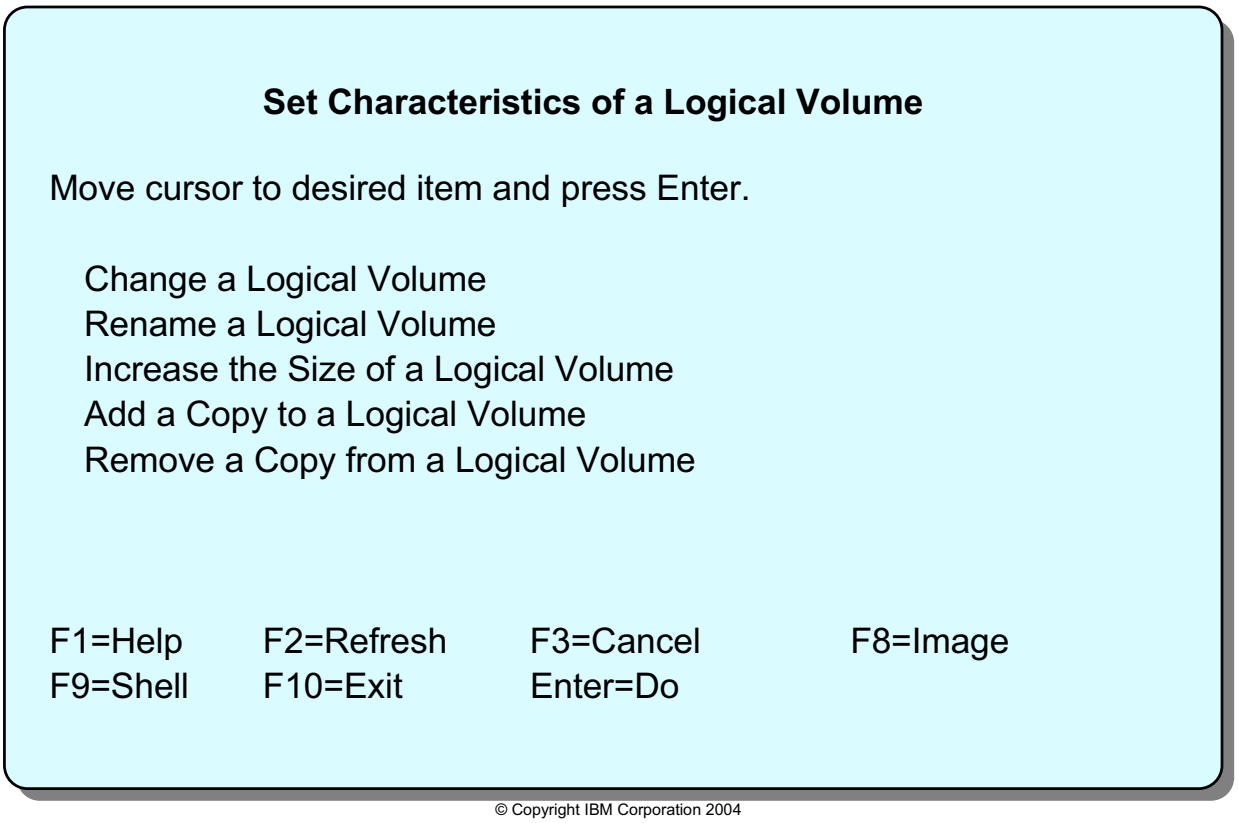


Figure 10-32. Set Characteristics of a Logical Volume AU1410.0

Notes:

The **chlv** command is used to change the characteristics of a logical volume. Characteristics that can be changed are the allocation and scheduling policies and the permissions. (When a logical volume is created it always has read/write permission, but this can be changed to read-only later.)

You can change the name of a logical volume using the **chlv** command with the **-n** option. No other **chlv** options can be specified if **-n** is used.

The size of a logical volume may be increased at any time, assuming that there is sufficient space in the volume group. To do this the **extendlv** command is used. You can now specify blocks, KB, MB and GB rather than number of partitions. You can set the allocation policies for the new partitions to different values than used by the original logical volume.

The size of a logical volume may not be decreased automatically. To make a logical volume smaller, back it up, delete it, create a new logical volume of the desired size and restore the data.

Showing LV Characteristics (1 of 2)

List all Logical Volumes by Volume Group

```
# lsvg -o | lsvg -i -l

rootvg:
LVNAME      TYPE    LPs   PPs   PVs   LV STATE      MOUNT POINT
hd6         paging  8     8     1     open/syncd    N/A
hd5         boot    1     1     1     closed/syncd  N/A
hd8         jfslog  1     1     1     open/syncd    N/A
hd9var      jfs     1     1     1     open/syncd    /var
hd4         jfs     1     1     1     open/syncd    /
hd2         jfs     77    77    1     open/syncd    /usr
hd3         jfs     3     3     1     open/syncd    /tmp
hd1         jfs2    11    11    1     open/syncd    /home
hd10opt     jfs     2     2     1     open/syncd    /opt
lv00        jfs2    1     2     2     open/syncd    /home/john
lv01        jfs2    4     4     2     open/syncd    /home/fred
```


Figure 10-33. Showing LV Characteristics (1 of 2) AU1410.0

Notes:

List all **Logical Volumes by Volume Group** uses **lsvg -o** to find out the active volume groups and then **lsvg -il** to list the logical volumes within them. The **-i** option of **lsvg** reads the list of volume groups from standard input.

The SMIT option **Show Characteristics of a Logical Volume** uses the **lslv lvname** to show status information about the selected logical volume.

Showing LV Characteristics (2 of 2)

Show Characteristics of a Logical Volume

```
# lslv lv02

 LOGICAL VOLUME:   lv02                   VOLUME GROUP:  course
 LV IDENTIFIER:    0000000000004c00000000e5cf75106f.4
 PERMISSION:       read/write
 VG STATE:         active/complete        LV STATE:      opened/syncd
 TYPE:             jfs2                   WRITE VERIFY:  off
 MAX LPs:          128                    PP SIZE:       4 megabyte(s)
 COPIES:           1                      SCHED POLICY:  parallel
 LPs:              10                     PPs:           10
 STALE PPs:        0                      BB POLICY:     relocatable
 INTER-POLICY:     minimum                RELOCATABLE:   yes
 INTRA-POLICY:     middle                 UPPER BOUND:   32
 MOUNT POINT:      /home/malcolm          LABEL:         /home/malcolm
 MIRROR WRITE CONSISTENCY:  on/ACTIVE
 EACH LP COPY ON A SEPARATE PV ?:  yes
 Serialize IO ?    NO
```


Figure 10-34. Showing LV Characteristics (2 of 2) AU1410.0

Notes:

Write Verify

Specifies whether to verify all writes to the logical volume with a follow-up read.

Bad Block

Indicates whether the LVM should try to relocate a bad block if one is encountered.

Add/Remove a Logical Volume Copy

 # smit mklvcopy

Add Copies to a Logical Volume

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

	[Entry Fields]	
* LOGICAL VOLUME name	lv00	
* NEW TOTAL number of logical partition copies	2	+
PHYSICAL VOLUME names	[ ]	+
POSITION on physical volume	middle	+
RANGE of physical volumes	minimum	+
MAXIMUM NUMBER of PHYSICAL VOLUMES to use for allocation	[32]	#
Allocate each logical partition copy on a SEPARATE physical volume?	yes	+
File containing ALLOCATION MAP	[ ]	
SYNCHRONIZE the data in the new logical partition copies?	no	+

Figure 10-35. Add/Remove a Logical Volume Copy AU1410.0

Notes:

The **mklvcopy** command is used to add copies (mirroring) to a logical volume that has none or to increase the copies from two or three. Specify the logical volume to change the desired total number of copies. This only succeeds if there are enough physical partitions to satisfy the requirements on the physical volumes that are specified to be used (that is, if all copies are to be on different physical volumes).

Also, in order for the copies to match, the logical volume has to be synchronized using the **syncvg** command. This can be done with the **-k** option when the copy is originally started. It can be done later using the **syncvg** command.

The **rmlvcopy** command is used to reduce the total number of copies for a logical volume. Specify the desired total number (for example, two if you are reducing the number of copies from three to two). The **rmlvcopy** command allows you to specify which disk to remove the copy from.

Once a logical volume has been created, striping cannot be imposed or removed.

Reorganize a Volume Group

 # smit reorgvg

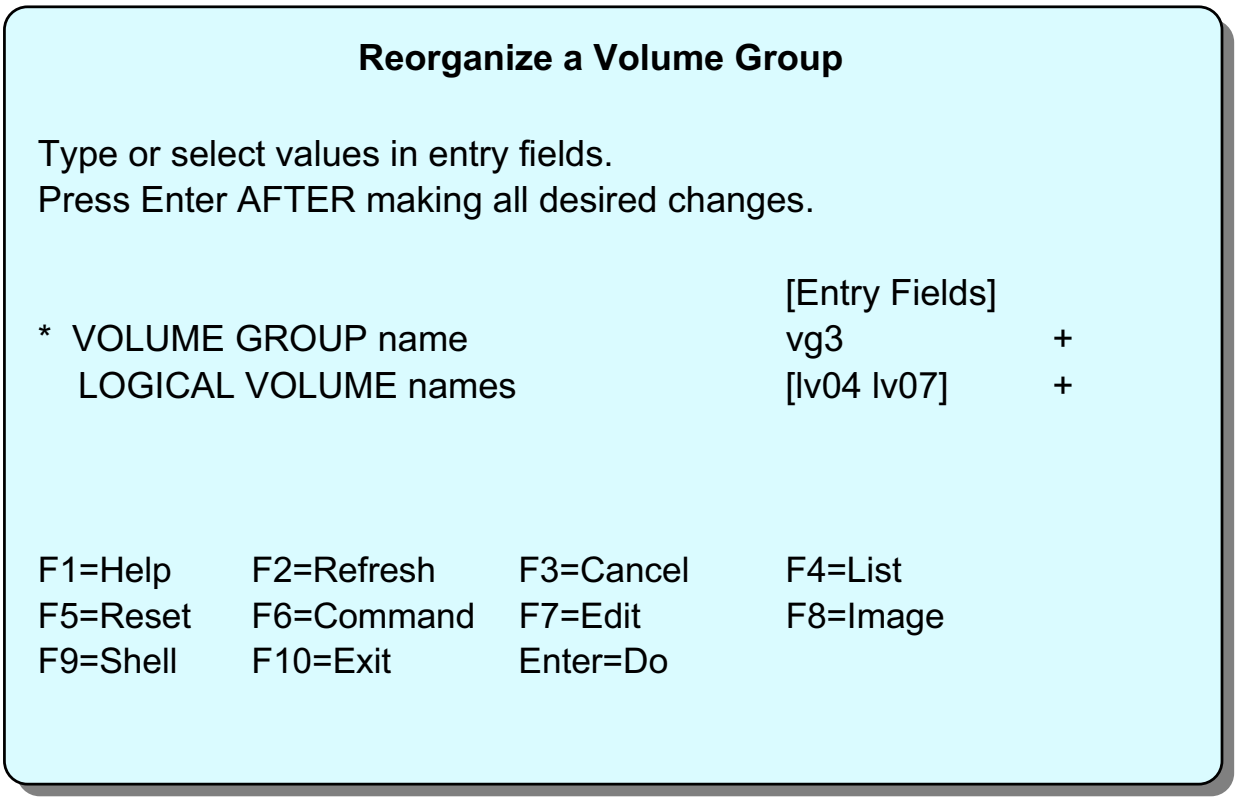


Figure 10-36. Reorganize a Volume Group AU1410.0

Notes:

If the intraphysical volume policy (center, middle, edge, and so forth) is changed after the LV is created, the physical partition will not relocate automatically.

The **reorgvg** command is used to redistribute the physical partitions of the logical volumes of a volume group according to their preferred allocation policies. This should improve disk performance. Preference is given in the order listed on the command line.

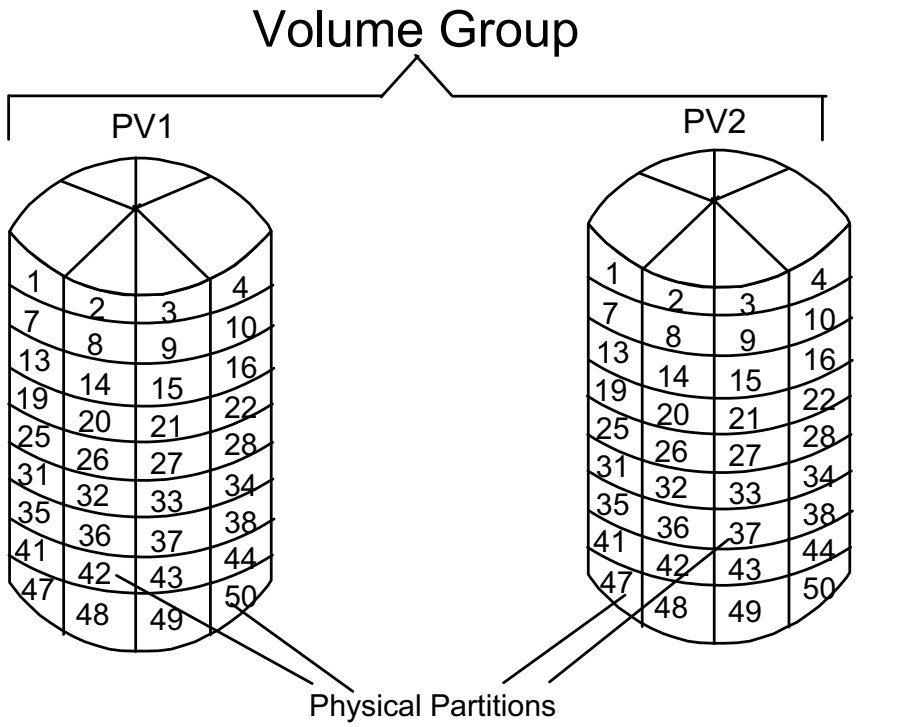
reorgvg *volumegroup [lvname]*

 # reorgvg vg3 lv04 lv07

In AIX V4.2 and later, if you enter the **reorgvg** command with the volume group name and no other arguments, the entire volume group is reorganized.

10.3 Physical Volumes

Physical Volumes



- Physical Volume (PV) — hard disk
- Physical Partition (PP) — smallest assignable unit of allocation on a physical disk

Figure 10-37. Physical Volumes AU1410.0

Notes:

A **Physical Partition** is a fixed size, contiguous set of bytes on a physical volume (PV). Physical partitions (PP) must be the same size across an entire VG. However, there may be multiple VGs on a single system, each having a different PP size. A PP can be 1 - 1024 MB.

AIX V4.3.2 and later versions provides support for more than 1016 physical partitions per physical volume. This support provides for multiples of 1016 PPs per PV. Using more than 1016 PPs per PV in this manner reduces the total number of disks that can exist in the volume group by the same fraction as indicated in the following table:

Reg VG # of PVs	# of PPs	Big VG # of PVs
32	1016	128
16	2032	64
8	4064	32
4	8128	16
2	16256	8

Big Volume Groups are available with AIX V4.3 and later versions. They can be created with **mkvg -B** or **chvg -B**.

Scalable Volume Groups (AIX 5.3) do not need to make a trade off between the max # of PPs/PV and the max # of PVs for the VG. They can have 1024 PVs with up to 2,097,152 PPs for the VG. The maximum number for PP is no longer on a PV by PV basis; it is a VG wide allocation. They can be created with the **mkvg -S** or **chvg -S** commands.

SMIT Physical Volumes Menu

 # smit pv

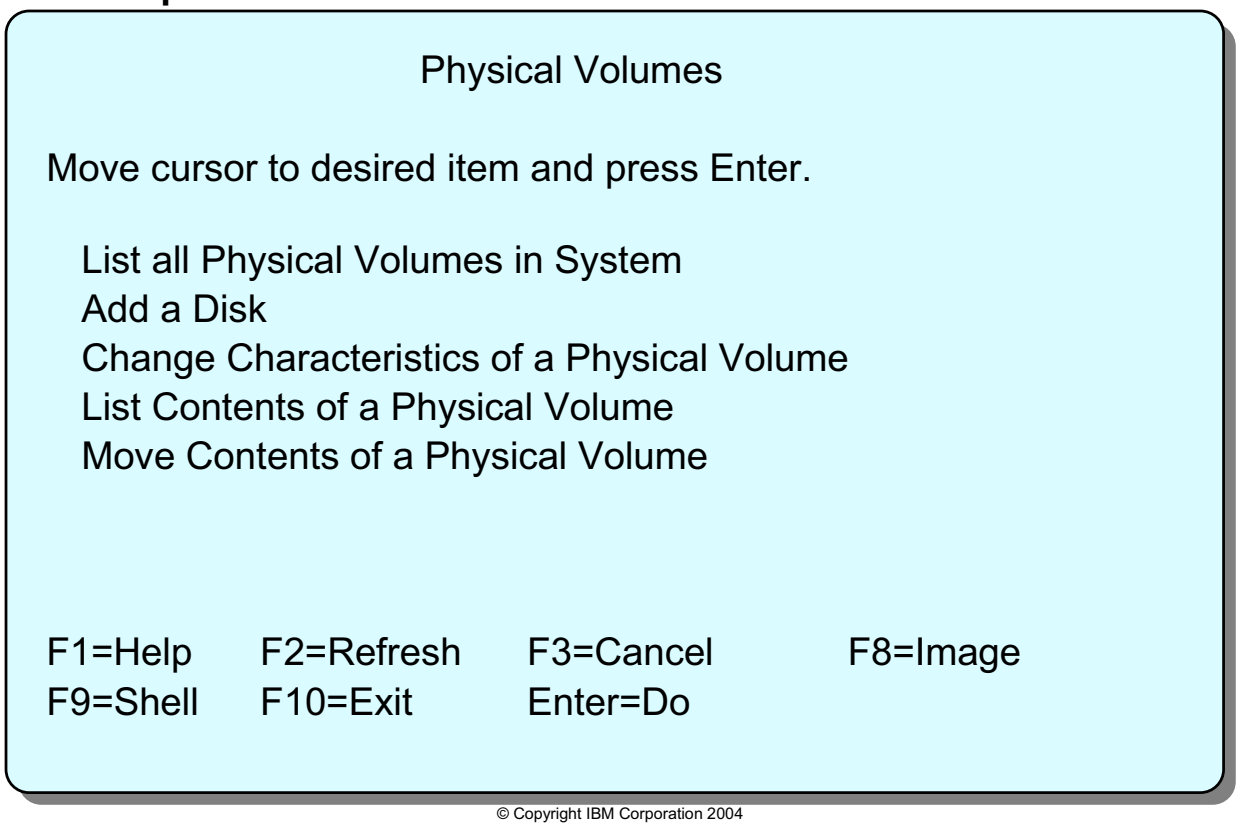


Figure 10-38. SMIT Physical Volumes Menu AU1410.0

Notes:

This is the top-level menu for physical volume. We explain each of these items in the following pages.

Listing Physical Volume Information (1 of 3)

- List all Physical Volumes in System:

```
# lspv

hdisk0      da1c923411d52ec91cd600802eda72c9      rootvg      active
hdisk1      bebc800000000000000802evg79c9         rootvg      active
```

- List Contents of a Physical Volume:

```
# lspv hdisk0

PHYSICAL VOLUME:    hdisk0                  VOLUME GROUP:       rootvg
PV IDENTIFIER:      da1c923411d52ec91cd600802eda72c9
VG IDENTIFIER:      000bc6fd00004c00000000e10fdd7f52
PV STATE:           active
STALE PARTITIONS:   0                       ALLOCATABLE:        yes
PP SIZE:            4 megabyte(s)           LOGICAL VOLUMES:    6
TOTAL PPs:          95   (380 megabytes)    VG DESCRIPTORS:     2
FREE PPs:           3    (12 megabytes)     HOT SPARE:          no
USED PPs:           92   (368 megabytes)    MAX REQUEST         256 KB
FREE DISTRIBUTION:  00..03..00..00..00
USED DISTRIBUTION:  19..16..19..19..19
```


Figure 10-39. Listing Physical Volume Information (1 of 3) AU1410.0

Notes:

List All Physical Volumes in System actually uses the undocumented command **getlvodm -C** to list the physical volumes in the system.

The **lspv** command with no parameters can be used to list the physical volume name, PV identifier and volume group for all physical volumes in the system.

The **lspv** ***pvname*** command gives status information about the physical volume. The most useful information here is: state (active or inactive), number of PP copies that are stale (are not up to date with other copies), total number of PPs, number of free PPs and distribution of free space on the PV.

Listing Physical Volume Information (2 of 3)

Logical Volumes

```
# lspv -l hdisk0

hdisk0:
LV NAME      LPs  PPs  DISTRIBUTION      MOUNT POINT
hd1          12   12   00..00..00..12..00  /home
hd3          3    3    00..03..00..00..00  /tmp
hd2          29   29   00..00..17..12..00  /usr
hd4          13   13   00..00..13..00..00  /
hd8          1    1    00..00..01..00..00  N/A
hd6          8    8    00..00..00..08..00  N/A
hd5          1    1    01..00..00..00..00  N/A
hd9var       2    2    00..00..02..00..00  /var
hd10opt      2    2    00..00..02..00..00  /opt
```


Figure 10-40. Listing Physical Volume Information (2 of 3) AU1410.0

Notes:

lspv -l pvname lists all the logical volumes on a physical volume including number of logical partitions, physical partitions and distributions on the disk.

Listing Physical Volume Information (3 of 3)

Physical Partition Map

```
# lspv -p hdisk0
hdisk0:
PP RANGE    STATE  REGION        LV NAME  TYPE    MOUNT  POINT
1-1         used   outer edge      hd5    boot    N/A
2-31        used   outer edge      hd2    jfs     /usr
32-32       free   outer edge
33-40       used   outer middle    hd6    paging  N/A
41-64       free   outer middle
65-65       used   center          hd8    jfslog  N/A
66-66       used   center          hd4    jfs     /
67-73       used   center          hd2    jfs     /usr
74-74       used   center          hd9var jfs     /var
75-76       used   center          hd3    jfs     /tmp
77-77       used   center          hd1    jfs2    /home
78-84       used   center          hd2    jfs     /usr
85-92       used   center          paging00 paging N/A
93-95       used   center          hd10opt jfs     /opt
96-159      used   inner middle    hd2    jfs     /usr
```


Figure 10-41. Listing Physical Volume Information (3 of 3) AU1410.0

Notes:

lspv -p pvname lists all the logical volumes on a disk and the physical partitions to which its logical partitions are mapped. It is listed in physical partition order and shows what partitions are free and which are used, as well as the location; that is, outer edge, outer middle, center, and so forth.

Add or Move Contents of Physical Volumes

- **Add a disk:**

  The device can either be added through SMIT or it can be configured through configuration manager when the system boots up.

- Move the contents of a Physical Volume:
  migratepv [-l *lvname*] *sourcePV targetPV* ..

```
# migratepv -l lv02 hdisk0 hdisk6
```


Figure 10-42. Add or Move Contents of Physical Volumes AU1410.0

Notes:

To add a physical volume to the system, the option performed is the **Add a Disk** option from the **Fixed Disks** menu under **Devices**. This adds the disk and assigns it an hdisk number. Once the disk has been added, it needs to be added to a volume group so that it can be used. Refer to the **Volume Groups** or **Define a Fixed Disk to the Operating System** menus.

The alternative method is to power down the system, connect the new disk to the system, power up the system, and in so doing **cfgmgr** is invoked, which picks up the new device (if it is a detectable device).

In AIX V4.3.1 and later, if you wish to add a disk that exceeds the 1016 PP/PV limitation to a pre-existing volume group, first convert the volume group so that it can hold multiples of 1016 partitions per disk. This is done using the **chvg -t (factor)** command, where *factor* is a value between 1 and 16. Thus, the maximum number of physical partitions per physical volume for this volume group changes to factor multiplied by 1016.

The **migratepv** command can be used to move all partitions (or partitions from a selected LV) from one physical volume to one or more other physical volumes in the same volume

group. This would be used if the physical volume is about to be taken out of service and removed from the machine or to balance disk usage.

Documenting the Disk Storage Setup

- List of the disks on the system (PVID and VG)

  lspv

- List the VGs

  lsvg

- List what LVs are contained in each VG

  lsvg -l *vgname*

- List the LVs on each disk

  lspv -l *pvname*

Figure 10-43. Documenting the Disk Storage Setup AU1410.0

Notes:

Exercise: Logical Volume Manager

Figure 10-44. Exercise: Logical Volume Manager AU1410.0

Notes:

This lab has you set up a new volume group and a new logical volume. You use this volume group and logical volumes in future exercises.

The exercise can be found in your Exercise Guide.

Checkpoint

1. True or false? An LV can span more than one physical volume.

2. True or false? An LV can span more than one volume group.

3. True or false? The contents of a PV can be divided between two VGs.

4. True or false? If mirroring LVs, it is not necessary to perform a backup.

5. True or false? SMIT can be used to easily increase or decrease the size of a logical volume.

6. True or false? Striping is done at a logical partition level.

Figure 10-45. Checkpoint AU1410.0

Notes:

Unit Summary

- SMIT or high-level commands can be used to Add, Change, or Delete volume groups, physical volumes and logical volumes.
- Mirroring is a way to have two or three copies of a logical volume for high availability requirements.
- Disk striping is used to provide high performance in large, sequentially accessed file systems.

Figure 10-46. Unit Summary AU1410.0

Notes:

Unit 11. Working with File Systems

What This Unit Is About

This unit provides a more in-depth discussion on the concepts and structure of AIX file systems.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Identify the components of an AIX file
- Add an enhanced journaled file system
- Change characteristics of a file system
- Add a RAM filesystem
- Add an UDF filesystem on a DVD-RAM

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise
- Activity

References

Online	*System Management Concepts: Operating System and Devices*
Online	*System Management Guide: Operating System and Devices*
GG24-4484	*AIX Storage Management Guide*

Unit Objectives

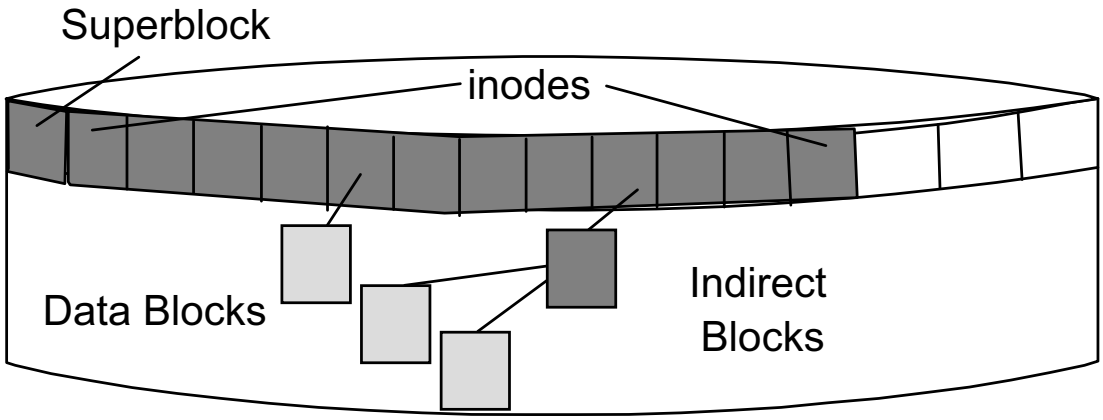
After completing this unit, you should be able to:

- Identify the components of an AIX file system
- Add an enhanced journaled file system
- Change characteristics of a file system
- Add a RAM filesystem
- Add an UDF filesystem on a DVD-RAM

Figure 11-1. Unit Objectives AU1410.0

Notes:

Structure of a Journaled File System



- **Superblock**
  - File system size and identification
  - Free list, fragment size, nbpi
- **inodes**
  - File size, ownership, permissions, times
  - Pointers to data blocks
- **Blocks**
  - Data blocks - contain data
  - Indirect blocks - contain pointers to data blocks

Figure 11-2. Structure of a Journaled File System AU1410.0

Notes:

AIX-journaled file systems are built within logical volumes. Because journaled file systems exist within logical volumes, the size of the file system always multiples of the logical partition size for that logical volume (for example, 4 MB).

An individual file within a file system will by default have units allocated to it in blocks of 4096 bytes. (This may change if you have implemented fragmentation or large files - to be discussed later.)

Some AIX commands often report file sizes in units of 512 bytes to remain compatible with other UNIX file systems. This is independent of the actual unit of allocation.

The first addressable logical block on the file system is the superblock. The superblock contains information such as the file system name, size, number of inodes, date/time of creation.

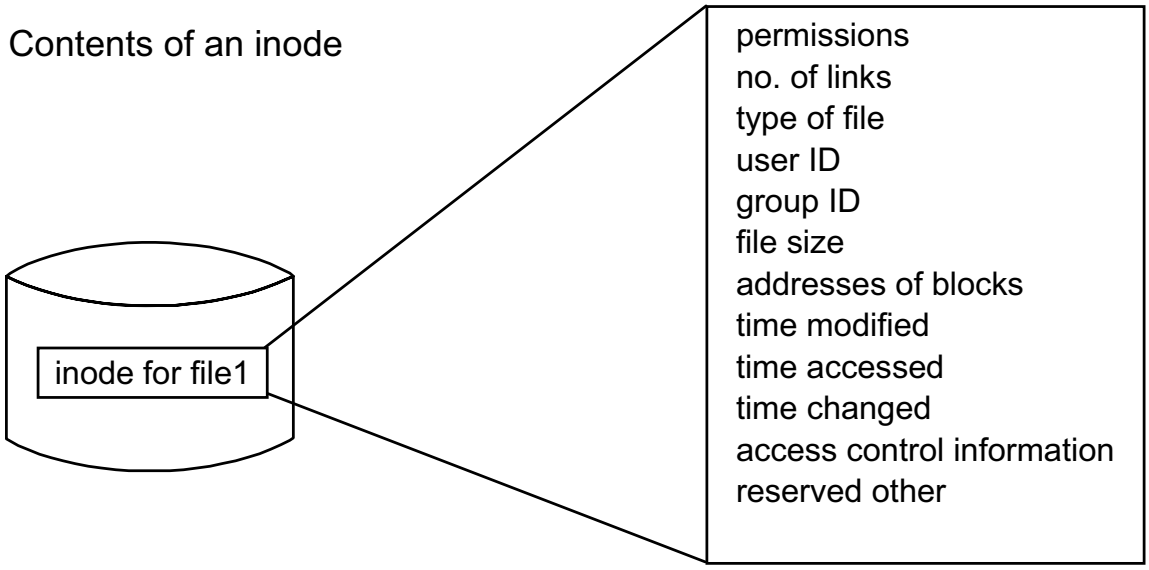
The superblock is critical to the file system and if corrupted, prevents the file system from mounting. For this reason a backup copy of the superblock is always written in block 31.

Immediately following the superblock are inodes which contain identifying information for files such as the file type, size, permissions, user/group/owner, create/modification and last access dates. They also contain pointers to the data block for fragment addresses which hold the data.

For larger files the system creates sets of indirect blocks filled with data block addresses to point to the data block or fragments which hold the data.

Structure of an Inode

- Contents of an inode



- This information can be seen with ls -li:

```
$ ls  -li  /home/team01
2132        drwxr - xr - x    2    team01 staff    512      May 2   14:33    c
2136        drwxr - xr - x    2    team01 staff    512      May 2   14:33    doc
2141        -rw-r - - r - -   1    team01 staff    28       May 16  10:11    Manuals
```


Figure 11-3. Structure of an Inode AU1410.0

Notes:

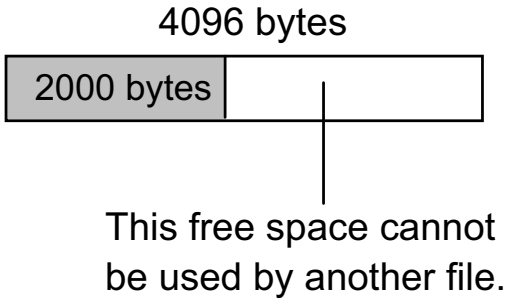
Each file is represented by a single inode. The inode contains information about that file such as:

- Ownership
- Access permissions
- Type
- Creation, modification and access times
- Number of links to the file
- Size
- Addresses of data blocks on disk

File System Fragmentation

No Fragmentation

File size = 2000 bytes



Fragmentation Enabled

File size = 2000 bytes
Fragment size = 1024 bytes

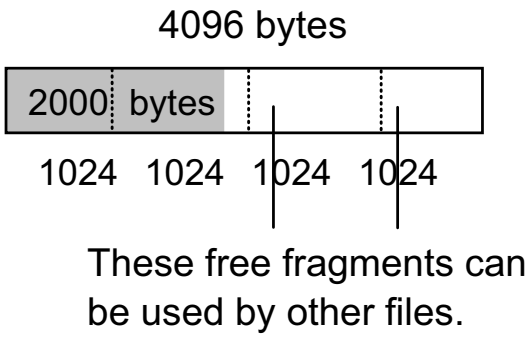


Figure 11-4. File System Fragmentation AU1410.0

Notes:

Fragmentation provides a way to allocate pieces (or fragments) of a 4 KB logical block to files and directories. Fragment support is helpful for small user files and directories. Fragment support applies to the last direct block of small user files and directories and long symbolic links. Fragment size is specified for a file system at creation time. The allowable fragment size for JFS file systems are 512, 1024, 2048 and 4096 bytes. The default fragment size is 4096 bytes.

Different file systems can have different fragment sizes, but only one fragment size can be used within a single file system. Different fragment sizes can also coexist on a single system so that administrators can select a fragment size which is most appropriate for each file system.

JFS fragment support provides a view of the file system as a contiguous series of fragments rather than logical disk blocks.

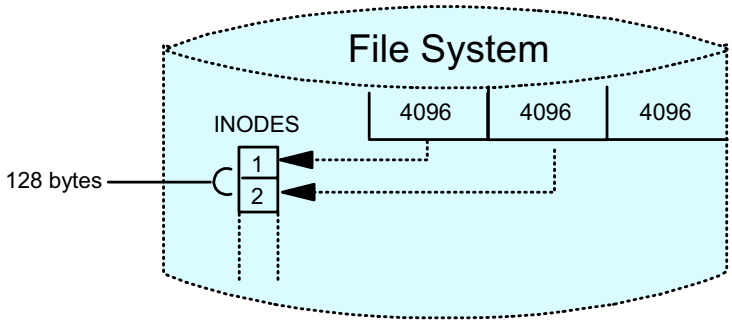
Both operational overhead (additional disk seeks and allocation activity) and better utilization of disk space increase as the fragment size for a file system decreases. In order

to maintain the optimum balance between increased overhead and increased usable disk space, the following factors apply to JFS fragment support:

- Disk space allocations of 4096 bytes of fragments are maintained for a file or directory's logical blocks where possible.
- Only partial logical blocks for files and directories less than 32 KB in size can be allocated less than 4096 bytes of fragments.

Variable Number of Inodes

With the default nbpi = 4096 an inode will be created for every 4096 bytes of file system.



Using the value nbpi = 1024 an inode will be created for every 1024 bytes of file system.

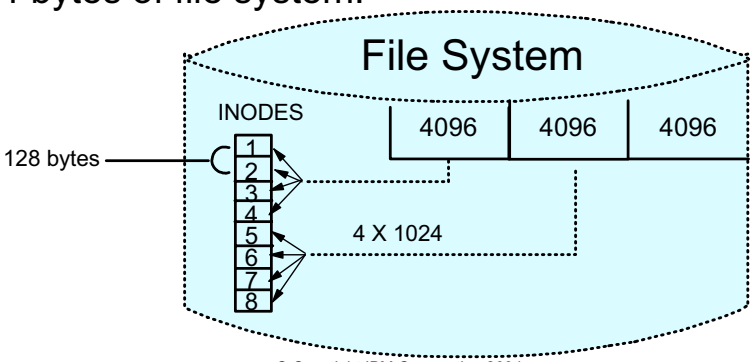


Figure 11-5. Variable Number of Inodes AU1410.0

Notes:

In all UNIX implementations, when a file system is created, inodes are written to disk. For each file or directory one such data structure is used which describes information pertaining to the file or directory. JFS also reserves a number of inodes for files and directories in each file system that is created.

In earlier versions of JFS, the number of inodes created for a file system was fixed. An inode was generated for every 4 KB of disk space that was allocated to the file system being created. In a 4 MB file system this would result in 1024 inodes being generated. As long as files and directories are allocated at a minimum of 4 KB, this would suffice.

However, since fragment support optimizes disk utilization, it increases the number of small files and directories that can be stored within a file system. Since each file or directory requires a disk inode, there needs to be a way to specify the number of inodes needed. JFS allows the number of disk inodes created within a file system to be specified in case more or less than the default number of disk inodes is desired. This number can be specified at file system creation as the number of bytes per inode (NBPI). For example, an

NBPI value of 1024 causes a disk inode to be created for every 1024 bytes of file system space. A small NBPI value results in a large number of inodes and vice versa.

The decision of fragment size and how many inodes to create for a file system should be based on the projected number of files contained by the file system and their size.

With JFS2 it is no longer necessary to project the number of files contained by the file system and their size. JFS2 dynamically allocates space for inodes as needed, and frees the space when it is no longer required.

Allocation Group Size

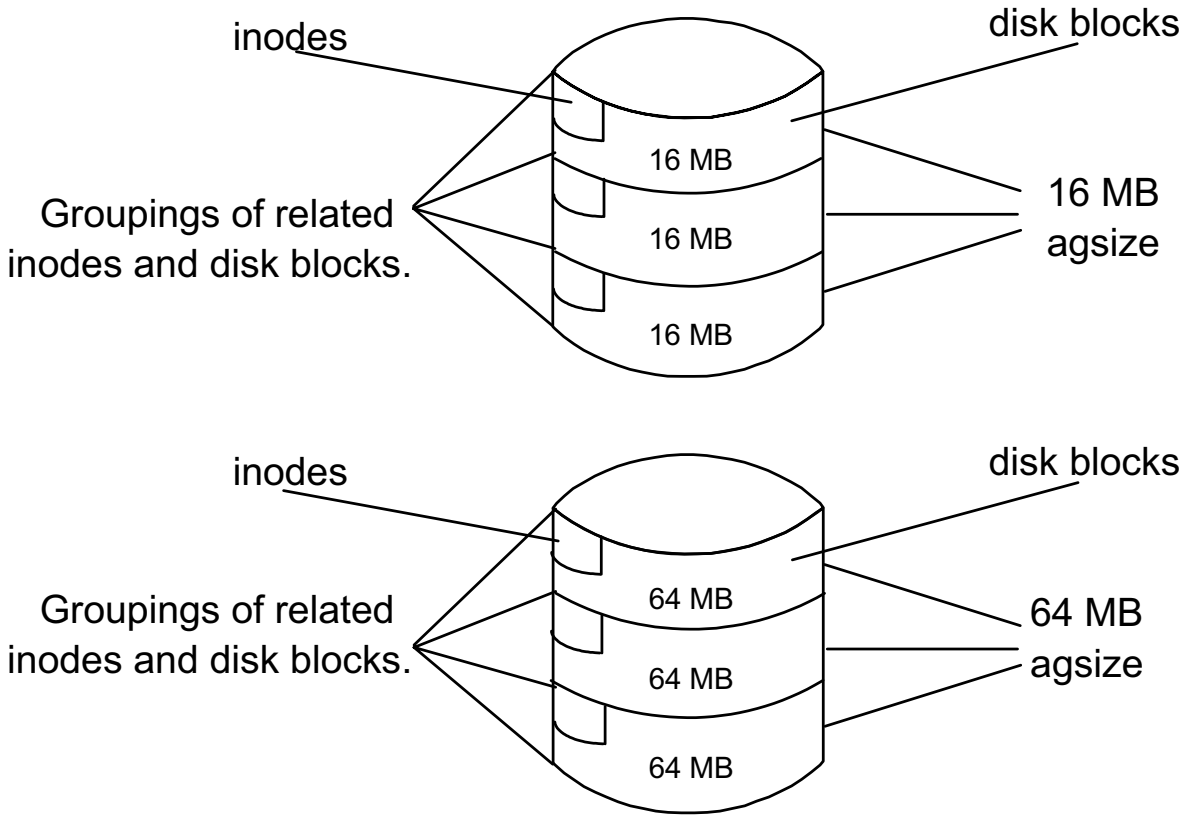


Figure 11-6. Allocation Group Size AU1410.0

Notes:

Allocation Group Size is supported by AIX V4.2 and later and is used to increase the efficiency of the file system. The inodes with the corresponding data blocks are further grouped in logical units of 8, 16, 32, or 64 MB within the file system. Building a relationship between the placement of the data blocks and related inode information reduces the physical action required by the drive heads when I/O operations are performed.

The allocation group size (AGS or agsize) value is a JFS configuration parameter which along with the NBPI and fragment size determine the overall characteristics of the file system.

The allowable set of NBPI values are also dependent on the allocation group size (agsize). For example, for an agsize value of 8 MB the only allowable NBPI values are 512, 1024, 2048, 4096, 8192 and 16384 bytes. If you were to double the agsize from 8 MB to 16 MB the range of NBPI values also doubles to 1024, 2048, 4096, 8192, 16384 and 32768 bytes respectively.

Refer to the table for more details.

Allocation Group Size	NBPI
8 MB	512,1024,2048,4096,8192,16384
16 MB	1024,2048,4096,8192,16384,32768
32 MB	2048,4096,8192,16384,32768,65536
64 MB	4096,8192,16384,32768,65536,131072

Compressed File Systems

compression = LZ (yes)
fragment size = 1024

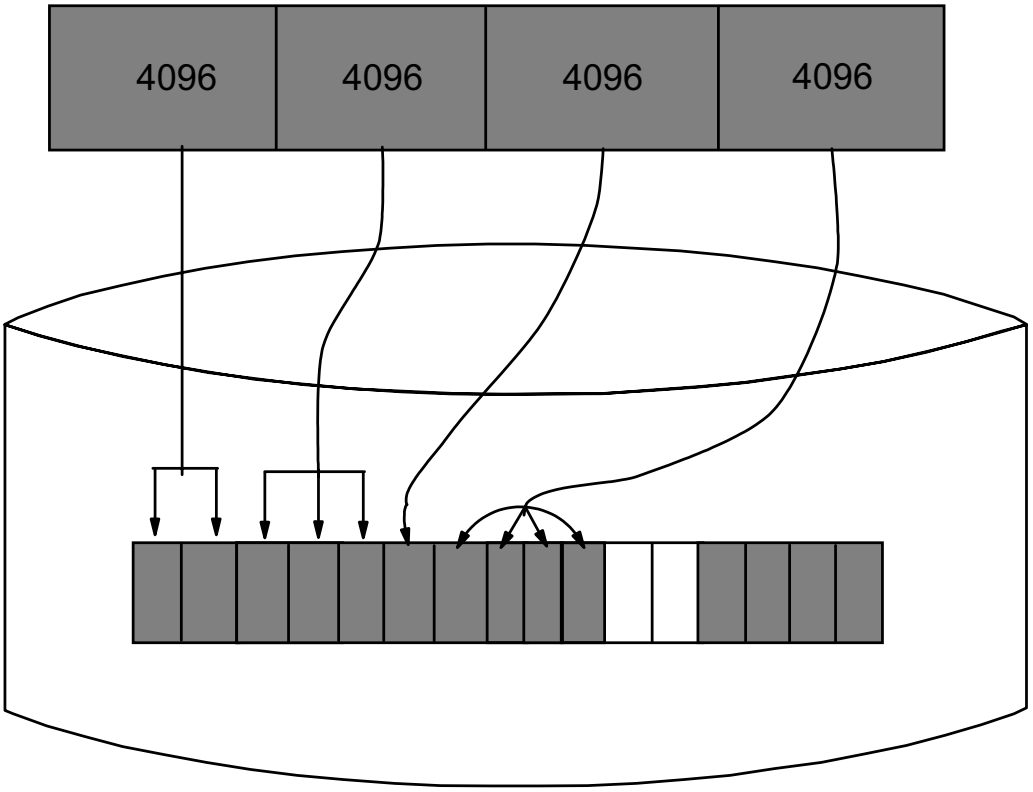


Figure 11-7. Compressed File Systems AU1410.0

Notes:

JFS supports fragmented and compressed file systems. Both types of file systems save disk space by allowing a logical block to be stored on the disk in units or fragments smaller than the full block size of 4096 bytes. In a fragmented file system only the last logical block of files no larger than 32 KB are stored in this manner, so that fragment support is only beneficial for the file systems containing numerous small files. Data compression however, allows all logical blocks of any-sized file to be stored as one or more contiguous fragments. On average, data compression saves disk space by about a factor of 2. JFS2 does not support file system compression.

The use of fragments and data compression does, however, increase the potential for fragmentation of the disk's free space. Fragments allocated to a logical block must be contiguous on the disk. A file system experiencing free space fragmentation may have difficulty locating enough contiguous fragments for a logical block's allocation, even though the total number of free fragments may exceed the logical block's requirements. JFS and JFS2 alleviate free space fragmentation by providing the **defragfs** utility which defragments a file system by increasing the amount of contiguous space. This utility can be used for fragmented and compressed file systems.

Warning: The root file system must not be compressed. Compression of the /**usr** file system is not recommended.

In addition to increased disk I/O activity and free space fragmentation problems, file systems using data compression have the following performance considerations:

- Degradation in file system usability arising as a direct result of the data compression/decompression activity. If the time to compress and decompress data is quite lengthy, it may not always be possible to use a compressed file system, particularly in a busy commercial environment where data needs to be available immediately.
- All logical blocks in a compressed file system, when modified for the first time, will be allocated 4096 bytes of disk space, and this space is subsequently reallocated when the logical block is written to disk. Performance costs are, therefore, associated with this allocation, which does not occur in non-compressed file systems.
- In order to perform data compression, approximately 50 CPU cycles per byte are required and about 10 CPU cycles per byte for decompression. Data compression, therefore, places a load on the processor by increasing the number of processor cycles.

Large File Enabled File Systems

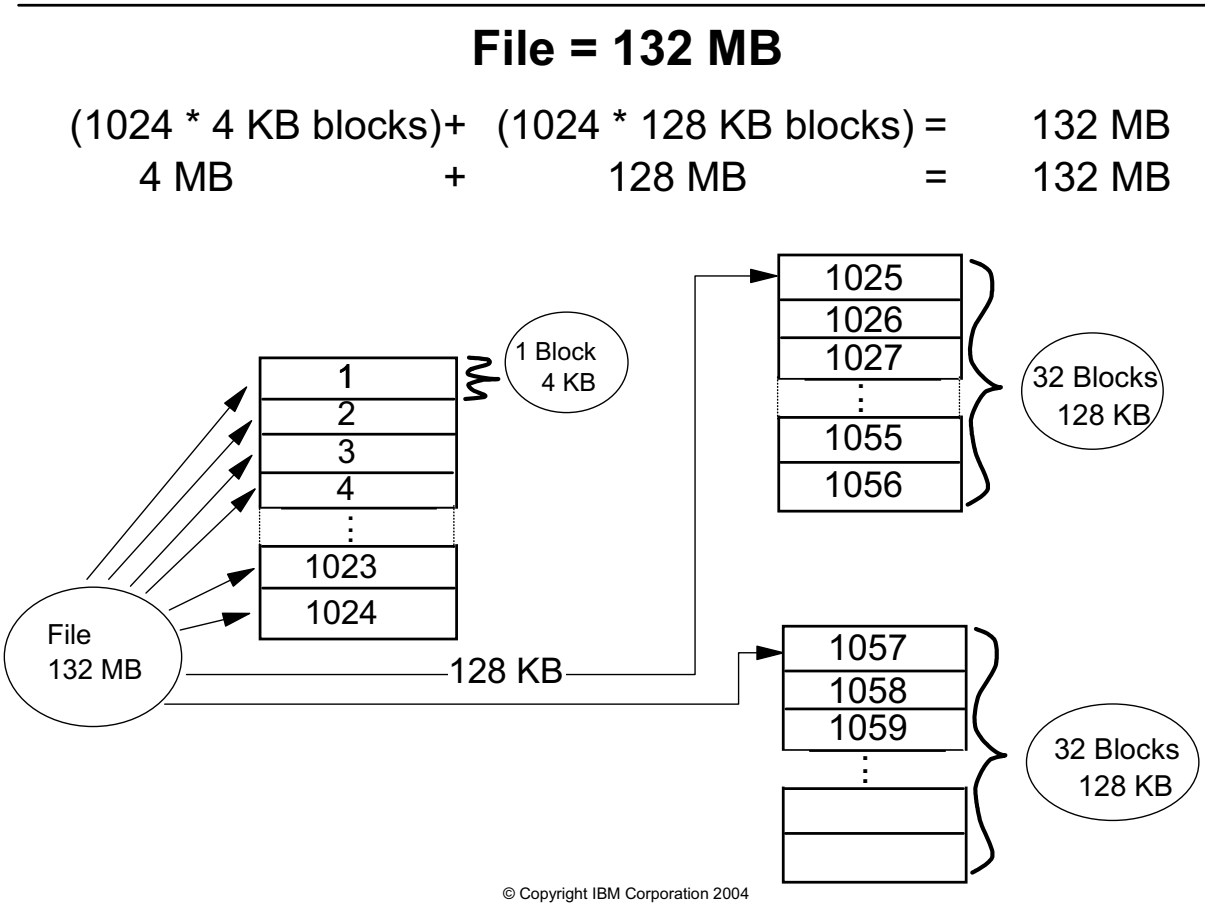


Figure 11-8. Large Enabled File Systems AU1410.0

Notes:

AIX V4.2 and later JFS supports large file enabled file systems. Only file systems enabled for large files can support files with a size greater than 2 GB.

In a file system enabled for large files, the data stored before the 4 MB file offset is allocated in 4096 byte blocks. File data stored beyond the 4 MB file offset is allocated with large disk blocks of 128 KB in size. The large disk blocks are actually 32 contiguous 4096 byte blocks. In the example above, a 132 MB file in a file system enabled for large files has 1024 4 KB disk blocks and 1024 128 KB disk blocks for a total of 2048 blocks.

In a regular standard file system the 132 MB file would require 33 single indirect blocks (each filled with 1024 4 KB disk addresses). However, the large file geometry requires only two single indirect blocks for the 132 MB file.

It is not necessary to use large enabled file systems in JFS2, since large file and file system support is built in by default.

Activity: Inodes and NBPI

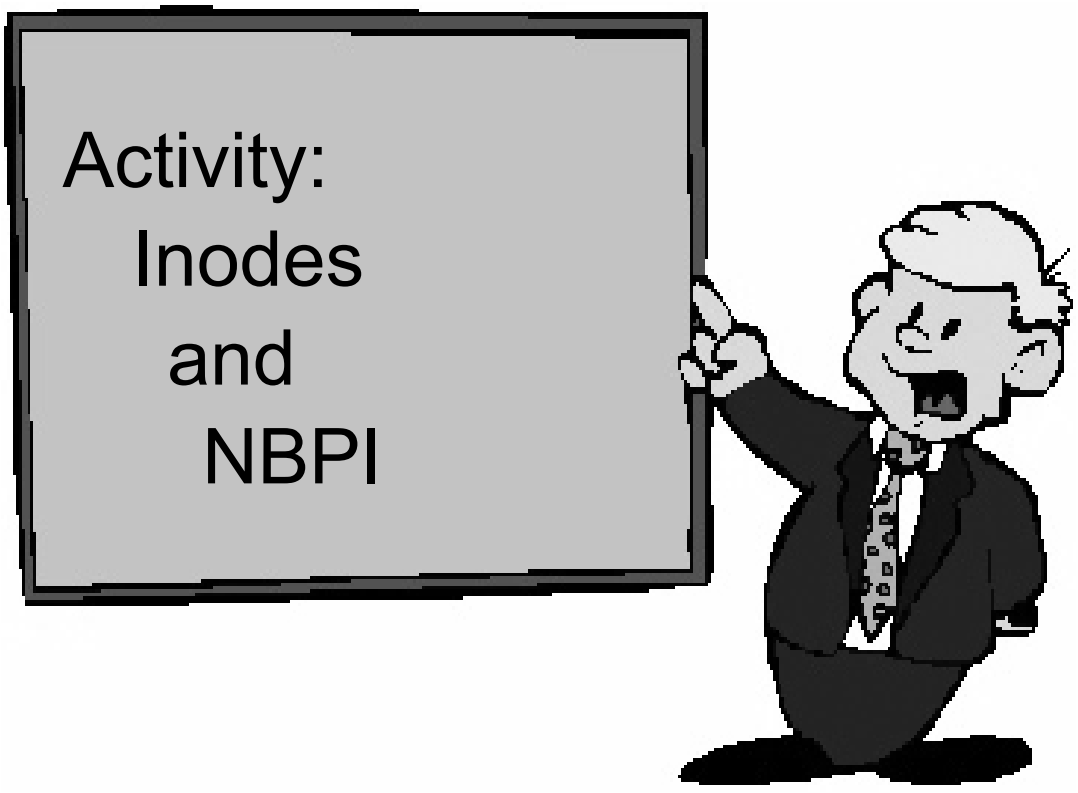


Figure 11-9. Activity: Inodes and NBPI AU1410.0

Activity

Complete the following questions regarding Fragmentation, NBPI and file system types.

1. If you are creating a JFS file system intended to store files that are smaller than 512 bytes in size, what would you to choose for the following values?

   Fragment Size _____ NBPI _____

   Regular or Large-file enabled _____

2. If you are creating a JFS file system intended to store files about 8 KB in size, what would you choose for the following values?

   Fragment Size _____ NBPI _____

   Regular or Large-file enabled _____

3. If you are creating a JFS file system intended to store files about 2 MB in size, what would you choose for the following values?

   Fragment Size _____ NBPI _____

Regular or Large-file enabled _____

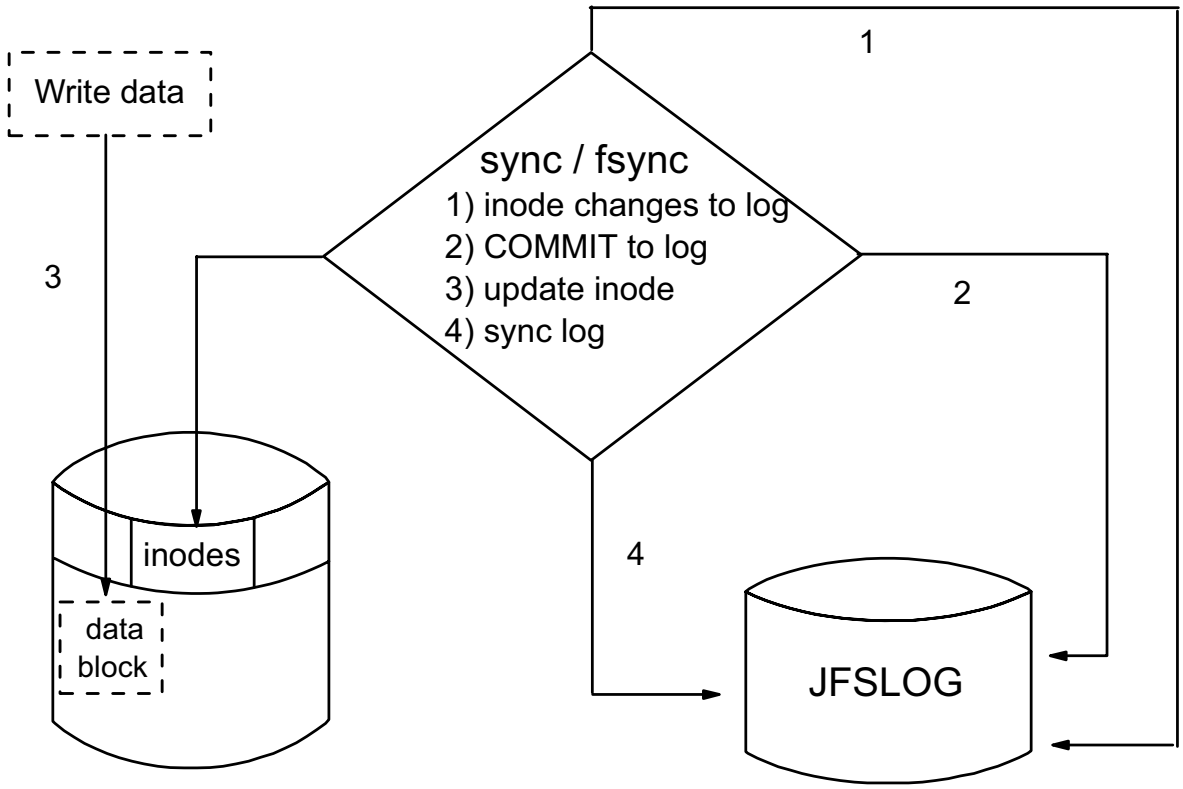
4. When should you use large file-enable file systems?

_____

5. When should you use compressed file systems?

_____

Journal Log



- No journaling of data blocks - only journals inode information (and indirect block information.)

Figure 11-10. Journaled Log AU1410.0

Notes:

AIX memory maps files in current use. Any writes to files are done first in memory and at a later stage are written out to disk when the **sync** system call runs - every minute.

The jfslog for the rootvg **(/dev/hd8)** is a circular log. It is created the size of one physical partition - one per each volume group. The jfslog ensures file system integrity by writing all metadata information to the jfslog immediately. It does this in the form of transactions as illustrated in the diagram. File system metadata consists of changes to the structure itself such as changes to the inodes and the free list.

When the data is written out to disk a sync point is indicated in the log and new transactions are written from that point forward.

By default, a single logical volume per volume group is used to contain the file system journal logs. When you create a new file system, the journal is added to the existing journal log logical volume. With default log logical volumes, the entire volume group depends on a single log logical volume.

User-created logs override the default log placement and put the file system log on a specific logical volume.

An **inline** log is a new feature specific to JFS2 file systems that allows you to log directly to the file system. The default inline log size is 0.4% of the logical volume size (in AIX 5.1).

The following table lists the default inline log size in AIX 5.2 and later.

LVsize	inline log size
<32 MB	256 KB
> 32 MB up to 64 MB	512 KB
>64 MB up to 128 MB	1 MB
128 MB	2 MB
128 MB to 1 GB	1/128th of size
1 GB to 2 GB	8 MB
2 GB to 128 GB	1/256th of size
128 GB up to 512 GB	512 MB
512 GB	1/1024th of size

The following table lists the three logging options and which file system type supports them.

Option	JFS	JFS2
Default volume group log	Yes	Yes
Specific user-created log	Yes	Yes
Log directly to the file system	No	Yes

JFS versus JFS2 File Systems

	JFS	JFS2
Maximum File Size Architectural / Tested	64 Gigabytes / 64 Gigabytes	1 Petabyte / 1 Terabyte
Maximum File System Size Architectural / Tested	1 Terabyte / 1 Terabyte	4 Petabytes / 1 Terabyte
Inode size	128 Bytes	512 Bytes
Number of inodes	Fixed, set at creation	Dynamic
Directory File Access	sequential	b-tree
Journal Log support	External JFSlog only	In-line or External JFS2log
Compression	Yes	No
Quotas	Yes	AIX 5.3

JFS2 uses extent based allocation for high performance and large file size.

Figure 11-11. JFS versus JFS2 File Systems AU1410.0

Notes:

Introduction to JFS2

Enhanced **J**ournaled **F**ile **S**ystem (JFS2) is a new file system type in AIX V5.1. It is based on JFS.

1 Petabyte (PB) = 1024 Terabytes (TB) = (2^{50}) bytes
1 Terabyte (TB) = 1024 Gigabytes (GB) = (2^{40}) bytes
1 Gigabyte (GB) = 1024 Megabytes (MB) = (2^{30}) bytes
1 Megabyte (MB) = 1024 Kilobytes (KB) = (2^{20}) bytes
1 Kilobyte (KB) = 1024 Bytes = (2^{10}) bytes

Extent-based allocation

JFS2 uses extent-based allocation. An extent is an address-length pair, which identifies the starting block address and the length of the extent in blocks. This allows multiple adjacent blocks to be addressed. The advantages of extent-based allocation are high performance and large file size.

Dynamic inodes

The traditional approach of reserving a fixed amount of space for inodes at file system creation time required accurate estimates of the number of files that would reside in the file system. If the estimate was high, disk space was wasted. If the estimate was low, no files could be added until the file system was expanded. JFS2 dynamically allocates space for inodes as needed, and frees the space when it is no longer required.

Directory File b-tree

In JFS the directory files are accessed sequentially. For large directory files this is inefficient. In JFS2, the directories files are accessed via a b-tree index. For very large directories, applications doing large numbers of add and delete to a JFS2 directory can see as much as a 40 fold improvement in performance.

In-line Journal Logs

Normally multiple filesystems use the same journal log. This associated contention can impact performance. Creating a separate journal log for each filesystem takes special planning and requires an excessive amount of disk storage. JFS2 allows the definition of in-line logs where each filesystem has its own log allocated out of the filesystems logical volume. The space used by the inline log can be as small as 256KB (for a filesystem < 32MB). For details, see the notes on the foil covering the role of a journal log.

JFS2 Disk Quota System

Prior to AIX 5.3 JFS2 did not support a Disk Quota system, though the Berkely Disk Quota System was supported under JFS.

JFS2 quotas may be set for individual users or groups on a per file system basis. The quota system will issue a warning to the user when a particular quota is exceeded, but allow some extra space for current work. Remaining over quota beyond a specified grace period will result in further allocation attempts being denied until the total usage is reduced below the user's or group's quota.

The administration is similar to the BSD Disk Quota (see **http://www.openbsd.org** for details) except that AIX added a new method for mapping the users to the quotas. The quotas are assigned to a Limits class and then the user are assigned to the class. This

greatly simplifies the quota administration. AIX 5.3 has added one new command to administer “Limits classes” - **j2edlimit**.

Migration

JFS file systems can co-exist on the same system with JFS2 file systems. However, to fully utilize the JFS2 features, the following steps will be necessary:

- Backup JFS file system data
- Create new JFS2 file systems
- Restore JFS file system data to new JFS2 file systems

Extended Attributes (EA)

- Extensions to regular attributes
- Two versions
  - AIX 5.2 or earlier supported only EAv1
  - EAv1 used for local file permission ACLs
  - EAv2 improved - more and larger attributes
  - JFS2 under AIX 5.3 supports both versions
- NFS V4 ACLs stored in JFS2 with EAv2
- User Defined Information may be in EAv2

```
$ getea  HenryVIII
     EAName:  Author
     EAValue:   Shakespeare
```


Figure 11-12. Extended Attributes AU1410.0

Notes:

Extended attributes are an extension of the normal attributes of a file (such as size and mode). They are (name, value) pairs associated with a file or directory. The name of an attribute is a null-terminated string. The value is arbitrary data of any length. There are two types of extended attribute: extended attribute version1 (EAv1) and extended attribute version 2 (EAv2). For many year AIX has supported extended attributes for Access Control Lists (ACL), which provide for more granular control of file access. That support was in EAv1 format. Starting with AIX 5L Version 5.3, EAv2 with JFS2 is now available.

EAv1 had restrictions of only eight attributes, 4 KB per attribute, 16-bit encoded names and no support for user defined attributes. EAv2 effectively eliminates these restrictions.

The primary use for EAv2, currently, is the support for the NFS V4 ACL capability. The discussion of NFS V4 ACLs is outside the scope of this class.

AIX V5.3 provides line commands to manage the user defined attributes. To set an attribute value you would use the `setea` command. To view a user attribute you would use the `getea` command.

The major concern for the system administrator, regarding EAv2, is the lack of backwards compatibility with earlier versions of AIX. AIX 5L Version 5.3 continues to support EAv1 as the default format, and provides an option to create a file system with EAv2 and a runtime command to convert dynamically from EAv1 to EAv2 to create or access named attributes and advanced ACL. However, once a file system is created with EAv2 or conversion has been initiated, AIX 5L Version 5.2 cannot access the file system and attempting to mount results in an EFORMAT error.

File Systems

 # smit fs

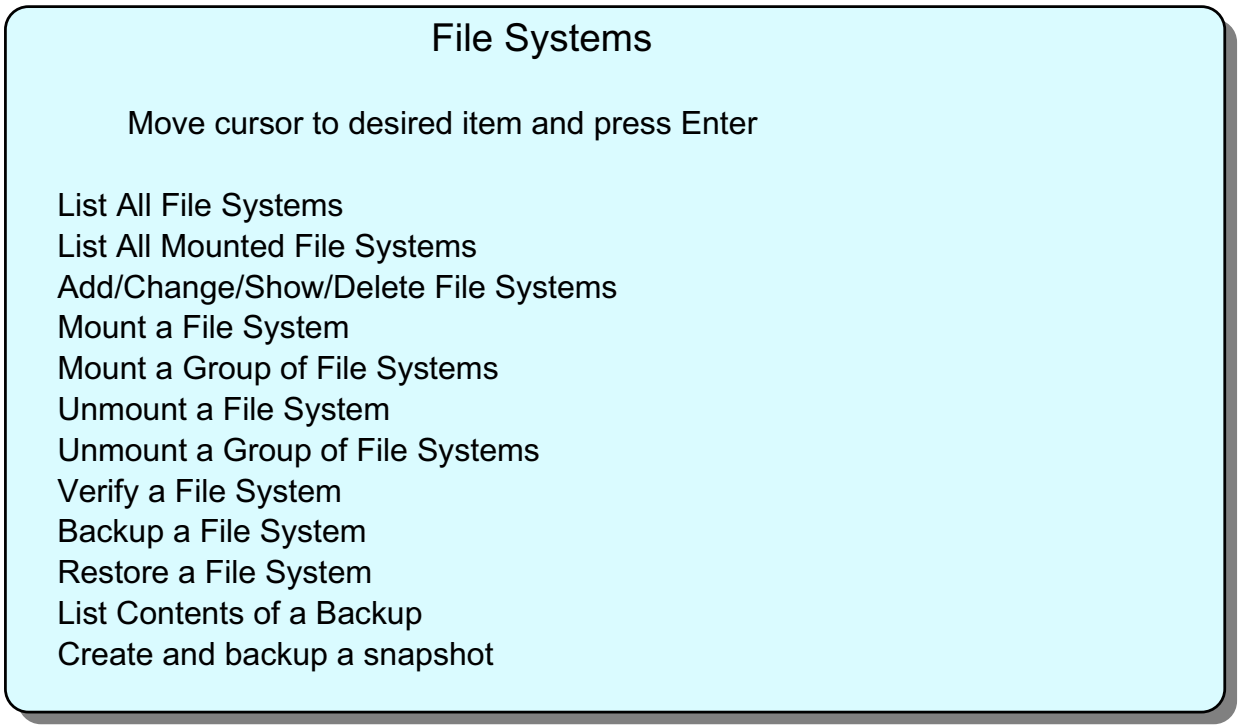


Figure 11-13. File Systems AU1410.0

Notes:

File systems can also be managed using the Web-based System Manager.

Listing File Systems

lsfs

Name	Nodename	Mount Pt	VFS	Size	Options	Auto
/dev/hd4	__	/	jfs	16384	__	yes
/dev/hd1	__	/home	jfs2	90112	__	yes
/dev/hd2	__	/usr	jfs	1277952	__	yes
/dev/hd9var	__	/var	jfs	8192	__	yes
/dev/hd3	__	/tmp	jfs	24576	__	yes
/proc	__	/proc	procfs		ro	yes
/dev/hd10opt	__	/opt	jfs	__	__	yes
/budget	sys4	/reports	nfs	__	bg,hard,intr	
/dev/cd0	__	/cdrom	cdrfs	__	ro	no

Figure 11-14. Listing File Systems AU1410.0

Notes:

You can list the various file systems that are defined using the **lsfs** command. This command will display information from /**etc**/**filesystems** and from the logical volumes in a more readable format.

lsfs will also display information about CD-ROM file systems and remote NFS file systems.

lsfs [-q] [-c | **-l][-v vfstype** | **-u mountgrp** | **file system]**

The data may be presented in line and colon (**-c**) or stanza (**-l**) format. It is possible to list only the file systems of a particular virtual file system type (**-v**), or within a particular mount group (**-u**). The **-q** option queries the superblock for the fragment size information, compression algorithm, and the number of bytes per inode.

The SMIT fastpath to get to the screen which accomplishes the same task as the lsfs command is **smit fs.**

List All Mounted File Systems

mount

node	mounted	mounted over	vfs	date	options
	/dev/hd4	/	jfs	Jul 11 20:14	rw,log=/dev/hd8
	/dev/hd2	/usr	jfs	Jul 11 20:15	rw,log=/dev/hd8
	/dev/hd9var	/var	jfs	Jul 11 20:15	rw,log=/dev/hd8
	/dev/hd3	/tmp	jfs	Jul 11 20:15	rw,log=/dev/hd8
	/dev/hd1	/home	jfs2	Jul 11 20:16	rw,log=/dev/loglv00
	/proc	/proc	procfs	Jul 11 20:16	rw
	/dev/hd10opt	/opt	jfs	Jul 11 20:16	rw,log=/dev/hd8
sys4	/budget	/reports	nfs	Jul 11 20:16	rw,hard,bg,intr
	/dev/ramdisk	/ramdisk	jfs	Jul 11 20:17	rw,nointegrity
	/dev/project	/project	jfs2	Jul 11 20:18	rw,log=INLINE
	/dev/cd0	/cdrom	cdrfs	Jul 11 20:19	ro

Figure 11-15. List All Mounted File Systems AU1410.0

Notes:

The **mount** command, when used with no parameters, is used to list all the file systems which are currently mounted within the overall file system structure.

File systems must be mounted to be accessed, that is, make the file system available for read or write access from your system.

The **mount** command when used with a number of parameters, is also used to perform the mount operation.

There are two types of file systems, system-created and user-created. System-created file systems are expected to be there by the system and by many applications. User-created file systems contain user applications and data.

Standard device names include:

- hd4 /
- hd1 /home
- hd2 /usr

- hd3 /tmp
- hd9var /var
- proc /proc
- hd10opt /opt

SMIT can also be used to obtain this information. From SMIT you want to select **List all Mounted File Systems** under **File Systems.**

Add/Change/Show/Delete File Systems

 # smit manfs

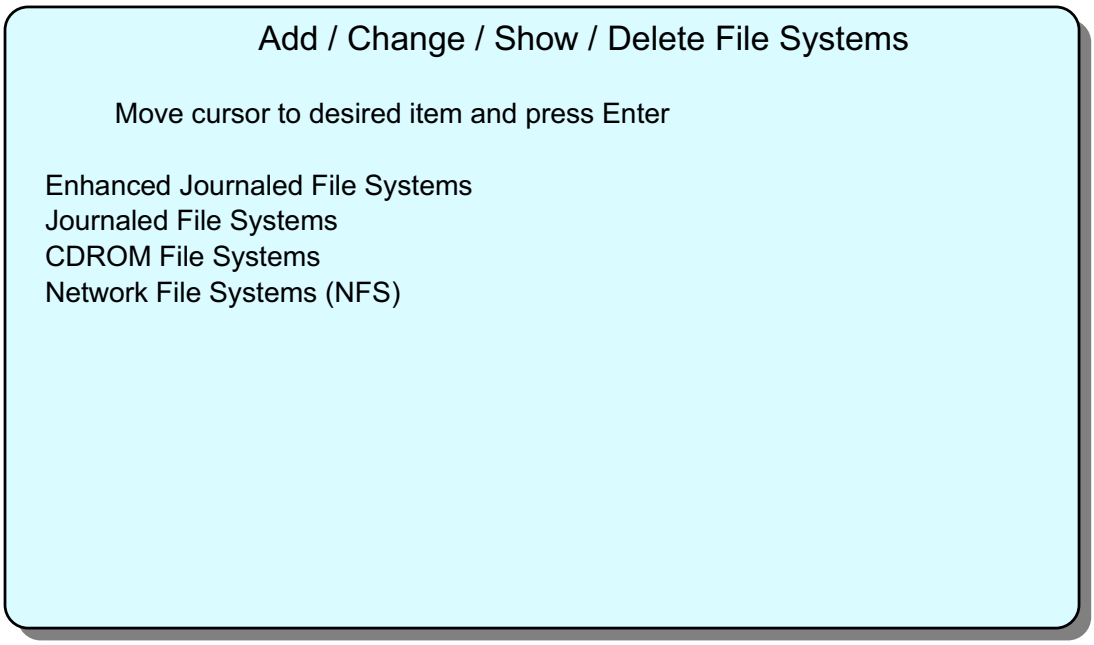


Figure 11-16. Add/Change/Show/Delete File Systems AU1410.0

Notes:

In AIX 5L, when asking to work with a filesystem smit will present a menu which prompts the administrator for the type of filesystem, be it the JFS, Enhanced JFS, CDROM Filesystem or NFS.

The fast path for working with JFS is: smit jfs

The fast path for working with the Enhanced JFS is: smit jfs2

Working with Journaled File Systems in SMIT

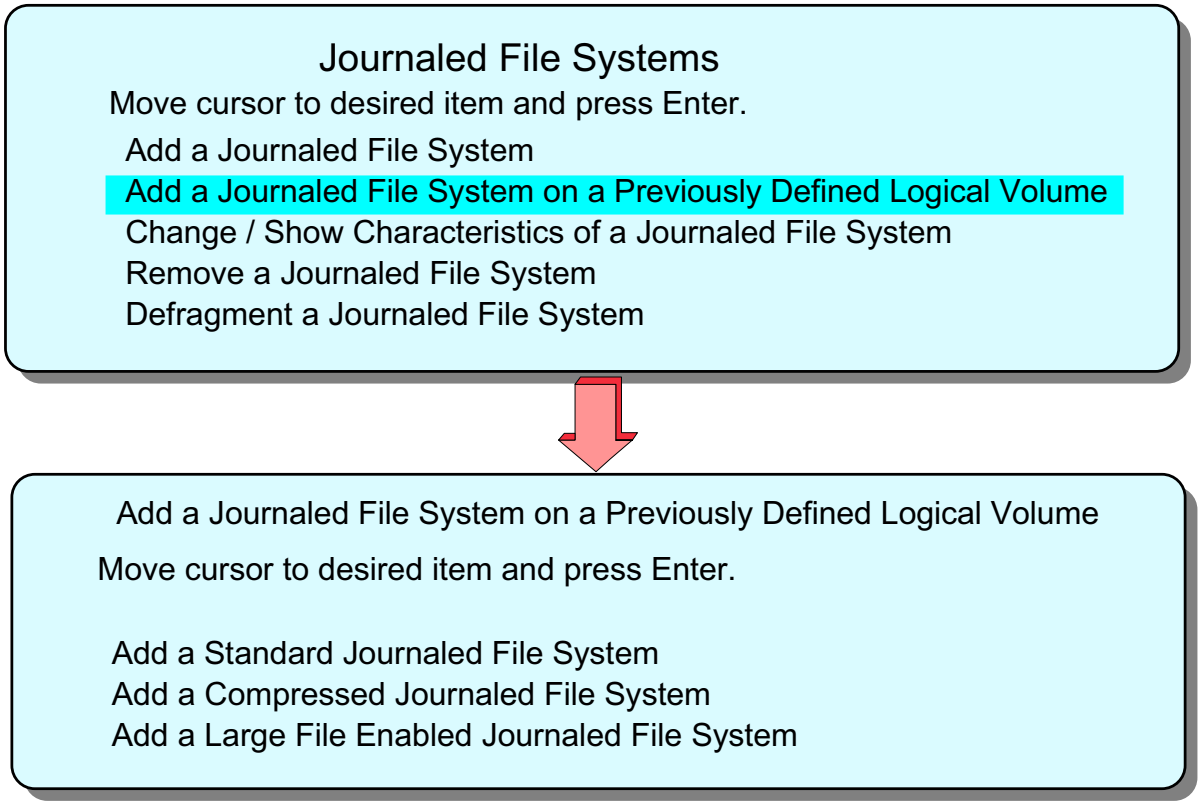


Figure 11-17. Working with Journaled Files Systems in SMIT AU1410.0

Notes:

When choosing to add a JFS file system, there are two options.

- If you choose to **Add a Journaled File System**, SMIT will use defaults to create the logical volume in which the file system sits.
- If you choose to **Add a Journaled File System on a Previously Defined Logical Volume**, this assumes that the logical volume has already been created according to your specifications. The size of the file system will be the size of the logical volume.

The diagram shows the SMIT menu displayed if using the **smit jfs** fastpath.

In AIX V4.2 and later, the second SMIT menu above is displayed no matter which option is chosen for adding a JFS file system.

Add a Standard Journaled File System on a Previously Defined Logical Volume

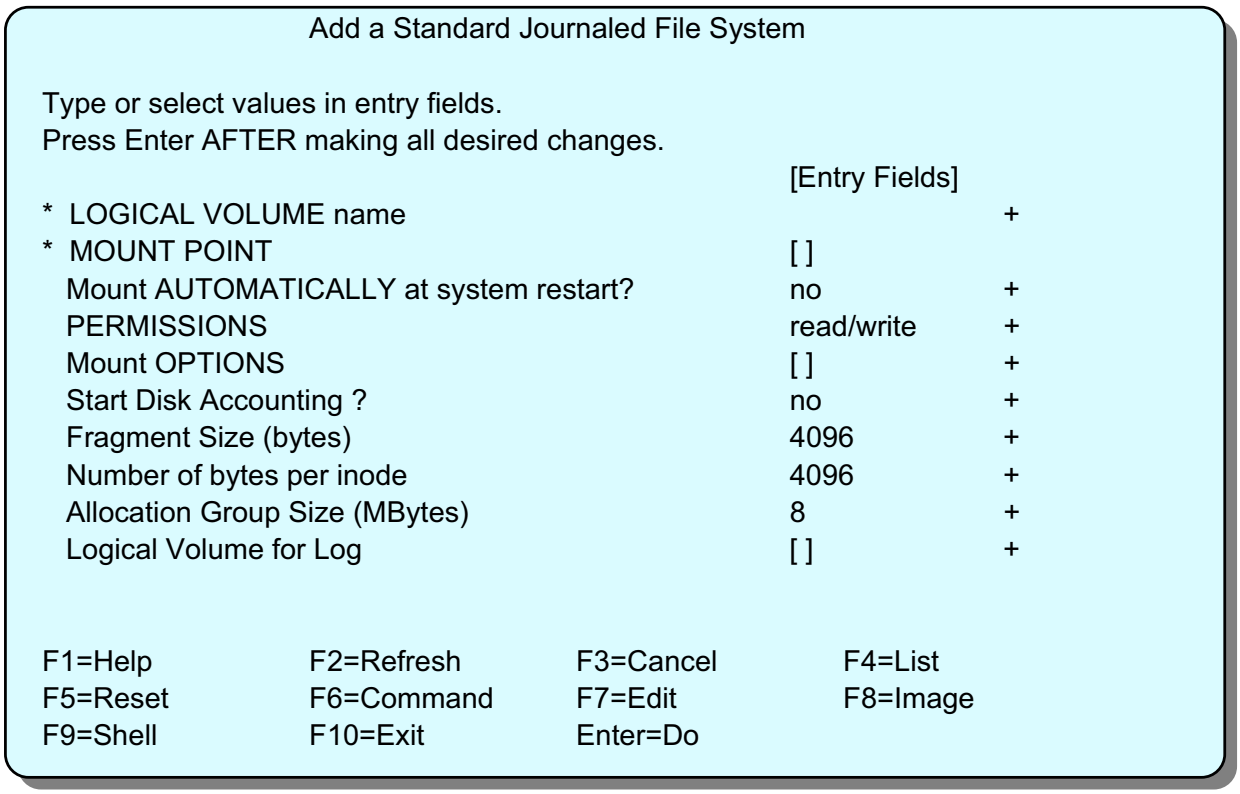


Figure 11-18. Add a Standard Journaled File System on a Previously Defined Logical Volume AU1410.0

Notes:

When a logical volume is created it is simply an empty container waiting to be formatted for use. The journaled file system is the most common way of using it. Thus, adding a file system to a previously created logical volume formats the logical volume for use as a file system. Adding a file system in this way provides you with the greatest level of control over where the file system will reside on disk.

The SMIT fastpath for this screen is **smit crjfslvstd**.

AIX V5.3 has added a new line to this panel: Logical Volume for log. Prior to AIX V5.3 you needed to edit /etc/filesystems after creating the file is you wanted to use anything other than the default /dev/hd8 LV for the log. With AIX V5.3, you can identify what log to use in the initial definition. Note that the jfslog itself has to be previously defined and formatted.

Add a Standard Journaled File System

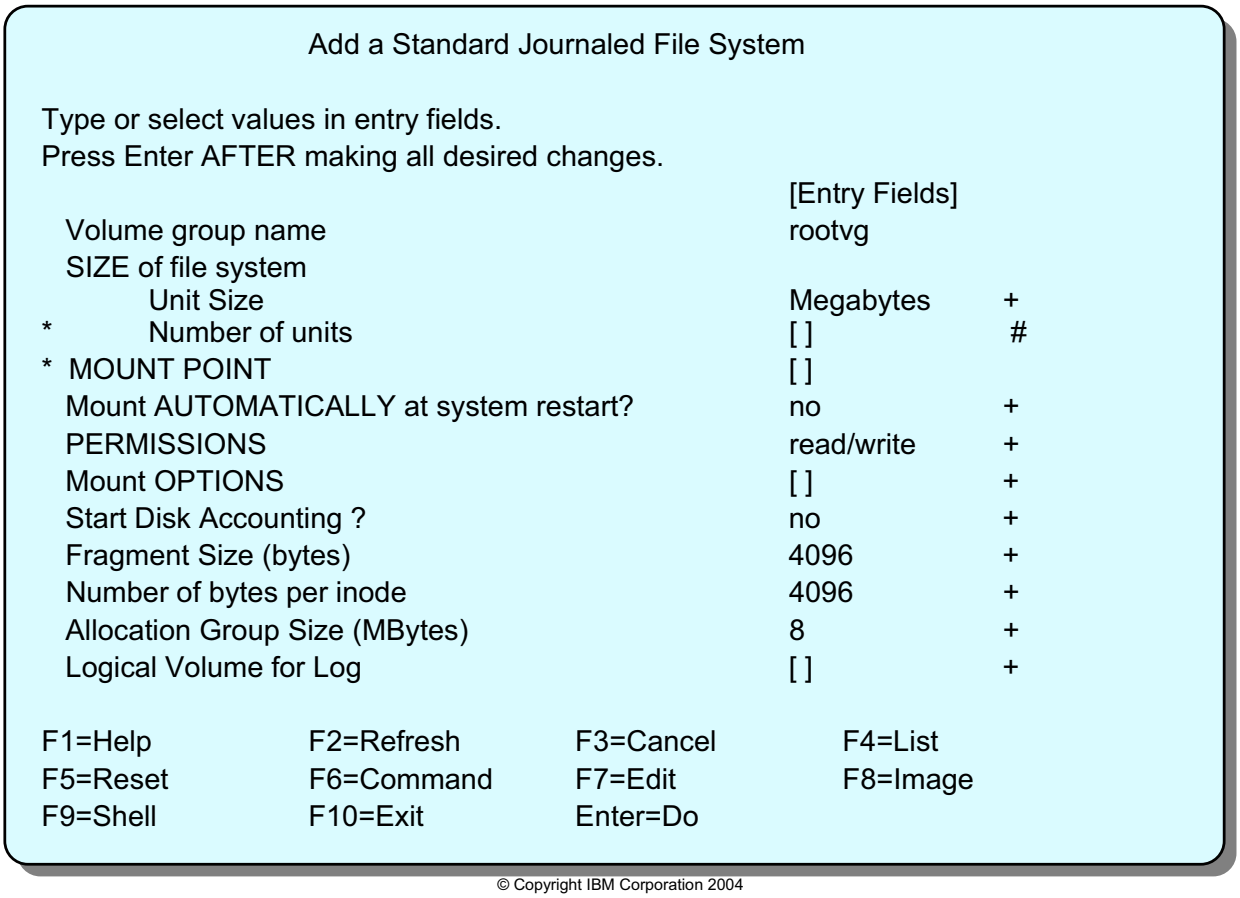


Figure 11-19. Add a Standard Journaled File System AU1410.0

Notes:

Use the smit fastpath **smit crjfsstd** to access this menu.

The **crfs** command is the high-level command to create a file system.

Note: Do not confuse the **crfs** command with the **mkfs** command which purely builds the file system structure within a logical volume. **crfs** does a lot more: It creates the logical volume if necessary using **mklv**, it builds the file system structure on that logical volume using **mkfs**, and then it makes all appropriate changes to the ODM and /**etc**/**filesystems** for that logical volume and file system.

There are many parameters which can be set as a JFS file system is being created. The most important of these are given below:

Volume group **(-g *volgrp***); that is, the volume group within which a new logical volume is to be created. The volume group must have sufficient free physical partitions for the new logical volume.

The unitsize **(Megabytes** | **Gigabytes** | **512bytes)** specifies the selected unit.

The size **(-a size=number of units)** of unitsize. The size of the file system will be rounded up to the nearest logical partition boundary. This attribute specifies the minimum file system and can't be decreased dynamically after the file system has been successfully created.

The mount point **(-m *mntpt***). The name of a directory within the overall file system on which the new file system will normally be mounted. The mount point must exist before the file system can be mounted and accessed. Under most circumstances the mount point should be empty.

A file system may be mounted at any other valid directory rather than its normal mount point. In this case, the mount is performed by the administrator, and it is usually for some type of maintenance activity.

Mount automatically at boot time? **(-A yes|no)**. The new file system may be listed to mount automatically when the system boots. This will place the **mount=true** line in the /**etc**/**filesystems** file and will cause the file system to be mounted automatically at its default mount point (above) when the system is restarted. If set to no then **mount = false** is added to the /**etc**/**filesystems** file.

Permissions **(-p rw|ro)**. A mounted file system may be mounted in read-only (**ro**) or read-write (**rw**) mode. This permission setting is used for the file system if it is mounted automatically, or if it is mounted without providing over-riding permissions.

The permissions setting for a mounted file system may not be by-passed regardless of the authority of the user and the permission bits associated with the file or directory on the file system.

Mount options specify security related mount options. Possible values are: **nosuid** which prevents the execution of setuid and setgid programs and **nodev**, which prevents open system calls of devices from this mount.

The fragment size **(-a fragment=*size***) specifies the JFS fragment size in bytes. A file system fragment is the smallest unit of disk storage that can be allocated to a file. This variable must be set to either 512, 1024, 2048 or 4096, the default value being 4096 bytes.

The number of bytes per inode **(-a nbpi=*value***) affects the total number of inodes on the file system. The variable must be either 512, 1024, 2048, 4096, 8192 or 16384, default value being 4096.

The compression attribute **(-a compress={no | LZ})** specifies the data compression algorithm LZ, which stands for the IBM version of the compression algorithm Lempel-Ziv. If you do not want data compression, set this attribute value to no, which is the default value.

The allocation group size **(-a ag= 8 | 16 | 32 | 64)** is a grouping of inodes and disk blocks within the file system. The default agsize is 8 MB. This attribute only applies to AIX V4.2 and later.

Working with Enhanced Journaled File Systems (JFS2) in SMIT

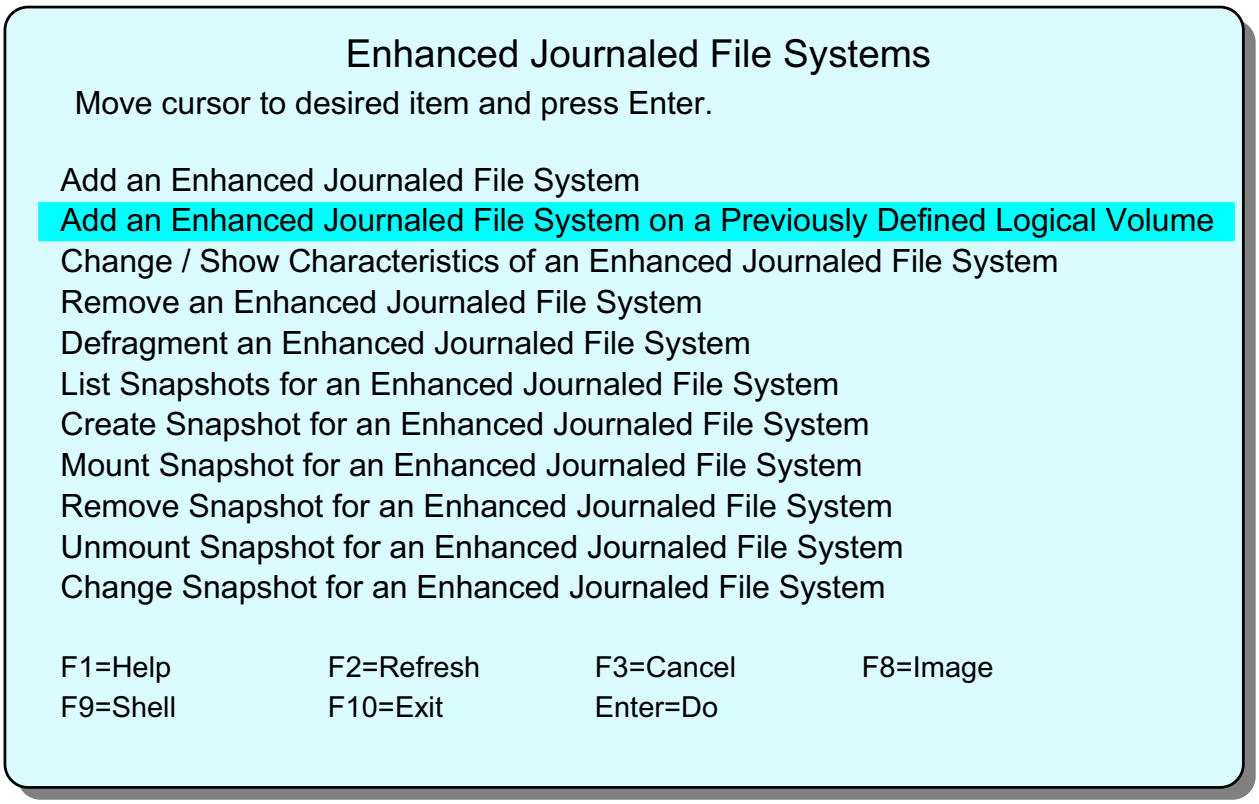


Figure 11-20. Working with Enhanced Journaled File Systems (JFS2) in SMIT AU1410.0

Notes:

When choosing to add a JFS2 file system, there are two options.

- If you choose to **Add an Enhanced Journaled File System**, SMIT uses defaults to create the logical volume in which the file system sits.
- If you choose to **Add an Enhanced Journaled File System on a Previously Defined Logical Volume**, this assumes that the logical volume has already been created according to your specifications. The size of the file system is the size of the logical volume.

The diagram shows the SMIT menu displayed if using the **smit jfs2** fastpath.

Add an Enhanced Journaled File System (JFS2) on a Previously Defined Logical Volume

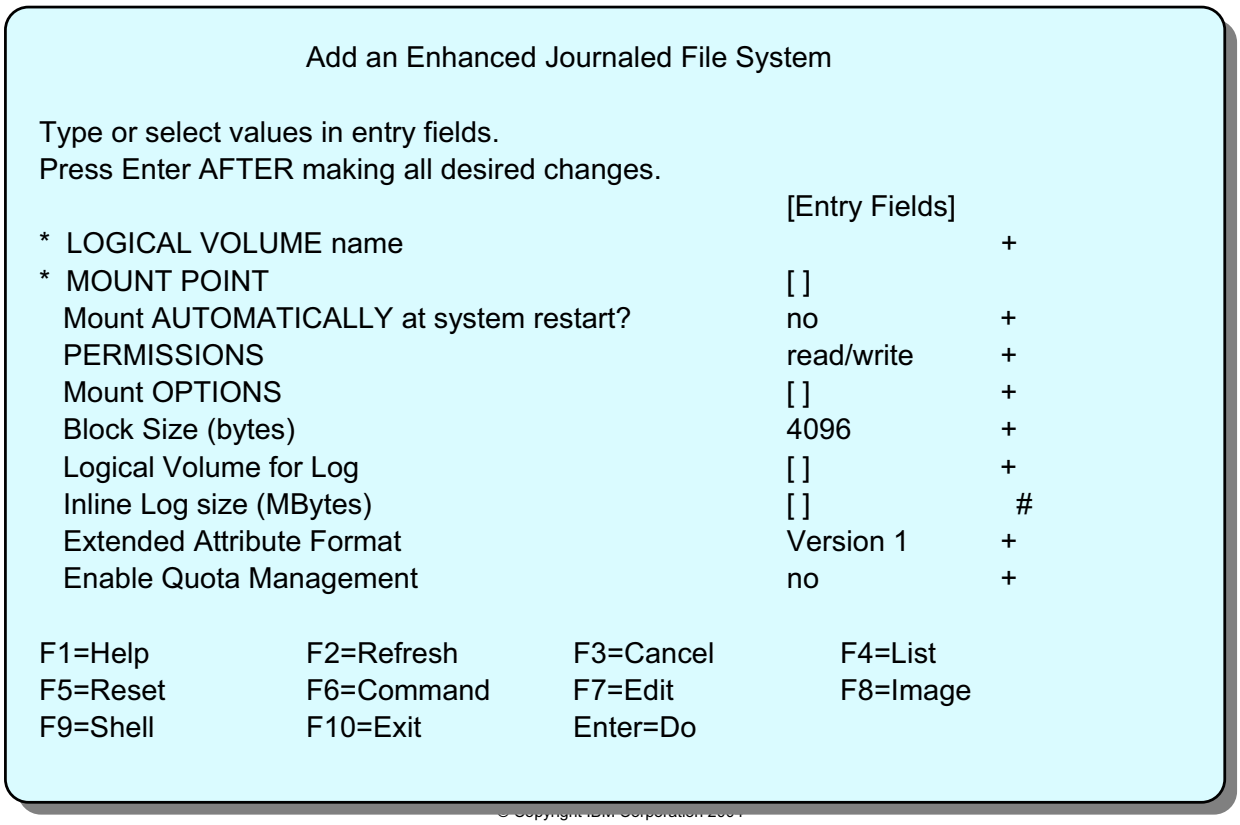


Figure 11-21. Add an Enhanced Journaled File System (JFS2) on a Previously Defined Logical Volume AU1410.0

Notes:

The SMIT fastpath for this screen is **crjfs2lvstd**.

The block size parameter refers to the aggregate block size, which is the smallest piece of disk which can be assigned to a file system. It has the same function as the fragment size in JFS.

Logical Volume for Log provides a choice between using either an existing JFS2log logical volume (the first jfs2log for this volume group is the default) or an inline log. If you use the inline log then you have the option to override the default log size.

With AIX 5.2, there are two additional attributes on this panel.

Extended Attribute Format allows to choose between the default EAv1 or EAv2.

Enable Quota Management does what it says for this particular filesystem. One should be sure to plan and build the user quota definitions before enabling disk quotas for a filesystem.

Add an Enhanced Journaled File System (JFS2)

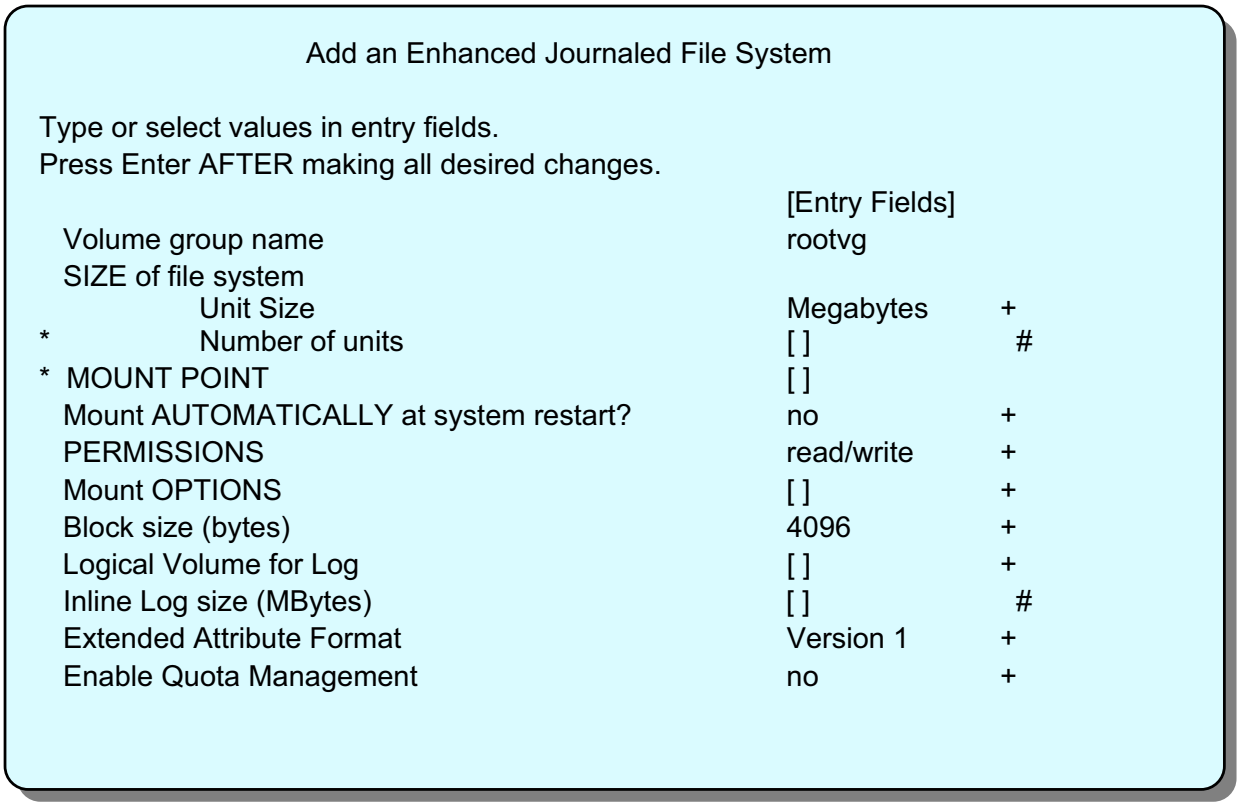


Figure 11-22. Add an Enhanced Journaled File System (JFS2) AU1410.0

Notes:

Use the smit fastpath **smit crjfs2std** to access this menu.

Mount a File System

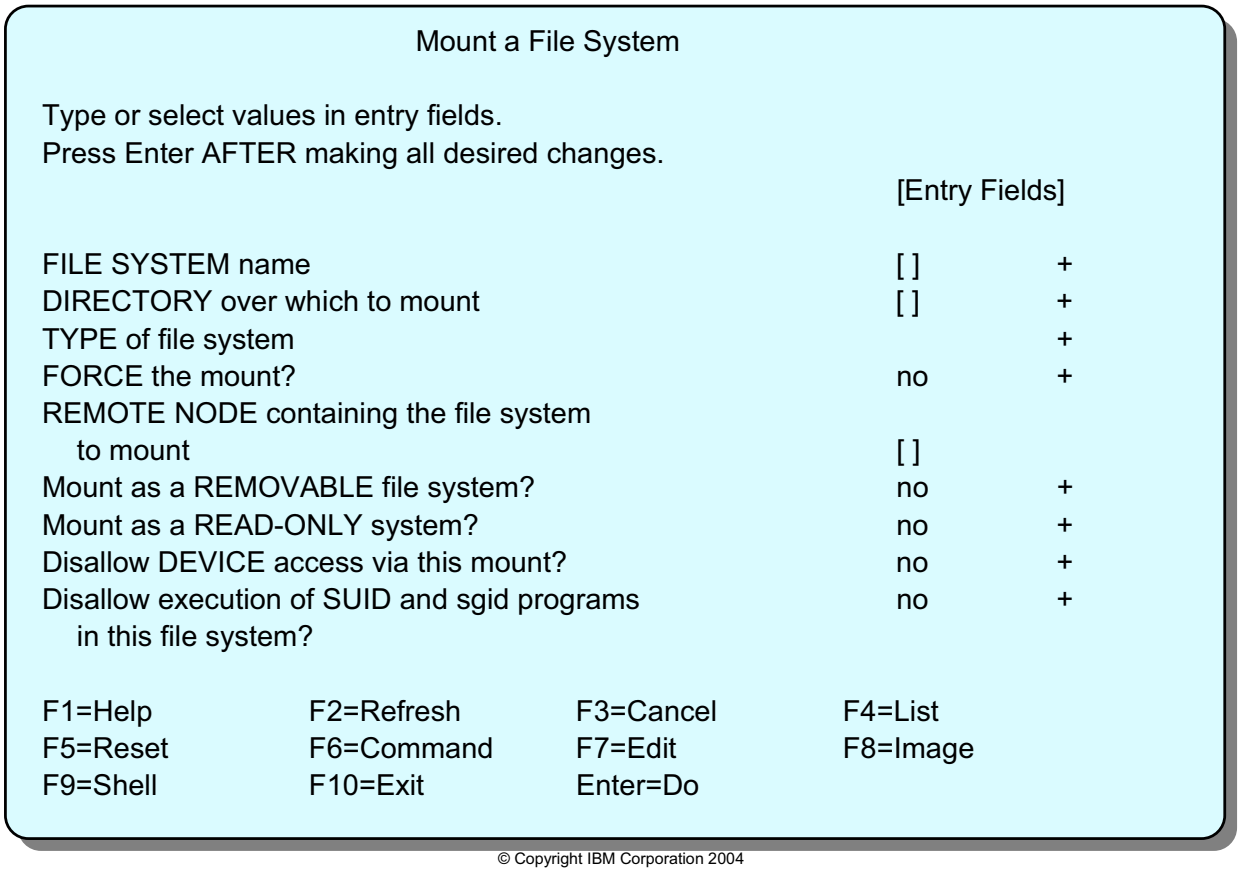


Figure 11-23. Mount a File System AU1410.0

Notes:

The files within a file system can only be accessed when the file system is mounted within the overall file system structure. Either an individual file system or a group of file systems can be mounted.

File systems defined with the **mount=true** or **mount=automatic** attribute in the **/etc/filesystems** file will be mounted automatically during system startup.

The syntax of the **mount** and **unmount** commands are:

mount [-t Type | Device | Node: Directory]Directory

mount /home/george/myfs

umount|unmount [FileSystem | -t Type]

unmount /home/george/myfs

File systems are usually mounted at startup and are unmounted as part of the **shutdown** procedure.

However, the administrator or members of the security group may issue **mount** commands at any time, and assuming that the user has write permission to the mount point and read permission on the root directory of the file system to be mounted, the command will be effective.

Normal users:	can mount a file system provided they belong to the system group and have write access to the mount point
root:	can mount anywhere under any set of permissions

The **mount** command has many options which may be issued by the user. The default values for these options are set by the system, or are contained within /**etc**/**filesystems**.

With the **unmount** command there are many other options that can be used other than **-t** Type or file system name.

Change/Show Characteristics of a Journaled File System

Change/Show Characteristics of a Journaled File System

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

		[Entry Fields]	
	File system name	/var	
	NEW mount point	[/var]	
	SIZE of file system (in 512-byte blocks)		
	Unit Size	512bytes	+
*	Number of units	[65536]	#
	Mount GROUP	[bootfs]	
	Mount AUTOMATICALLY at system restart ?	yes	+
	PERMISSIONS	read/write	+
	MOUNT OPTIONS	[ ]	+
	Start Disk Accounting ?	no	+
	Fragment Size (bytes)	4096	
	Number of bytes per inode	4096	
	Compression algorithm	no	
	Large File Enabled	true	
	Allocation Group Size (MBytes)	16	

Figure 11-24. Change/Show Characteristics of a Journaled File System AU1410.0

Notes:

A Journaled File System may have some of its characteristics changed both while it is in use (mounted) and when it is not in use. To do this, use the **chfs** command.

Many characteristics may be changed. The most important of these are: The mount point **(-m mntpnt)**. The default mount point may be changed while the file system is in use but the change is only effective when the file system is next mounted. The unit size can be changed to Megabytes, Gigabytes or 512bytes. The size of a Journaled File System may be **increased** while it is in use **(-a size=number of units)**. The size of a file system may not be decreased at any time, so it is often better to create a new file system and mount it at an appropriate point within the existing file system than to increase the size if it is suspected that the increased size is only temporarily required.

Increasing the size of the file system extends the logical volume, so the new size will be rounded up to the next logical partition boundary. If you extend the logical volume directly, the partitions are added, but the file system is not changed. Extending the file system will use those added partitions. The mount group of a file system may be changed **(-u mntgrp)**, and the change is effective the next time the new mount group is referenced.

Mount automatically a system restart? Whether a file system is automatically mounted at system startup may be changed **(-A yes|no)** and the change is effective at the next startup.

The permissions associated with the file system may be changed **(-p ro|rw)** and the change is effective the next time the file system is mounted.

Change/Show Characteristics of an Enhanced Journaled File System

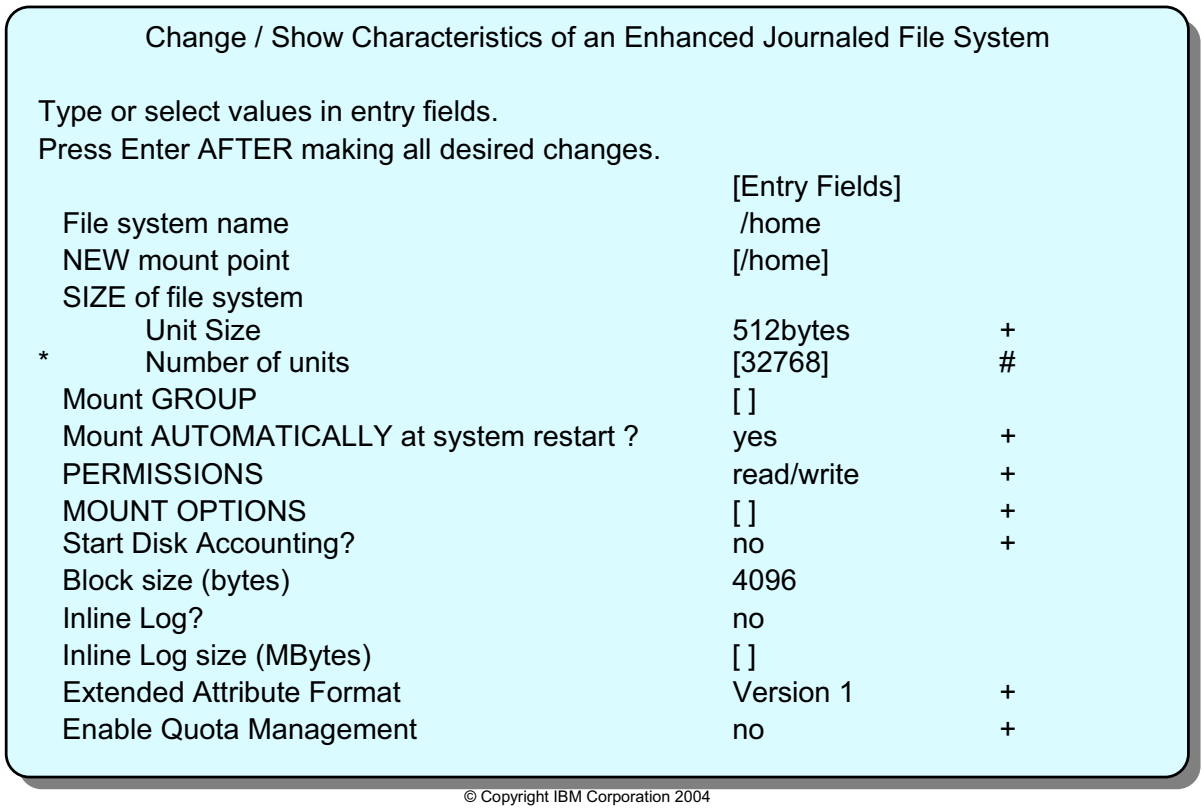


Figure 11-25. Change/Show Characteristics of an Enhanced Journaled File System AU1410.0

Notes:

An Enhanced Journaled File System (JFS2) may have some of its characteristics changed both while it is in use (mounted) and when it is not in use. To do this, use the **chfs** command.

Many characteristics may be changed. See the notes with the last visual on changing the characteristics of Journaled File Systems.

Dynamically Shrinking a JFS2 Filesystem

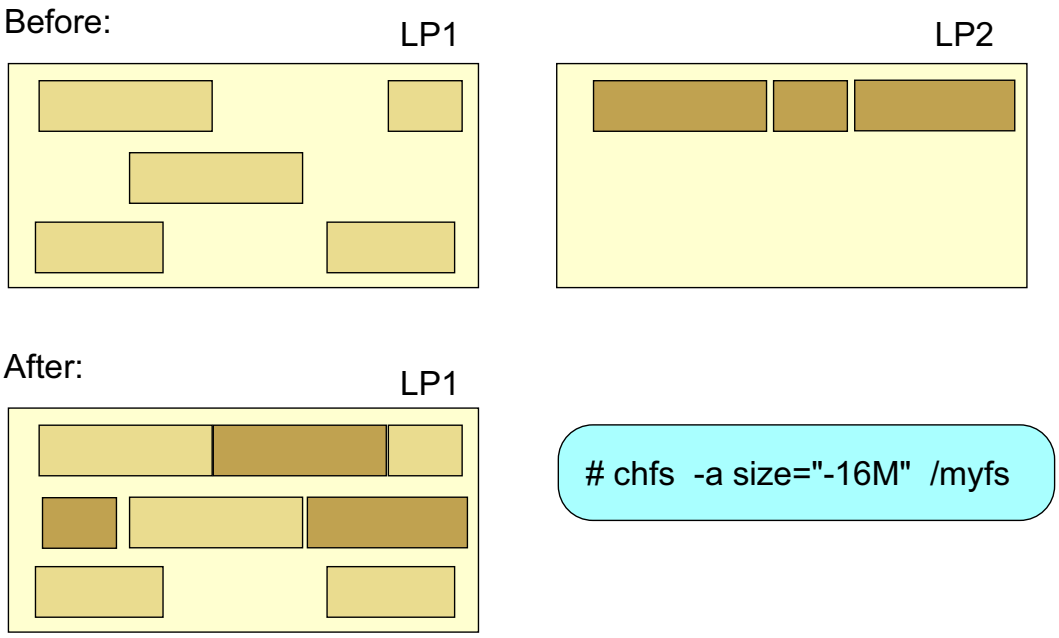


Figure 11-26. Dynamically Shrinking a JFS2 Filesystem AU1410.0

Notes:

Prior to Version 5.3 there is no way to shrink a file system dynamically while you are using it, although you can easily extend as needed. The procedure to shrink a file system was to create a new smaller version, copy the data, take the old version offline, then delete the old version. In AIX 5L Version 5.3, dynamic file system shrink is now available with Enhanced Journaled File System (JFS2).

The **chfs** command (and corresponding smit panel) support for the size attribute has been changed in AIX 5.3 to support either a final size which is smaller than the current size or a decrement (value preceded with the minus sign). The requested difference is translated into a whole number of physical partitions with any remaining amount beyond being ignored. This asking to decrease by 1 MB would have no effect (minimum PPsize for JFS2 is 16 MB).

There must be enough freespace in the remaining Physical Partitions of the filesystem to stored the file data and metadata structures being moved from the freed PPs.

If there is an inline log, that log is also proportionally adjusted in size.

Remove a Journaled File System

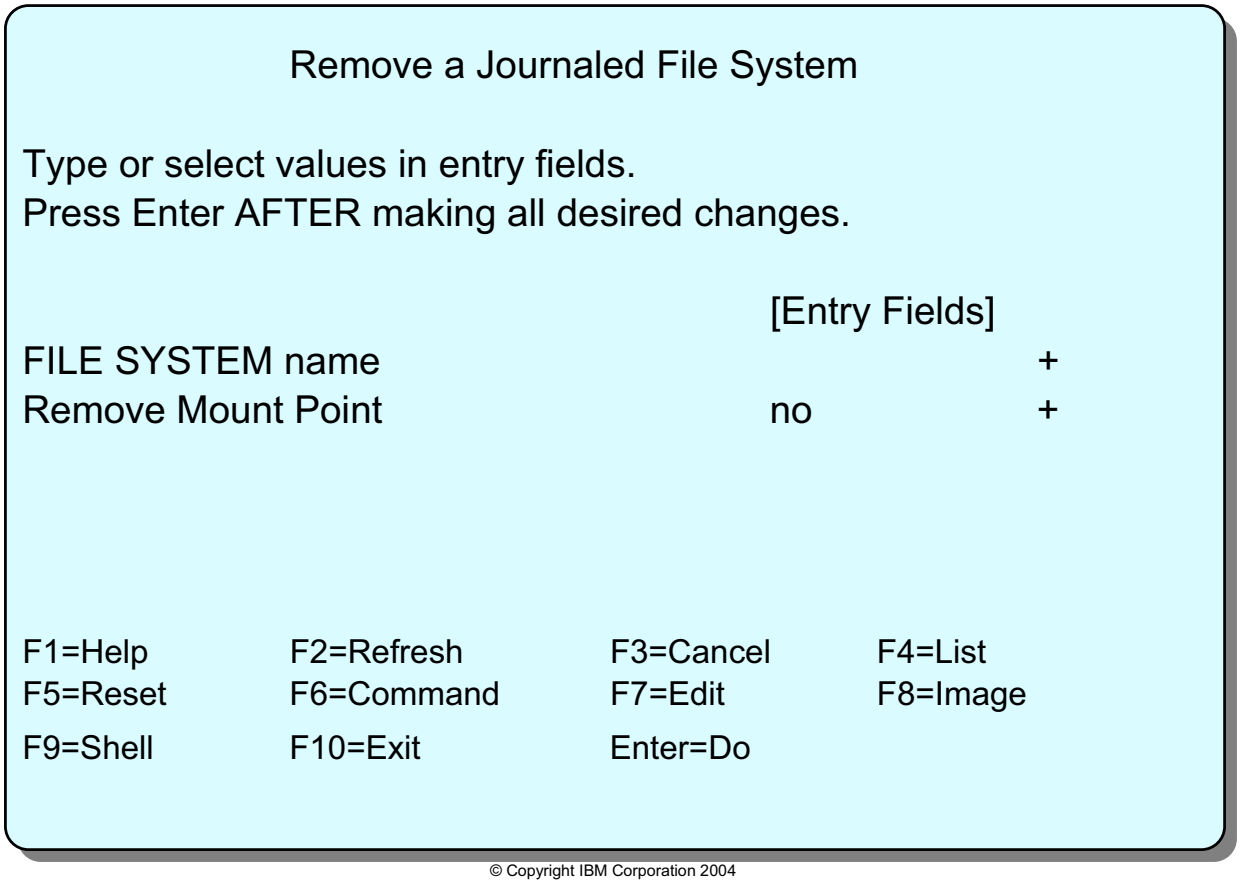


Figure 11-27. Remove a Journaled File System AU1410.0

Notes:

The **rmfs** command is the high-level command used to remove a file system.

In order to remove a file system, it must be unmounted from the overall file tree, and this cannot be done if the file system is in use, that is, some user or process is using the file system or has it as a current directory.

rmfs removes any information for the file system from the ODM and /**etc**/**filesystems**. When the file system is removed, the logical volume on which it resides is also removed.

JFS2 file system removal works the same way.

The syntax of the **rmfs** command is:

rmfs [-r] [-i] FileSystem

-r Removes the mountpoint of the filesystem

-i Displays warning and prompts the user before removing the filesystem

rmfs -r /home/george/myfs

Add a RAM File System

- Create a RAM disk of 4 MB

```
# mkramdisk 4M
/dev/rramdisk0
```

- Create a JFS File System on this RAM disk

```
# mkfs -V jfs /dev/ramdisk0
mkfs: destroy /dev/ramdisk0 (yes)? y
```

- Create Mountpoint

```
# mkdir /ramdisk
```

- Mount RAM File System

```
# mount -V jfs -o nointegrity /dev/ramdisk0 /ramdisk
```


Figure 11-28. Add a RAM File System AU1410.0

Notes:

The purpose of the **mkramdisk** command is to create file systems directly in memory. This is useful for applications that make many temporary files.

Use ramdisk only for data that can be lost. After each reboot the ramdisk file system is destroyed and must be rebuilt.

Add an UDF File System on a DVD-RAM

- Create an UDF Filesystem

```
# udfcreate -d /dev/cd0
```

- Change the label on an UDF File System

```
# udflabel -d /dev/cd0 -l testdvd
```

- Create a Mountpoint

```
# mkdir /dvddisk
```

- Mount an UDF File System

```
# mount -V udfs -o rw /dev/cd0 /dvddisk
```

- Check an UDF File System

```
# udfcheck -d /dev/cd0
```


Figure 11-29. Add an UDF File System on a DVD-RAM AU1410.0

Notes:

Once you have created an UDF on a DVD-RAM, you can just treat it like a normal hard disk. It enables you to read, write, delete, copy, move, mount, unmount and edit a file within the DVD directory.

The Universal Disk Format Specification (UDFS) is based on the Micro Design International (MDI)'s UDF implementation. It supports UDFS 1.50, 2.00, 2.01. It is now possible to read and write to a DVD media in 32/64bit mode.

The implementation is based on UDFS 2.01, but backward compatible to 2.00 and 1.50.

System Storage Review

Logical Volume Structure

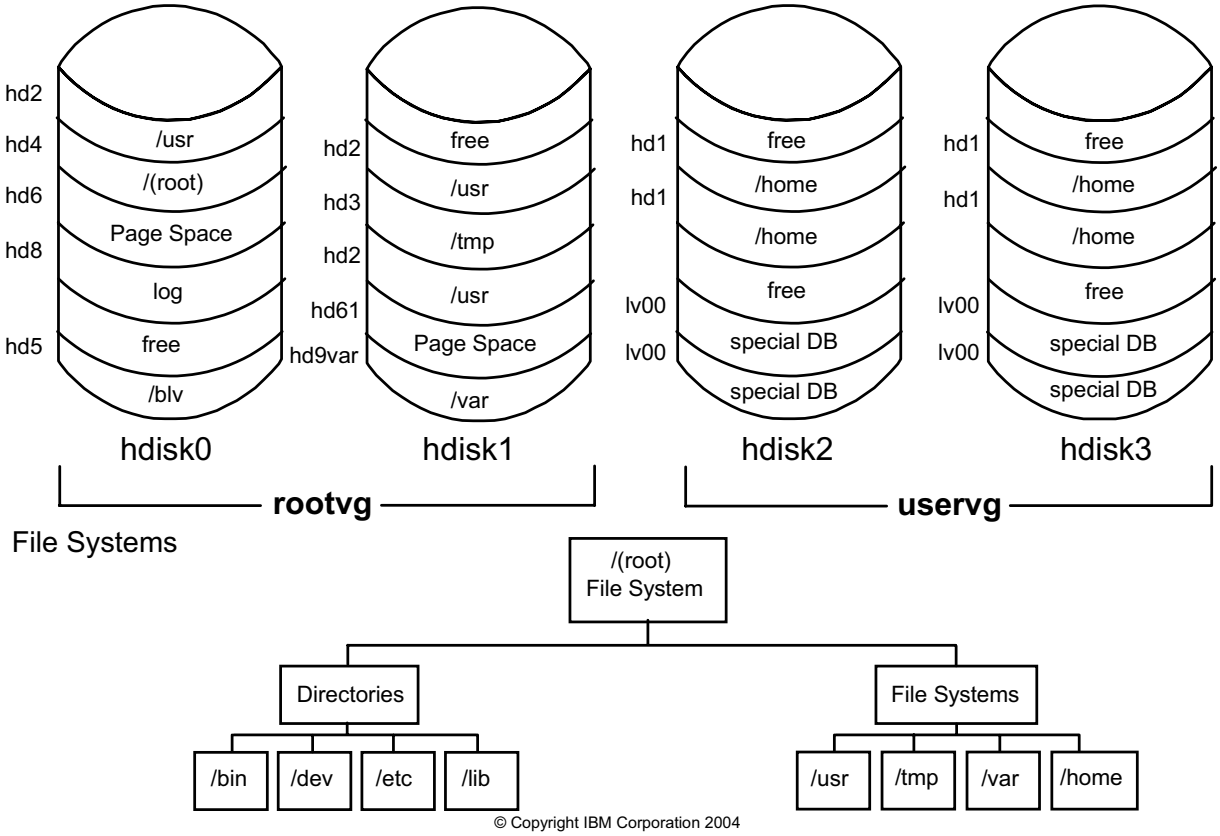


Figure 11-30. System Storage Review AU1410.0

Notes:

It is important to understand the difference between a file system and a directory. A file system is a section of disk that has been allocated to contain files. This section of disk is the logical volume. The section of disk is accessed by mounting the file system over a directory. Once the file system is mounted, it looks like any other directory structure to the user.

The directories on the right of the bottom portion of the visual are all file systems. These file systems are all mounted on the directories **/usr, /tmp, /var** and **/home**. Notice the corresponding logical volume in the graphic at the top of the visual.

The directories on the left of the bottom portion of the visual are strictly directories that contain files and are part of the /(root) file system.

Exercise: Working with File Systems

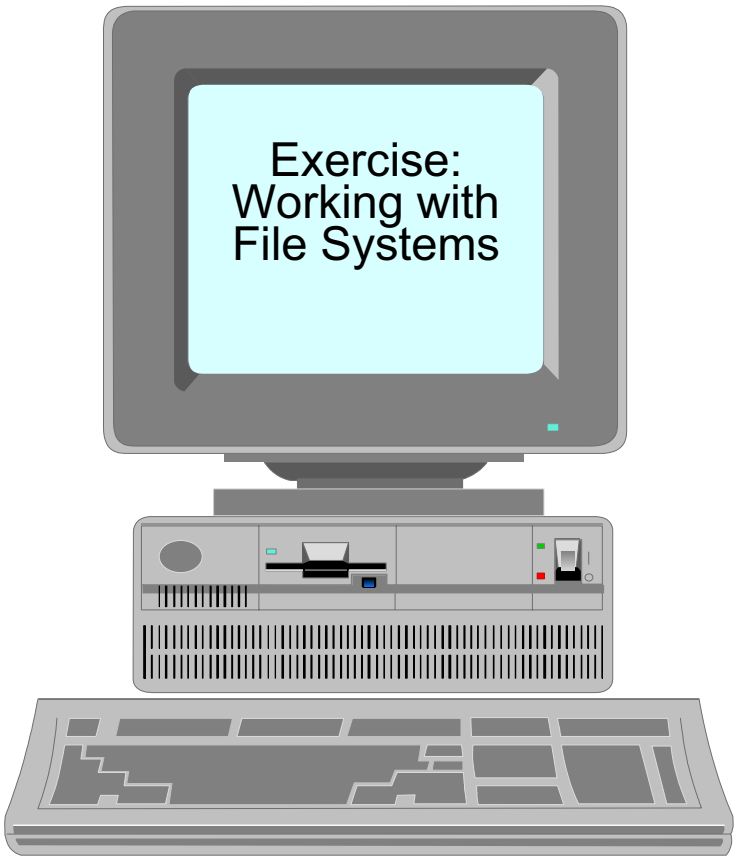


Figure 11-31. Exercise: Working with File Systems AU1410.0

Notes:

This lab has you build on the logical volume you created in the last exercise. It also gives you an opportunity to create a file system and learn to increase the size of both the logical volume and file system.

The exercise can be found in your Exercise Guide.

Checkpoint

1. Will the size of the file system change when the size of the logical volume it is on is increased?

   _____

2. If a file system is the same size as the logical volume on which it sits, will the size of the logical volume increase when the size of the file system that is sitting on it increases?

   _____

3. If you remove a logical volume, is the file system that is sitting on it removed as well?

   _____
   _____
   _____

Figure 11-32. Checkpoint AU1410.0

Notes:

Unit Summary

- The components of an AIX file system are the superblock, inodes, data blocks and indirect blocks.
- Important issues to consider when creating a journaled file system are: fragment size, NBPI, allocation group size, compression and whether it should be large file enabled.
- JFS2 supports large files, large file systems, and improves performance.
- File systems can be added and removed from the system, and their characteristics can also be changed, all through SMIT.

Figure 11-33. Unit Summary AU1410.0

Notes:

Unit 12. Managing File Systems

What This Unit Is About

This unit illustrates the methods that can be used to manage the AIX file systems.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Monitor file system growth and control growing files
- Manage file system disk space usage
- Implement basic file system integrity checks

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise

References

Online	*System Management Guide: Operating System and Devices*

Unit Objectives

After completing this unit, you should be able to:

- Monitor file system growth and control growing files
- Manage file system disk space usage
- Implement basic file system integrity checks

Figure 12-1. Unit Objectives AU1410.0

Notes:

Space Management

- File systems expand upon notice, NOT automatically
- To keep from running into problems:
  - Monitor file system growth
  - Determine causes
  - Control growing files
  - Manage file system space usage
  - Control user disk usage
  - Defragment file system

Figure 12-2. Space Management AU1410.0

Notes:

Although AIX provides for dynamic expansion of a file system, it does not expand the file system on the fly. The system administrator must continually monitor the file system growth to expand it before the file system gets full. If the file system becomes 100% full then the users receive out of space messages on file system expansion.

For example, the **df** command can be run via **cron** (the job scheduler) to perform a regular check of the space available in the file system and produce a report. **cron** will be covered in a later unit.

You can use as well the new Resource Monitoring and Control (**RMC**) subsystem that is based on the Reliable Scalable Cluster Technology (RSCT) on the IBM SP platform. Use the WSM to configure RMC. You will have 84 conditions and 8 responses to predefine. The **ctrmc** subsystem is started in the /etc/inittab.

The further concepts of RMC are not topic of this course but are good described in the *AIX 5L Differences Guide Version 5.2 Edition* (SG24-5765-02).

Listing Free Disk Space

- The **df** command displays information about total space and available space on a file system

```
# df
```

Filesystem	512-blocks	Free	%Used	Iused	%Iused	Mounted on
/dev/hd4	16384	7600	53%	1243	30%	/
/dev/hd2	1630208	101648	93%	22217	10%	/usr
/dev/hd9var	24576	22360	9%	257	8%	/var
/dev/hd3	24576	21520	12%	144	3%	/tmp
/dev/hd1	24576	5160	79%	518	16%	/home
/proc	-	-	-	-	-	/proc
/dev/hd10opt	65536	48728	26%	374	5%	/opt
/dev/lv00	24576	3172	86%	620	22%	/home/john
/dev/ramdisk0	8192	7848	5%	17	2%	/ramdisk

Figure 12-3. Listing Free Disk Space AU1410.0

Notes:

This is an important command to be aware of and use frequently. If you run out of space in a file system (especially / or /**tmp**), system corruption could occur.

The **df** command lists the free space on all mounted file systems.

The options **-m** and **-g** are only available in AIX V5.2.

```
df -I reports space used and free space

df -k     reports free space in 1 KB blocks and I-nodes used

df -m     reports free space in 1 MB blocks and I-nodes used

df -g     reports free space in 1 GB blocks and I-nodes used
```


Control Growing Files

- /var/adm/wtmp
- /var/spool/*/*
- $HOME/smit.log
- $HOME/smit.script
- $HOME/websm.log
- $HOME/websm.script
- /etc/security/failedlogin
- /var/adm/sulog

Figure 12-4. Control Growing Files AU1410.0

Notes:

Growing files should be monitored and cleaned out periodically. These are some of the files that grow.

If accounting is turned on, /**var**/**adm**/**wtmp** is kept to a reasonable size. /**var**/**adm**/**wtmp,** /**etc**/**security**/**failedlogin** and /**var**/**adm**/**sulog** are needed because they contain historical data regarding login activity. Thus, these files should always have a few days worth of login activity kept in them. If accounting is not turned on, to capture the data to archive it, use **who -a** on /**var**/**adm**/**wtmp** and /**etc**/**security**/**failedlogin** and redirect the output to a save file. Then the file can be purged by using **cat** /**dev**/**null** redirected to either /**var**/**adm**/**wtmp** or /**etc**/**security**/**failedlogin.** /**var**/**adm**/**sulog** can be edited directly.

/**var**/**spool** contains cron entries, the mail, and other items that grow on an ongoing basis, along with printer files. If there is a problem you can try to clear the queueing subsystem by executing the following commands:

1. stopsrc -s qdaemon
2. rm /var/spool/lpd/qdir/*

3. rm /var/spool/lpd/stat/*
4. rm /var/spool/qdaemon/*
5. startsrc -s qdaemon

skulker

- The **skulker** command cleans up file systems by removing unwanted or obsolete files
- Candidate files include (can use file aging as criteria):
  - those in /tmp directory
  - a.out file
  - core files
  - ed.hup files
- **skulker** is normally invoked daily by the **cron** command as part of the root's crontab file
- Modify the skulker shell script to suit local needs for the removal of files

Figure 12-5. skulker AU1410.0

Notes:

The following is an example of the types of entries that are in the /**usr**/**sbin**/**skulker** program. To analyze the commands that are executed for each type of entry, print out or view the contents of the /**usr**/**sbin**/**skulker** file. Use care if modifying the file.

Removes all:

- old primary.output that got lost
- old **qdir** files
- files that are left in the mail queues
- files in /**tmp** older than 24 hours and not accessed or modified in the past 24 hours
- files in /**var**/**tmp**
- news items older than 45 days
- ***.bak, *.bak, a.out, core, proof, galley, ed.hup** files that are more than one day old
- anything in a **.putdir** directory more than a day old

Listing Disk Usage

- The **du** command can be used to list the number of blocks used by a file or a directory

  # du /home | sort -r -n

```
624   /home
392   /home/fred
98    /home/tom
54    /home/mary
52    /home/liz
23    /home/suzy
2     /home/guest
1     /home/steve
```

- To view individual file sizes, use the ls -l command

Figure 12-6. Listing Disk Usage AU1410.0

Notes:

There may be a number of files or users that are causing the increase of use in a particular file system. The **du** command helps to determine the cause.

du gives information in 512-byte blocks, by directory. Use the **-k** option to display sizes in 1 KB units, use the **-m** option to display sizes in 1 MB units, use the **-g** option to display sizes in 1 GB units. With the **-a** option, output is displayed by file rather than directory. If used with **sort** on the first column in descending order, it can be an aid in determining which files/directories are the largest. Then using an **ls -l**, you can determine the file/directory's owner. The options **-m** and **-g** are only available in AIX V5.2.

The **-x** option is also very useful. When using **du -ax**, the report only shows information from the specified file system. This is the best way to determine what file is filling a particular file system.

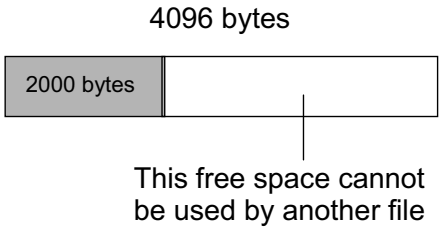
The find command is useful to locate files that are over a certain size. For example, to find all files that have greater than 1,000,000 characters and then list them use:

 # find . -size +1000000c -exec ls -l {} \;

Fragmentation Considerations

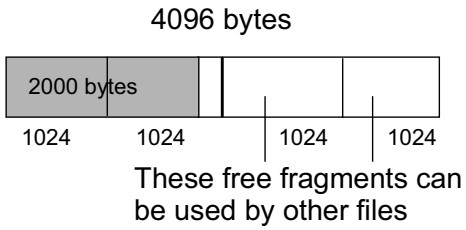
Without fragmentation

File size = 2000 bytes



With fragmentation

File size = 2000 bytes
Fragment size = 1024 bytes



Considerations to be made:
- Disk space allocation
- Disk space utilization
- I/O activity
- Free space fragmentation
- Fragment allocation map

Figure 12-7. Fragmentation Considerations AU1410.0

Notes:

In JFS, as many whole fragments as necessary are used to store a file or directory's data. Consider that we have chosen to use a JFS fragment size of 4 KB and we are attempting to store file data which only partially fills a JFS fragment. Potentially, the amount of unused or wasted space in the partially filled fragment can be quite high. For example, if only 500 bytes are stored in this fragment then 3596 bytes will be wasted. However, if a smaller JFS fragment size, say 512 bytes was used, the amount of wasted disk space would be greatly reduced to only 12 bytes. It is, therefore, better to use small fragment sizes if efficient use of available disk space is required.

Although small fragment sizes can be beneficial in reducing wasted disk space, this can have an adverse effect on disk I/O activity. For a file with a size of 4 KB stored in a single fragment of 4 KB, only one disk I/O operation would be required to either read or write the file. If the choice of the fragment size was 512 bytes, a 4 KB file would only be allocated a 4 KB block if one were available. If a single 4 KB block were not available, 512 byte fragments would be used, with a potential to allocate eight fragments for this file. If fragments are used, for a read or write to complete, several additional disk I/O operations (disk seeks, data transfers and allocation activity) would be required. Therefore, for file

systems which use a fragment size of 4 KB, the number of disk I/O operations will be far less than for file systems which employ a smaller fragment size.

For file systems with a fragment size smaller than 4 KB, there is likely to be an increase in allocation activity when the size of existing files or directories are extended.

Free space fragmentation can occur much more within a file system that uses smaller fragment sizes.

The fragment allocation map, used to hold information about the state of each fragment for each file system, is held on the disk and in virtual memory. The use of smaller fragment sizes in file systems results in an increase in the length of these maps and therefore requires more resources to hold.

In JFS2 the block size has a similar function to the JFS fragment size. The default is 4096 and can be altered by the system administrator.

Defragmenting a File System

- The **defragfs** command increases a file system's contiguous free space

- The file system must be mounted

```
defragfs [-q | -r | -s]  filesystem
```

Options:

-q	Reports the current state of the file system
-r	Reports the current state of the file system and the state that would result if the **defragfs** command is run without either **-q, -r** or **-s**
-s	Reports shortly the current state of the file system

Figure 12-8. Defragmenting a File System AU1410.0

Notes:

Some of the information that is returned with the **defragfs** command is:

- Number of Fragments Moved: Tells you how many data blocks need to be moved.
- Number of Logical Blocks Moved: Tells how many non-contiguous blocks that are in the system currently and how many that are relocated, if possible.
- Number of Allocation Attempts: This is the required number of calls to the allocation routine to defragment the file system.
- Number of Exact Matches: This is the number of exact matches, based on file sizes, that are in the allocation thus allowing the file to be rewritten contiguously.

Note: Sometimes the estimates provided when running **defragfs** with the **-q** or **-r** options will return different results than what is actually done when running **defragfs** without any options.

Verify a File System

- Command syntax:

```
fsck [-p | -y | -n] [-f] [   file system ]
```

- Checks Journal Log
- Checks inodes, indirect blocks, data blocks, free lists
- If no file system name is specified, the **fsck** command will check all filesystems which have the **check=true** attribute set in the **/etc/filesystems**
- Orphan files are placed in the **/lost+found** directory

Figure 12-9. Verify a File System AU1410.0

Notes:

A file system can be verified using the **fsck** (file system check) command.

This check consists of a number of stages, including:

- Check the journal log for errors
- Check the blocks to ensure that each block is either allocated to a single file or is in the free list
- Check file sizes
- Check directory entries

The **-p** option (preen) is used to check a file system making only minor changes without bothering the user. The command when run under SMIT uses this option.

If **fsck** encounters errors it reports them to the screen. The **-y** option (yes) or **-n** (no) option is used to indicate a yes or no answer to all questions. The yes option is typically used to recover a badly damaged file system. Using the **-y** option will allow **fsck** to discard some badly damaged files. Note, however, that mounted file systems are not repaired.

If any files are found that are not allocated to a directory anywhere, then **fsck** creates an entry for that data in the **lost+found** directory in the / directory of that file system. If the **lost+found** directory for a file system does not exist, it can be created using the AIX command **mklost+found**.

The **fsck** command also executes each time the system boots up (from the /**etc**/**rc** file).

Documenting File System Setup

- Run the **lsfs** command
- Get the contents of the **/etc/filesystems** file
- Run the **df** command to check free space
- Check all the mounted file systems by running the **mount** command

Figure 12-10. Documenting File System Setup AU1410.0

Notes:

Exercise: Managing File Systems

Figure 12-11. Exercise: Managing File Systems AU1410.0

Notes:

The lab allows you to get some experience with the file system management tools. It also allows you to build and test file systems with different characteristics.

This exercise can be found in your Exercise Guide.

Checkpoint

1. What command can you use to determine if a file system is full?

   _____

2. What two commands can be used to find the files and users that are taking the most disk space?

   _____

3. True/False It is good practice to run fsck -y on all file systems, even if they are mounted.

Figure 12-12. Checkpoint AU1410.0

Notes:

Unit Summary

- File system management does not just happen on the system. File systems need to be regularly monitored to ensure that they do not run out of space.
- To ensure the integrity of file systems, checks have to be carried out whenever file system corruption is suspected.

Figure 12-13. Unit Summary AU1410.0

Notes:

Unit 13. Paging Space

What This Unit Is About

This unit outlines the concepts of paging space.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Define why paging space is required in AIX
- List and monitor the paging space utilization of the system
- Perform corrective actions to rectify too little or too much paging space scenarios

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise

References

Online	*System Management Concepts: Operating System and Devices*
Online	*System Management Guide: Operating System and Devices*
Online	*Performance Tuning Guide*
SG24-5765-02	*AIX 5L Differences Guide Version 5.2 Edition*

Unit Objectives

After completing this unit, you should be able to:

- Define why paging space is required in AIX
- List and monitor the paging space utilization of the system
- Perform corrective actions to rectify too little or too much paging space scenarios

Figure 13-1. Unit Objectives AU1410.0

Notes:

What Is Paging Space?

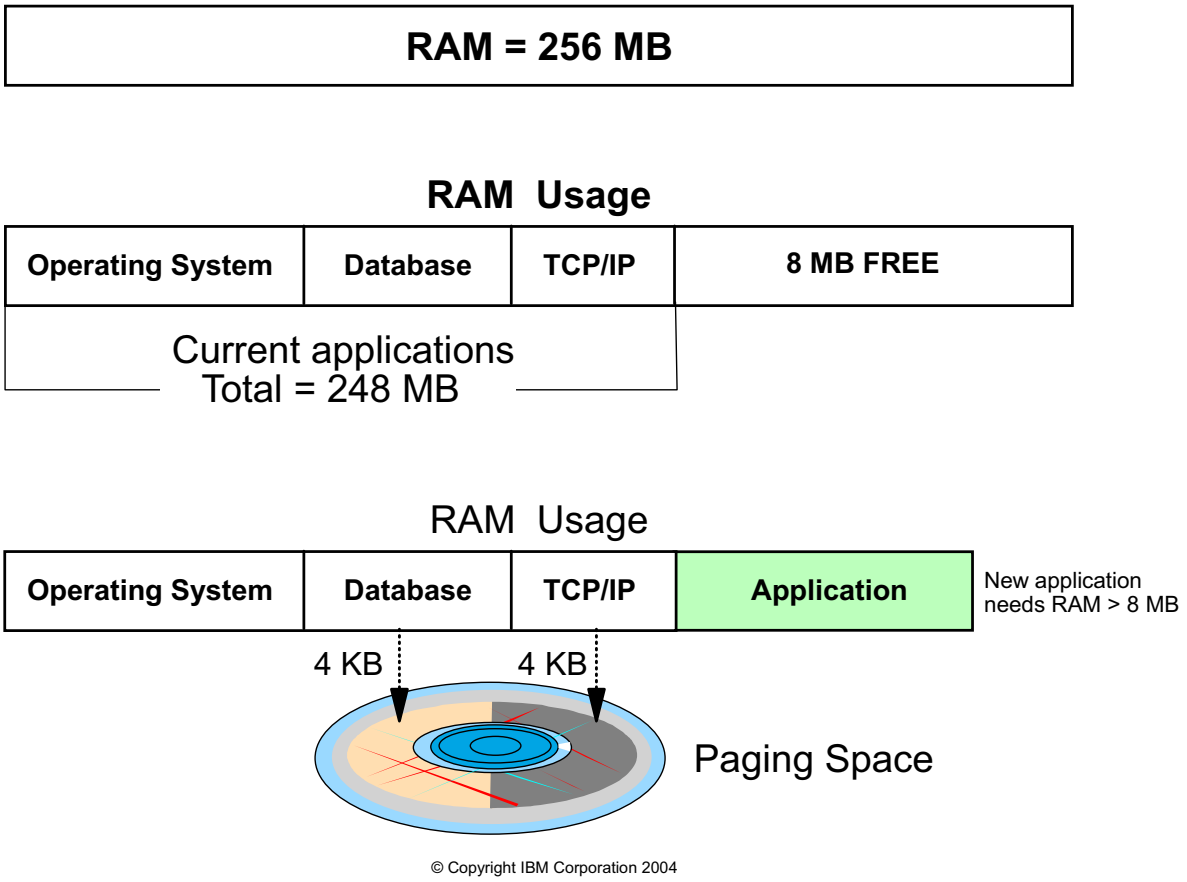


Figure 13-2. What Is Paging Space? AU1410.0

Notes:

For a process to be actively running, it must be loaded into memory. When it is loaded into memory, it is assigned a number of 4 KB areas called page frames. As more processes are loaded into memory, memory may become full. Not everything that resides in memory is active. When memory is full, memory is scanned to locate those page frames that are least-recently used. When one is located, a 4 KB block or page of disk space is allocated and the data from the page frame is moved to disk. This area on disk is called paging space.

The paging space is a reserved area on disk that can contain data that resided in memory but was inactive and was moved to make room for processes that are active. If a paged-out process is needed in memory again, the page is retrieved and brought back into memory or paged-in.

In the AIX environment, paging and virtual storage is managed by the Virtual Memory Manager (VMM).

Paging Space

- Is a secondary storage area for over-committed memory
- Holds inactive 4 KB *pages* on disk
- Is not a substitute for real memory

Figure 13-3. Paging Space AU1410.0

Notes:

Paging space is disk storage information that is resident in virtual memory, but is not currently being accessed. As memory fills, inactive pages are moved to the paging area on disk.

It is very important to remember that paging is a temporary holding area for inactive pages; it is not a substitute for real memory. If your machine has many active processes, it will require more real memory. You must make sure the machine has enough memory to maintain all the active processes. If you run out of memory, your machine reaches a constant state of paging called thrashing. As it attempts to make room in memory, it completes a page-out; as soon as the page reaches the disk, it is needed again because it is still active. Your machine's resources are wasted performing only paging activity, and no real work gets done.

Increasing the amount of paging space when your machine is thrashing does not solve the problem. Thrashing is result of not enough real memory.

Sizing Paging Space

- Created at installation up to twice the size of real memory
- Amount needed is dependent on applications
- Monitor paging space : **lsps -a**
- Running low on paging space is bad

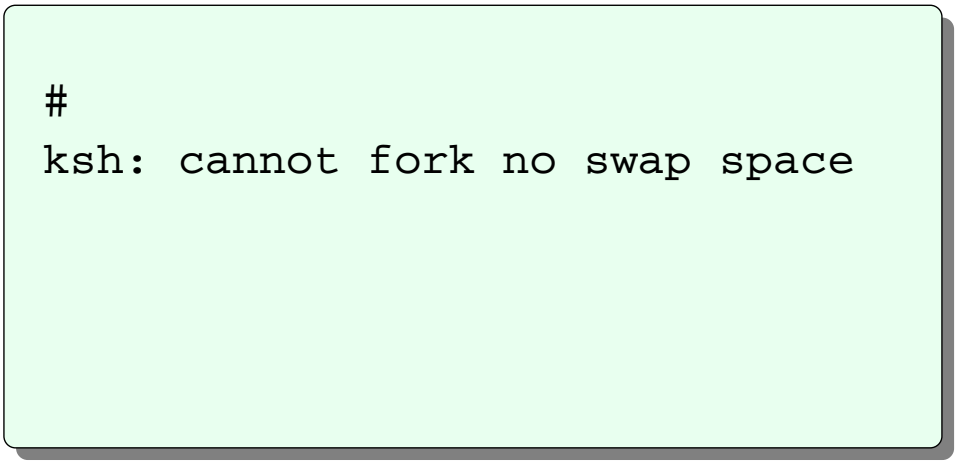


Figure 13-4. Sizing Paging Space AU1410.0

Notes:

Paging space is created during installation. The initial size is dependent on the amount of RAM in your system. If RAM is greater than or equal to 64 MB, paging space is RAM + 16 MB. If RAM is less than 64 MB, paging space is twice the size of RAM.

This is just a starting point. This is not necessarily the amount of the paging space that is right for your machine. The number and types of applications will dictate the amount of paging space needed. Many sizing rules of thumb have been published, but the only way to correctly size your machine's paging space is to monitor the amount of paging activity.

Monitoring the activity is done with the command **lsps -a**. This command and its output will be covered shortly.

If your system runs low on paging space, a message is sent to the console and sometimes to users as well. At this point the system is unable to start any new processes until some running processes are terminated or release allocated memory. This situation should obviously be avoided. If any of the following messages appear on the console or in response to a command on any terminal, it indicates a low paging space.

```
"INIT: Paging space is low"

"ksh: cannot fork no swap space"

"Not enough memory"

"Fork function failed"

"fork () system call failed"

"Unable to fork, too may processes"

"Fork failure - not enough memory available"

"Fork function not allowed.  Not enough memory available."

"Cannot fork: Not enough space"
```

The situation can get worse. If paging space continues to fill, non-system processes are terminated and the system may even crash. Make sure you have enough paging space.

Paging Space Placement

- Only one paging space per disk
- Use disks with the least activity
- Paging spaces roughly the same size
- Do not extend paging space to multiple PV's
- Use multiple disk controllers

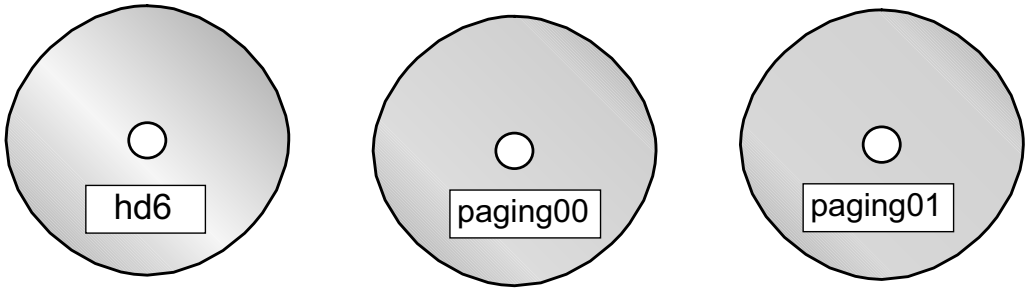


Figure 13-5. Paging Space Placement AU1410.0

Notes:

Placement and size of your paging space will impact its performance. The following are tips for paging space.

Do not have more that one paging space per disk. The paging space is allocated in a round-robin manner, and uses all paging areas equally. If you have two paging areas on one disk, then you are no longer spreading the activity across several disks.

Paging space performs best when it is not competing with other activity on the disk. Use disks that do not have much activity.

Paging spaces should be roughly the same size. Because of the round-robin technique that is used, if they are not the same size, then the paging space usage is not balanced. Smaller paging areas fill faster.

Do not extend a paging space to span multiple physical volumes. Although you can spread a paging area (like a regular logical volume) across several disk, the round-robin technique treats the paging area as one single paging area. Therefore, the activity is not evenly spread across the disks.

Use disks on different controller. If the disks are attached to different controllers you get better throughput when reading and writing to the disk. That improves your performance.

Paging Space

List Paging Activity

```
# lsps -a
Page Space  Physical Volume  Volume Group  Size   %Used  Active  Auto  Type
hd6         hdisk0           rootvg        64 MB  43%    yes     yes   lv
paging00    hdisk2           rootvg        64 MB  20%    yes     yes   lv
```

Total RAM

```
# lsattr -El sys0 -a realmem
realmem 262144 Amount of usable physical memory in KB False
```

Paging Space Activated at startup

```
# cat /etc/swapspaces
hd6:
        dev = /dev/hd6

paging00:
        dev  =  /dev/paging00
```


Figure 13-6. Paging Space AU1410.0

Notes:

The **lsps** command lists details of the paging spaces on the system including whether they are in use at the time and, if so, what percentage of their total space is allocated.

Another useful option available with the **lsps** command is the **-s** option which specifies the summary characteristics of all paging spaces. The information consists of the total size of the paging spaces (in MBs) and the percentage of paging spaces currently used.

Note that the output of the **lsps** command in the example shows two paging spaces: hd6 and paging00. The paging space created during system installation is named hd6. Paging spaces created by the system administrator after system installation are named paging00, paging01, and so on.

The file /**etc**/**swapspaces** contains a list of the paging space areas that are activated at system startup.

Adding Paging Space

smit mkps

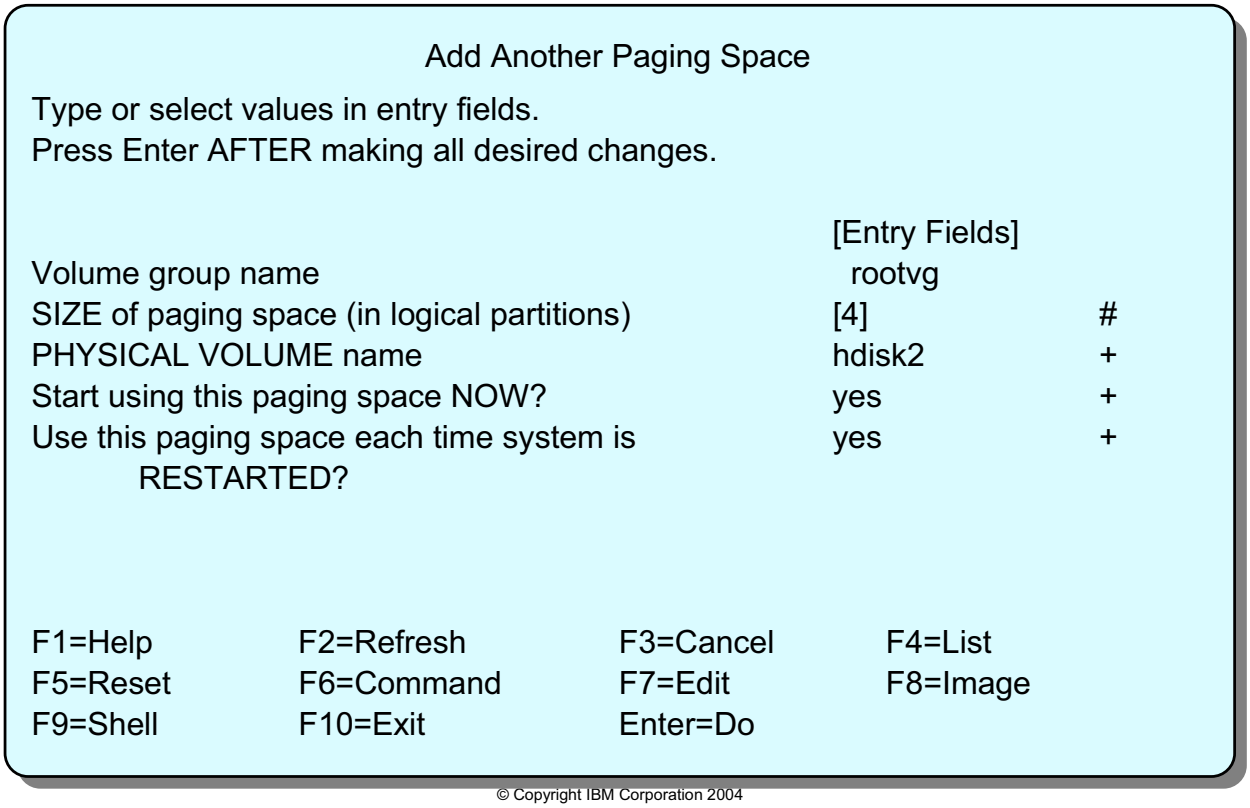


Figure 13-7. Adding Paging Space AU1410.0

Notes:

To add extra paging space volumes to the system, use SMIT, the **mkps** command, or the Web-based System Manager. If using the **mkps** command, the options are:

mkps [-a] [-n] -s NumLPs Vgname Pvname

Vgname	The volume group within which to create the paging space
Pvname	Specifies the physical volume of the volume group
-s NumLPs	Sets the size of the new paging space in logical partitions
-a	Activate the paging space at the next restart (add it to **/etc/swapspaces**)
-n	Activate the paging space immediately

When a paging space is created, the **/etc/swapspaces** file is also updated if needed.

An example of the high-level command is: **# mkps -s 4 -n -a rootvg**

Change Paging Space

smit chps

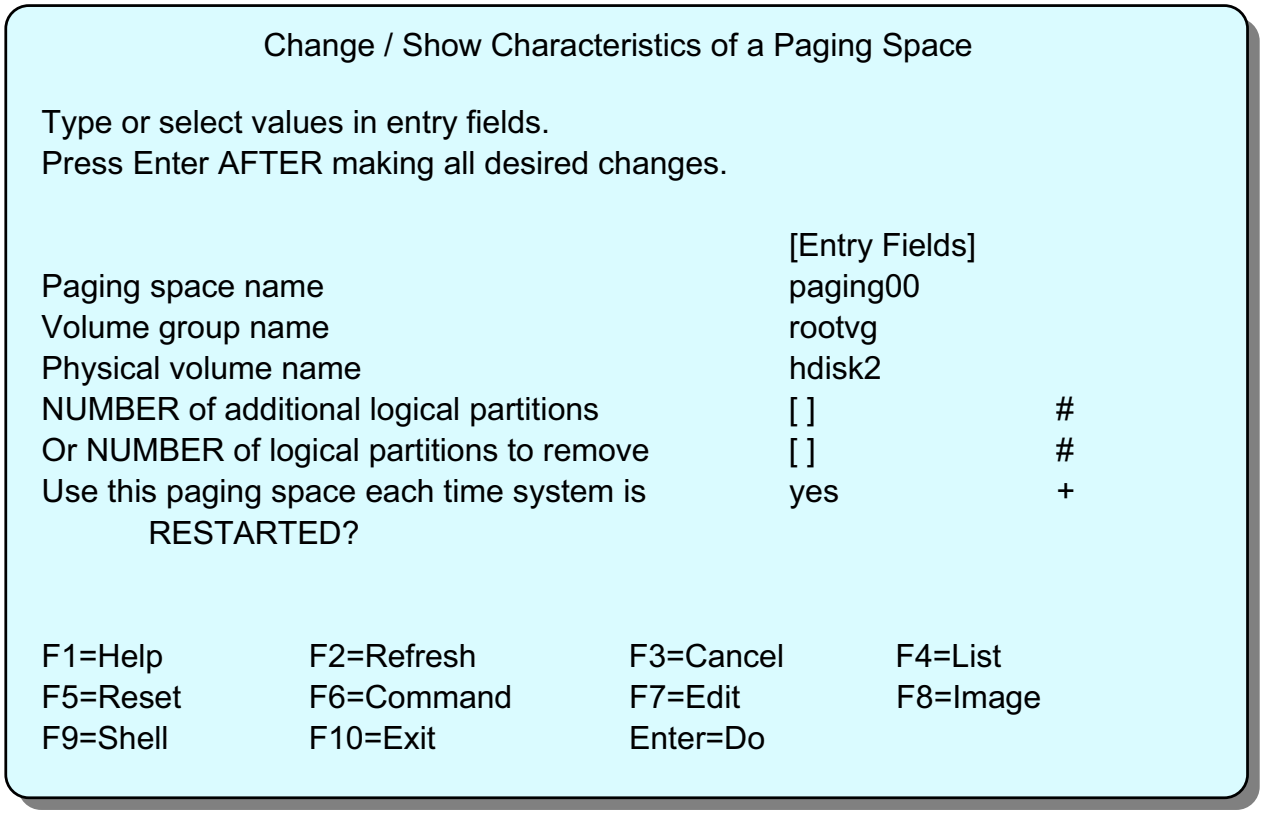


Figure 13-8. Change Paging Space AU1410.0

Notes:

Paging space may have its size increased or decreased and may have its autostart options changed while it is in use (this updates **/etc/swapspaces**). The high-level command to perform this action is **chps**.

Decreasing paging space

The ability to decrease paging space was introduced in AIX V5.1. The argument **-d** to the **chps** command calls the **shrinkps** shell script to reduce the size of an active paging space. The use of a shell script reduces the possibility of getting into an unbootable state because users are not allowed to run out of paging space. The script checks paging space actually in use and adds a buffer for paging space warning threshold. The SMIT fastpath is **smit chps**.

#chps -d 1 paging00

#chps -s 1 paging00

The process **chps** goes through to decrease an active paging space is:

Step	Action
1	Create a new, temporary space from the same volume group as the one being reduced
2	Deactivate the original paging space
3	Reduce the original paging space
4	Reactivate the original paging space
5	Deactivate the temporary space

The primary paging space (usually hd6) cannot be decreased below 32 MB.

When you reduce the primary paging space, a temporary boot image and a temporary /sbin/rc.boot pointing to this temporary primary paging space are created to make sure the system is always in a state where it can be safely rebooted.

These command enhancements are also available through the Web-based System Manager in AIX V5.2.

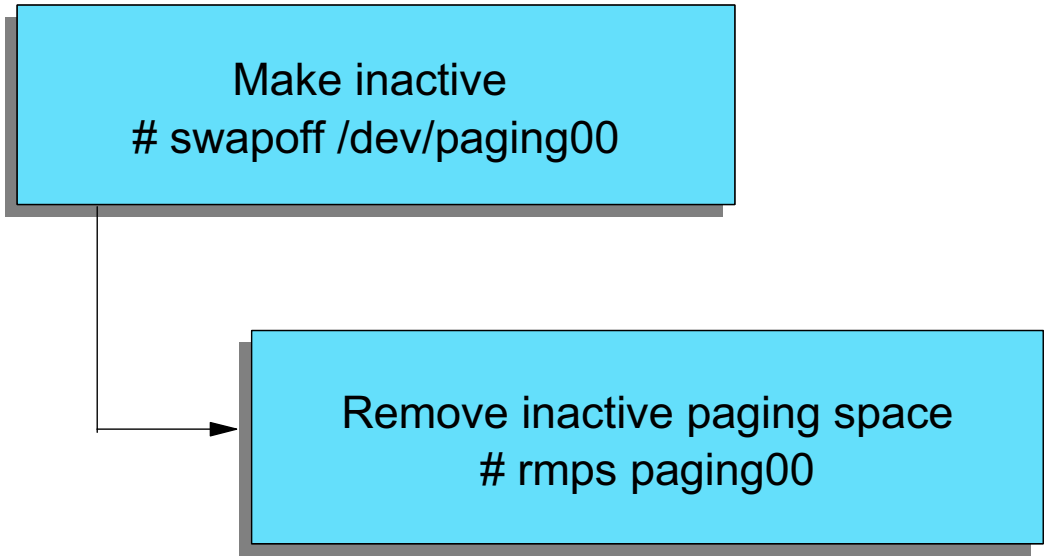
Activating paging space

Inactive paging spaces may be activated dynamically once they have been defined. To do this enter: **swapon /dev/pagingnn**

Note: this operation is supported through SMIT as well, fastpath **pgsp**. Alternatively, use: **swapon -a** to activate all paging spaces defined in /**etc**/**swapspaces**. This command is run in /**etc**/**rc** at system startup.

Remove Paging Space

In order to remove an active paging space:



NOTE: /dev/hd6 cannot be removed using this process

Figure 13-9. Remove Paging Space AU1410.0

Notes:

Paging space can be added to the system, and surplus paging space can be deleted to free up the disk space for other logical volumes.

Inactive paging space can be activated dynamically to meet system demand. In order to delete paging space it must be inactive (that is, not used by the kernel.) Beginning with AIX V5.1, active paging spaces can be deactivated while the system is running using the **swapoff** command or with the SMIT fastpath **swapoff**.

The **swapoff** command may fail due to:

- Paging size constraints. The process to remove an active paging space is to move all the pages of the paging space being removed to another paging space. If there is not enough active paging space to do this, the command fails.
- I/O errors.

Problems with Paging Space

- Paging space too small:
  Dynamically increase the size by allocating more partitions
  chps -s *LogicalPartitions PagingSpace*

  Example:
  # chps -s 1 paging00

- Paging space too large:
  Dynamically decrease the size by deallocating partitions
  chps -d *LogicalPartitions PagingSpace*

  Example:
  # chps -d 1 paging00

Figure 13-10. Problems with Paging Space AU1410.0

Notes:

Documenting Paging Space Setup

- Run the **lsps** command
- Have a hardcopy of the /**etc/swapspaces** file

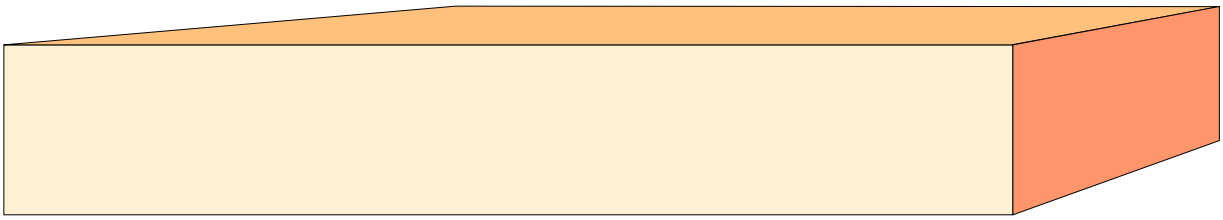


Figure 13-11. Documenting Paging Space Setup AU1410.0

Notes:

Run **lsps** to monitor the activity of the paging space. Keep good documentation so that you know what is normal for that system.

Keep a copy of /etc/swapspaces so that you know what paging spaces are defined to start at boot.

Exercise: Paging Space

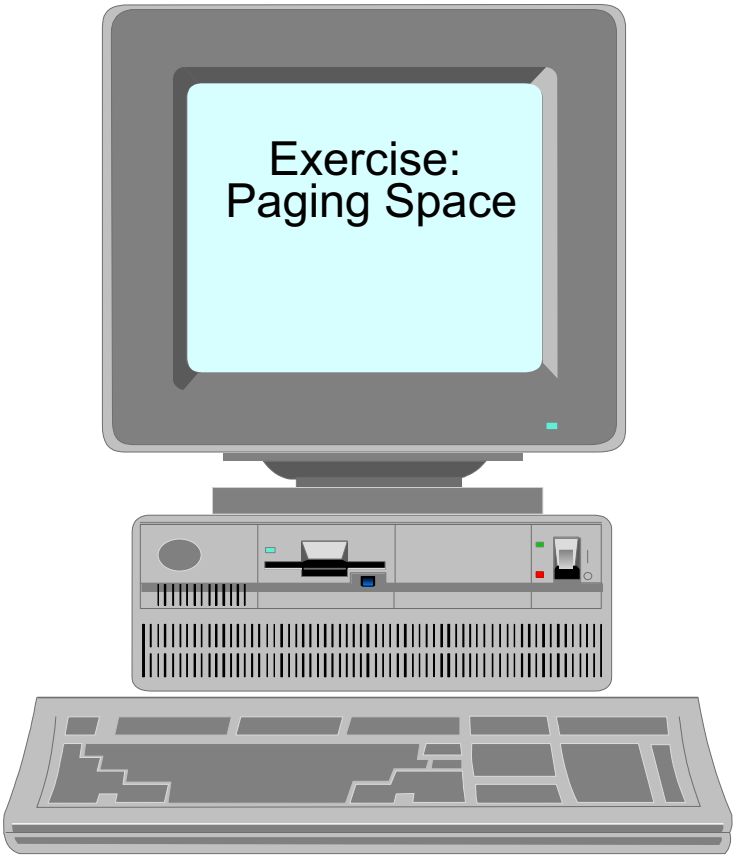


Figure 13-12. Exercise: Paging Space AU1410.0

Notes:

This lab allows you to add, decrease, monitor, and remove paging space.

This exercise can be found in your Exercise Guide.

Checkpoint

1. What problems can you conclude from the following listing?

Page Space	Physical Volume	Volume Group	Size	%Used	Active	Auto	Type
hd6	hdisk0	rootvg	64 MB	43%	yes	yes	lv
paging00	hdisk1	rootvg	64 MB	7%	yes	yes	lv
paging01	hdisk1	rootvg	16 MB	89%	yes	yes	lv

_____
_____
_____
_____
_____
_____

2. The size of paging00 (in the above example) can be dynamically decreased. True or false?

_____

Figure 13-13. Checkpoint AU1410.0

Notes:

Unit Summary

- Paging space is a requirement in AIX for the system to boot up. The default paging space is /dev/hd6.
- The percent utilization of all the paging spaces should be regularly monitored to ensure that the system has the correct amount of page space defined. The **lsps** command can be used to do this.
- Paging space can be inactivated and the size can be increased or decreased dynamically.

Figure 13-14. Unit Summary AU1410.0

Notes:

Unit 14. Backup and Restore

What This Unit Is About

This unit describes how a system can be backed up and restored.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Identify issues which have to be considered when deciding which backup policies to implement:
  - Media to be used
  - Frequency of the backup
  - Type of backup
- List the different backup methods supported through SMIT and on the command line
- Create a customized installable system image backup
- Execute other useful commands to manipulate the backed up data on the media

How You Will Check Your Progress

Accountability:

- Activity
- Checkpoint questions
- Exercises

References

Online	*AIX System Management Concepts: Operating System and Devices*
Online	*AIX System Management Guide: Operating System and Devices*
SG24-5765-02	*AIX 5L Differences Guide Version 5.2 Edition*
SG24-5766-00	*AIX 5L Differences Guide Version 5.3 Edition*

Unit Objectives

After completing this unit, you should be able to:

- Identify issues which have to be considered when deciding which backup policies to implement:
  - Media to be used
  - Frequency of the backup
  - Type of backup
- List the different backup methods supported through SMIT and on the command line
- Create a customized installable system image backup
- Execute other useful commands to manipulate the backed up data on the media

Figure 14-1. Unit Objectives AU1410.0

Notes:

Why Backup?

- Data is very important:
  - Expensive to recreate
  - Can it be recreated?
- Disaster recovery:
  - Hardware failure
  - Damage due to installation/repair
  - Accidental deletion
- Transfer of data between systems
- Reorganizing file systems
- Defragmentation to improve performance
- System image for installation
- Checkpoint (before/after upgrade)
- Long term archive

Figure 14-2. Why Backup? AU1410.0

Notes:

The data on a computer is usually far more important and expensive to replace than the machine itself. Many companies have gone out of business because they did not plan for disaster recovery. Backup to tape is the cheapest alternative but a duplicate disk or complete system would also provide protection and fast recovery from a disaster.

Backups should be taken before installing/maintaining hardware/software, in case a disk or files accidentally get damaged.

Backups are not just used for disaster recovery. One way of transferring a number of files from one machine to another is to back those files up to diskette, tape or a file on disk and then transfer that backup media to another machine.

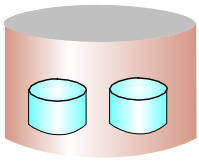
When reorganizing the file systems on the disk you need to backup file systems so that they can be deleted and moved to another location.

If you are going to install a number of similar machines, or wish to be able to quickly reinstall a machine then a complete system image backup should be used.

Types of Backup

Three types of backup:

- System
  Records image backup of the operating system
- Full
  Preserves all user data and configuration files
- Incremental
  Records changes since previous backups
  Must be used carefully
  Very quick



rootvg

Figure 14-3. Types of Backup AU1410.0

Notes:

There are two types of incremental backups:

The first method is to do a full backup. For example, on Sunday, and then for the rest of the week, only backup the changes from the previous day. This method has the advantage of being quick, but there are a lot of tapes involved. Should one of the tapes be missing, you will have problems restoring using the remaining tapes.

The second method again involves taking a full backup on Sunday. However, the other days of the week backup only the changes made since the full backup; that is, since Sunday. The backups take slightly longer than the previous method, and towards the end of the week, if most of your system has changed, then the time taken is similar to a full backup. The restoration procedure does not depend on the tape from the previous day.

Backup Strategy

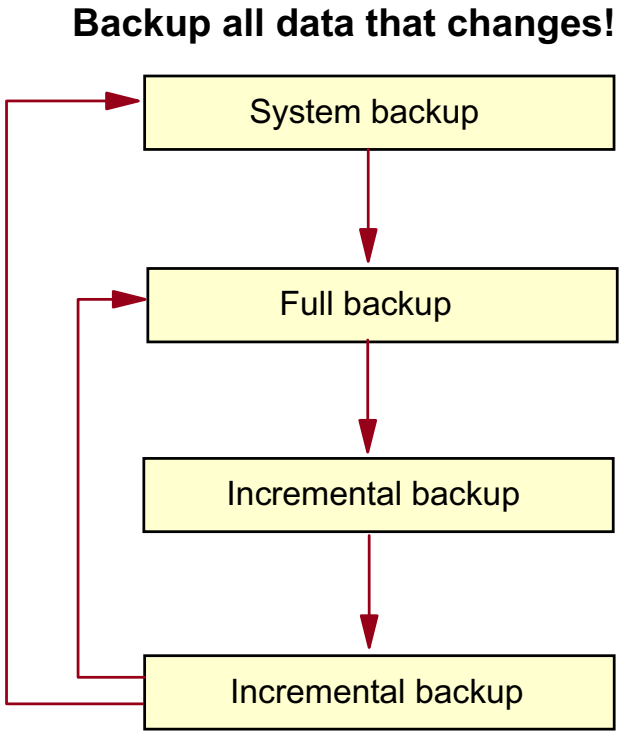


Figure 14-4. Backup Strategy AU1410.0

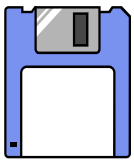
Notes:

Every organization sets its own backup policy, but a suggested strategy could include doing a system backup when the system is installed or upgraded, then a full backup periodically, perhaps weekly. The incremental backups can be run each day to copy files that have changed since the last incremental backup or the last full backup.

The key to any backup strategy is to ensure the data that is changing is saved regularly while trying to avoid interruptions to users' access to the data on your system.

Backup Devices - Diskette

/dev/fd0 Built in 3 1/2-inch diskette drive
/dev/fd1 Second diskette drive



Drive

	3 1/2-inch (1.44)	3 1/2-inch (2.88)
/dev/fdxl	720 KB	720 KB
/dev/fdxh	1.44 MB	2.88 MB
/dev/fdx.9	720 KB	720 KB
/dev/fdx.18	1.44 MB	1.44 MB
/dev/fdx.36	-	2.88 MB

Figure 14-5. Backup Devices - Diskette AU1410.0

Notes:

Diskettes can be used to backup data. Of course, this media is only practical when backing up small amounts of data.

The logical device name for a diskette drive is /**dev**/**fdx**. Your system most likely has one diskette drive - **fd0**. When writing to a diskette, the highest density supported is the default value. The chart shows there are multiple logical names associated with the diskette drive that allow writing at different densities. To read the diskettes on a low-density drive, you must write using the low-density settings.

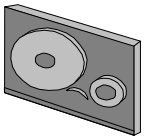
To format a diskette, use the **format** command. There is a **-l** options if you want to format at low density.

The **flcopy** command is used to copy diskettes (similar to the DOS diskcopy command).

Diskettes can also be formatted using DOS formatting with the command **dosformat**. AIX can read from and write to DOS diskettes using **dosread** and **doswrite**. There is also a **dosdir** to view the content of the diskette. To use these tools, the fileset **bos.dosutil** must be installed.

Backup Devices - Tape

- 4 mm DAT
- 8 mm



- 1/2 - inch
- DLT
- VXA
- QIC

	Low Capacity	Retension on Open	Rewind on Close
/dev/rmtx	no	no	yes
/dev/rmtx.1	no	no	no
/dev/rmtx.2	no	yes	yes
/dev/rmtx.3	no	yes	no
/dev/rmtx.4	yes	no	yes
/dev/rmtx.5	yes	no	no
/dev/rmtx.6	yes	yes	yes
/dev/rmtx.7	yes	yes	no

Figure 14-6. Backup Devices - Tape AU1410.0

Notes:

The most common device used for backups are tapes. AIX supports a variety of tape devices, tape subsystems and tape libraries. Here are some highlights of some of the tape technologies.

4 mm DAT (Digital Audio Tape) - can hold up to 40 GB of data with a data transfer rate of 6 MB/sec.
8 mm Tape - can hold up to 40 GB of data with a data transfer rate of 6 MB/sec.
Quarter Inch Cartridge (QIC) - can hold up to 4 GB with a data transfer rate of 380 KB/sec.
DLT - Digital Linear Tape - can hold up to 70 GB at a transfer rate of 10 MB/sec.
Magstar - another tape technology usually used in tape subsystems. It offers up to 420 GB per cartridge with a transfer rate of 15 MB/sec.
VXA Tape Data Cartridge - can hold up to 160 GB with a data transfer rate of 12 MB/sec.
8 mm Data Cartridge with smart clean technology - can hold up to 150 GB with a data transfer rate of 30 MB/sec.

For large scale backups, tape subsystems and tape libraries would the sensible choice. For details on all tape devices supported on the RS/6000, go to: **www.ibm.com/storage/tape**

The tape devices use the logical device name of **rmtx** (raw magnetic tape). In the chart, you see the seven additional logical names assigned to each tape device. These names control tape device characteristics:

- Write at low capacity
- Retension the tape (fast forward and rewind before starting the operation)
- Rewind the tape at the finish of the operation

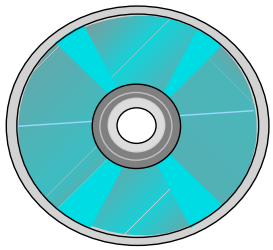
The most common devices that are used are rmtx and rmtx.1. For most tape operations, high capacity and no retension are the norm. Whether or not you want to rewind the tape depends on your particular operation.

Tapes are formatted at the factory. Tape movement can be controlled using **tctl** or **mt** commands. And, if there two tape devices, tcopy allows tape to tape transfers. Details on these commands are discussed later.

Backup Device - Read/Write Optical Drive

- Use with CD-ROM file system for read only operations
- Use with journal file systems for read/write operation

- For CD
  - OEM cd-rw drive
  - Third-party cd burn software (AIX Toolbox for Linux Applications)



- For DVD
  - Need 7210 DVD-RAM Drive
  - No additional software needed for UDF format

Figure 14-7. Backup Device - Read/Write Optical Drive AU1410.0

Notes:

AIX supports read/write optical drives as well as standard CD-ROM. The R/W Optical drives support CD-ROM file systems and JFS file systems. If the optical drive is mounted as a CD-ROM file system, it will be read only.

CD-ROM file system - To use the information on the read/write optical drive like a standard CD-ROM. The steps to access the data is the same as with a regular CD-ROM.

1. Create the file system (**smit crcdrfs** -or- **crfs -v cdrfs -p ro -d DeviceName**)
2. Mount the file system (**mount mount_point**)

JFS file system - To use the read/write optical drive as a read/write device, you must create a volume group using the same commands that used with a hard drive.

1. Make the VG (**smit mkvg** -or- **mkvg -f -y VGName -d 1 DeviceName**)
2. Create a file system
   (**smit crfs** -or-
   crfs -v jfs -g VGName -a size=SizeFileSystem -m MountPoint -A [yes | **no] -p rw**)
   the -A option designates whether to automatically mount at system start.

3. Mount the file system

The optical drive VG must be wholly contain on the single optical disk. It cannot span beyond one optical drive.

To burn a backup image onto a CD (IS09660), one must install an OEM drive and software that is capable of CD writes.

To find out what cd writers are supported examine:
/usr/lpp/bos.sysmgt/README.oem_cdwriters.

Two of the cd burner software packages that have been tested with AIX and are provided on the AIX Toolbox for Linux Applications CD are **mkisofs** and **cdrecord**. You may alternatively download the software from:
http://www.ibm.com/servers/aix/products/aixos/linux/download.html

Whatever software package is installed you will need to link their executables to the AIX standard command names of /usr/sbin/mkrr_fs and /usr/sbin/burn_cd. For more details refer to:
/usr/lpp/bos.sysmgt/mkcd.README.

Backing up to DVD is only supported with the IBM 7210 (see next foil) and there is no need to install special software in order to write using the standard UDF format.

In order to boot from a mksysb CD or DVD, you need to be sure that your hardware is at the latest firmware level. Procedures for updating pSeries firmware is covered in the *Q1316 AIX System Administration II: Problem Determination* course.

Backup Device - 7210 External DVD-RAM Drive

- Writes DVD-RAM media
- Reads DVD media in 2.6 GB, 4.7 GB, 5.2 GB and 9.4 GB
- Supports CD-ROM media in Modes 1 or 2, XA, and CDDA and audio formats
- Reads multi-session disks, CD-R, CD-ROM, and CD-RW disks
- SCSI attachable
- Loading tray accommodates 8 cm and 12 cm media

Figure 14-8. Backup Device - 7210 External DVD-RAM Drive AU1410.0

Notes:

The IBM 7210 External DVD-RAM Drive Model 025 is a DVD-RAM drive designed to provide a high performance storage solution. This self-powered stand-alone drive is designed for the open systems environment, which includes the IBM iSeries, pSeries, AS/400, and RS/6000 servers.

Backup Menus

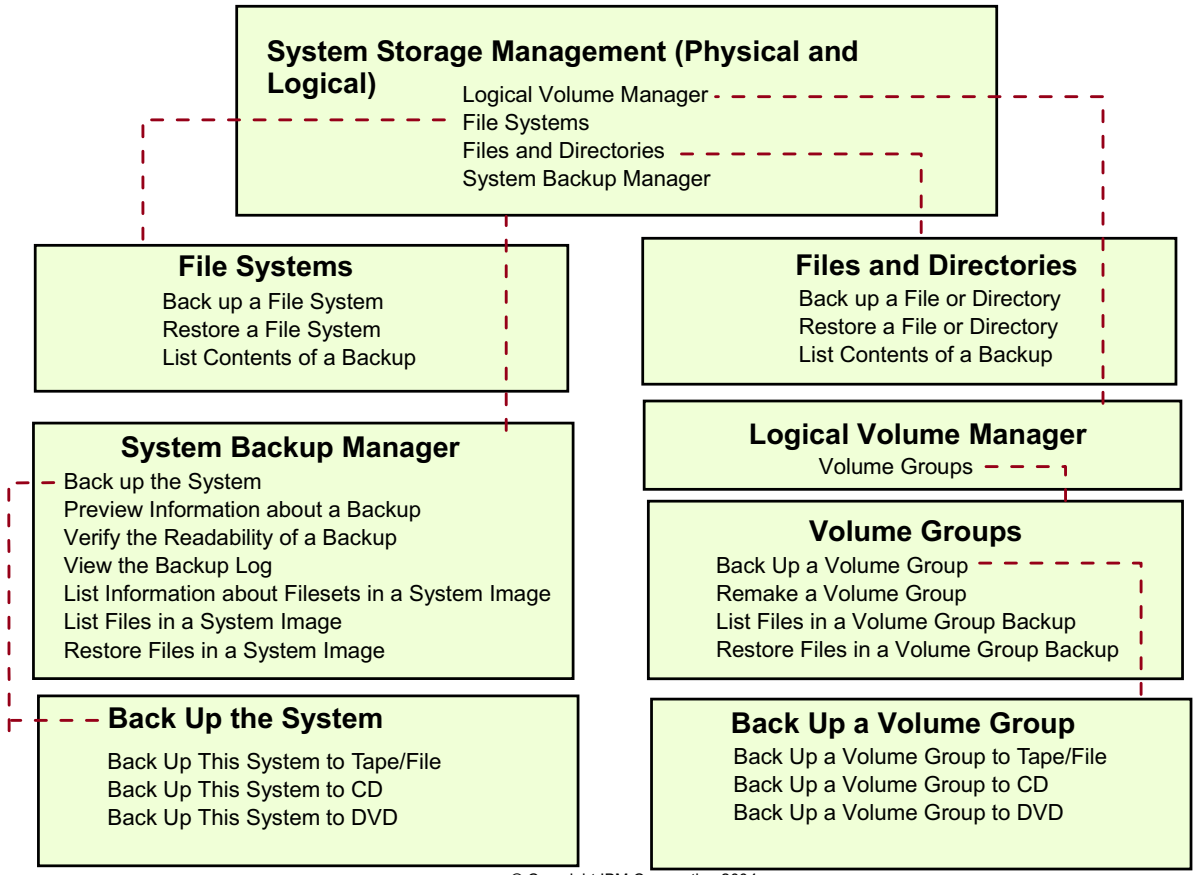


Figure 14-9. Backup Menus AU1410.0

Notes:

Please note that SMIT screens only show the backup options and not all the options.

Backups can also be performed using the Web-based System Manager.

rootvg Backup Process - mksysb

- Backs up rootvg only
- Unmounted file systems are not backed up
- Bootable tape is created in backup format
- Provides facilities for a non-interactive installation
- Saves system-created paging space definitions
- Saves logical volume policies
- There should be minimal user and application activity

Figure 14-10. rootvg Backup Process - mksysb AU1410.0

Notes:

mksysb provides the following functions:

- Saves the definition of the paging space
- Provides a non-interactive installation that gives information required at installation time through a data file
- Saves the inter/intra policy for the logical volumes
- Saves map files for logical volumes if requested by the user
- Provides the ability to shrink the file system and logical volume in a volume group at install time
- Saves the file system block size and number of bytes in inodes
- Saves the file system compression characteristics
- Saves striped logical volume attributes in AIX V4.2 and later
- Allows the user to restore single or multiple files from a system image

The volume group image is saved in **backup** format. The **rootvg** is created as an installable image.

If the **mksysb** command is used for a backup of the source system, it is considered a system backup. However, if the intent of the backup is to provide a customized system for use on other machines, the **mksysb** is considered a clone. Cloning means preserving either all or some of a system's customized information for use on a different machine. The **mksysb** files are system specific.

If the mksysb tape, by itself, is used to clone a machine that is not a hardware clone, it may not work or may not provide support for hardware devices unique to the new machine. For example, loading a mksysb image made from a uniprocessor machines does not install correctly on a multiprocessor machine because they use different AIX filesets. However, this is an easy problem to resolve. In additional to the mksysb tape, you will also need an AIX installation CD to provide the filesets needed by the other machine. If the CD is also available, during installation the proper fileset is automatically selected and loaded from the CD.

If a system backup is being made to install another system or to reinstall the existing system, a customer can predefine install information so questions at installation time are already answered. This keeps user interaction at the target node to a minimum. The system backup and BOS Install interact through several files. **mksysb** saves the data used by the install through taking a snapshot of the current system and its customized state.

The utilities for creating a system backup include messages, SMIT menus, and commands that are packaged in the **bos.sysmgt.sysbr** option of the bos.sysmgt package. They are separately installable, although this fileset is automatically installed in beginning with AIX V4.3. If your system does not include the **mksysb** command, install the **bos.sysmgt.sysbr** option to get **mksysb** and the bos install routines.

/image.data File for rootvg

```
image data:
        IMAGE_TYPE= bff
        DATE_TIME= Fri Nov 29 10:23:36 NFT 2002
        UNAME_INFO= AIX ibm150 2 5 00428DFB4C00
        PRODUCT_TAPE= no
        USERVG_LIST=
        PLATFORM= chrp
        OSLEVEL= 5.2.0.0
        CPU_ID= 00428DFB4C00
logical_volume_policy:
        SHRINK= no
        EXACT_FIT= no
ils_data:
        LANG= en_US
#Command used for vg_data, /usr/sbin/lsvg
 vg_data:
        VGNAME= rootvg
        PPSIZE= 16
        VARYON= yes
        VG_SOURCE_DISK_LIST= hdisk0
        BIGVG= no
        TFACTOR= 1
#Command used for source_disk_data: /usr/sbin/bootinfo
source_disk_data: (stanza is repeated for each disk in rootvg)
        PVID=(physical volume id)
        LOCATION=(disk location)
        SIZE_MB=(size of disk in megabytes)
        HDISKNAME=(disk name)
#Command used for lv_data; /usr/sbin/lslv
lv_data: (stanza for each logical volume in rootvg)
        .
fs_data: (stanza for each MOUNTED filesystem in rootvg)
```


Figure 14-11. /image.data File for rootvg AU1410.0

Notes:

The /**image.data** file has information used by bos install for creating the target **rootvg**. The /**image.data** file, while being flexible, is not intended for every user. The **mksysb** utility calls **mkszfile** (if **-i** or **-m** options specified) to create an **image.data** file from existing information. If users edit the **image.data** file, then they should call the **mksysb** command without the **-i** or **-m** options to use the existing **image.data** file.

In general, the stanza information found in the /**image.data** file is generated using one of the **lsxx** commands; that is, **lsvg** for the volume group data, **lslv** for the logical volume data, **lsjfs** for the file system data and so forth. Some fields like LV_MIN_LPS are created through calculations and are not directly available from commands.

The user can provide additional processing (if required) after bos install by using the **BOSINST_FILE=** field in the post_install_data stanza or through their own program. The **BOSINST_FILE** and **SHRINK=** fields must be edited by the user before calling **mksysb** if changes are desired.

logical_volume_policy

Contains information to be used at reinstall time. The **SHRINK=** field when set to YES, causes the system to create logical volumes and file systems in the volume group based on the values set for each with the **LV_MIN_LPs** and **FS_MIN_SIZE** fields. This option is always set to NO when created by **mkszfile.** The **EXACT_FIT=** field when set to YES, causes the system to place the logical volumes on the disk according to the physical partition maps that were generated with the **-m** flag of the **mksysb** or **mkszfile** command.

If the only thing you wish to change is the SHRINK or EXACT_FIT field, there is no need to edit this file. Both of these settings can be controlled by the menus presented during the installation of a mksysb.

vg_data

Contains information about the Volume Group. The **VG_SOURCE_DISK_LIST**= field specifies the disks that bos install uses on a best effort basis to place the volume Group. If the **EXACT_FIT**= field is set to YES, the user is warned before installation begins.

lv_data

Contains information about logical volumes. This type of data stanza is also used to contain paging space information. Information about striped logical volumes and large file enabled file systems are placed in this stanza in AIX V4.2 and later.

/bosinst.data File for rootvg

```
control_flow:
        CONSOLE = Default
        INSTALL_METHOD = overwrite
        PROMPT = yes
        EXISTING_SYSTEM_OVERWRITE = yes
        INSTALL_X_IF_ADAPTER = yes
        RUN_STARTUP = yes
        RM_INST_ROOTS = no
        ERROR_EXIT =
        CUSTOMIZATION_FILE =
        TCB = no
        INSTALL_TYPE =
        BUNDLES =
        RECOVER_DEVICES = Default
        BOSINST_DEBUG = no
        ACCEPT_LICENSES =
        INSTALL_64BIT_KERNEL =
        INSTALL_CONFIGURATION =
        DESKTOP = CDE
        INSTALL_DEVICES_AND_UPDATES = yes
        IMPORT_USER_VGS =
        ENABLE_64BIT_KERNEL = no
        CREATE_JFS2_FS = no
        ALL_DEVICES_KERNELS = yes
        (some bundles ....)

    target_disk_data:
        LOCATION =
        SIZE_MB =
        HDISKNAME =

    locale:
        BOSINST_LANG =
        CULTURAL_CONVENTION =
        MESSAGES =
        KEYBOARD =
```


Figure 14-12. /bosinst.data File for rootvg AU1410.0

Notes:

This file allows the administrator to specify the requirements at the target system and how the user interacts with the target system. It provides flexibility by allowing different target hardware to use the same backup image. The system backup utilities simply copy the **/bosinst.data** into the second file in the **rootvg** on the **mksysb** tape. If this file is not in the root directory, the **/usr/lpp/bosinst/bosinst.template** is copied to the **/bosinst.data.**

The sample file shown above has been condensed to highlight key areas. The actual file is well documented with comments contained within the file.

The control_flow stanza contains variables that control the way the installation program works.

CONSOLE specifies the full path name of the device you want to use as the console. For example, **/dev/lft0.**

INSTALL_METHOD specifies a method of installation: migration, preserve or overwrite.

PROMPT specifies whether the installation program uses menus from which you can make choices. You must fill in values for all variables in the locale and control_flow stanzas if you set the PROMPT variable to no with two exceptions: the ERROR_EXIT and CUSTOMIZATION_FILE variables, which are optional.

EXISTING_SYSTEM_OVERWRITE confirms that the install program overwrites existing files. This variable is only applicable for non-prompted overwrite installation.

INSTALL_X_IF_ADAPTER installs AIXWindows if the selected console is a graphical terminal.

RUN_STARTUP starts the Installation Assistant on first boot after the BOS installation completes.

RM_INST_ROOTS removes all files and directories in the **/usr/lpp/*/inst_roots** directories.

ERROR_EXIT starts an executable program if an error occurs in the installation program.

CUSTOMIZATION_FILE specifies the path name of a customization file you create. The customization file is a script that starts immediately after the installation program concludes.

TCB specifies whether you want to install the Trusted Computing Base.

INSTALL_TYPE specifies what software to install on the machine. The values are full (full-function configuration), client (client configuration), and personal (personal workstation configuration). The full configuration includes all the software in client and personal. Change full to client or personal if you want to install one of these subsets of the full-function configuration.

BUNDLES specifies what software bundles to install. Type the bundle names separated by a space between each name.

RECOVER_DEVICES specifies whether to reconfigure the devices.

BOSINST_DEBUG specifies whether to show debug output during BOS installation.

ACCEPT_LICENSES specifies whether to accept software license agreements during the BOS installation.

INSTALL_64BIT_KERNEL specifies whether to enable the 64-bit kernel and JFS2 filesystems.

INSTALL_CONFIGURATION specifies Default or Minimal installations.

DESKTOP specifies the desktop to be installed. Choices include CDE (the default), NONE, GNOME, and KDE. If you choose GNOME or KDE, you install open-source software.

The target_disk_data stanza contains variables for disks in the machine where the program will install BOS. The default **bosinst.data** file has one target_disk_data stanza, but you can add new stanzas to install BOS on multiple disks, one stanza for each disk. The installation program determines a target disk by checking the variables in hierarchical order. For example, if the LOCATION variable specifies a location code, the program installs BOS on

that disk, regardless of the remaining variables. If you accept the default values, which are blank, the installation program chooses a target disk based on the initial hardware query.

LOCATION specifies a location code for the disk where the program will install BOS.

SIZE_MB specifies the formatted size of the disk (in megabytes) where the program will install BOS.

HDISKNAME specifies the path name of the target disk.

The locale stanza contains variables for the primary language the installed machine will use.

BOSINST_LANG specifies the language the installation program uses for prompts, menus and error messages.

CULTURAL_CONVENTION specifies the primary locale to install.

MESSAGES specifies the locale for the messages catalogs to install.

KEYBOARD specifies the keyboard map to install.

You must install the Base Operating System (BOS) before you can access and modify the default **bosinst.data file**. Once you have installed BOS, retrieve and edit the file like any other ASCII file. There are basically three different ways that you will use a customized /**bosinst.data** file.

- Customize the **bosinst.data** file, then create a backup image of the system to use in subsequent installations from a backup tape.
- Customize a **bosinst.data** file for each client you want to install via the network.
- Customize the **bosinst.data** file, then copy the modified file to a diskette that supplements your installation medium, either tape or CD-ROM. Note that if you use this method then you must also have on your diskette a file called signature. The file signature must contain the word data.

With both the /**image.data** and the /**bosinst.data** files created, the reinstallation of AIX Version 4 and later can be made unattended.

The procedure to accomplish this is as follows:

1. Edit the **bosinst.data** file as follows:
   a. Set **CONSOLE=/dev/lft0 or CONSOLE=/dev/tty0** according to your system.
   b. Set **PROMPT=no**
   c. Set **EXISTING_SYSTEM_OVERWRITE=yes**
   d. Set **RUN_STARTUP=no**
2. Create the **signature** file:

   echo "data" > signature

3. Create the floppy diskette with

ls ./bosinst.data ./signature | backup -iqv

4. Run the command **mksysb /dev/rmt0.1**

The assumption for 3) is that there is already a preformatted diskette in the drive.

The assumption for 4) is that there is a tape in the first tape drive and that it is large enough to hold all the data for the root volume group.

Having completed these steps, the diskette is usable with the backup tape.

The diskette is put in the target system's diskette drive prior to starting the installation of the target machine. When the target machine is booted from the install media, the BOS install program uses the diskette file rather than the default /**bosinst.data** file shipped with the install media.

The purpose of the **signature** file is to verify that this really is a **bosinst.data** diskette.

You can break out of an unassisted install by typing **000** <**Enter**> when you see the startup symbols \ | / on the display.

rootvg - Back Up the System

 # smit sysbackup

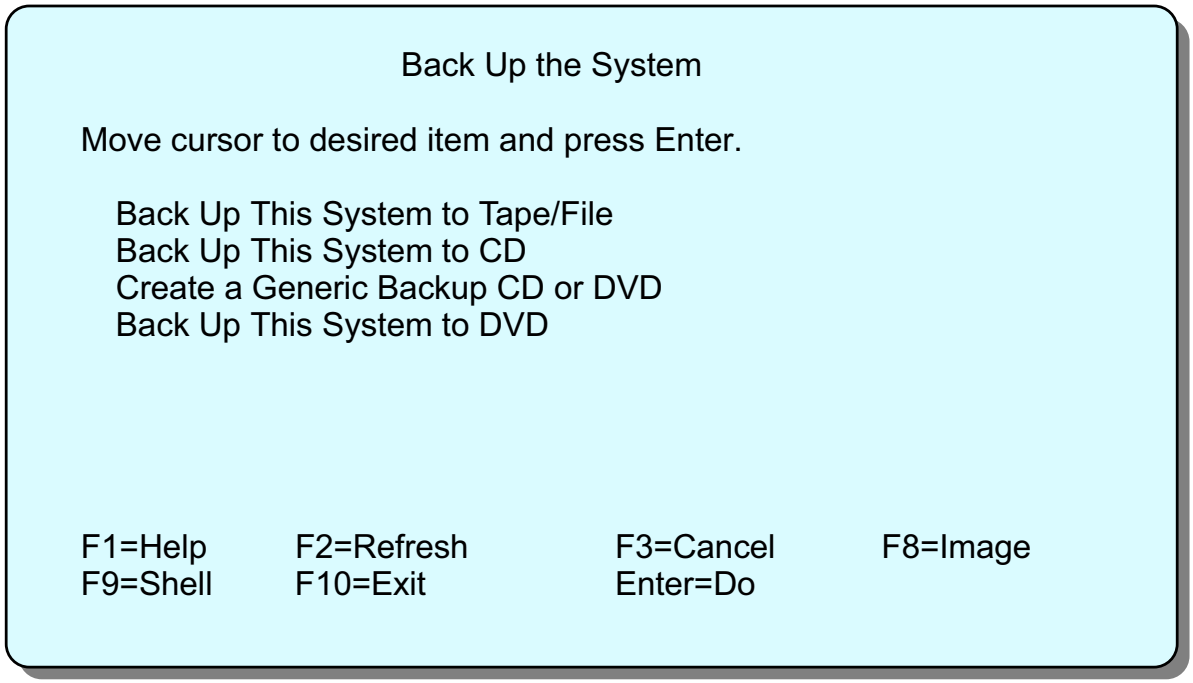


Figure 14-13. rootvg - Back up the System AU1410.0

Notes:

In AIX V5L you can use **smit sysbackup** to preselect if you like to back up the system (rootvg) to Tape/File, CD or DVD.

On the **following** foils you see:

1. Back up the System to Tape/File
2. Back up a Volume Group to Tape/File
3. Restore the System from Tape
4. Restore a Volume Group from Tape
5. Back up the System to CD
6. Back up the System to ISO9660 DVD
7. Back up the System to UDF DVD
8. Back up a Volume Group to CD

9. Back up a Volume Group to ISO9660 DVD
10. Back up a Volume Group to UDF DVD

rootvg - Back Up the System to Tape or File

 # smit mksysb

```
                                Back Up the System

Type or select values in entry fields.
Press Enter AFTER making all desired changes.
                                                      [Entry Fields]
   WARNING:   Execution of the mksysb command will
              result in the loss of all material previously
              stored on the selected output medium. This
              command backs up only rootvg volume group.

* Backup DEVICE or FILE                               [ ]              +/
  Create MAP files?                                   no               +
  EXCLUDE files?                                      no               +
  List files as they are backed up?                   no               +
  Verify readability if tape device?                  no               +
  Generate new /image.data file?                      yes              +
  EXPAND /tmp if needed?                              no               +
  Disable software packing of backup?                 no               +
  Backup extended attributes?                         yes              +
  Number of BLOCKS to write in a single output        [ ]              #
    (Leave blank to use a system default)

F1=Help       F2=Refresh    F3=Cancel     F4=List
F5=Reset      F6=Command    F7=Edit       F8=Image
F9=Shell      F10=Exit      Enter=Do
```


Figure 14-14. rootvg - Back up the System to Tape or File AU1410.0

Notes:

The options on the menu are:

Creation of a MAP File

This option generates a layout mapping of the logical-to-physical partitions for each logical volume in the volume group. This mapping is used to allocate the same logical-to-physical partition mapping when the image is restored.

EXCLUDE Files?

This option excludes the files and directories listed in the **/etc/exclude.rootvg** file from the system image backup.

List files as they are backed up?

Change the default to see each file listed as it is backed up. Otherwise, you see a percentage-completed progress message while the backup is created. This option is supported at AIX V4.2 and later.

Verify readability if tape device?

Verifies the file header of each file on the backup tape and report any read errors as they occur.

Generate new /image.data file?

If you have already generated a new /image.data file and don't want a new file created, change the default to no.

EXPAND /tmp if needed?

Choose yes if the /tmp file system can automatically expand if necessary during the backup.

Disable software packing of backup?

The default is no, which means the files are packed before they are archived to tape. Files that cannot be compressed are placed in the archive as is. Restoring the archive automatically unpacks the files packed by this option. If the tape drive you are using provides packing or compression, set this field to yes. This option is supported at AIX V4.2 and later.

Number of BLOCKS to write in a single output

This specifies the number of 512 bytes to write in a single output operation, referred to as the block size. If a number is not specified, the **backup** command uses a default value appropriate for the physical device selected. Larger values result in larger physical transfers to tape devices. The block size must be a multiple of the physical block size of the device being used.

Backup extended attributes?

This is a new option in AUX 5.3. By default, the mksysb and savevg and backup utilities will save any extended attributes. If you plan to restore the to a back-level system which does not understand the format with extended attributes, then this option allows you to override that default behavior.

Only mounted file systems in **rootvg** are backed up. Use one of the other **backup** commands to backup other volume groups.

mksysb Image

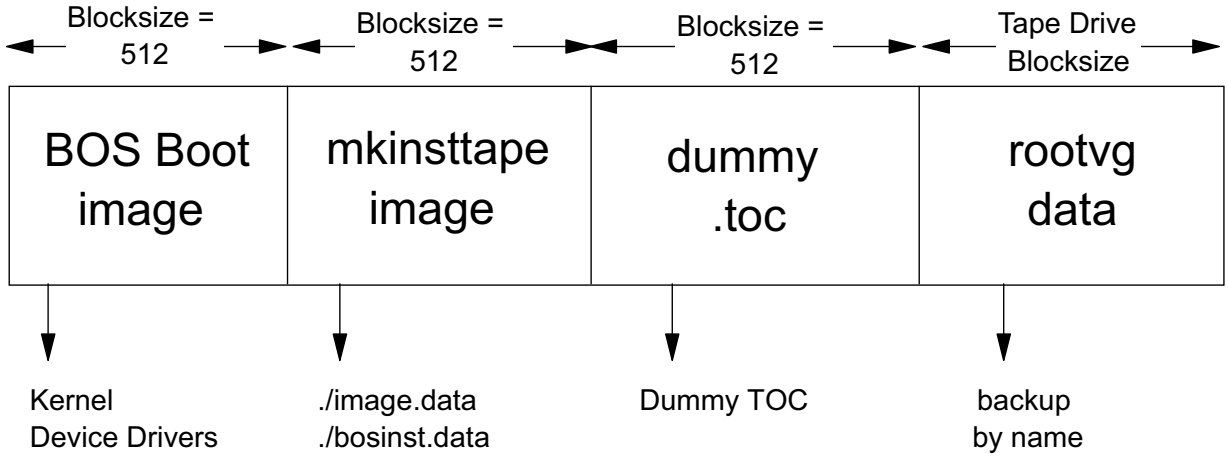


Figure 14-15. mksysb Image AU1410.0

Notes:

This shows the tape layout of a mksysb image.

BOS Boot Image - contains a copy of the system's kernel and device drivers needed to boot from the tape.

mkinsttape Image

./image.data - holds the information needed to recreate the root volume group and its logical volumes and file systems.
./bosinst.data - contains the customizable install procedures and dictates how the BOS install program will behave. This file allows for the non-interactive installs.

Dummy TOC - used to make mksysb tapes have the same number of files as BOS install tapes.

Rootvg Data - contains all the data from the backup. This data is saved using the backup command which is discussed shortly.

Back Up a Volume Group

 # smit vgbackup

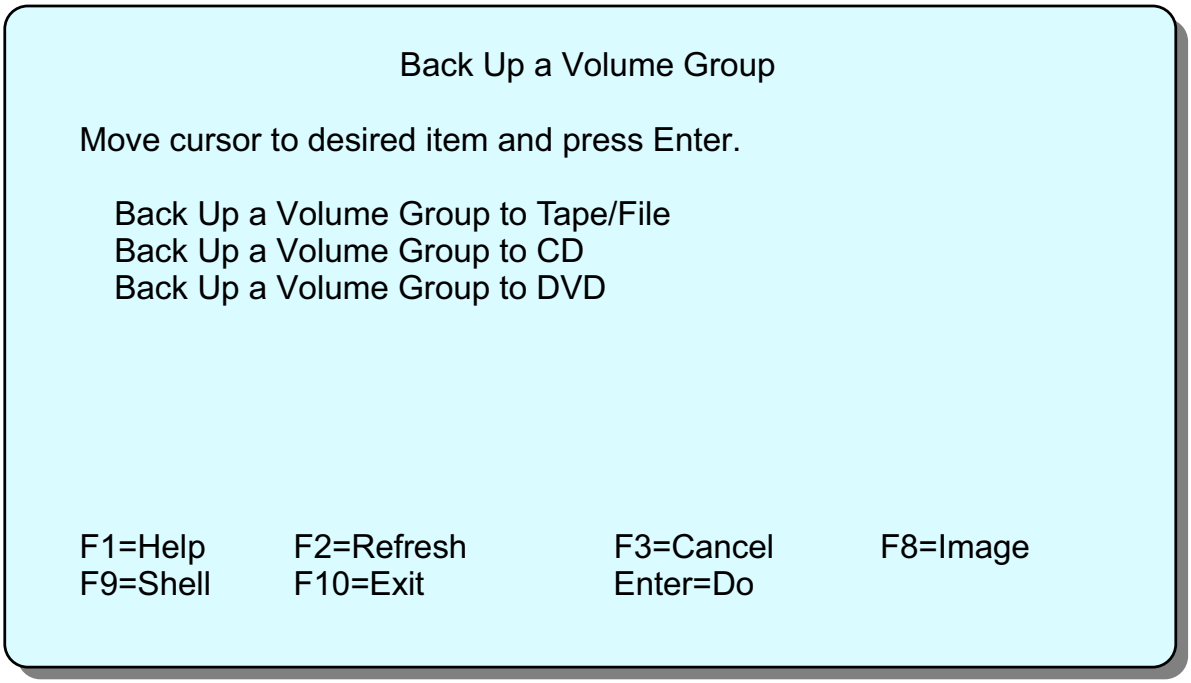


Figure 14-16. Back Up a Volume Group AU1410.0

Notes:

In AIX 5L you can use **smit vgbackup** to preselect if you like to back up a data volume group to Tape/File, CD or DVD.

Back Up a Volume Group to Tape/File

 # smit savevg

```
                        Back Up a Volume Group to Tape/File

Type or select values in entry fields.
Press Enter AFTER making all desired changes.
                                                      [Entry Fields]
    WARNING: Execution of the savevg command will
                  result in the loss of all material previously
                 stored on the selected output medium.

* Backup DEVICE or FILE                                [ ]              +/
* VOLUME GROUP to back up                              [ ]              +
  List files as they are backed up?                    no               +
  Generate new vg.data file?                           yes              +
  Create MAP files?                                    no               +
  EXCLUDE files?                                       no               +
  EXPAND /tmp if needed?                               no               +
  Disable software packing of backup?                  no               +
  Backup extended attributes?                          yes              +
  Number of BLOCKS to write in a single output         [ ]              #
    (Leave blank to use a system default)
  Verify readability if tape device                    no               +

F1=Help          F2=Refresh       F3=Cancel        F4=List
F5=Reset         F6=Command       F7=Edit          F8=Image
F9=Shell         F10=Exit         Enter=Do
```


Figure 14-17. Back Up a Volume Group to Tape/File AU1410.0

Notes:

The savevg SMIT screen looks very similar to the mksysb SMIT screen. This is because they are both performing a volume group backup except mksysb creates bootable images. The command that SMIT is using is savevg. Listed below are some of the differences between the mksysb screen and this screen.

VOLUME GROUP to back up - name the volume you wish to back up.

Generate new **vg.data** file - This file is equivalent to the **image.data** file for rootvg. Unless you have a customized file that you wish to use, let SMIT (**savevg**) create this file for you. The file will be called **/tmp/vgdata/vg_name/vg_name.data**. This file can be created by running **mkvgdata vg_name**.

EXCLUDE files - this allows you exclude file (during the backup) located in mounted file systems within the volume group. Create a file called **/etc/exclude.vg_name** and add the list of filenames that are not wanted.

Restoring a mksysb (1 of 2)

- **Boot the system in install/maintenance mode:**

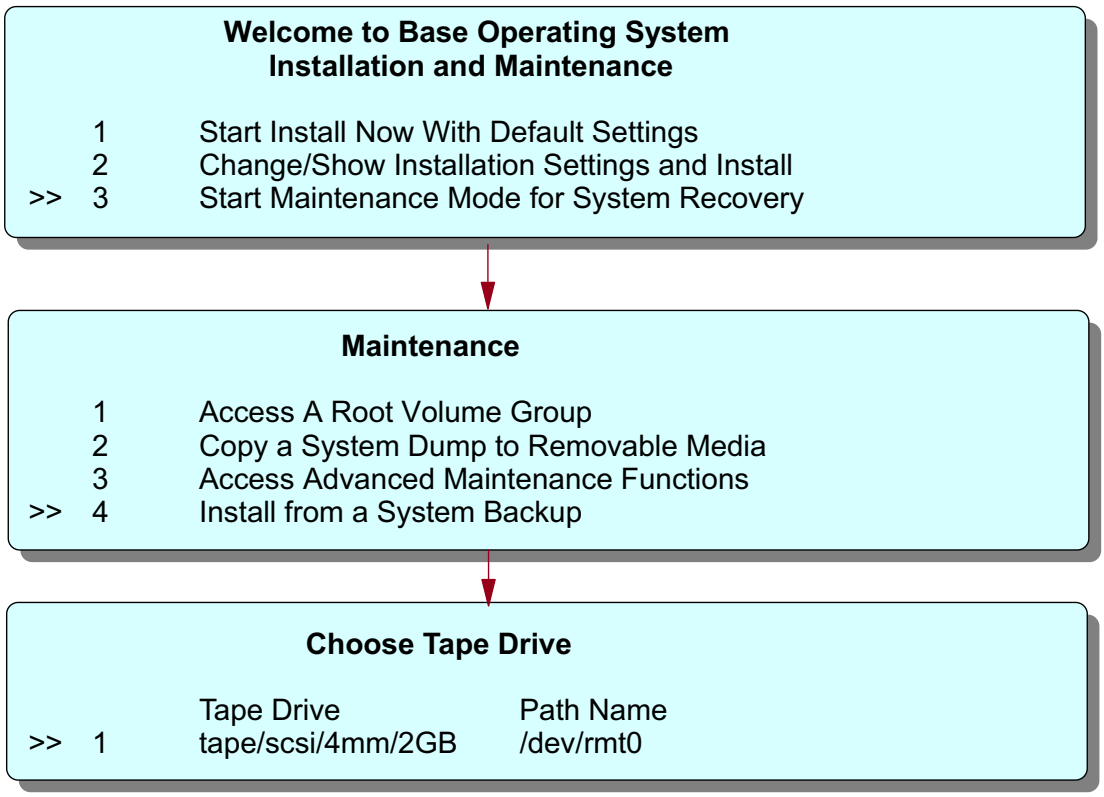


Figure 14-18. Restoring a mksysb (1 of 2) AU1410.0

Notes:

To restore a mksysb image, boot the machine just as if you were performing an installation. Be sure your boot list contains the tape device before the hard drive (run **bootlist -om normal** to display). Then insert the mksysb tape and power the machine on. The machine boots from the tape and prompts you to define the console and select a language for installation. Once you have answered those questions, then the Installation and Maintenance menu is presented.

Also, you can boot from an installation CD. The CD presents the same screens. Just be sure to put the mksysb tape in the tape drive before answering the last question.

Select 3 Start Maintenance Mode for System Recovery, then 4 Install from a System Backup and select the tape drive that contains the mksysb tape.

Restoring a mksysb (2 of 2)

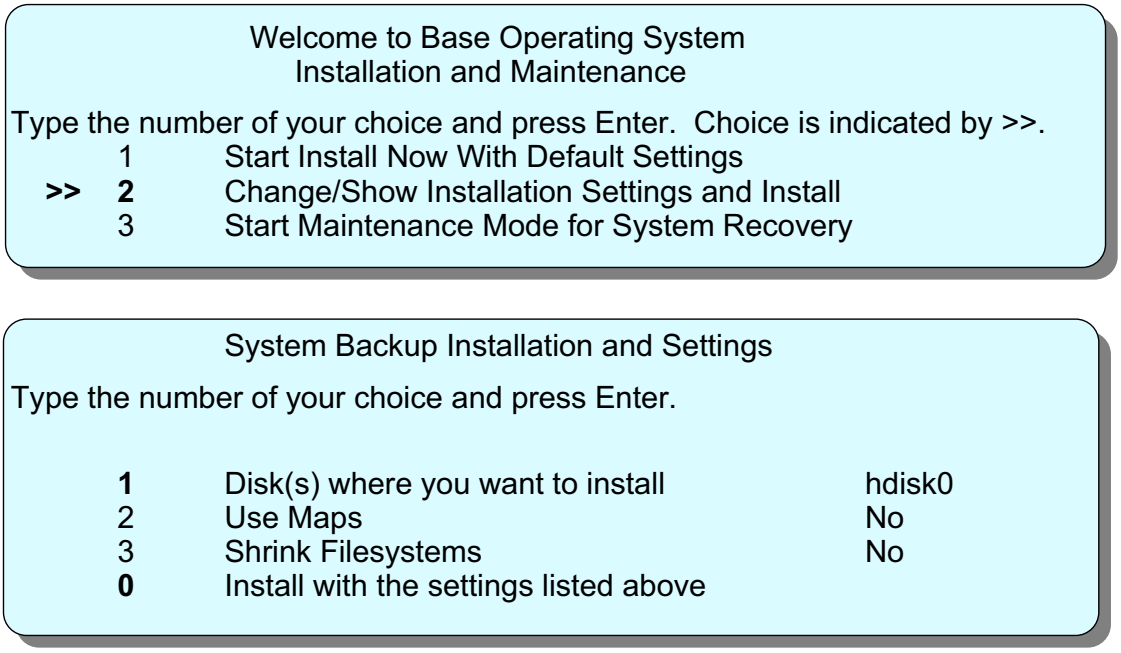


Figure 14-19. Restoring a mksysb (2 of 2) AU1410.0

Notes:

After selecting the tape drive (and a language, which is not shown on the visuals), you return to the Installation and Maintenance menu. Now select option 2.

From the System Backup and Installation and Settings menu, select 1 and provide the disks where you want to install. Be sure to select all disks where you want to install. If your rootvg was mirrored, you need to select both disks.

Two other options can be enabled in this menu:

1. The option **Use Maps** lets you use the map file created (if you did create them) during the backup process of the mksysb tape. The default is no.
2. The option **Shrink Filesystems** installs the file systems using the minimum required space. The default is no. If yes, all file systems in rootvg are shrunk. So remember after the restore, evaluate the current file system sizes. You might need to increase their sizes.

At the end, select option 0 (Install with the settings above). Your mksysb image is restored.

The system then reboots.

Note: The total restore time varies from system to system. A good rule of thumb is twice the amount of time it took to create the mksysb.

Remake/Restore a non-rootvg Volume Group

smit restvg

```
                                Remake  a Volume Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                      [Entry Fields]
* Restore DEVICE or FILE                             [/dev/rmt0]      +/
  SHRINK the filesystems?                            no               +
  Recreate logical volumes and filesystems only      no               +
  PHYSICAL VOLUME names                              [ ]              +
    (Leave blank to use the PHYSICAL VOLUMES listed
     in the vgname.data file in the backup image)
  Use existing MAP files?                            yes              +
  Physical partition SIZE in megabytes               [ ]              +#
    (Leave blank to have the SIZE determined
     based on disk size)
  Number of BLOCKS to read in a single input         [ ]               #
    (Leave blank to use a system default)
  Alternate vg.data file                             [ ]              /
    (Leave blank to use vg.data stored in
     backup image)

F1=Help          F2=Refresh       F3=Cancel        F4=List
F5=Reset         F6=Command       F7=Edit          F8=Image
F9=Shell         F10=Exit         Enter=Do
```


Figure 14-20. Remake/Restore a non-rootvg Volume Group AU1410.0

Notes:

SHRINK the filesystems - When restoring the volume group, like with rootvg, you have the option to shrink the file system contained in the volume group. Always be sure to check the size of the file systems after the restore is complete. You might need to increase them once again.

PHYSICAL VOLUME names - If left blank, the VG goes back to the disks it came from. If you need to change the location, this is the place to do it.

Use existing MAP files - If map files exists, they are used by default during recovery. If you don't want to use them, set this selection to no.

Physical partition SIZE determined based on disk size - AIX properly sizes the PPs for the disk it is using. If you prefer to have a larger PP size than the standard, you can set it here. If for example you have a 4.5 GB drive, the partition size is 8 MB. If you want it to be 16 MB, you can set it here.

This characteristic makes it easy to resize the partitions in a VG. If you want to move the VG to a larger disk, the PP adjusts automatically during the restore.

mksysb - ISO9660 Burn Image

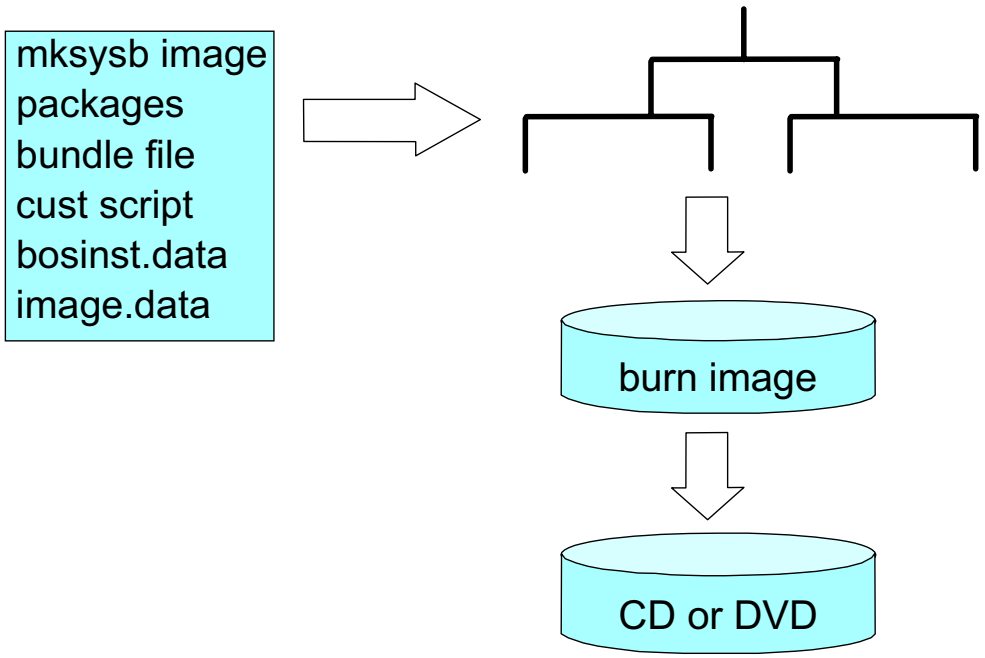


Figure 14-21. mksysb - ISO9660 Burn Image AU1410.0

Notes:

When creating a system backup on CD or DVD, we are actually creating a filesystem on the disk. Within the filesystem we store many things.

Obviously we store the mksysb image file itself (in backup format).

We also need to store the files that would normally be placed in the second record of a mksysb tape: bosinst.data and image.data.

If we want to be able to install additional software during the restore (such as device drivers) we can place them in this filesystem as packages or additionally defined as bundles.

Finally, we may want to run a customization script after the image restore to do additional configuration.

When burning the filesystem onto a CD or DVD, using the ISO9660 standard, we need to first build a burn image on our hard drive. Then we need to actually burn that to the disc.

It should be noted that when using ISO9660, we need to identify (1) where to stored the mksysb image (2) where to build the file structure and (3) where to build the burn image.

mksysb - UDF DVD

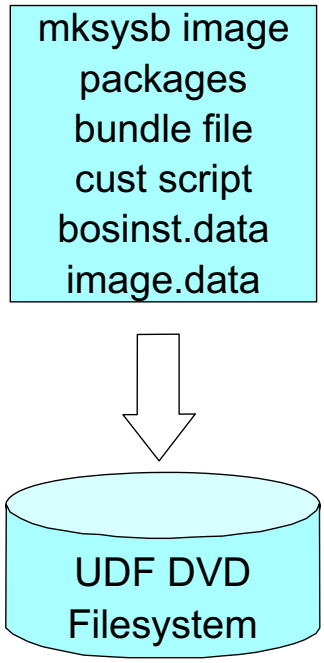


Figure 14-22. mksysb - UDF DVD AU1410.0

Notes:

The Universal Disk Format (UDF) filesystem on a DVD allows us to write to the DVD as a mounted filesystem thus avoiding the need to first build a burn image on our hard drive.

While we are still storing the same kind of information in a file structure, that directory tree is built directly on the DVD.

As a result, we does not to a identify any filesystems on our hard drives.

The only item that needs to be pre-built before write to DVD is the mksysb image file itself.

rootvg - Back Up the System to CD (ISO9660)

smit mkcd

```
                        Back Up This System to CD

Type or select values in entry fields.
Press Enter AFTER making all desired changes.
                                                      [Entry Fields]

  CD-R Device                                        [ ]              +
  mkysyb creation options:
    Create map files?                                no               +
    Exclude files?                                   no               +
  File system to store mksysb image                  [ ]               /
  File system to store CD file structure             [ ]               /
  File system to store final CD images               [ ]               /
  If file systems are being created:
    Volume Group for created file systems            [rootvg]         +
  Advanced Customization Options:
  Do you want the CD to be bootable?                 yes              +
  Remove final images after creating CD?             yes              +
  Create the CD now?                                 yes              +
  Install bundle file                                [ ]               /
  File with list of packages to copy to CD           [ ]               /
  Location of packages to copy to CD                 [ ]              +/
  Customization script                               [ ]               /
  User supplied bosinst.data file                    [ ]               /
  Debug output?                                      no               +
  User supplied image.data file                      [ ]               /

F1=Help          F2=Refresh       F3=Cancel        F4=List
F5=Reset         F6=Command       F7=Edit          F8=Image
F9=Shell         F10=Exit         Enter=Do
```


Figure 14-23. rootvg - Back Up the System to CD AU1410.0

Notes:

Backup volume groups in ISO9660 format on CD or DVD-RAM requires a significant amount of space. As such the mkcd command allow you to specify where you want to create the various structures and images needed to:

1. Create backup image
2. Create CD file system and copy backup to it
3. Create CD image on hard disk
4. Burn to media

Be sure you have sufficient space in the selected filesystems to hold the pre-burn data.

rootvg - Back Up the System to ISO9660 DVD

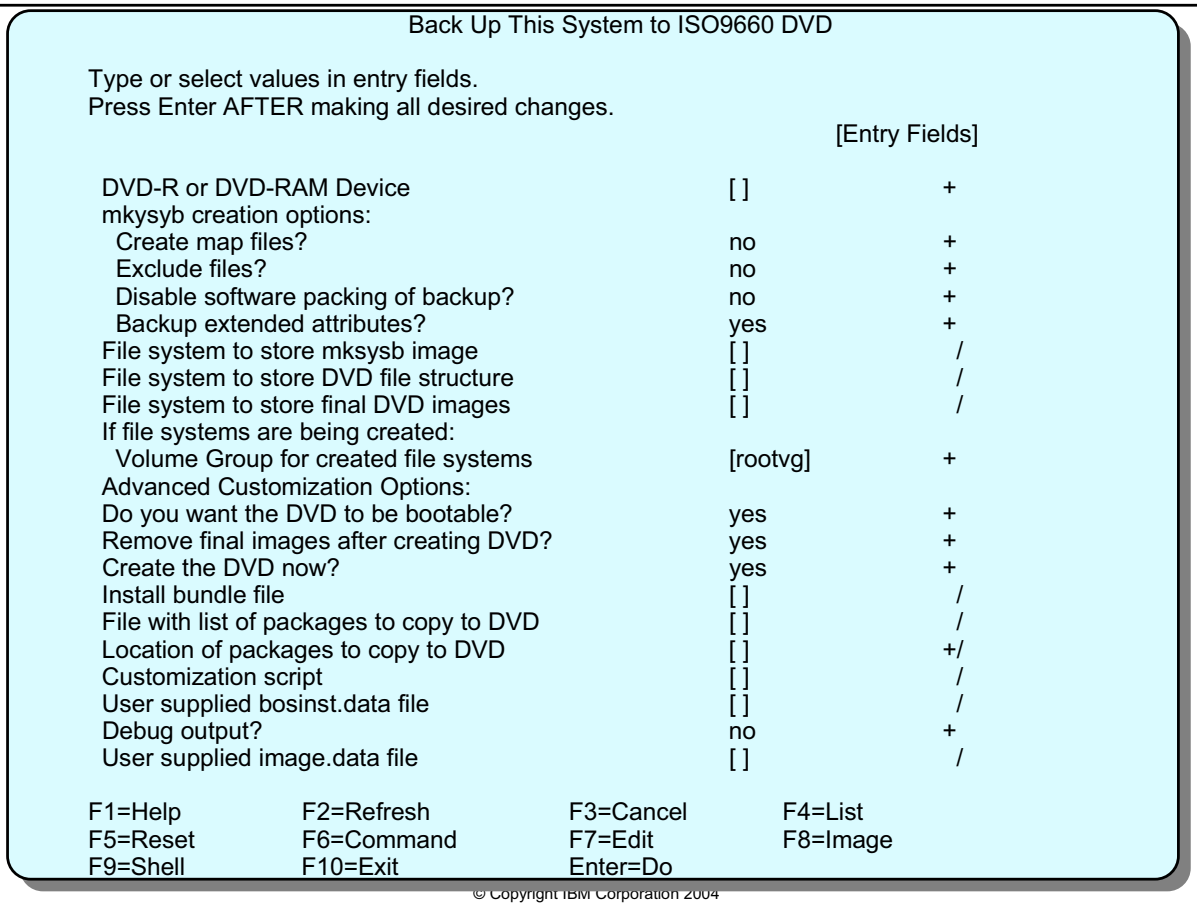


Figure 14-24. rootvg - Back Up the System to ISO9660 DVD AU1410.0

Notes:

The smit fastpath for this panel is: smit mkdvd, when prompted choose the ISO9660 option.

The types of information to write to media and the mechanisms are about the same for CD or DVD when using ISO9660 to first build the image and then burn it to the media.

rootvg - Back Up the System to UDF DVD

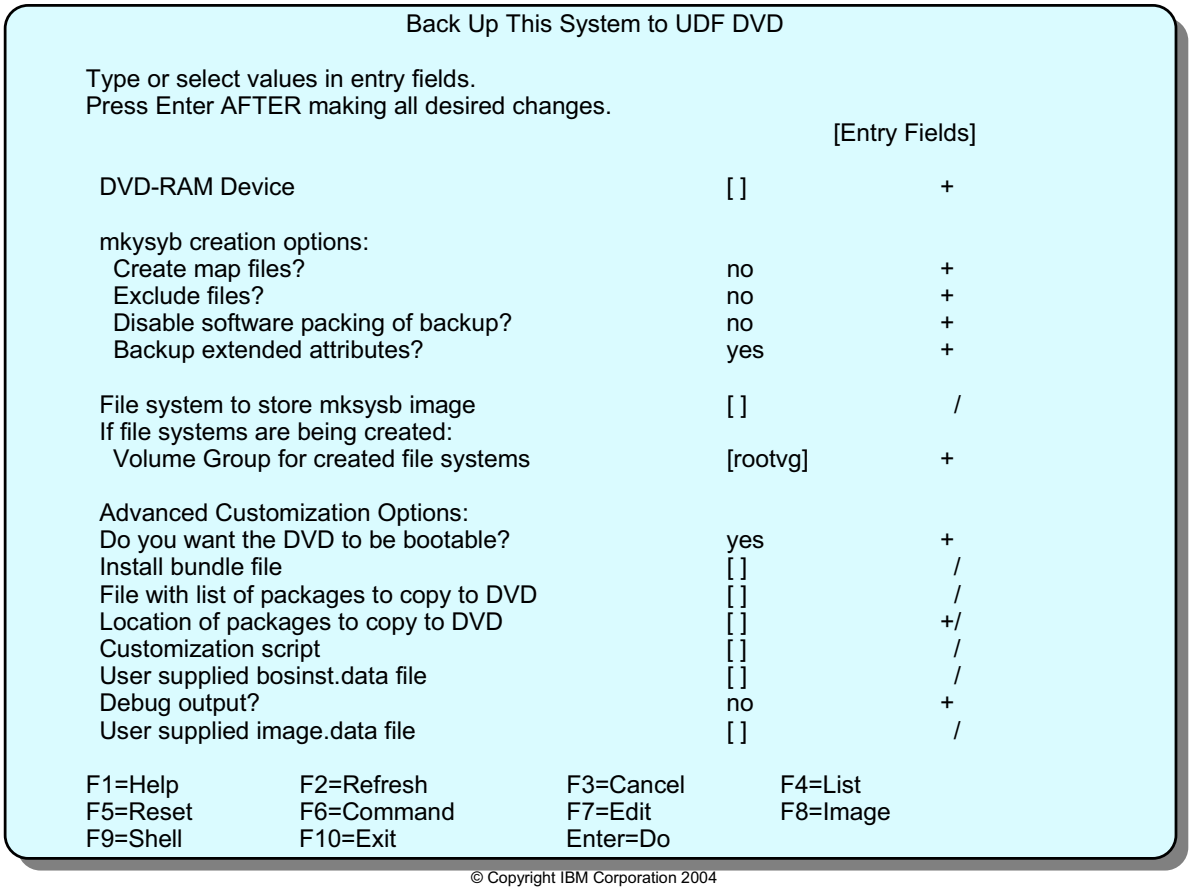


Figure 14-25. rootvg - Back Up the System to UDF DVD AU1410.0

Notes:

The smit fastpath for this panel is: smit mkdvd, when prompted choose the UDF option.

Backup volume groups in UDF (Universal Disk Format) format on DVD-RAM requires only the space for the backup image.

1. Create backup image.
2. Burn to media.

Allow modification of files such as bosinst.data, image.data, and vgname.data

Back Up a Volume Group to CD

smit savevgcd

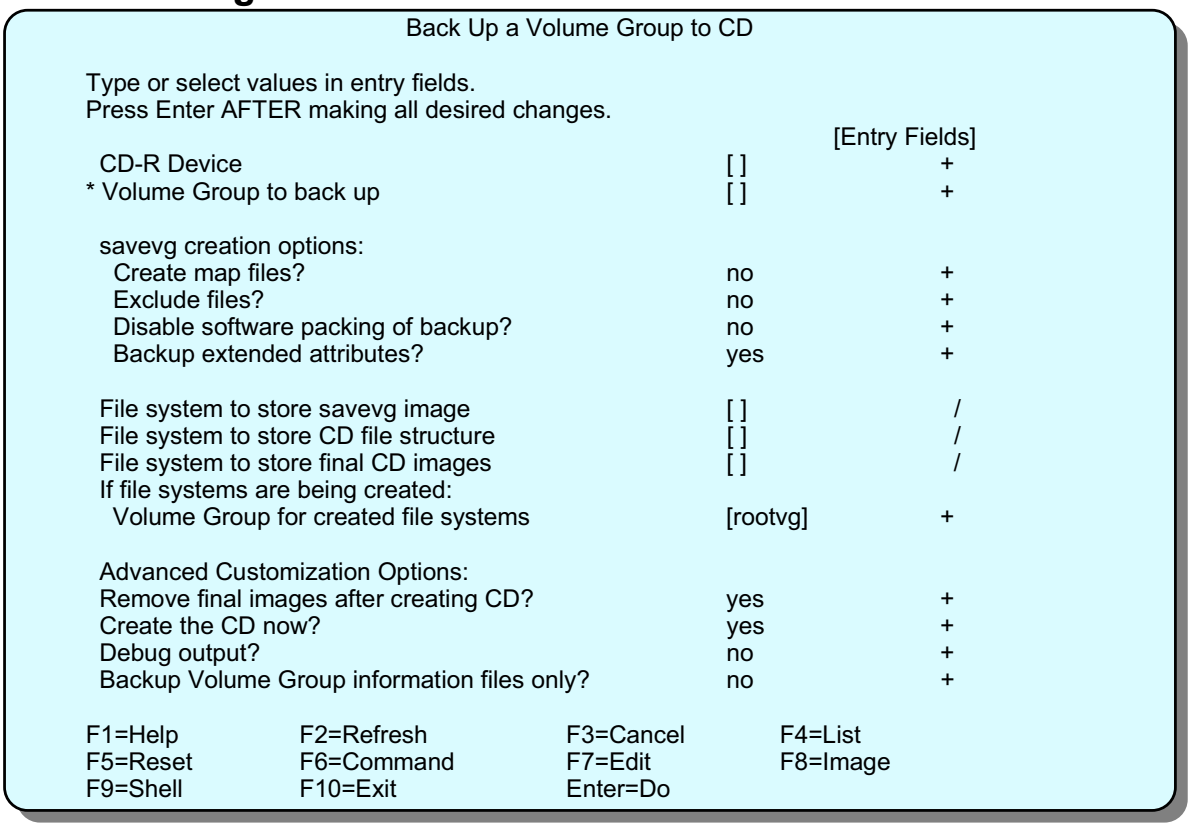


Figure 14-26. Back Up a Volume Group to CD AU1410.0

Notes:

We don’t have the multiple types of information backed up for a non-rootvg Volume Group as we did for the system backups, but the mechanisms are very similar when using ISO9660.

Back Up a Volume Group to ISO9660 DVD

smit savevgdvd

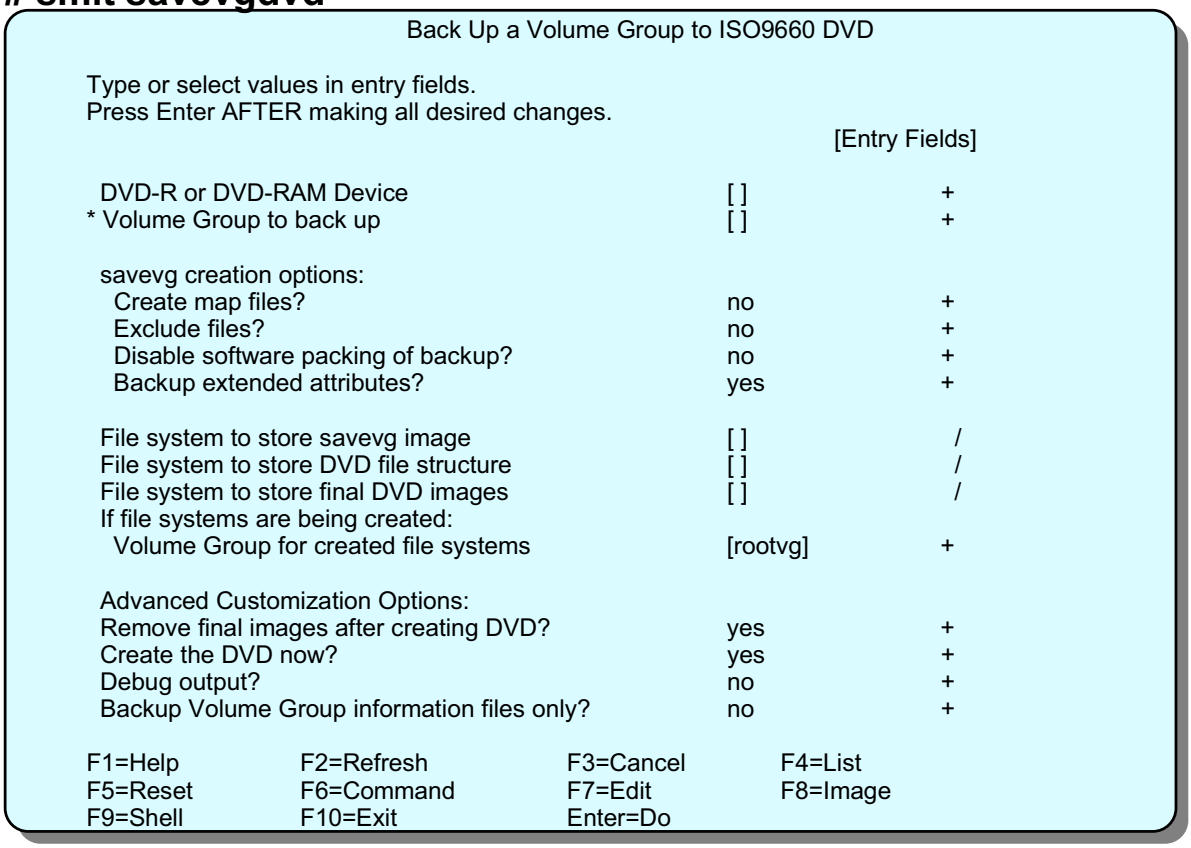


Figure 14-27. Back Up a Volume Group to ISO9660 DVD AU1410.0

Notes:

Back Up a Volume Group to UDF DVD

smit savevgdvd

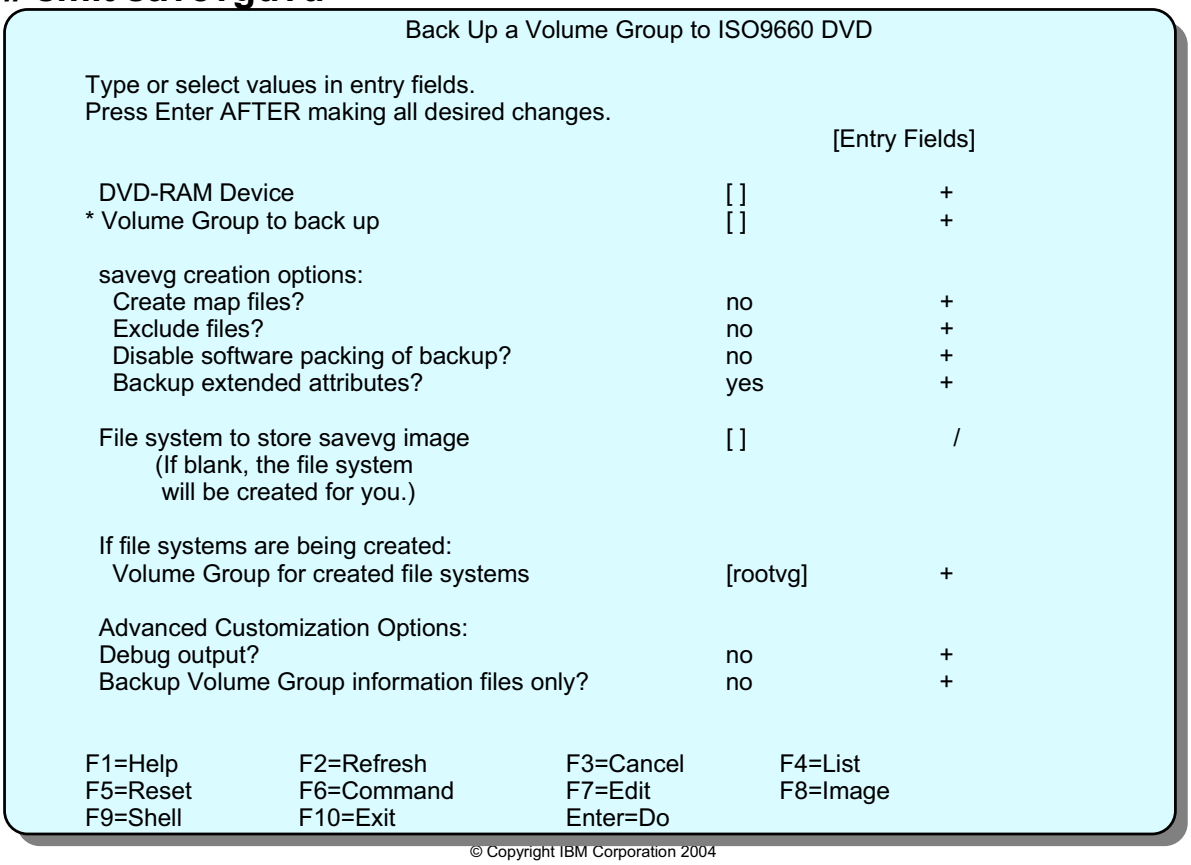


Figure 14-28. Back Up a Volume Group to UDF DVD AU1410.0

Notes:

Activity: savevg

Figure 14-29. Activity: savevg AU1410.0

Backup and Restore - Activity

Instructions

In this activity, you create a backup of **datavg** and save it to the a file in **rootvg**.

1. Create a file system (called /**home**/**savevg**) in **rootvg** that will hold the backup image and mount it. Make sure the file system is in rootvg!
2. Back up the **datavg** volume group to /**home**/**savevg**/**bkup**.
3. Make sure the backup complete successfully before doing this step.
   Remove the datavg volume group. You need to unmount all mounted file systems in datavg first.
4. Recover the volume group from your backup.
5. Verify that the volume group is back.
6. Examine the contents of the file /**tmp**/**vgdata**/**datavg**/**datavg.data**. What is the file used for?

Instructions with Hints

In this activity, you will create a backup of **datavg** and save it to the a file in **rootvg**.

1. Create a file system (called /**home**/**savevg**) in **rootvg** that will hold the backup image and mount it. Make sure the file system is in rootvg!

   # smit fs
   Select **Add/Change/Show/Delete File Systems**
   Select **Journaled File Systems**
   Select **Add a Journaled File System**
   Select **Add a Standard Journaled File System**
   Select **rootvg** for the volume group name.
   Volume group namerootvg
   * SIZE of file system (in 512-byte blocks)[**32768**]#
   * MOUNT POINT[/**home**/**savevg**]
   OK or ENTER

   Use <F3> to move back to the File Systems menu.
   Select **Mount a File System**

   FILE SYSTEM name[/**home**/**savevg**]

   OK or ENTER

   OR

   # crfs -v jfs -g rootvg -a size=32768 -m /home/savevg
   # mount /home/savevg

2. Back up the **datavg** volume group to /**home**/**savevg**/**bkup**.

   # smit savevg

   * Backup Device or FILE[/**home**/**savevg**/**bkup**]
   * VOLUME GROUP to back up[**datavg**]
   OK or ENTER

   OR

   # savevg -f /home/savevg/bkup -i datavg

3. Make sure the backup complete successfully before doing this step.
   Remove the datavg volume group. You need to unmount all mounted file systems in datavg first.

   # smit vg
   Select **Remove a Volume Group**

   *VOLUME GROUP name[datavg]
   OK or ENTER

   OR

   # reducevg -df datavg hdiskn

4. Recover the volume group from your backup.

   # smit restvg

   * Restore DEVICE or FILE[/**home**/**savevg**/**bkup**]
   SHRINK the filesystems?**no**
   PHYSICAL VOLUME names[**hdiskn**]
   OK or ENTER

   OR

   # restvg -q -f /home/savevg/bkup hdisk1

5. Verify that the volume group is back.

   # smit lsvg

   List Content of a Volume Group

   VOLUME GROUP name[datavg]+
   List OPTIONstatus+

   OK or ENTER

   <F10> to exit SMIT

6. Examine the contents of the file **/tmp/vgdata/datavg/datavg.data**. What is the file used for?

   # more /tmp/vgdata/datavg/datavg.data

END

backup by File Name

backup -i [-q] [-p] [-v] [*-f device*]

-q media is ready
-p pack files which are less than 2 GB
-v verbose - display filenames during backup

Filenames are read from standard input

Figure 14-30. backup by File Name AU1410.0

Notes:

The **backup** command is the preferred command for making backups of AIX files and directories. **Backup** supports two different methods - **backup by name** and **backup by inode** (also call a file system backup). When performing a backup by name, the files must be in a mounted file system to be backed up. Backups by inode backup file systems even when they are unmounted.

The syntax is shown for the backup by name.

The **-i** option is used to indicate a backup by name.

The **-q** option is for quiet. It suppresses the comment, press Enter to continue, that displays when the backup command is executed. This is helpful for automated backups.

The **-p** option compresses files during the backup process. It can only compress files smaller than 2 GB. Also, don't use the **-p** option on active file systems. Modifying a file during the compression may corrupt the file and make it unusable on recovery.

The **-v** option displays the files and pathnames to standard out as they are backed up.

backup by File Name Examples

Read input from a file

```
#cat listfile
/home/roy/file1
/home/roy/file2
/home/roy/file3
# backup -iqvf /dev/rmt0  < listfile
```

Use **find** to generate list

```
# find /home/roy | backup -iqvf  /dev/rmt0
# cd  /home/roy
# find . | backup -iqvf /dev/rmt0
```

Relative vs Full Filenames will impact Location of Files on Recovery!

Figure 14-31. backup by File Name Examples AU1410.0

Notes:

The list of files backup uses can be supplied by a file or by commands. The graphics provides a sample of each.

In the first example, the file **listfile** contains the files we want to back up. That is fed into the **backup** command by using a redirection (<).

In the second example, there are two examples that can be used to back up the same data using the **find** command to generate the file list. Both commands back up the files stored in /home/roy.

Even though both **find** examples save the same data, the filenames will be stored differently. There are two types of filenames - relative and full (or absolute). The difference is a full pathname shows the location referenced from the root directory. Basically, the name starts with a slash (/). The relative pathname shows the location referenced by the current directory. This distinction is important when you try to recover the data.

Full pathname backups restore to the same location in the directory structure since their position is referenced from the root directory. But, a relative pathname file is restored based

upon the current directory when the restore command is issued. Full pathnames provide certainty of location and relative pathnames provided flexibility.

Back Up a File or a Directory

smit backfile

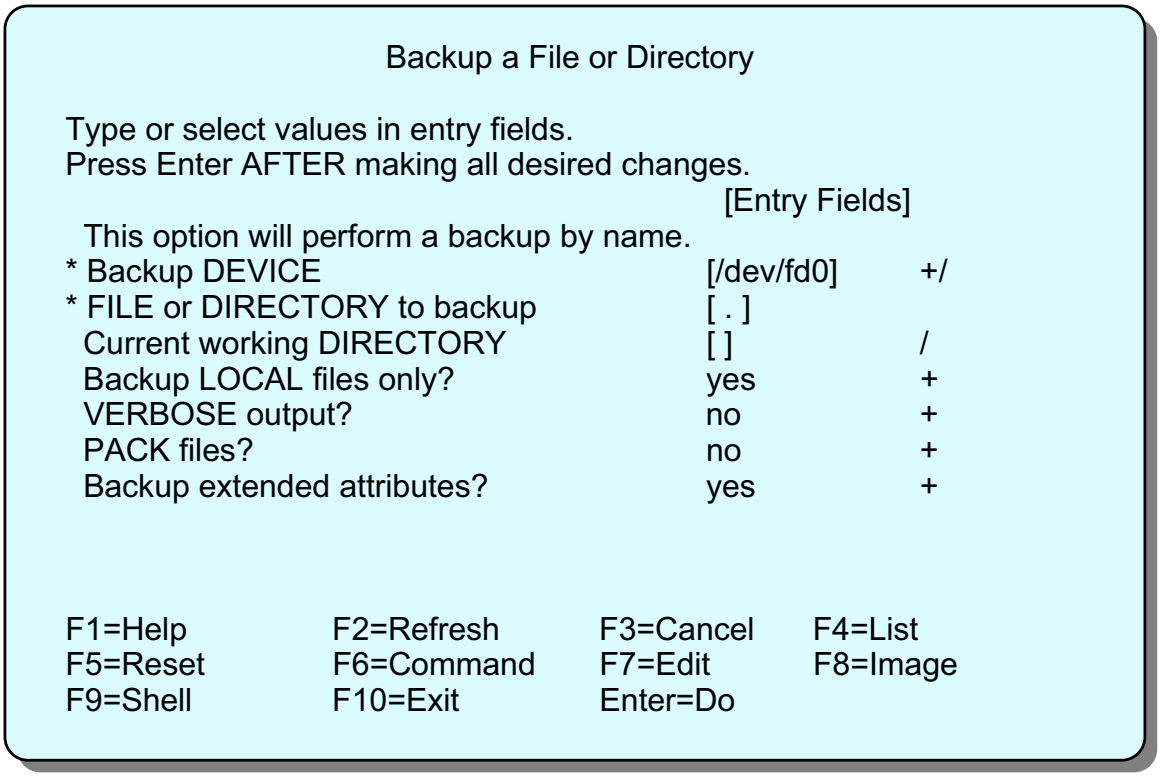


Figure 14-32. Back up a File or a Directory AU1410.0

Notes:

You can perform backups through SMIT.

FILE or DIRECTORY to backup - This is a parameter for the **find** command that will run behind the scenes. The dot (.) indicates to start the **find** command from the current directory. This will provide a relative pathname backup. If a full pathname was used here (like /home/roy) then the names would be stored with full pathnames.

Current working DIRECTORY - performs a cd to that directory before starting the backup. If you want a backup from the current directory (.), and you want to make sure you are in the right directory, you can put the name of the directory here.

Backup LOCAL files only - ignores any network file systems. Files backed up are from the local system only.

Back Up a File System by Inode

Syntax:

backup [-u] [-level] [-f device] filesystem

Levels provide incremental backups:
-0 Full File system back up
-1,-2, ... backup changes since level -1
/etc/dumpdates contains a backup history
-u updates /etc/dumpdates

```
# backup  -u -1 -f /dev/rmt0  /home
```


Figure 14-33. Back up a File by Inode AU1410.0

Notes:

If you do not specify the **-i** option, the **backup** command will perform a file system backup by inode.

The **-level** option allows you to perform incremental backups. The **-0** level backs up all files in the file system. The **-1** level backs up all files changed since the last **-0** backup, and so on. (If you do not specify a level, **-9** is assumed.)

You should **unmount** the file system before you use backup by inode. This is recommended for user-created logical volumes /**dev**/**lvnn** and system logical volumes (other than /) otherwise errors in mapping on restore may occur. This is not required for / (it's difficult to **unmount** it in any case!). If you do not specify a file system, the root / is backed up. The file system parameter can specify either the physical device name or the directory on which the file system is mounted. You must have read access to the file system device in order to perform backups by inode.

The **-u** option causes **backup** to update the /**etc**/**dumpdates** file to record the date and level of the last inode **backup** for that file system. This file holds file system backup

information for the backup command. The information included in this file is the name of the file system, the level number of the last backup, and the date of the incremental backup.

Incremental Backup Example

Sun	Mon	Tue	Wed	Thur	Fri	Sat
					1 **level 0**	2
3	4 **level 6**	5 **level 6**	6 **level 6**	7 **level 6**	8 **level 3**	9
10	11 **level 6**	12 **level 6**	13 **level 6**	14 **level 6**	15 **level 0**	16
17	18 **level 6**	19 **level 6**	20 **level 6**	21 **level 6**	22 **level 3**	23
24	25 **level 6**	26 **level 6**	27 **level 6**	28 **level 6**	29 **level 0**	30
31						

Figure 14-34. Incremental Backup Example AU1410.0

Notes:

You can use the **-level** parameter to back up either all files on the system (a full backup) or only the files that have been modified since a specific full backup (an incremental backup). The possible levels are 0 through 9. If you do not supply a level the default level is 9. A level 0 (zero) backup includes all files in the file system. An n level backup includes all files modified since the last n-1 backup or lower. The levels, in conjunction with the **-u** flag, provide a way to maintain a hierarchy or incremental backups for each file system.

The calendar shows how this can be accomplished.

- A level 0 backup is performed on the first Friday, and thereafter every other Friday.
- A level 6 is performed on each day of the week except on the Fridays that a full backup is not carried out, when a level 3 backup is performed.
- During the first full week, the level 6 backup on Monday backs up all files modified since the level 0 backup on the previous Friday. Each level 6 backup Tuesday through Thursday backs up all files that have been modified since the last n-1 backup or lower (in this case level 0).

- The first level 3 backup of the month backs up all files modified since the level 0 backup. The remaining level 3 backups backs up all those files modified since the last level 0 backup.
- During the second full week, the level 6 backups on Monday through Thursday back up all files that were modified since the last level 3 backup. The level 3 backups on Fridays backs up everything since the last level 0.

Back Up a File System by Inode

smit backfilesys

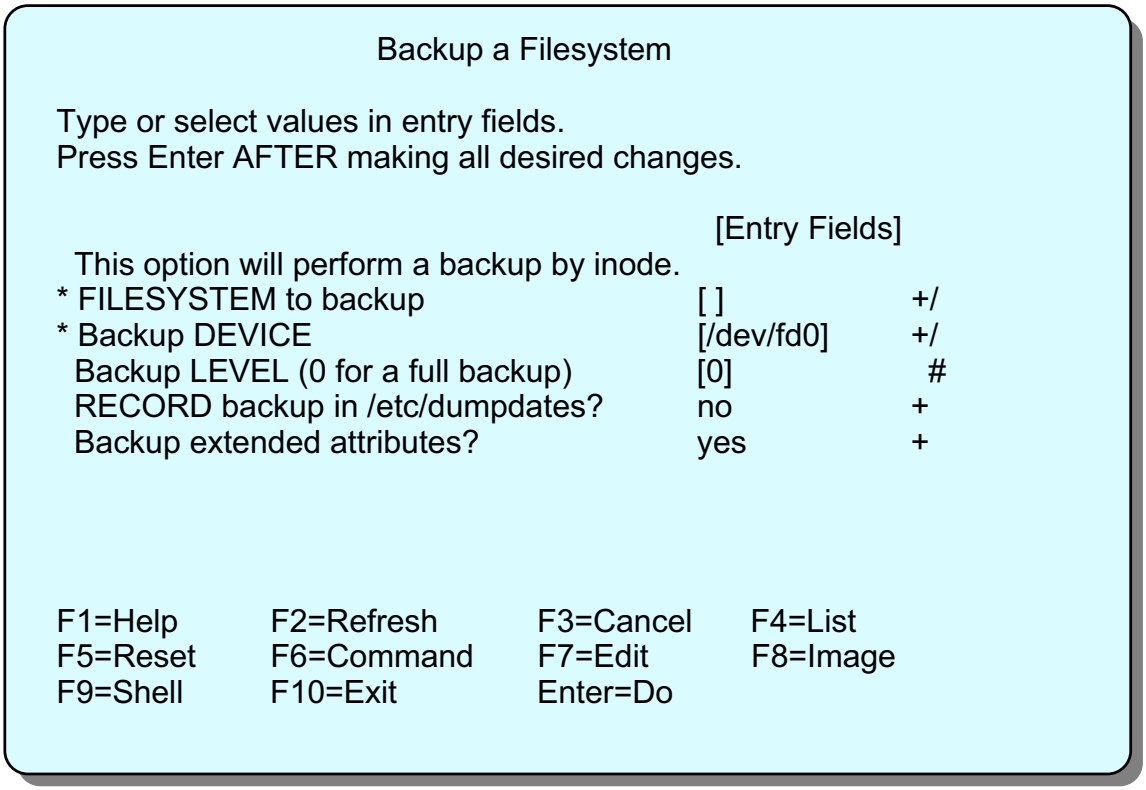


Figure 14-35. Backup a File System by Inode AU1410.0

Notes:

SMIT provides a front-end for file system backups as well.

Each line represents the options from the command line.

restore Command (1 of 2)

- List files on media (Verify the backup)
  restore -T [-q] [-v] [-f *device*]

```
# restore -Tvf /dev/rmt0
```

- Restore individual files.
  restore -x [-q] [-v] [-f *device*] [*file1 file2* ..]

```
# restore -xvf  /dev/rmt0  /home/mike/manual/chap1
```

- Restore complete file system
  restore -r [-q] [-v] [-f *device*]
  Restore backups in order, that is, -0 then -1 and so forth

```
# restore -rqvf /dev/rmt0
```


Figure 14-36. restore Command (1 of 2) AU1410.0

Notes:

The **restore** command is used to restore data backed up with the **backup** command. **restore -T** shows the contents of the media and display the list of files.

restore -x can be used to restore selective files from the backup. The file names and paths on the backup are preserved on the restore. If the backup was created with relative path names, then the files are restored relative to the current directory when the restore is issued. **restore -x** can be used to restore selected files from a backup by name and a filesystem backup.

restore -r works with backups by inode. It ensures that the proper order is used to recover incremental backups. During the restore process, a file called **restoresymtable** is created in the root directory (top level directory) of the file system. This file is checked each time **restore -r** is run to ensure that the recovery sequence is correct. The recovery should progress in ascending order by level number. When you have recovered the entire file system, remove the **restoresymtable** file to be ready for future recoveries. Otherwise, the next time you need to restore a level 0, you are told you are not going in the correct sequence.

Make sure the file system exists and is mounted before recovering a file system backup. The data will be recovered into the existing directory structure using the file names. If the file system is not mounted, the data goes into a different file system. Be careful!

restore -i is another option available when working with an inode backup. This allows for an interactive restore.

restore Command (2 of 2)

- Restores the file attributes without restoring the file contents

  restore -P string [-q] [-v] [-f *device*] [file1 file2 ...]

  string can be:

  - A Restore all attributes
  - a Restore only the permissions of the file
  - o Restore only the ownership of the file
  - t Restore only the timestamp of the file
  - c Restore only the ACL attributes of the file

  To restore only the permissions of the file /etc/passwd from the archive:

```
# restore -Pa -vf /dev/rmt0 ./etc/passwd
```

  To display only the permissions of the file /etc/passwd on the archive:

```
# restore -Ta -vf /dev/rmt0 ./etc/passwd
```


Figure 14-37. restore Command (2 of 2) AU1410.0

Notes:

These options are only available on AIX V5.2.

Restore a File or a Directory

smit restfile

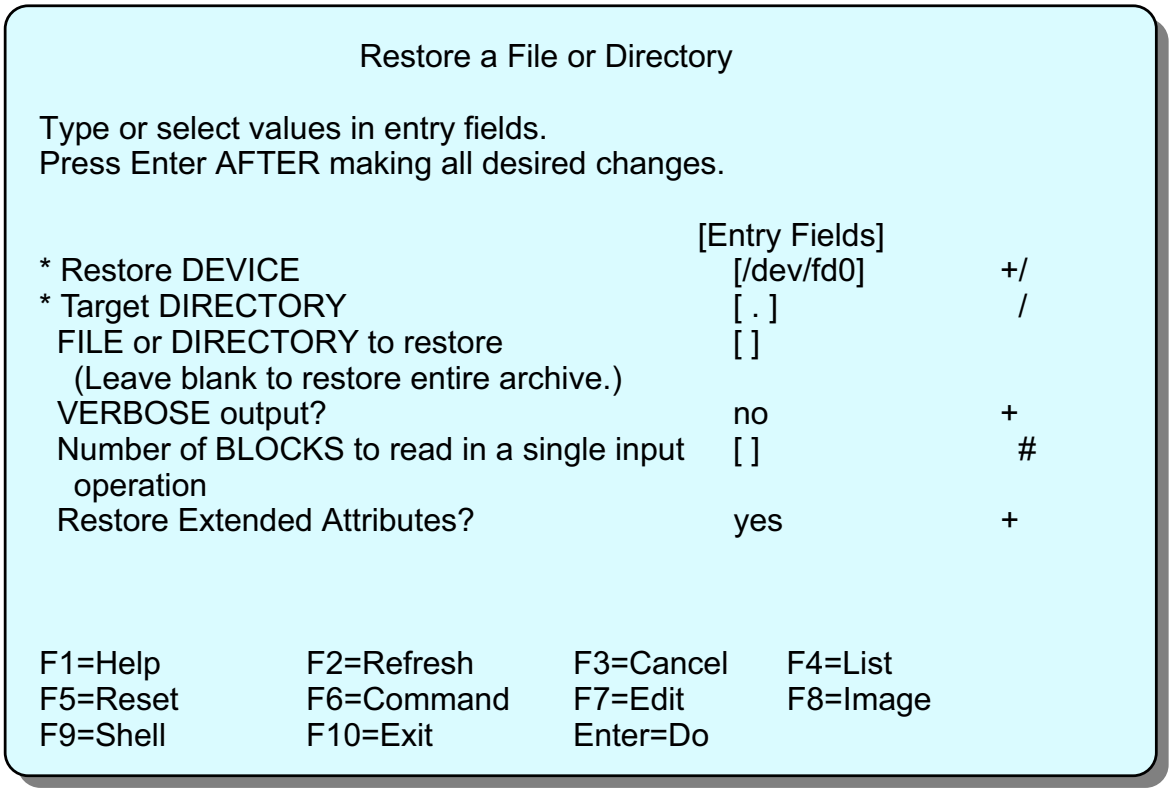


Figure 14-38. Restore a File or a Directory AU1410.0

Notes:

There is another SMIT screen (fastpath **smit restfilesys**), which, as the name suggests, can be used to restore an entire file system rather than a file or a directory. The screen contents are identical to this screen (**smit restfile**) apart from the one option FILE or DIRECTORY to restore, which does not appear on the restore a file system screen. All other options are present.

Exercise: Using Backup and Restore

Figure 14-39. Exercise: Using Backup and Restore AU1410.0

Notes:

This lab allows you to perform backups and recoveries using the AIX tools - backup and restore. It gives you an opportunity to perform a backup by name and a backup by inode.

This exercise can be found in your Exercise Guide.

Other UNIX Backup Commands

- tar (tape archive)
  - Widely available
  - Good for transfer of data between platforms
  - Had no support for extended inode (ACLs) until AIX 5.3

- cpio (copy input to output)
  - Widely available
  - Difficulties can occur with many symbolic links
  - Has no support for extended inode (ACLs)

- dd (device to device)
  - Makes backup copies that are an exact image
  - Can also be used for conversions
    For example: can convert ASCII to EBCDIC

Figure 14-40. Other UNIX Backup Commands AU1410.0

Notes:

The AIX **backup** tool is preferred for an AIX backup intended to be used exclusively on AIX machines. AIX supports access control lists (ACL) and Trusted Computing Base (TCB) which provide additional security-related features for AIX files and directories. Only the **backup** command supports these additional security features. If you are using ACLs or TCB, you need to use **backup** or these elements of security are lost during the backup.

AIX does support other generic UNIX backup tools. For backups that are recovered on another UNIX operating system, these tools would need to be used since only AIX supports **backup** and **restore**.

tar is widely used throughout UNIX and is supported on AIX as well. **cpio** is also widely used and is also in AIX. Neither support ACLs or TCB. Also, **cpio** has difficulties following symbolic links. It may not have enough memory to follow the link and the link is lost in the backup.

dd is used to copy and convert data byte-by-byte.

tar Command

Generate a tar backup

```
# tar -cvf /dev/rmt0.3  /home
```

Restore a file from a tar image

```
# tar -xvf  /dev/rmt0    /home/team01/mydir
```

List (verify) content of a tar file

```
# tar -tvf  /dev/rmt0
```


Figure 14-41. tar Command AU1410.0

Notes:

The **tar** command only works with mounted file systems.

Here is a list of the commonly use options:

- **-c** create a **tar** backup
- **-x** extract (restore) a file(s) from a **tar** file
- **-t** reads the content of the **tar** file (verify the backup)
- **-v** verbose output - displays files as they are backed up and restored
- **-f** identify the file or device holding the **tar** image

To perform a **tar** backup, use the **-c** option. The **-f** option can specify a device (like rmt0) or a file in a directory. The **tar** command does recursive backups. In the example, /home is the starting point for the **tar** command. It backs up all of /home and its subdirectories, and so on.

When recovering, use the **-x** to extract a file. If you want just one file, name it on the command line. If you want a directory and all of its subdirectories, name it. The example

shows the recovery of the /home/team01/mydir directory. If no file is named, then the entire **tar** image is restored.

To verify the **tar** image, use **-t**. In the example, the content of rmt0 is displayed. With **-t**, no files are actually recovered.

The **tar** command has been modified to exit now with error when trying to extract a file that is not part of the **tar** archive.

tar -xvf /dev/rmt0 aaa bbb ccc

File aaa not present in the archive.
File bbb not present in the archive.
File ccc not present in the archive.

echo $?

3

AIX V5.3 has provided some very nice enhancements to the tar utility.
Here is a list of the new options:

- **-D** suppress recursive processing (only current directory)
- **-R** use recursive processing (default)
- **-L <filename>** input list of filenames to process
- **-x** exclude list of files or directories to not be copied
- **-U** use extended ACLs

cpio Command

Generate a cpio backup

```
# find   /home | cpio -ov> /dev/rmt0
```

Restore from a cpio image

```
# cpio -idv </dev/rmt0
```

List (verify) contents of a cpio image

```
# cpio -itv < /dev/rmt0
```


Figure 14-42. cpio Command AU1410.0

Notes:

The **cpio** tool is another generic UNIX tool. **cpio** stands for copy input/output.

Some of the common options that are used with cpio:

-o create a **cpio** image (output)
-i read from a **cpio** image (input)
-t read (verify) the content of a **cpio** image
-v verbose output - list files during backup and restore operations
-d create necessary directories when recovering an image
-m retain the original modification times associated with files contained in a **cpio** image. Without the **-m** option, all files will have modification times associated with the time they were restored

cpio must be fed a list of files much like the **backup** command. The **find** command is frequently used to do this. Instead of using the **-f** option like **tar** and **backup**, **cpio** uses the redirection symbol (**>**).

Take a look at the examples:

To create the **cpio** image the find command recursively lists all files in the /home directory. **cpio** then creates its output, **-o**, on /dev/rmt0.

To restore from a **cpio** image, the **-i** is used to read in from the image. The **-d** creates directories and **-m** retains the time stamps. If a file is named, then only the file is restored. If no file is named, the entire image is restored.

To verify or read the content of the **cpio** image, use the **-t** option.

dd Command

Converts and copies files

- To copy a file to diskette

```
# dd  if=/etc/inittab  of=/dev/rfd0
```

- To convert a file from ASCII to EBCDIC

```
# dd if=text.ascii  of=text.ebcdic  conv=ebcdic
```

- To convert data to uppercase characters

```
# cat lcase.data | ddconv=ucase
```


Figure 14-43. dd Command AU1410.0

Notes:

The **dd** command reads in standard input or the specified input file, converts it, and then writes to standard out or the named output.

The common options are:

if= specifies the input file
of= specifies the output file
conv= designate the conversion to be done

In the first example, the file /**etc/inittab** is copied to the floppy diskette.

In the second example, the file **text.ascii** is converted into EBCDIC and is written to a file called **ebcdic.text**.

In the last example, no output or input file is specified so standard out and standard in is used. The file containing lower case characters, **lcase**, is converted into uppercase characters and displayed to standard out.

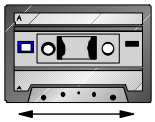
dd is also useful when you need to copy specific blocks of data. For example, if a file systems superblock (stored in the first block of the file system) is corrupt, a copy is kept at

the 31st block. The dd command can copy that 31st block back to the 1st to repair the file system. The command is:

dd count=1 bs=4k skip=31 seek=1 if=/dev/hd4 of=/dev/hd4

dd can span volumes with the **span=yes** parameter on the command line.

Controlling the Tape



tctl
- rewind - rewinds a tape
- fsf - fast forwards a tape
- offline - ejects a tape
- rewoffl - rewinds and ejects a tape

```
# tctl  -f /dev/rmt0  rewind
# tctl  -f /dev/rmt0.1  fsf 3
# tctl  -f /dev/rmt0  rewoffl
```

restore -s

```
# restore  -s 4 -xvf  /dev/rmt0.1  ./etc/inittab
```


Figure 14-44. Controlling the Tape AU1410.0

Notes:

The tape control, **tctl**, command is used to position the tape and eject the tape. All of the backup commands addressed so far assume the tape was positioned correctly. None of those commands reads the entire tape, rather they only look at the tape file where the tape is positions. To ensure you position it correctly, be sure to document the content and order of the data on the tape.

The **tctl** command has many options. These are ones more commonly used. The **rewind** option is generally the first place to start. This ensures you start from the beginning. The **fsf** moves the tape forward. It counts end-of-file markers. In the example, **fsf 3** positions the tape to the beginning of the fourth file.

The **offline** and **rewoffl** options will eject the tape.

The **restore** command has the capability to position a tape as well. The **-s** option is used to seek the file specified. In the example above, the fourth file on the tape is read and the **./etc/inittab** file is restored.

Both the **fsf** example and the **restore -s** example are both positioning the tape to the same location. If they were being used on a mksysb tape, this is how you can restore an individual file from the tape.

There is also a **tcopy** command that can be used to copy a tape to another tape. To do this, you must have two tape devices. The syntax is **tcopy** source target. The **tcopy** command can be given just a source. When this is done, the entire tape is read and a report showing the number of files and blocks sizes is displayed.

Good Practices

- Verify your backups
- Check the tape device
- Keep old backups
- Offsite secure storage
- Label tape
- Test recovery procedures before you have to!

Figure 14-45. Good Practices AU1410.0

Notes:

This shows a list of good practices for your backup strategy.

Always verify your tapes. Use **restore -T** (or **tar -t**...) to view the contents. Even with mksysb tapes, you can position the tape to the correct file and verify it without having to restore the entire contents.

Check you tape device. The **tapechk** command can be used to detect malfunctioning hardware. The command used **# tapechk 2**. The number specifies how many file on the tape should be read.

Keep old backups in case something goes wrong with the new ones.

Store a set of backups off site in case something happens to your site.

Label your tapes. There is no way to know what is on the tape by looking at it. The label should at least list the tape files, the commands used to create the tape, the date created and the block size.

Test your recovery procedure before you have to. Know that you can recover before you have to recover.

Optional Exercise: Using tar and cpio

Figure 14-46. Optional Exercise: Using tar and cpio AU1410.0

Notes:

This is an optional exercise. The instructor determines if there is time and interest to complete this exercise. It gives an opportunity to try out the generic UNIX tools - tar and cpio.

This exercise can be found in your Exercise Guide.

Checkpoint

1. What is the difference between A and B?
   a. find /home/fred | backup -ivf /dev/rmt0
   b. cd /home/fred; find . | backup -ivf /dev/rmt0

   _____
   _____
   _____

2. On a **mksysb** tape if you entered **tctl rewind** and then **tctl -f/dev/rmt0.1 fsf 3** which element on the tape could you look at?

   _____
   _____

3. Which command could you use to restore these files?

   _____
   _____

4. True or false? SMIT **mksysb** backs up all file systems, provided they are mounted.

Figure 14-47. Checkpoint AU1410.0

Notes:

Unit Summary

- In order to perform successful backups, consideration must be given to the frequency of the backup, the media to be used and the type of backup.
- Backups can be initiated on a single file, a file system or an entire volume group, all of which are supported through SMIT.
- By modifying the **bosinst.data** and the **image.data** files, a customized system image backup can be created.
- There are many other UNIX backup commands which can be used, however their limitations must be fully understood. The commands include: **tar**, **cpio** and **dd.**
- Other useful commands also exist to manipulate the data on the backup media such as **tctl.**

Figure 14-48. Unit Summary AU1410.0

Notes:

Unit 15. Security and User Administration

What This Unit Is About

This unit introduces the concepts of AIX users and groups, and also the files that contain user account information.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Define the concepts of users and groups, and define how and when these should be allocated on the system
- Define ways of controlling root access on the system
- Define the uses of SUID, SGID, and SVTX permission bits
- Identify the data files associated with users
- Administer user and group accounts

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise

References

Online *System Management Guide: Operating System and Devices*

http://www.redbooks.ibm.com *(refer to security related information)*

Unit Objectives

After completing this unit, you should be able to:

- Define the concepts of users and groups, and define how and when these should be allocated on the system
- Define ways of controlling root access on the system
- Define the uses of SUID, SGID and SVTX permission bits
- Add/Change/Delete user and group accounts
- Identify the data files associated with users and security

Figure 15-1. Unit Objectives AU1410.0

Notes:

15.1 Security Concepts

Security Concepts

User Accounts

- Each user has a unique name, numeric ID and password
- File ownership is determined by a numeric user ID
- The owner is usually the user who created the file, but ownership can be transferred by root
- Default users:
  - root — super user
  - adm, sys, bin ... — IDs that own system files but cannot be used for login

Figure 15-2. Security Concepts AU1410.0

Notes:

The security of the system is based on a user being assigned a unique name, user ID (UID) and password. When the user logs in, the UID is used to validate all requests for file access.

When a file is created, the UID associated with the process that created the file is assigned to the file. Only the owner or **root** can change the access permissions.

There are several user accounts automatically created. **root**, for example, is one. Some user accounts are not made for login but only to own certain files. **adm**, **sys**, and **bin** are examples of that type of account.

Groups

- A group is a set of users, all of whom need access to a given set of files
- Every user is a member of at least one group and can be a member of several groups
- The user has access to files in their groupset. To list the groupset use **groups**
- The user's primary group is used for file ownership on creation. To change the primary group use the **newgrp**
- Default groups:
  - System administrators
  - Staff ordinary users

Figure 15-3. Groups AU1410.0

Notes:

Users that require shared access to a set of files are placed in groups. A user can belong to multiple groups. Each group has a unique name and Group ID (GID). The GID is also assigned to a file when it is created.

There are several groups predefined on an AIX system. For example, the **system** group is root's group and the **staff** group is for all ordinary users.

The creation of groups to organize and differentiate the users of a system or network is part of systems administration. The guidelines for forming groups should be part of the security policy. Defining groups for large systems can be quite complex and once a system is operational, it is very difficult to change the group structure. Investing time and effort in devising group definitions before your system arrives is recommended.

Groups should be defined as broadly as possible and be consistent with your security policy. Do not define too many groups because defining groups for every possible combination of data type and user type can lead to impossible extremes.

A group administrator is a user who is allowed to assign the members and administrators of a group. It does not imply that the user has any administrative abilities for the system.

There are three types of groups on the system:

User Groups
User groups should be made for people who need to share files on the system, such as people who work in the same department, or people who are working on the same project.

System Administrator Groups
System administrators are automatically members of the **system** group. Membership of this group allows the administrators to perform some of the system tasks without having to be the **root** user.

System Defined Groups
Several system-defined groups exist. **staff** is the default group for all non-administrative users created in the system. **security** is another system-defined group having limited privileges for performing security administration. The system-defined groups are used to control certain subsystems.

Groups

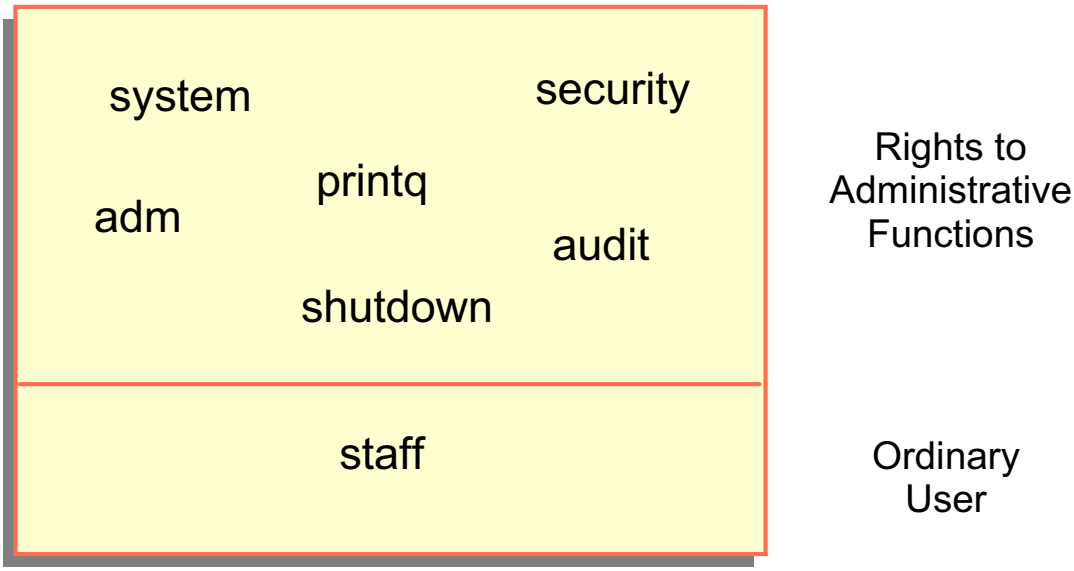


Figure 15-4. Groups AU1410.0

Notes:

Common groups on the system are:

system	For most configuration and standard hardware and software maintenance.
printq	For managing queuing. Typical commands which can be run by members of this group are: **enable**, **disable**, **qadm**, **qpri**, and so forth.
security	To handle most passwords and limits control. Typical commands which can be run by members of this group are: **mkuser**, **rmuser**, **pwdadm**, **chuser**, **chgroup**, and so forth.
adm	Most monitoring functions such as performance, **cron**, accounting
staff	Default group assigned to all new users. You may want to change this in **/usr/lib/security/mkuser.defaults.**
audit	For auditors.
shutdown	Allows use of the **shutdown** command.

User Hierarchy

- To protect important users/groups from members of the **security** group AIX has **admin users** and **admin groups**
- Only **root** can add, remove, or change an **admin user** or **admin group**
- Any user on the system can be defined as an **admin user** regardless of the group they are in

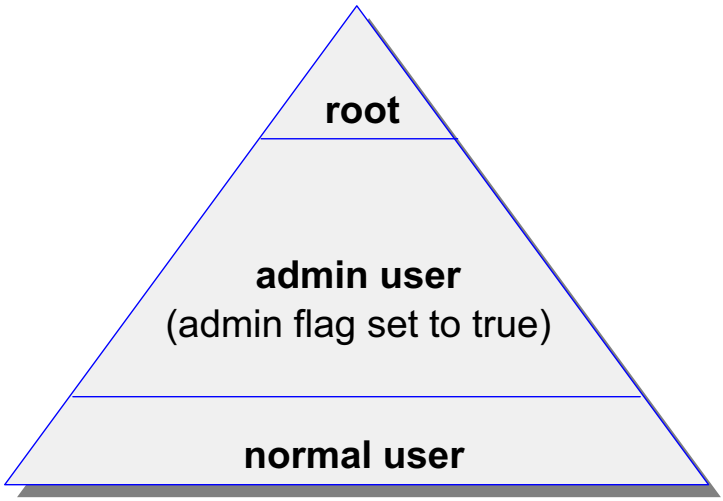


Figure 15-5. User Hierarchy AU1410.0

Notes:

The ability to perform certain system tasks (like creating users) depends upon the standard AIX file permissions. Most system admin tasks can be performed by users other than **root** by assigning those users to groups such as **system, security, printq, cron, adm, audit** or **shutdown**. In particular, a user in the **security** group can add/remove/change other users and groups.

To protect important users/groups from users in the **security** group, AIX has three levels of user hierarchy: root, admin users/groups and normal users/groups. Only **root** can add, remove, or change an admin user or admin group. Therefore, you can define a user with a high level of access, but who is protected from users in the **security** group.

Control root's Access

- Restrict access to privileged logins
- root's passwords should be changed on an unannounced schedule by the system administrator
- Assign different root passwords to different machines
- System administrators should always login as themselves first and then su to root instead of logging in as root. This helps provide an audit trail for root usage
- Do not include unsecured directories in root's PATH

Figure 15-6. Control root's Access AU1410.0

Notes:

If the **root** password is known by too many people, no one can be held accountable. The **root** password should be limited to just two or three administrators. The fewer people who know **root's** password the better.

The system administrator should ensure that distinct **root** passwords are assigned to different machines. You may allow normal users to have the same passwords on different machines, but never do this for **root**.

Attempts to become **root** through **su** can be investigated. Successful and unsuccessful attempts might be logged by the audit system.

root's PATH is used by many implicit system functions, not just by a user logged in as **root**.

Security Logs

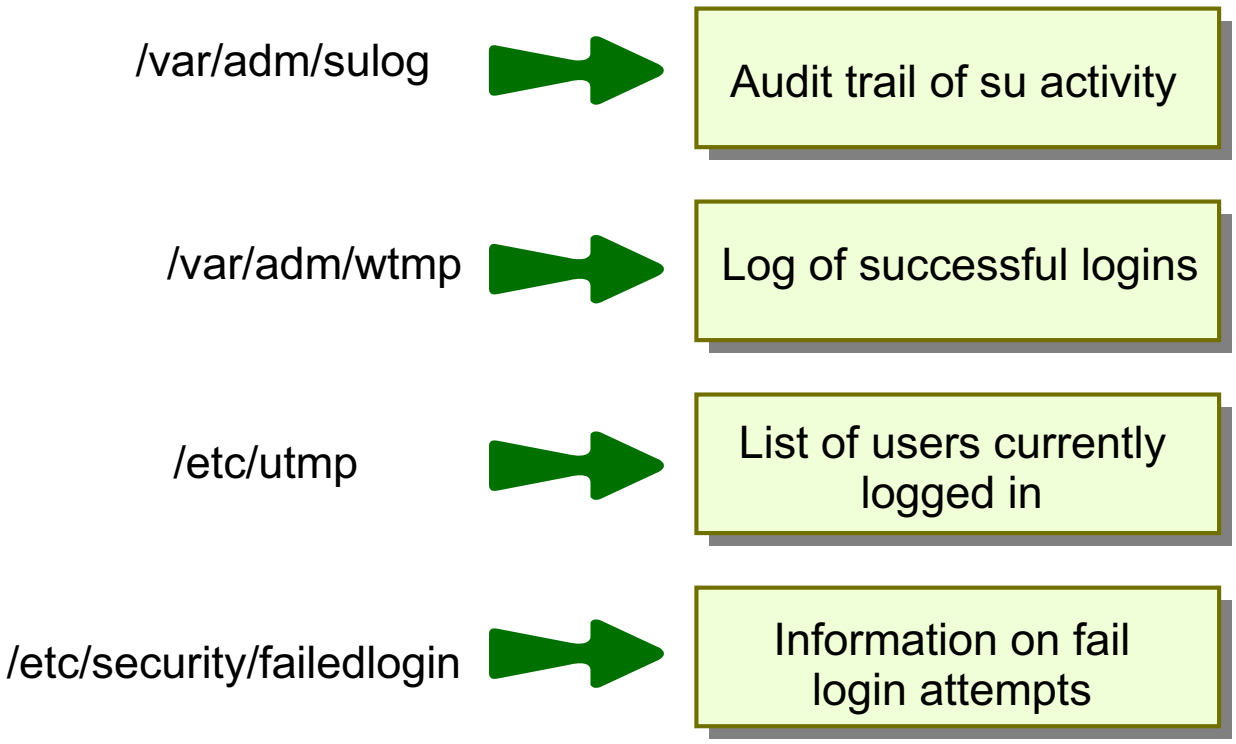


Figure 15-7. Security Logs AU1410.0

Notes:

The **sulog** file is an ASCII text file that can be viewed with **more** or **pg**. In the file, the following information is recorded: date, time, terminal name and login name. The file also records whether the login attempt was successful (and indicates a success by a **+** and a failed login by a **-**).

The /**etc**/**utmp** file contains a record of users logged into the system, and the /**var**/**adm**/**wtmp** file contains connect-time accounting records. To obtain information from either file use the **who** command with the file name. The **who** command normally examines the /**etc**/**utmp** but you can specify either one of the named files as arguments to the command.

The **last** command can also be used to display in reverse chronological order, all previous logins and logoffs still recorded in the /**var**/**adm**/**wtmp file**. The /**var**/**adm**/**wtmp** file collects login and logout records as these events occur and holds them until the records are processed by the accounting commands.

For example:

last root displays all the recorded logins and logoffs by the user **root**
last reboot displays the time between reboots of the system

AIX V5.2 introduces a new daemon called **utmpd**, to manage the entries in the /etc/umpd file. The validity of the user process entries are monitored at regular intervals. The default interval time would be 300 seconds.

The **syntax** of the command is:

/usr/sbin/utmpd [Interval]

To **start** utmpd from the /etc/inittab, add the following entry to the file:

utmpd:2:respawn:/usr/sbin/utmpd

File/Directory Permissions

File	Perm. Bit	Directory
read content of file	r	list content of directory
modify content of file	w	create/remove files in directory
use file name to execute as a command	x	gives access to directory
run program with effective UID of owner	SUID	_____
run program with effective GID of group	SGID	files created in directory inherit the same group as the directory
_____	SVTX	must be owner of file to delete files from directory

Figure 15-8. File/Directory Permissions AU1410.0

Notes:

There are a number of permission bits associated with files and directories. The standard **r** (read), **w** (write) and **x** (execute) permissions define three levels of access for the user (owner), group and others. In addition there are three permission bits known as **SUID** (set UID), **SGID** (set GID) and **SVTX** (sticky bit).

SUID on an executable file means that when the file runs, the process runs with an effective UID of the owner of the file. **SUID** is not supported on shell scripts.

SUID has no meaning on a directory.

SGID on an executable file means that when the file runs, the process runs with an effective GID of the group owner of the file.

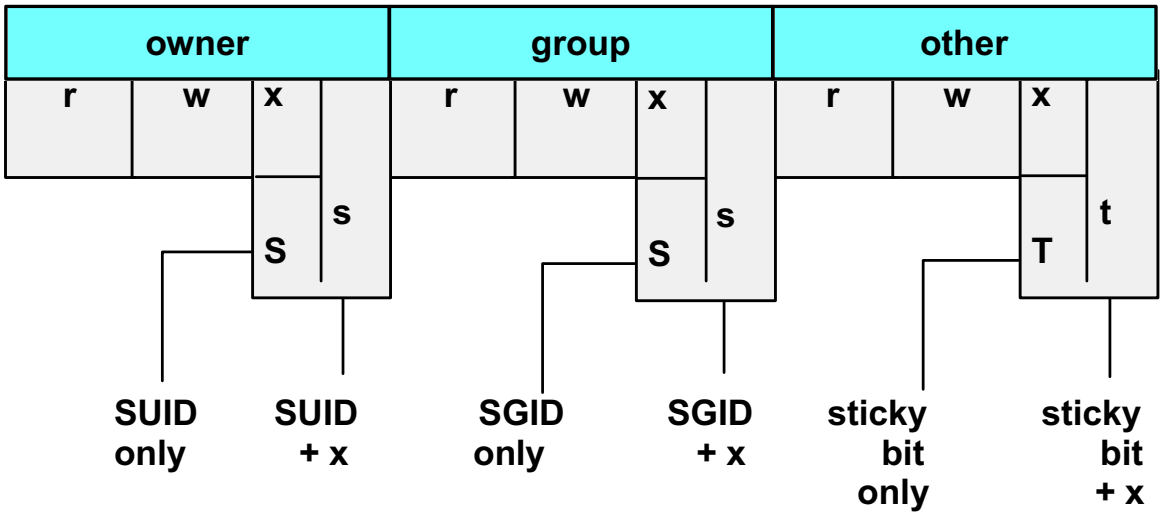
SGID on a directory means that any file/directory created within the directory will have the same group ownership as the directory rather than the primary group of the user.

SVTX on a file has no meaning in AIX (It was used in earlier versions of UNIX.) **SVTX** on a directory means that even if the directory has global write permission (for example, /**tmp**), users cannot delete a file within it unless they either own the file or the directory.

Traditional UNIX used **SVTX** to keep a program in memory after it had completed running, but with memory management routines, this is no longer necessary. **SVTX** is known as the sticky bit.

The **SGID** permission bits are propagated down through the directory structure, so that any directory created in a directory with the **SGID** bit set also inherits that bit.

Reading Permissions




```
# ls -ld  /usr/bin/passwd  /usr/bin/crontab  /tmp

-r-sr-xr-x      root    security  ...    /usr/bin/passwd
-r-sr-sr-x      root    cron      ...    /usr/bin/crontab
drwxrwxrwt      bin     bin       ...    /tmp
```


Figure 15-9. Reading Permissions AU1410.0

Notes:

The SUID bit is indicated by an **S** or **s** in the slot normally reserved for the execute permission for owner (user). The SGID bit is indicated by an **S** or **s** in the slot normally reserved for the execute permission for group. The SVTX bit is indicated by a **T** or **t** in the slot normally reserved for the execute permission for others. Since this slot must show if execute is on/off and whether the additional permission bit on/off, the uppercase **S** or **T** indicates that the execute permission is off. The lower case **s** or **t** indicates the execute permission is on.

There are three examples of files that use these additional permissions. The **passwd** command allows users to change their password even though passwords are stored in a restricted area. **crontab** allows users to create a crontab file even those the directory where these files reside is restricted from ordinary users. And /**tmp** allows everyone to write to the directory, but only the owner of a file can remove a file from the /**tmp** directory.

Changing Permissions

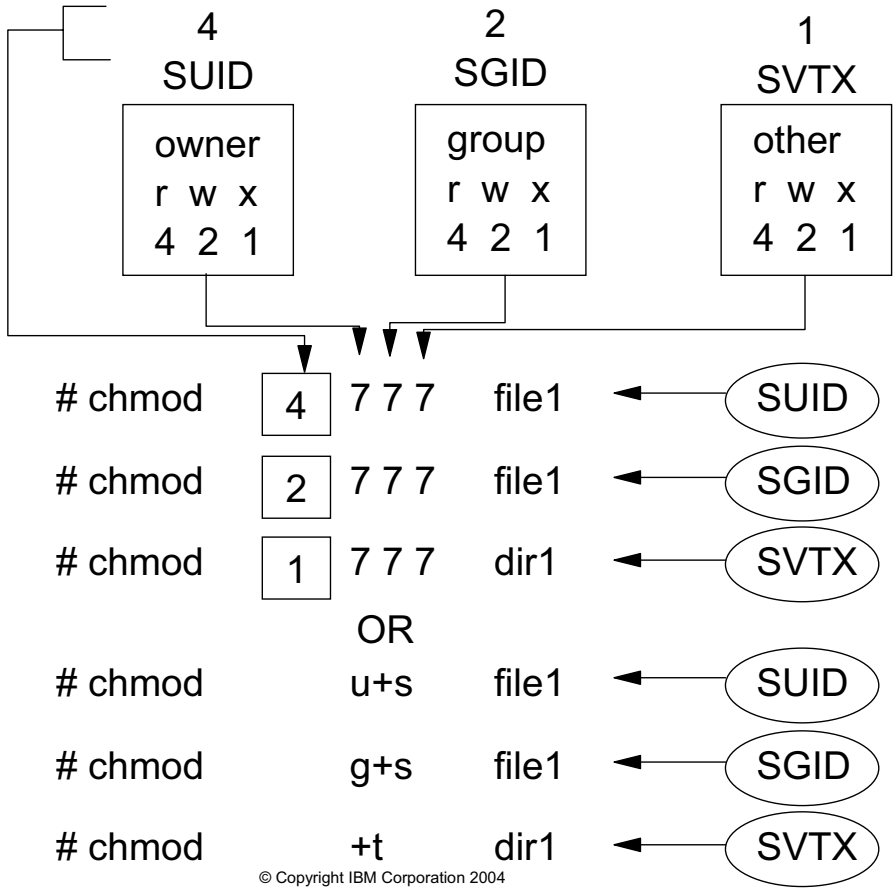


Figure 15-10. Changing Permissions AU1410.0

Notes:

To set the additional permission bits, you use the same command (**chmod**) as you do to set the regular permission bits.

If using the octal notation, you are probably familiar with setting permissions using a command like: **# chmod 777 file1**. When you issue this command, the more complete command would be: **# chmod 0777 file1**. The fourth number, a zero, is implied. This fourth position determines whether the additional bits are turned on.

You normally use the binary values of 4, 2, and 1 to set **r**, **w** and **x**. That remains the same. To set the additional bits, you are affecting the **x** position in either the user, group or other area. If you assign binary values to user (4), group (2), and other (1), these are the values that you insert into the fourth position to set the additional bit. SUID is indicated in the user's area; therefore use a **4** in the fourth position. The SGID is indicated in the group area; therefore use a **2** in the fourth position. The SVTX is indicated in the others area; therefore use a **1** in the fourth position.

You can also use the symbolic methods. The graph shows how to set the values using the symbolic method.

umask

- The **umask** governs permissions on new files and directories
- System default umask is 022. A umask of 027 is recommended
- If the umask value is set to 022, then any ordinary files or directories created will inherit the following permissions:

  Ordinary file: rw - r -- r --

  Directory: rwxr - xr - x
- **/etc/security/user** specifies default and individual user umasks

Figure 15-11. umask AU1410.0

Notes:

The **umask** specifies what permission bits are set on a new file when it is created. It is an octal number that specifies which of the permission bits will not be set.

If no **umask** was used, then file would be created with permission of 666 and directories would be created with permissions of 777. The system default **umask** is **022** (indicates to remove the 2 bit or **write** from the group and others area). Therefore, removing **write** from group and other results in an initial permission for files of 644 and, for directories, 755. Execute permission is never set initially on a file.

The default setting of the **umask** is 022. For tighter security you should make the umask 027, or even 077.

To view/change the value of the **umask** for the current session use the **umask** command.

The **umask** is specified in /**etc**/**security**/**user**. The default stanza in this file specifies the system wide default, but a value can be specified on a per-user basis.

Changing Ownership

chown command

```
# chown fred file1
# chgrp staff  file1
# chown fred:staff  file1
```

Only root can change file ownership

Figure 15-12. Changing Ownership AU1410.0

Notes:

The **chown** command can be used by root to change the ownership on a file.

The **chgrp** command is used to change the group ownership of a file. Any owner of a file can change the group ownership to any group in their groupset. Root can change the group ownership to any group on the system.

chown can be used by root to set both the ownership and group ownership of a file. It can be done two different ways: **# chown fred:staff file1** or **# chown fred.staff file1**.

Exercise: Security Files

Figure 15-13. Exercise: Security Files AU1410.0

Notes:

This lab gives you a chance to look at some of the security files and allows you an opportunity to work with the SUID, SGID, and SVTX.

This exercise can be found in your Exercises Guide.

15.2 User Administration

Login Sequence

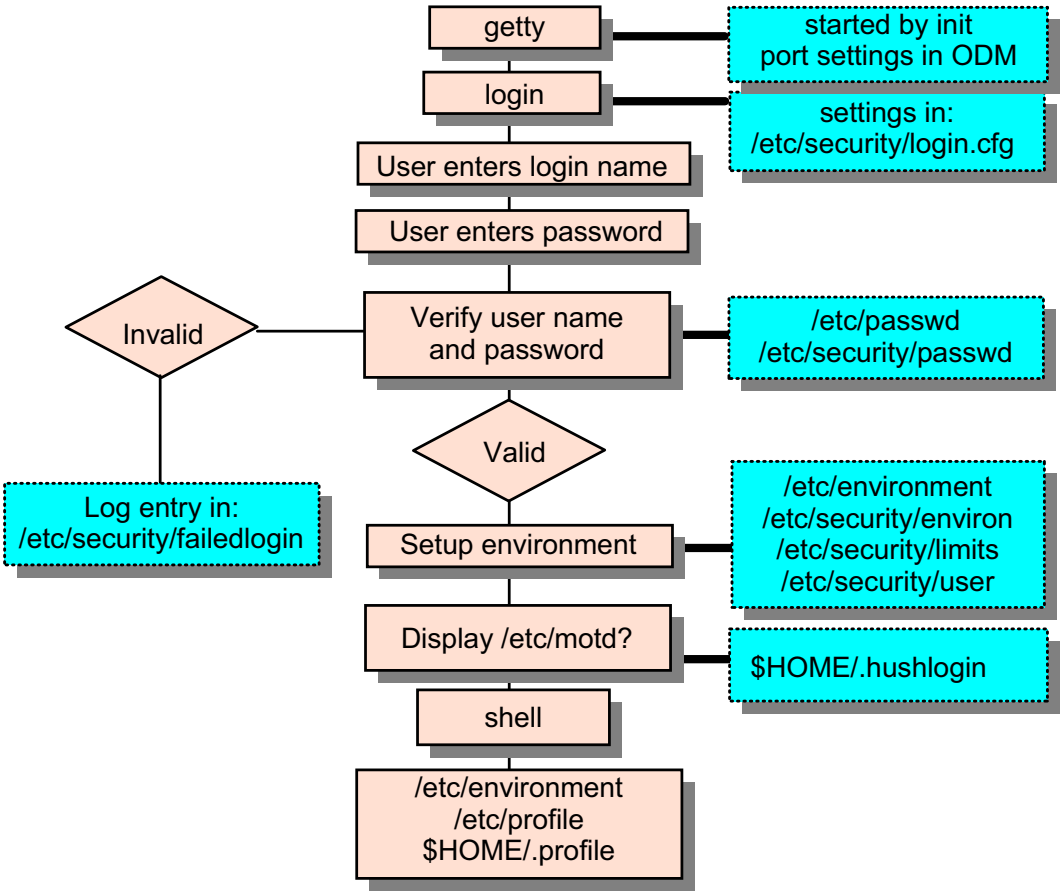


Figure 15-14. Login Sequence AU1410.0

Notes:

When a user attempts to log in, AIX checks a number of files to determine if entry is permitted to the system and, if permitted, what parts of the system the user can access. This provides an overview of the checks performed during the login process.

Ports set up for login are listed in the **/etc/inittab**. When **init** runs, a **getty** process is started for each port in the list providing a login prompt on the terminal attached to that port. The actual message displayed (also known as the herald) by the **getty** process is defined in **/etc/security/login.cfg**. Once it is displayed, the **getty** process waits for a user to make a login attempt.

When a user is ready to log in, they enter their user name at the login prompt. The login program is passed the user name and then checks **/etc/passwd** and **/etc/security/passwd** to see if a password is required. If a password is required or the user name doesn't match a valid name, the Password: prompt is displayed and the invis terminal attribute is set so that the password is not displayed as it is entered.

When the user enters the password, it is checked. If it is incorrect or an invalid user name was given, then the login fails and an entry is made in the **/etc/security/failedlogin** file. (To

view this file, type: **who /etc/security/failedlogin**.) The number of failed attempts is also tracked (by user account) in **/etc/security/lastlog**. The Login: prompt is redisplayed for another attempt.

It is possible to set the characteristics for a user to prevent unlimited attempts on an account. If the number of attempts exceeds the maximum allowable failed attempts, the account is locked.

If a user successfully enters the user name and password, the **usw** stanza in **/etc/security/login.cfg** is checked. This stanza sets the maximum number concurrent logins for a user account. If that number is exceeded, the login is denied and a message is displayed to the user.

If everything is successful to this point, then the user's environment is set using **/etc/environment**, **/etc/security/environ**, **/etc/security/limits** and **/etc/security/user**. The login program sets the current directory to the user's HOME directory and displays the content of **/etc/motd** (if no **.hushlogin** file is found in the HOME directory), date of the last successful login, and the number of unsuccessful login attempts since the last successful login.

Finally, control is passed to the login shell (as defined in **/etc/passwd**) which will read the /etc/environment and run **/etc/profile** and **$HOME/.profile** when using Korn or Bourne shells.

When a user logs out, the shell terminates and a new **getty** process is spawned for that port.

User Initialization Process

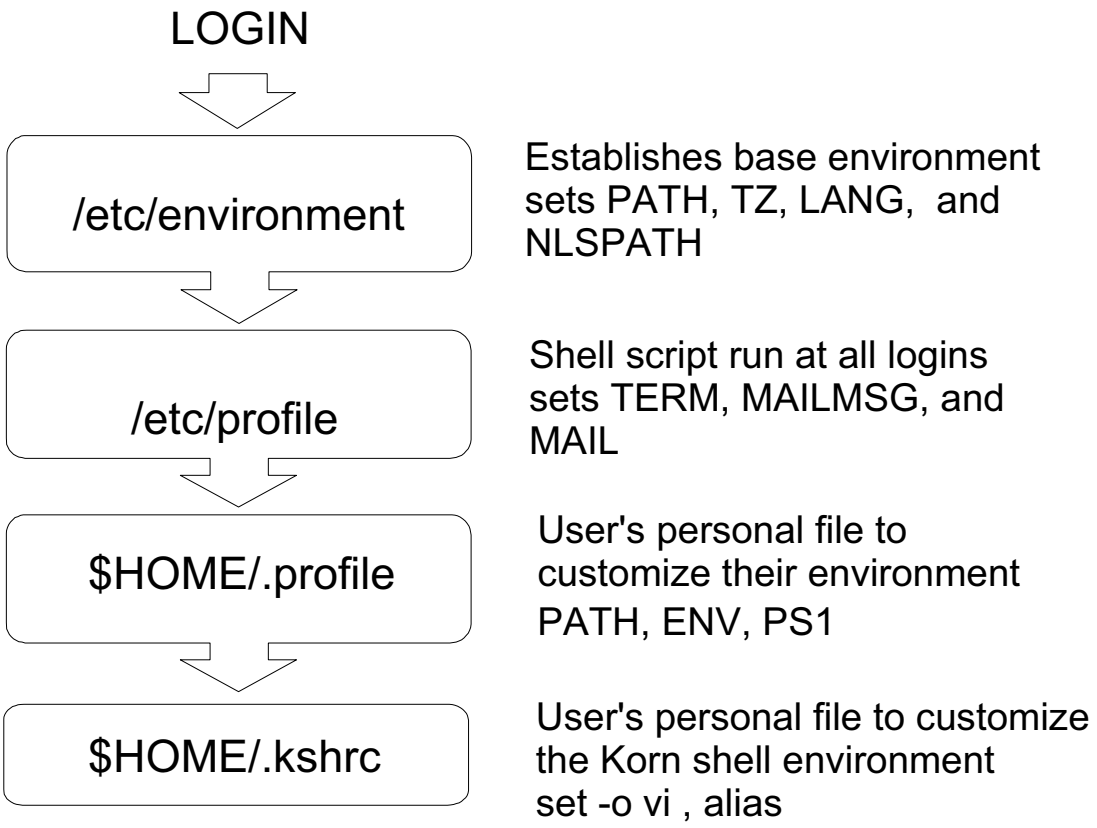


Figure 15-15. User Initialization Process AU1410.0

Notes:

/**etc**/**environment** is used to set variable. No commands should be placed in this file.

/**etc**/**profile** will be read and executed during every login.

/**etc**/**environment** and /**etc**/**profile** can be changed only by root.

$HOME/**.profile** and **$HOME**/**.kshrc** can be customized by the user. The user can overwrite any variable set in /**etc**/**environment** and /**etc**/**profile**.

If you are using CDE (Common Desktop Environment), **.profile** is not read by default. In the users HOME directory, the **.dtprofile** file is used to establish the environment when working with CDE. **.dtprofile** replaces the function of **.profile** in the CDE environment. If you want to use both, in the **.dtprofile**, uncomment the line near the end of the file that references the **DTSOURCEPROFILE** variable.

Security and Users

smit security

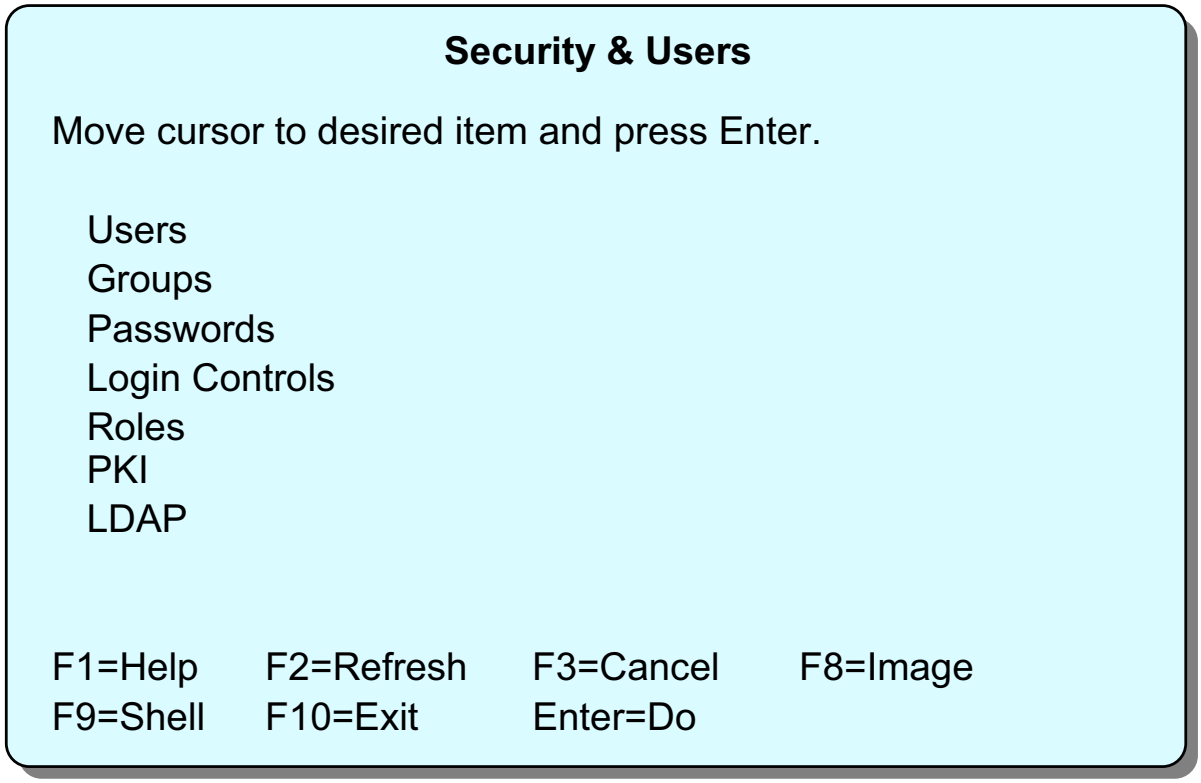


Figure 15-16. Security and Users AU1410.0

Notes:

The **Security and Users** menu is used to manage user and group IDs on the system. The menu consists of five options:

- **Users** - This option is used to add users to the system, delete existing users and change the details of existing users.
- **Groups** - This option is used to add groups to the system, delete groups and change the details of existing groups.
- **Passwords** - This option is used to change the password for a user. It is required when setting up a new user or when a user has forgotten their password.
- **Login Controls** - This option provides functions to restrict access on a user account or on a particular terminal.
- **Roles** - This option sets up user roles. User roles allow root to give authority to an ordinary user to perform a portion of root's functions.

- **PKI** - PKI stands for X.509 Public Key Infrastructure certificates. This option is used to authenticate users using certificates and to associate certificates with processes as proof of a user's identity.
- **LDAP** - LDAP stands for Light Directory Access Protocol. It provides a way to centrally administer common configuration information for many platforms in a networked environment. A common use of LDAP is the central administration of user authentication. The smit option here allows us to configure this platform as either an ldap client or an ldap server.

The Web-based System Manager can also be used to manage users and groups.

SMIT Users

smit users

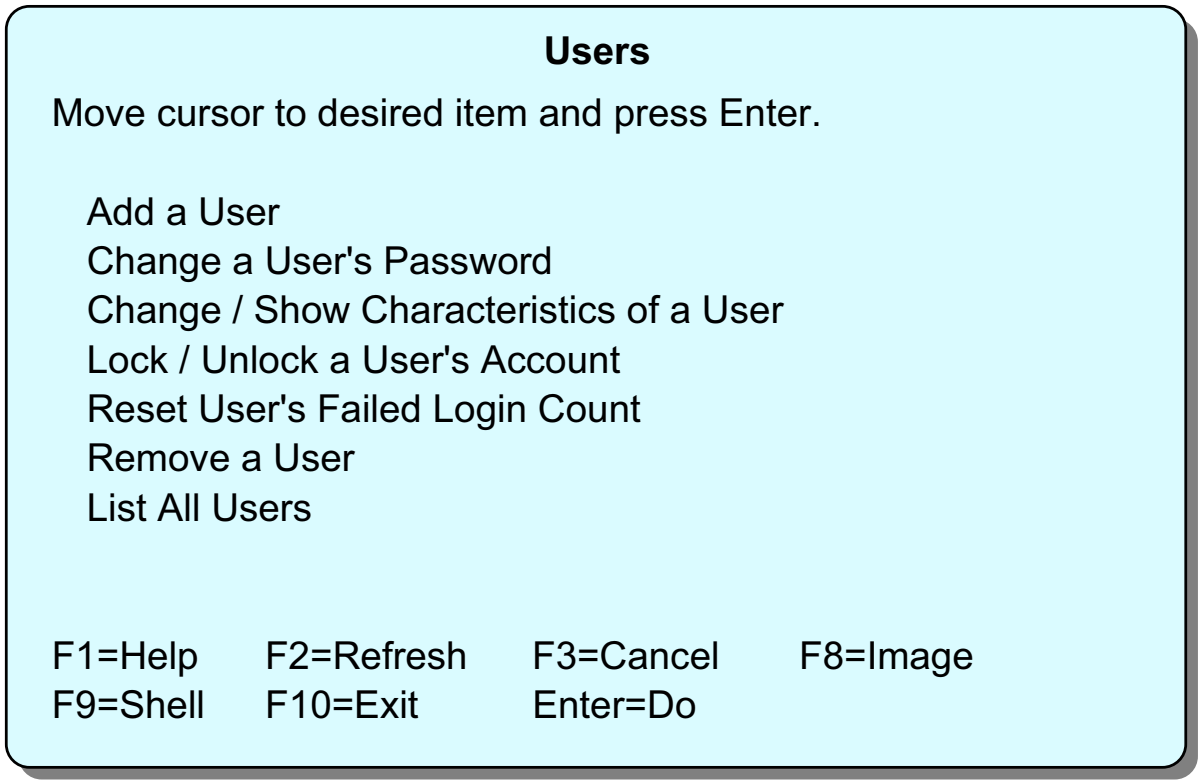


Figure 15-17. SMIT Users AU1410.0

Notes:

Add a User - Add user accounts.

Change a User's Password - Password changes.

Change/Show Characteristics of a User - Changes the many characteristics that are a part of the user account. The password restrictions are part of this area.

Lock/Unlock a User's Account - This is used to temporarily disable an account. It is a good security practice to disable accounts if they are not expected to be used, like when someone is on an extended leave of absence.

Reset User's Failed Login Count - If the administrator has set a limit to the number of failed attempts that can be made on an account before locking it, this resets that count.

Remove a User - Removes the user account, but not files owned by that user.

List all users - Runs the **lsuser** command.

List All Users

lsuser [-c | -f] [-a attribute ..]{ALL | username ..}

```
# lsuser -a id home ALL
root id=0 home=/
daemon id=1 home=/etc
bin id=2 home=/bin
john id=200 home=/home/john
```


Figure 15-18. List All Users AU1410.0

Notes:

The **lsuser** command is used to list the attributes of all users (ALL) or individual users on the system.

When the **List All Users** option in SMIT is used, the user name, id and home directory are listed.

When the command is issued directly, the data may be listed in line format, in colon format (**-c**) or in stanza format (**-f**). Individual attributes or all attributes may be selected. The output can also be generated for individual users.

The information is gathered from the various security files: /**etc**/**passwd,** /**etc**/**security**/**limits** and /**etc**/**security**/**user**.

Add a User to the System

smit mkuser

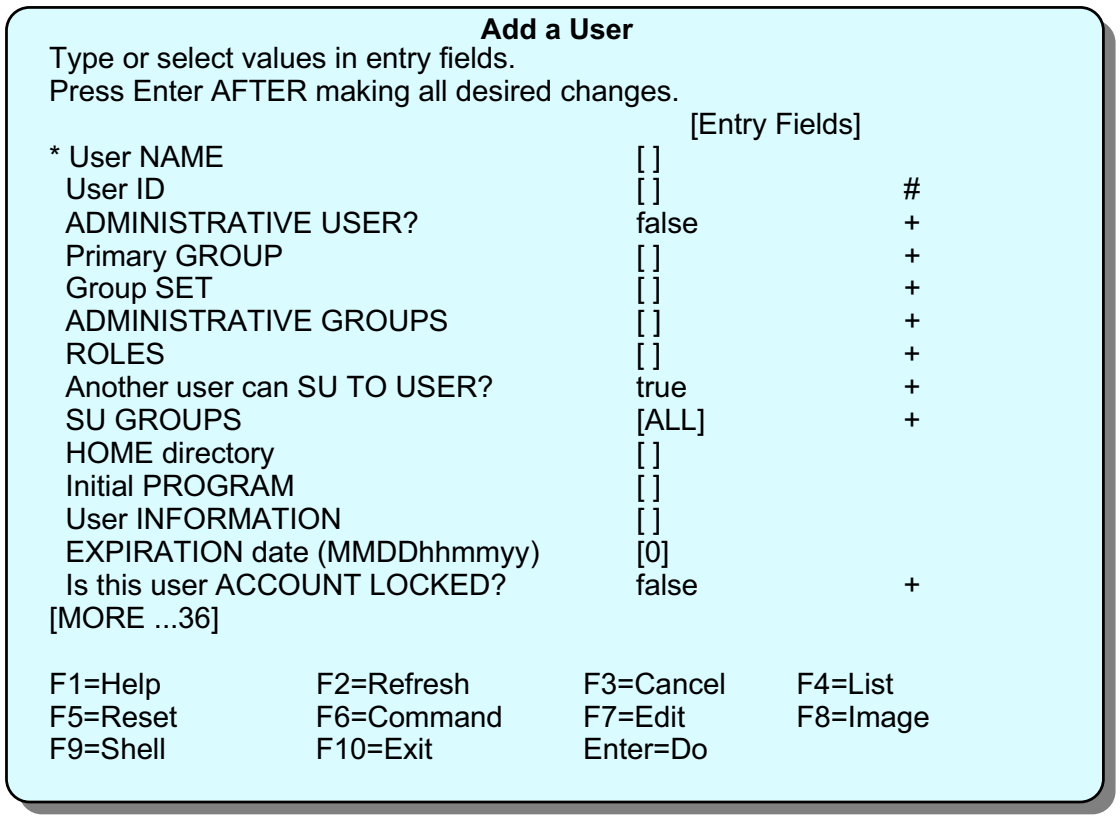


Figure 15-19. Add a User to the System AU1410.0

Notes:

Default ID numbers in:	/etc/security/.ids
Shell script to set up ID:	/usr/lib/security/mkuser.sys
Default characteristics in:	/usr/lib/security/mkuser.default /etc/security/user
Default .profile:	/etc/security/.profile

The **mkuser** command is used to add a user. User attributes can be specified to override the default values.

The only required value is the user name. Traditionally this name was restricted to 8 characters in length. In AIX 5.3, this limit can be changed to allow names as long as 255 characters. The limit is modified in the Change/Show Attributes of the Operating System panel (smit chsys).

The defaults for the **mkuser** command are stored in the file **/usr/lib/security/mkuser.default**. This file can only be edited by the **root** user. This file contains the following information:

user:

pgrp = staff
groups = staff
shell = /usr/bin/ksh
home = /home/$USER

admin:

pgrp = system
groups = system
shell = /usr/bin/ksh
home = /home/$USER

The user stanza of this file is picked up if an ordinary user is being added and the admin stanza is picked up if an administrative user is being added.

If the user ID is not specified, then a default ID number is chosen from the /**etc**/**security**/**.ids** file. Administrative users are given IDs starting from 6 and normal users starting from 200.

The shell script /**usr**/**lib**/**security**/**mkuser.sys** is run during the user creation process. This creates the user's home directory and creates the **.profile** file. This shell script can be modified to perform any function that is required when setting up the user.

The full list of user characteristics contains some entries which are not often used. Many of these fields may be left empty with no ill-effect. For the complete list refer to SMIT (fastpath **smit mkuser**).

When a new user is created the ID is disabled (an asterisk is placed in the password field of the /**etc**/**passwd** file). To enable the ID a password must be set with the **Change a User's Password** option or the **passwd** or **pwdadm** commands.

Change / Show Characteristics of a User

smit chuser

Change / Show Characteristics of a User

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

	[Entry Fields]	
* User NAME	[george]	
User ID	[206]	#
ADMINISTRATIVE USER?	false	+
Primary GROUP	[staff]	+
Group SET	[staff, security]	+
ADMINISTRATIVE GROUPS	[ ]	+
ROLES	[ ]	+
Another user can SU TO USER?	true	+
SU GROUPS	[ALL]	+
HOME directory	[/home/george]	
Initial PROGRAM	[/usr/bin/ksh]	
User INFORMATION	[ ]	
EXPIRATION date (MMDDhhmmyy)	[0]	
Is this user ACCOUNT LOCKED?	false	+

[MORE ...36]

F1=Help F2=Refresh F3=Cancel F4=List
F5=Reset F6=Command F7=Edit F8=Image
F9=Shell F10=Exit Enter=Do

Figure 15-20. Change / Show Characteristics of a User AU1410.0

Notes:

The **Change** / **Show Characteristics of a User** option which runs the **chuser** command, allows any of the user characteristics listed previously (except the user name) to be changed. This can only be executed by **root** or a member of the **security** group (only **root** can change an admin user). This SMIT screen holds exactly the same attributes as the Add a User screen.

The user information is not required by the system. This is the fifth field in the /**etc**/**passwd** file which is usually used to hold the user's real name, telephone number, and so forth. Some programs use this information when reporting on user activity for example, the **finger** program in TCP/IP. Users can change their own user information.

The initial program is the shell which the user logs into. It is usually set to one of:

/**usr**/**bin**/**bsh** (the Bourne shell)
/**usr**/**bin**/**csh** (the C shell)
/**usr**/**bin**/**ksh** (the Korn shell) (default)

A user can only change their shell to one of the above whereas root can change a user's shell to any program. Also note that users can change their own full name and login shell.

The following command can be used to change/show characteristics of a user:

 # chuser attribute=value username

Remove a User from the System

- The **rmuser** command or SMIT can be used to delete a user from the system.

```
– # rmuser -p team01
```

- The user's home directory is not deleted, therefore you must manually clean up the user directories (remembering to **backup** important files first !)

```
– # rm -r /home/team01
```


Figure 15-21. Remove a User from the System AU1410.0

Notes:

The **Remove a User from the System** option or the **rmuser** command can be used to remove any user from the system. Only the **root** user may remove administrative users.

The **-p** option removes authentication information from the /**etc**/**security**/* files. Typically this information is the user password, as well as other login restrictions which have been previously set for the ID.

The user's home directory and associated files are not removed by this option. They must be removed separately by the administrator. To do this you can use the **-r** option on the **rm** command to recursively remove files. Remember to back up any important files before removing the user's home directory.

Passwords

- A new user ID cannot be used until a password is assigned
- There are two commands available for changing the password:
  - **passwd [*username*]**

    root or *username* only
    SMIT uses the **passwd** command
  - **pwdadm *username***

    root or user in security group

Figure 15-22. Passwords AU1410.0

Notes:

When a user ID is created with SMIT or with the **mkuser** command, the user ID is disabled (an * is in the password field of /**etc**/**passwd**. To enable the ID, the **passwd** or **pwdadm** command must be used to set up the initial password for the user.

When passwords are entered, they are not displayed. When changing a password, the new password is requested a second time for verification.

If **root** or a member of the **security** group sets the password for a user, the ADMCHG flag is set in the flags field in /**etc**/**security**/**passwd**. The user is then prompted to change the password at the next login.

There is no way to examine an existing password on the system. The only way to recover from a forgotten password is for an administrator or **root** to set a new one for the user.

The option **Passwords** on the **Users** menu of SMIT uses the **passwd** command.

If a user uses **passwd** to change their password, they are first prompted for the old password, and then they are asked twice for a new password. When root uses **passwd** to set a user's password, root only prompts twice for the new password.

Members of the security group can use **pwdadm** to change the password of non-administrative accounts. Security group members are first prompted to enter their own password, then prompted twice to enter the user's new password. Root only prompts twice for the new password.

Only **root** can change the password for a user who has the ADMIN flag set in **/etc/security/passwd**.

Regaining root's Password

Boot from CD-ROM or a bootable tape

- Select option 3 from the Installation and Maintenance menu: Start Maintenance Mode for System Recovery
- Follow the options to activate the root volume group and obtain a shell
- Once a shell is available, execute the **passwd** command to change root's password.
- # sync ; sync

  Reboot the system

Figure 15-23. Regaining root's Password AU1410.0

Notes:

To recover the root password, you must boot your machine from media other than its normal hard drive. An installation CD or a mksysb tape works just fine. Remember to invoke the service boot list - usually by pressing **F5** while your machine is booting.

You will need to define your system console and select a language. Then the installation and maintenance menu will display. Be certain to select option **3** - **Start Maintenance Mode for System Recovery**. If you select option 1 or 2, you are reinstalling your operating system.

You need to activate the root volume group and start a shell. This gets you access to **rootvg** without any passwords. Once you get the # prompt, just use the **passwd** command like you normally would.

Run **# sync ; sync**. This ensures the memory buffer is written to disk. In other words, it ensures the new **password** is saved to disk.

Then reboot your system - **shutdown -Fr**.

SMIT Groups

smit groups

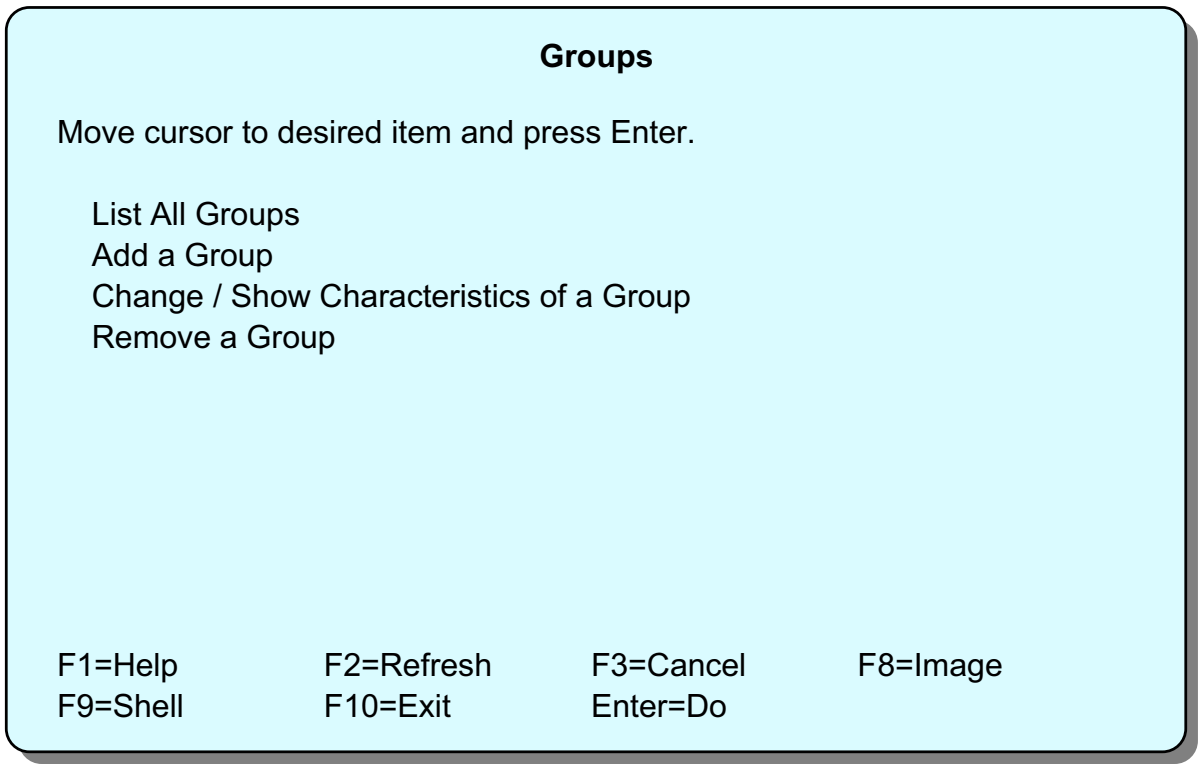


Figure 15-24. SMIT Groups AU1410.0

Notes:

The purpose of groups is to give a common set of users the ability to share files. The access is controlled using the group set of permission bits.

Only root and members of the security group can create groups. Root and security group members can select a member of the group to be the group administrator. This privilege allows the user to add and remove users from the group.

Remember there are a number of predefined groups on AIX systems like the **system** group (which is root's group) and the **staff** group (which contains the ordinary users).

List All Groups

lsgroup [-c | - f] [-a *attribute*] { ALL | *groupname* }

 # lsgroup ALL

```
system id=0 admin=true users=root registry=files
staff id =1 admin=false users=invscout,ipsec,ldap,daemon,team01,team02 registry=files
bin id=2 admin=true users=root,bin registry=files
sys id=3 admin=true users=root,bin,sys registry=files
adm id=4 admin=true users=bin,adm registry=files
uucp id=5 admin=true users=uucp registry=files
mail id=6 admin=true users= registry=files
security id=7 admin=true users=root registry=files
cron id=8 admin=true users=root registry=files
printq id=9 admin=true users=lp registry=files
audit id=10 admin=true users=root registry=files
nobody id=-2 admin=false users=nobody,lpd registry=files
usr id=100 admin=false users=guest registry=files
perf id=20 admin=false users= registry=files
shutdown id=21 admin=true users= registry=files
lp id=11 admin=true users=root,lp,printq registry=files
snapp id=12 admin=true users=snapp registry=files
imnadm id=188 admin=false users=imnadm registry=files
ipsec id=201 admin=false users= registry=files
ldap id=202 admin=false users=ldap registry=files
```


Figure 15-25. List All Groups AU1410.0

Notes:

The **lsgroup** command is used to list selected or all groups on the system. The data is presented in line format by default or in colon format (**-c**) or in stanza format (**-f**).

The **-c** option displays the attribute for each group in colon separated records.

The **-f** option displays the group attributes in stanza format with each stanza identified by a group name.

Add Groups

 # smit mkgroup

Add a Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

	[Entry Fields]	
* Group NAME	[support]	
ADMINISTRATIVE group?	false	+
Group ID	[300]	#
USER list	[fred,barney]	+
ADMINISTRATOR list	[fred]	+
Projects	[ ]	+

F1=Help F2=Refresh F3=Cancel F4=List
F5=Reset F6=Command F7=Edit F8=Image
F9=Shell F10=Exit Enter=Do

Figure 15-26. Add Groups AU1410.0

Notes:

The **mkgroup** command is the command used to create a new group. The group name, traditionally, must be a unique string of eight characters or less. With AIX V5.3 and later, the maximum name length can be modified to be as large as 255 characters. The (**-a**) parameter is used to indicate that the new group is to be an administrative group. Only the **root** user can add administrative groups to the system.

The (**-A**) option makes the invoker of the **mkgroup** command the group administrator.

A user may belong to no more than 32 groups. **ADMINISTRATOR list** is a list of members from the **USER list** that are allowed to change the characteristics of a group and add or remove members.

Staring with AIX 5.3, there is a new option, projects, for tracking resource usage in the Advanced Accounting provided in AIX 5.3.

Change / Remove Groups

 # smit chgroup

Change Group Attributes

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

	[Entry Fields]	
Group NAME	[support]	
Group ID	[300]	#
ADMINISTRATIVE group?	false	+
USER list	[fred,barney,wilma]	+
ADMINISTRATOR list	[fred]	+
Projects	[ ]	+

F1=Help F2=Refresh F3=Cancel F4=List
F5=Reset F6=Command F7=Edit F8=Image
F9=Shell F10=Exit Enter=Do

Figure 15-27. Change / Remove Groups AU1410.0

Notes:

The **chgroup** command is used to change the characteristics of a group. It can only be run by **root** or a member of the **security** group. The group attributes are:

- Group ID (**id=groupid**). It is not advisable to change the groupID, but it is occasionally done immediately after a group has been created to match the ID of a previously deleted group, or a specific groupID for a particular software package.
- ADMINISTRATIVE group? (**admin=true**|**false**). Only the **root** user can change a group to be an administrative group or make changes to an existing administrative group.
- USER list (**users=usernames**). This is a comma separated list of the names of all the members of the group. The group may be their primary group or an additional one.
- ADMINISTRATOR list (**adms=adminnames**). This is the list of group administrators.

The **chgrpmem** command can be used by any user to change either the administrators or the members a group for which they are group administrator.

The **rmgroup** command is used to remove a group from the system. This command has no options and the only parameter is the group name. Only the **root** user can delete an administrative group.

Message of the Day

- The file **/etc/motd** contains text that is displayed every time a user logs in.
- This file should only contain information necessary for the users to see.
- If the **$HOME/.hushlogin** file exists in a user's home directory, then the contents of the **/etc/motd** file are not displayed to that user.

Figure 15-28. Message of the Day AU1410.0

Notes:

This is a convenient way to communicate information to all users, such as installed software version numbers or current system news. The message of the day is contained in the /**etc**/**motd** file.

To change the message of the day, simply edit this file.

Many other commands exist to communicate with the user community. Several of these commands are covered in the AIX Version 5.2 Basics course such as **write, wall, mail** and **talk**.

Exercise: User Administration

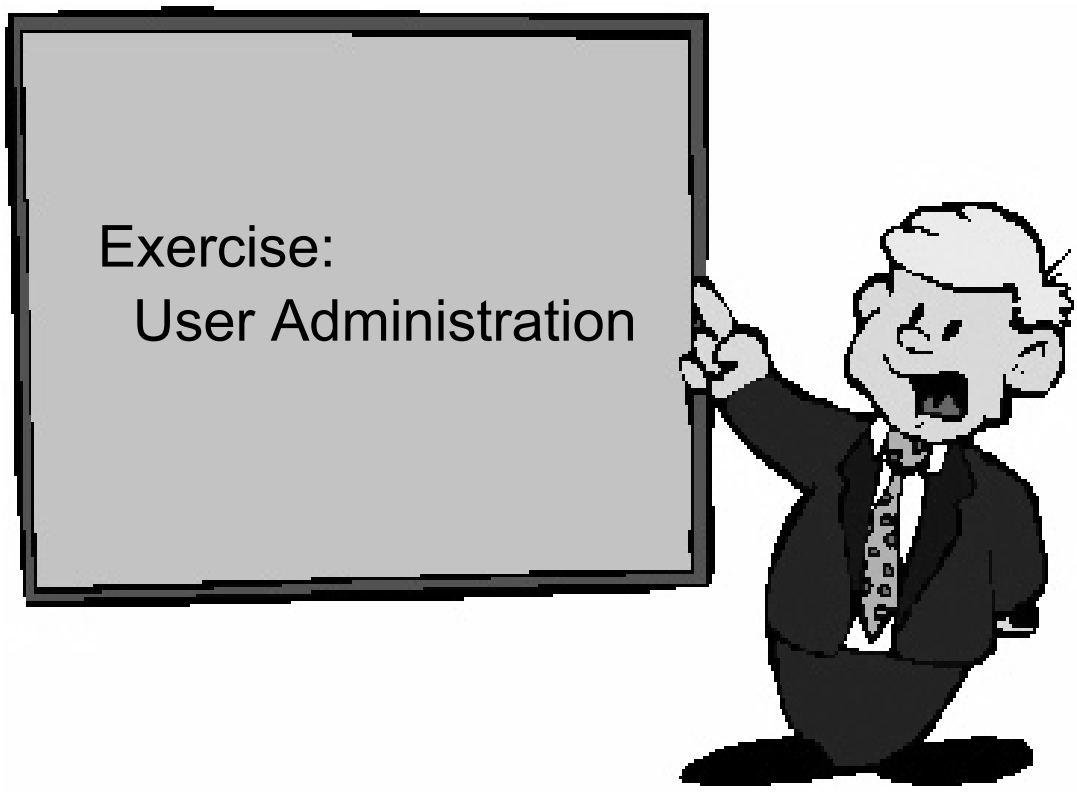


Figure 15-29. Exercise: User Administration AU1410.0

Notes:

This lab gives you an opportunity to expand your knowledge of user administration. You add users and groups and review many of the user characteristics.

This exercise can be found in your Exercise Guide.

15.3 Security Files

Security Files

- Files used to contain user attributes and control access:
  - /etc/passwd — valid users (not passwords)
  - /etc/group — valid groups
  - /etc/security — directory not accessible to normal users
  - /etc/security/passwd — user passwords
  - /etc/security/user — user attributes, password restrictions
  - /etc/security/group — group attributes
  - /etc/security/limits — user limits
  - /etc/security/environ — user environment settings
  - /etc/security/login.cfg — login settings

Figure 15-30. Security Files AU1410.0

Notes:

The security on the system is controlled by a number of ASCII files.

The /**etc**/**passwd** file lists the valid users, their user ID, primary group, home directory and default login shell.

The /**etc**/**group** file lists the valid groups, their group ID and members.

The above files have global read access to all users. A number of other files control the attributes of users. They are in the /**etc**/**security** directory which can only be accessed by root or the security group.

/**etc**/**security**/**passwd** contains the encrypted password and update information for users.

/**etc**/**security**/**user** contains extended user attributes.

/**etc**/**security**/**group** contains extended group attributes.

/**etc**/**security**/**limits** contains process resource limits for users.

/**etc**/**security**/**environ** contains environment variables for users. This file is not often used.

/etc/security/login.cfg is a configuration file for the login program. This contains security enhancements that limit the logins on a port, for example, the number of login attempts and the valid login programs (shells).

/etc/passwd File

 # cat /etc/passwd

```
root:!:0:0::/:/bin/ksh
daemon:!:1:1::/etc:
bin:!:2:2::/bin:
sys:!:3:3::/usr/sys:
adm:!:4:4::/var/adm:
uucp:!:5:5::/usr/lib/uucp:
guest:!:100:100::/home/guest:
nobody:!:4294967294:4294967294::/:
lpd:!:9:4294967294::/:
john:!:200:0:X7560 5th floor:/home/john:/usr/bin/ksh
bill:*:201:1::/home/bill:/usr/bin/ksh
```


Figure 15-31. /etc/passwd File AU1410.0

Notes:

The /**etc**/**passwd** file lists the users on the system and some of their attributes. This file must be readable by all users, because commands such as **ls** access it.

The fields in the /**etc**/**passwd** file are:

- user name - up to eight alphanumeric characters (not all upper case)
- password - on older UNIX systems this contained the encrypted password. This will still work, but since AIX Version 5.1 it cannot contain the encrypted password and should contain a ! to refer to the /**etc**/**security**/**passwd** file. Other common values are a * which means the id is invalid, and no value means there is no password assigned.
- uid - the user ID number for the user
- gid - the ID of the primary group to which this user belongs
- information - any descriptive text for the user
- directory - the login directory of the user and the initial value of the $HOME variable

- login program - Specifies that the initial program or shell that is executed after a user invokes the **login** command or **su** command.

In AIX, additional files can be created to be used as an index for the /**etc**/**passwd,** /**etc**/**security**/**passwd** and /**etc**/**security**/**lastlog** files. These index files provide for better performance during the login process. Use the **mkpasswd -f** command to create the indexes. The command **mkpasswd -c** can be used to check the indexes and rebuild any that look suspicious.

/etc/security/passwd File

 # cat /etc/security/passwd

```
root:
        password = 92t.mzJBjlfbY
        lastupdate = 885485990
        flags =

daemon:
        password = *

bin:
        password = *

john:
        password = q/gD6q.ss21x.
        lastupdate = 884801337
        flags = ADMCHG,ADMIN,NOCHECK
```


Figure 15-32. /etc/security/passwd File AU1410.0

Notes:

The **/etc/security/passwd** file can only be accessed by root. The **login, passwd, pwdadm** and **pwdck** commands (which run with **root** authority) update this file. This file is in stanza format with a stanza for each user. The valid entries are:

- **password** — Either the encrypted password or * for invalid, or blank for no password
- **lastupdate** — The date and time of the last password update in seconds from January 1, 1970
- **flags** — ADMCHG - the password was last changed by an administrator or **root**
  ADMIN - the user's password can only be changed by **root**
  NOCHECK - password restrictions are not in force for this user. (see **/etc/security/user** for password restrictions)

In AIX, additional files can be created to be used as an index for the **/etc/security/passwd** file. These index files provide for better performance during the login process. These indexes are created using the **mkpasswd** command.

/etc/security/user File (1 of 2)

 # cat /etc/security/user

```
default:
        admin = false
        login = true
        su = true
        daemon = true
        rlogin = true
        sugroups = ALL
        admgroups =
        ttys = ALL
        auth1 = SYSTEM
        auth2 = NONE
        tpath = nosak
        umask = 022
        expires = 0
          .
          .
          .
```


Figure 15-33. /etc/security/user File (1 of 2) AU1410.0

Notes:

admin
Defines the administrative status of the user. Possible value: true or false.

login
Defines whether a user can login. Possible values: true or false.

su
Defines whether other users can switch to this user account. The **su** command supports this attribute. Possible values: true or false.

daemon
Defines whether the user can execute programs using the system resource controller (SRC). Possible values: true or false.

rlogin
Defines whether the user account can be accessed by remote logins. Commands rlogin and **telnet** support this attribute. Possible values: true or false.

sugroups
Defines which groups can switch to this user account. Alternatively you may explicitly deny groups by preceding the group name with a ! character. Possible values: A list of valid groups separated by commas, ALL or *

admgroups
Lists the groups that a user administers. The value is a comma-separated list of valid group names.

ttys
Defines which terminals can access the user account. Alternatively you may explicitly deny terminals by preceding the terminal name with the ! character. Possible values: List of device paths separates by commas, ALL or *

auth1
Defines the primary authentication method for a user, which by default is set to the password program. The commands login, telnet, rlogin and **su** support these authentication methods.

auth2
Defines the secondary authentication methods for a user. It is not a requirement to pass this method to login.

tpath
Defines the user's trusted path characteristics. Possible values: nosak, notsh, always or on. (For more information refer to online documentation).

umask
Defines the default umask for the user. Possible values: 3-digit octal value.

expires
Defines the expiration time for the user account. Possible values: a valid date in the form MMDDHHMMYY or 0. If 0, the account does not expire. The 'YY' supports the last two digits of the years 1939 to 2038. If 0101000070 then the account is disabled.

/etc/security/user File (2 of 2)

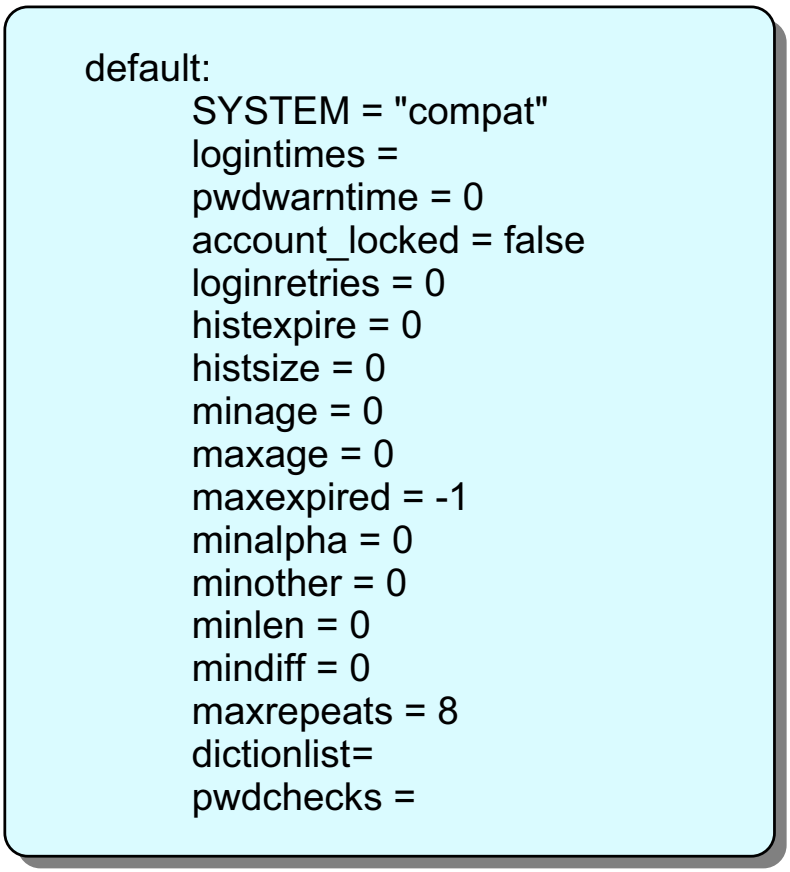


Figure 15-34. /etc/security/user File (2 of 2) AU1410.0

Notes:

SYSTEM

This attribute can be used to describe multiple or alternate authentication methods the user must use successfully before gaining access to the system. Possible tokens are:

files which allows only local users access to the system

compat which is the normal login procedure and therefore allows local and NIS users access to the system

DCE which is the Distributed Computing Environment authentication.

logintimes
Defines the times a user can login. The value is a comma separated list of items as follows:

[!][MMdd[-MMdd]]:hhmm-hhmm
or
[!]MMdd[-MMdd][:hhmm-hhmm]
or
[!][w[-w]]:hhmm-hhmm
or
[!]w[-w][:hhmm-hhmm]

where MM is a month number (00=January, 11-December), dd is the day on the month, hh is the hour of the day (00 - 23), mm is the minute of the hour, and w is a weekday (0=Sunday, 6=Saturday).

pwdwarntime
The number of days before a forced password change that a warning is given to the user informing them of the impending password change. Possible values: a positive integer or 0 to disable this feature.

account_locked
Defines whether the account is locked. Locked accounts cannot be used for login or **su**. Possible values: true or false.

loginretries
The number of invalid login attempts before a user is not allowed to login. Possible values: a positive integer or 0 to disable this feature.

histexpire
Defines the period of time in weeks that a user will not be able to reuse a password. Possible values: an integer value between 0 and 260. 26 (approximately 6 months) is the recommended value.

histsize
Defines the number of previous passwords which cannot be reused. Possible values: an integer between 0 and 50.

minage
Defines the minimum number of weeks between password changes. Default is 0. Range: 0 to 52.

maxage
Defines the maximum number of weeks a password is valid. The default is 0, which is equivalent to unlimited. Range: 0 to 52.

maxexpired
Defines the maximum number of weeks after maxage that an expired password can be changed by a user. The default is -1, which is equivalent to unlimited. Range: -1 to 52. maxage must be greater than 0 for maxexpired to be enforced. (**root** is exempt from maxexpired).

minalpha
Defines the minimum number of alphabetic characters in a password. The default is 0. Range: 0 to 8.

minother
Defines the minimum number of non-alphabetic characters in a password. The default is 0. Range: 0 to 8.

minlen
Defines the minimum length of a password. The default is 0. Range: 0 to 8. Note that the minimum length of a password is determined by minlen and/or "minalpha + minother", whichever is greater. "minalpha + minother" should never be greater than 8. If "minalpha + minother" is greater than 8, then minother is reduced to "8 - minalpha".

mindiff
Defines the minimum number of characters in the new password that were not in the old password. The default is 0. Range: 0 to 8.

maxrepeats
Defines the maximum number of times a given character can appear in a password. The default is 8, which is equivalent to unlimited. Range: 0 to 8.

dictionlist
Defines the password dictionaries used when checking new passwords. The format is a comma separated list of absolute path names to dictionary files. A dictionary file contains one word per line where each word has no leading or trailing white space. Words should only contain 7 bit ASCII characters. All dictionary files and directories should be write protected from everyone except root. The default is valueless which is equivalent to no dictionary checking.

pwdchecks
Defines external password restriction methods used when checking new passwords. The format is a comma separated list of absolute path names to methods or method path names relative to /**usr**/**lib**. A password restriction method is a program module that is loaded by the password restrictions code at run time. All password restriction methods and directories should be write protected from everyone except root. The default is valueless, which is equivalent to no external password restriction methods.

Group Files

 # more /etc/group

```
system:!:0:root,john
staff:!:john
bin:!:2:root,bin
sys:!:3:root,bin,sys
adm:!:4:bin,adm
uucp:!:5:uucp
mail:!:6:
security:!:7:root
nobody:!:4294967294:nobody,lpd
usr:!:100:guest
accounts:!:200:john
      . . . . .
```

 # more /etc/security/group

```
system:
        admin=true
staff:
        admin=false
accounts:
        admin=false
        adms=john
        projects=system
```


Figure 15-35. Group Files AU1410.0

Notes:

The fields in the **/etc/group** file are:

- group - up to eight alphanumeric characters (not all upper case)
- password - this field is not used in AIX and should contain a !
- gid - the group ID
- members - a comma-separated list of the users who belong to this group

The **/etc/security/group** file is a stanza file with one stanza for each group. The valid entries are:

admin	true or false, whether the group is an administrative group
adms	a comma-separated list of the users who are administrators for the group. If **admin=true** this stanza is ignored because only root can change an administrative group.
projects	a list of project names to be associated with the group

/etc/security/login.cfg File

```
default:
        herald ="This is the console. Restricted use only.\n\rlogin:"
        logintimes =
        logindisable = 0
        logininterval = 0
        loginreenable = 0
        logindelay = 0
        pwdprompt = "Password: "
        usernameecho = false
```


Figure 15-36. /etc/security/login.cfg File AU1410.0

Notes:

herald
Specifies the initial message to be printed out when **getty** or **login** prompts for a login name. This value is a string that is written out to the login port. If the herald is not specified, then the default herald is gotten from the message catalog associated with the language set in **/etc/environment.**

logintimes
Defines the times a user can use this port to login.

logindisable
Number of unsuccessful login attempts before this port is locked. Use this in conjunction with logininterval.

logininterval
The number of seconds during which logindisable unsuccessful attempts must occur for a port to be locked.

loginreenable
The number of minutes after a port is locked that it automatically unlocked.

logindelay
The delay in seconds between unsuccessful login attempts. This delay is multiplied by the number of unsuccessful logins - that is, if the value is two, then the delay between unsuccessful logins is two seconds, then four seconds, then six seconds and so forth.

pwdprompt
Defines the password prompt message printed when requesting password input. The value is a character string.

usernameecho
Defines whether the user name should be echoed on a port. If true, this is the default, the user name echo is enabled. If false, user name echo is disabled. The user name is not echoed at the login prompt and is masked out of security-related messages.

Changes to the /etc/security/login.cfg file can be done by the command **chsec**:

chsec -f /etc/security/login.cfg -s default -a pwdprompt=”Password:”

chsec -f /etc/security/login.cfg -s default -a pwdprompt=”usernameecho=false”

To reset to the default value:

chsec -f /etc/security/login.cfg -s default -a pwdprompt=

Validating the User Environment

- **pwdck** verifies the validity of local authentication information.
  pwdck {-n|-p|-t|-y} {ALL | *username*}
  Verifies that /etc/passwd and /etc/security/passwd are consistent with each other and with /etc/security/login.cfg and /etc/security/user

- **usrck** verifies the validity of a user definition.
  usrck {-n|-p|-t|-y} {ALL | *username*}
  Checks each user name in /etc/passwd, /etc/security/user, /etc/security/limits and /etc/security/passwd. Also, checks are made to ensure that each has an entry in /etc/group and /etc/security/group.

- **grpck** verifies the validity of a group
  grpck {-n|-p|-t|-y} {ALL | *groupname* }
  Verifies that the files /etc/passwd, /etc/security/user, /etc/group and /etc/security/group are consistent

Figure 15-37. Validating the User Environment AU1410.0

Notes:

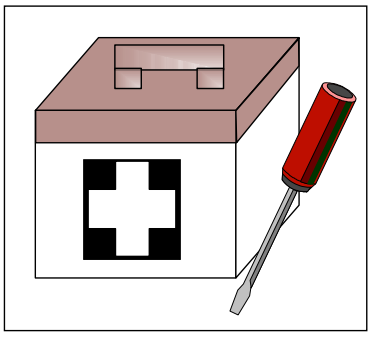
These commands can be executed by **root** or any user in the **security** group to clean up after a change to the user configuration. Because they run with **root** permissions, they give administrative users the ability to make necessary changes to the /**etc**/**security**/**passwd** file in a controlled way, without knowing the **root** password.

The **usrck** command verifies the validity of the user definitions in the user database files, by checking the definitions for ALL the users or for the users specified by the user parameter. You must select a flag to indicate whether the system should try to fix erroneous attributes.

All the options for **pwdck**, **usrck**, and **grpck** are as follows:

-n	reports errors but does not fix them
-p	fixes errors but does not report them
-t	reports errors and asks if they should be fixed
-y	fixes errors and reports them

System Management Services



Utilities

PASSWORD

Figure 15-38. System Management Services AU1410.0

Notes:

The power-on and privileged passwords are security features that help protect the information on a your RS/6000.

These passwords can only be enabled or disabled through the Utilities menus in the System Management Services menus.

To get to the correct screen, boot the SMS programs. Select - **Utilities** -> **Password**.

PCI RS/6000 Passwords

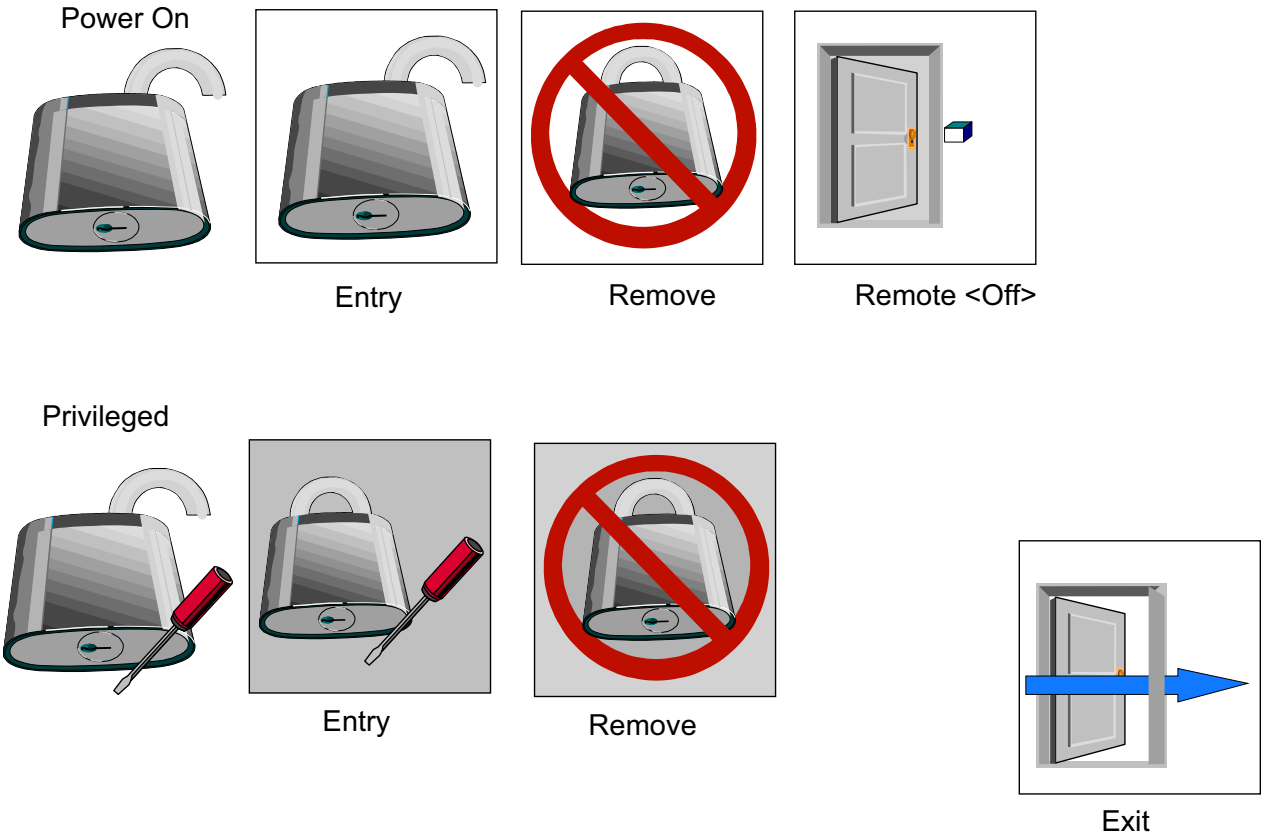


Figure 15-39. PCI RS/6000 Passwords AU1410.0

Notes:

You can use any combination of up to eight characters (A-Z, a-z, and 9-0). After you set a power-on password, you are prompted to enter it each time you power on the system. Before you can use the system, you must type the correct password and press the Enter key.

When you enter the correct password, the system is unlocked and resumes normal operations. If you enter the wrong password, you are prompted to enter the correct one. After three incorrect entries, you must power off the system and start again.

A power-on password can be set only after system power has been turned off and then on again. You cannot set a power-on password after doing a warm system startup.

The supervisory or privileged password protects against the unauthorized use of the System Management Services program. If you forget the supervisory password, there is no way to reset it. Some models of PCI RS/6000 systems allow you to take the covers off the system, remove the ISA/PCI riser, and remove the battery for at least 30 seconds. However, **be careful** as some models require that they be returned to IBM service if the supervisory/privileged password is lost.

Documenting Security Policy and Setup

- Identify the different types of users and what data they will need to access
- Organize groups around the type of work that is to be done
- Organize ownership of data to fit with the group structure
- Set SVTX on shared directories
- Remember that UNIX/AIX has no concept of application ownership

Figure 15-40. Documenting Security Policy and Setup AU1410.0

Notes:

Plan and organize your user and group administration. Every user does not need their own group. Good planning up front reduces any reorganizing of user and groups later on.

Always protect your shared directories by setting the sticky bit. Then users won't be removing each others file accidentally (or on purpose).

Checkpoint (1 of 2)

1. What are the benefits of using the su command to switch user to root over logging in as root?

   _____

   _____

2. Why is a umask of 027 recommended?

   _____

   _____

3. As a member of the security group, which password command would you use? _____

4. Which password change command does SMIT use?

   _____

5. True or false? When you delete a user from the system, all the user's files and directories are also deleted.

Figure 15-41. Checkpoint (1 of 2) AU1410.0

Notes:

Checkpoint (2 of 2)

6. If an ordinary user forgets their password, can the system administrator find out by querying the system as to what the user's password was set to? Why? _____

7. Password restrictions are set in which of the following files?
   a. /etc/passwd
   b. /etc/security/passwd
   c. /etc/security/restrictions
   d. /etc/security/user

8. Which of the following statements are true?
   a. A user can only belong to one group.
   b. A member of the security group can administer user accounts.
   c. An admin user is a user whose account cannot be administered by any member of the security group.
   d. The chmod g + s command sets the SUID permission of a file.
   e. The root user, commonly known as the superuser has UID=0 and GID=0.

Figure 15-42. Checkpoint (2 of 2) AU1410.0

Notes:

Activity: Examine the Security Files

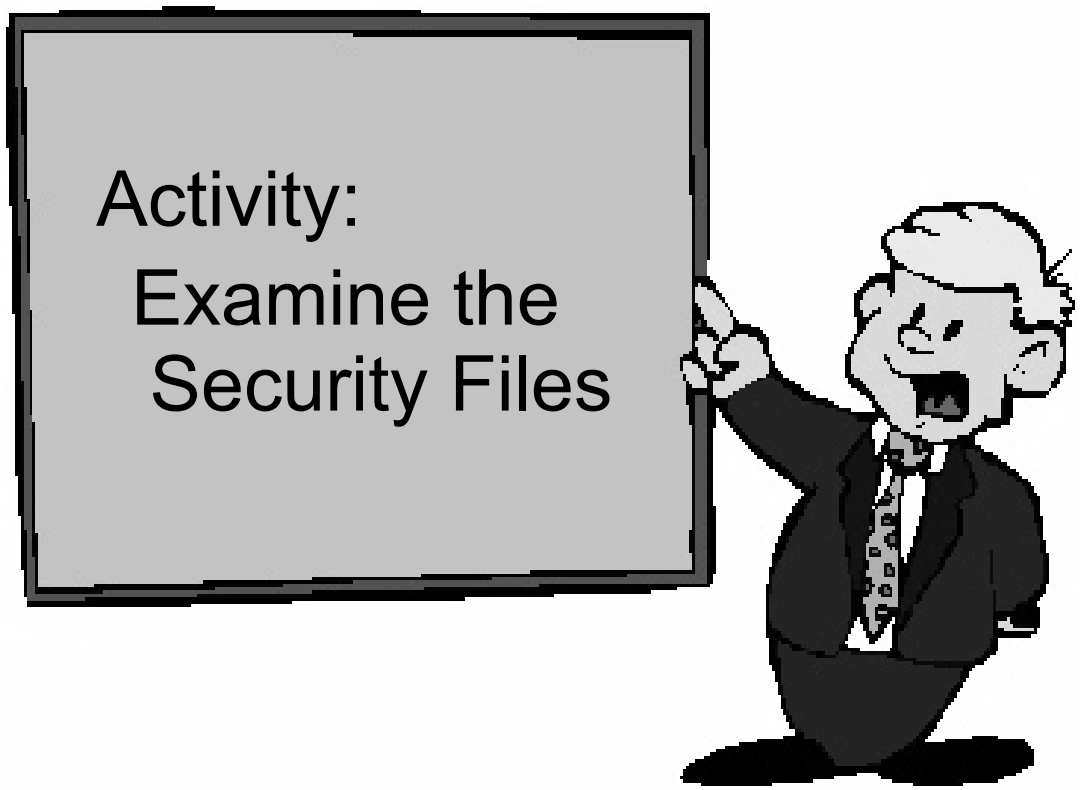


Figure 15-43. Activity: Examine the Security Files AU1410.0

Activity

In this activity, you examine the security files covered in this unit and change your login prompt. If you are sharing your machine with other students, you will need to work together to configure the new login prompt.

Examine the Security Set Up

1. As **root**, examine any of the security files you have not yet seen.

   # more /etc/passwd

   # more /etc/security/passwd

   # more /etc/security/user

   # more /etc/group

   # more /etc/security/group

   # more /etc/profile

   # more /etc/environment

 # more /etc/security/environ

 # who /etc/security/failedlogin

 # who /etc/security/login.cfg

Customizing the Login Herald

2. ONLY ONE PERSON PER MACHINE CAN PERFORM THIS STEP.

   You can customize the login prompt that appears on an individual terminal or customize it so that all terminals use the same login herald depending on what stanza you change in **/etc/security/login.cfg**. In this step, you will set up a global default herald.

   The herald should read:
   . **Your Company Name**
   . **Unauthorized users will be prosecuted**.

   First, make a backup of the **/etc/security/login.cfg** file. If you corrupt this file, you are not able to log in again.

   # cp /etc/security/login.cfg /etc/security/login.cfg.bk

3. Edit the **default** stanza in **/etc/security/login.cfg** and add the herald line.

   # vi /etc/security/login.cfg

default:

sak_enabled = false

logintimes =

logindisable = 0

logininterval = 0

loginreenable = 0

logindelay = 0

herald = "\n\n YOUR COMPANY NAME\r\nUnauthorized users will be prosecuted..\r\nlogin: "

Tip! - Do not use <ENTER> at what looks like the end of the line. Let **vi** wrap the line. The **\r** and **\n** to the <RETURN> and <NEW LINE> for you.

When finished, save the file and log out.

If you are using an ASCII screen, your new herald should be displayed. If you are using CDE, you will not see your changes unless you select the **Option** button and selection **"Command Line"**. If you don't see your new herald, then check your entry in **/etc/security/login.cfg**.

END OF ACTIVITY

Unit Summary

- User and groups can be added and deleted from the system SMIT or by high level commands.
- Passwords must be set for all users either using **pwdadm** or **passwd.**
- Administrative users and groups can only be administered by root.
- Every user must be in at least one group.
- Certain groups give users additional privileges.
- Security files are located in ACSII text files in **/etc** and **/etc/security.**

Figure 15-44. Unit Summary AU1410.0

Notes:

Unit 16. Scheduling

What This Unit Is About

This unit describes how jobs can be scheduled on the system.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Use **crontab** files to schedule jobs on a periodic basis
- Use the **at** command to schedule a job or series of jobs at some time in the future
- Use the **batch** command to schedule jobs in a queue, to alleviate immediate system demand

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise

Unit Objectives

After completing this unit, you should be able to:

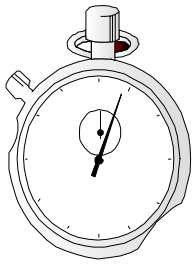
- Use **crontab** files to schedule jobs on a periodic basis
- Use the **at** command to schedule a job or series of jobs at some time in the future
- Use the **batch** command to schedule jobs in a queue, to alleviate immediate system demand

Figure 16-1. Unit Objectives AU1410.0

Notes:

cron Daemon

- Responsible for running scheduled jobs



- Starts:
  - **crontab** command events (regularly scheduled jobs)
  - **at** command events (one time only execution at specified time)
  - **batch** command events (run when CPU load is low)

Figure 16-2. cron Daemon AU1410.0

Notes:

The system process that allows batch jobs to be executed on a timed basis is the **cron** daemon. A lot of people rely on **cron** to execute jobs. Jobs are submitted to the **cron** daemon a number of different ways.

The **at** and **batch** facilities are used to submit a job for one-time execution. **crontab** files are used to execute jobs periodically - hourly, daily, weekly.

cron is usually started at system startup by /**etc**/**inittab**. It runs constantly as a daemon. If killed, it is automatically restarted.

All **cron** events can be configured.

For example, **crontab** events, by default will be inspected every 60 seconds and run at a nice value of two less than the default and there may be up to 100 executing simultaneously.

This may be changed by modifying the /**var**/**adm**/**cron**/**queuedefs** file.

For example, if jobs were to run at a nice value of 10 less than the default with files inspected every two minutes and allow up to 200 jobs allowed, then the following entry should be made to the file:

```
c.200j10n120w
| |    |   |
| |    |   wait period (in seconds)
| |    |
| |    nice value
| |
| jobs
|
cron
```

crontab Files

- Used to start regularly occurring jobs
- Schedule is defined in
  /var/spool/cron/crontabs/ $USER
- Files to control users' crontab privileges

/var/adm/cron/cron.deny	list user who cannot use crontab
/var/adm/cron/cron.allow	list user who can use crontab

- An empty **cron.deny** exists by default

Figure 16-3. crontab Files AU1410.0

Notes:

The **cron** daemon starts processes at specified times. It can be used to control regularly scheduled jobs using files in the /**var**/**spool**/**cron**/**crontabs** directory or it can be used to schedule a command for one-time-only execution using the **at** command.

All users by default have the privilege to set up scheduled jobs to be monitored by **cron**. This is because the file /**var**/**adm**/**cron**/**cron.deny**, which denies privileges to users, is empty. As the administrator, you can restrict access to **cron** by adding user names to this text file.

There is another file that also restricts users privileges - /**var**/**adm**/**cron**/**cron.allow**. To use this file, you should remove **cron.deny** and create the **cron.allow** to list the users that are allow to use cron. If **cron.allow** exists and is empty, NO user is able to use cron - that includes root. If both **cron.allow** and **cron.deny** exist, then **cron.allow** is the file that is used. If neither **cron.allow** or **cron.deny** exist, then only root can use cron.

crontab File

To view current crontab

```
# crontab -l
#
#COMPONENT_NAME: (CMDCNTL) commands needed for
#basic system needs
#
#0 3 * * * /usr/sbin/skulker
#45 2 * * 0 /usr/lib/spell/compress
#45 23 * * * ulimit 5000; /usr/lib/smdemon.cleanu >
/dev/null
0 11 * * * /usr/bin/errclear -d S,O 30
0 12 * * * /usr/bin/errclear -d H 90
```

Format:

```
minute  hour  date-of-month  month  day-of-week  command
```


Figure 16-4. crontab File AU1410.0

Notes:

The crontab file can be view by using **crontab -l**. In this file is the schedule of jobs to run. Each user has their own crontab file located in **/var/spool/cron/crontab/$USER**.

The syntax for the lines in this file is:

minute (0-59)
hour (0-23)
date of the month (1-31)
month of the year (1-12)
day of the week (0-6, where 0=Sunday, 1=Monday, and so forth)

Each field is separated by a space. To indicate a field is always true use an asterisk (*). To indicate multiple values in a field, use a comma (,). A range can also be specified by using a dash (-). Here are some examples:

To start the **backup** command at midnight, Monday through Friday:

0 0 * * 1-5 backup -0 -u -f /dev/rmt0

To execute a command called **script1** every 15 minutes between 8 AM and 5 PM, Monday through Friday:

0,15,30,45 8-17 * * 1-5 /home/team01/script1

Editing crontab

To edit crontab file:

```
# crontab -e
```

Safer method:

```
# crontab -l > /tmp/crontmp

# vi /tmp/crontmp

# crontab /tmp/crontmp
```


Figure 16-5. Editing crontab AU1410.0

Notes:

To schedule a job, you must create a **crontab** file. The cron daemon keeps the crontab files in memory so you cannot update the **cron** entries by just modifying the file on disk.

To edit the file, one method is to use **crontab -e**. This opens up your crontab file with the editor set with the EDITOR variable. Edit the file as you normally would any file. When the file is saved, the **cron** daemon is automatically refreshed.

The **crontab -l** command will always show your file that cron is using. Another method to update the file is to use **crontab -l > mycronfile**. This creates a copy of the current crontab file and allows you to safely edit the **mycronfile** without affecting the current crontab file. To submit your changes, use the command:
crontab mycronfile. The content of the **mycronfile** replaces the content of your file in the **crontab** directory and refresh the cron daemon all at once. Now, you also have a backup of the **crontab** file in **mycronfile**.

Use **crontab -r** if you would like to remove your current crontab file.

The at and batch Commands

- The **at** command submits a uniquely occurring job for cron

```
# at now +2 mins
banner hello > /dev/tty3
<ctrl-d>
job user.time.a will be run at date
```

```
# batch
banner hello > /dev/tty3
<ctrl-d>
```


Figure 16-6. The at and batch Commands AU1410.0

Notes:

The **at** command runs a unique occurring job for **cron** to process. It reads the commands to execute from standard input.

at can only be used by **root** unless one of the following file exists:

- /**var**/**adm**/**cron**/**at.deny**: if this file exists, anybody can use **at** except those listed in it. An empty **at.deny** file exists by default. Therefore, all users can use **at** by default.
- /**var**/**adm**/**cron**/**at.allow**: if this file exists, only users listed can use **at** (root included)

The Bourne shell is used by default to process the commands. If **-c** is specified the C shell is run, and if **-k** is specified the Korn shell is run. If you specify the **-m** option, **at** mails you to say that the job is complete.

The time can be specified as an absolute time or date (for example, **5 pm Friday**), or relative to now (for example, **now + 1 minute**).

The **batch** command submits a job when the processor load is sufficiently low.

Example keywords or parameters that can be used with **at** are: **noon, midnight, am, pm, A** for **am, P** for **pm, N** for **noon, M** for **midnight, today, tomorrow**.

Controlling at Jobs

- To list **at** jobs:
  at -l [*user*]
  atq [*user*]

```
# at -l

root.962649853.a  Mon Jul 3 14:44:13  EDT  2003
root.962649886.a  Mon Jul 3 14:44:46  EDT  2003
adm.962649912.a   Mon Jul 3 14:45:12  EDT  2003
```

- To cancel a job:
  at -r *job*
  atrm [*job* | user]

```
# at -r  adm.962649912.a
The adm.962649912.a   at file is deleted
```

- To cancel all of your jobs:
  atrm -

Figure 16-7. Controlling at Jobs AU1410.0

Notes:

To list **at** jobs use the **at -l** command or **atq**. **root** can look at other user's jobs with **atq *user***.

To cancel a job use **at -r** or **atrm** followed by the job number. Use **atrm -** to cancel all of your jobs. **root** can cancel all jobs for another user using **atrm *user***.

Documenting Scheduling

- Have a copy of user's crontab files
- Have a copy of /etc/inittab

Figure 16-8. Documenting Scheduling AU1410.0

Notes:

Exercise: Scheduling

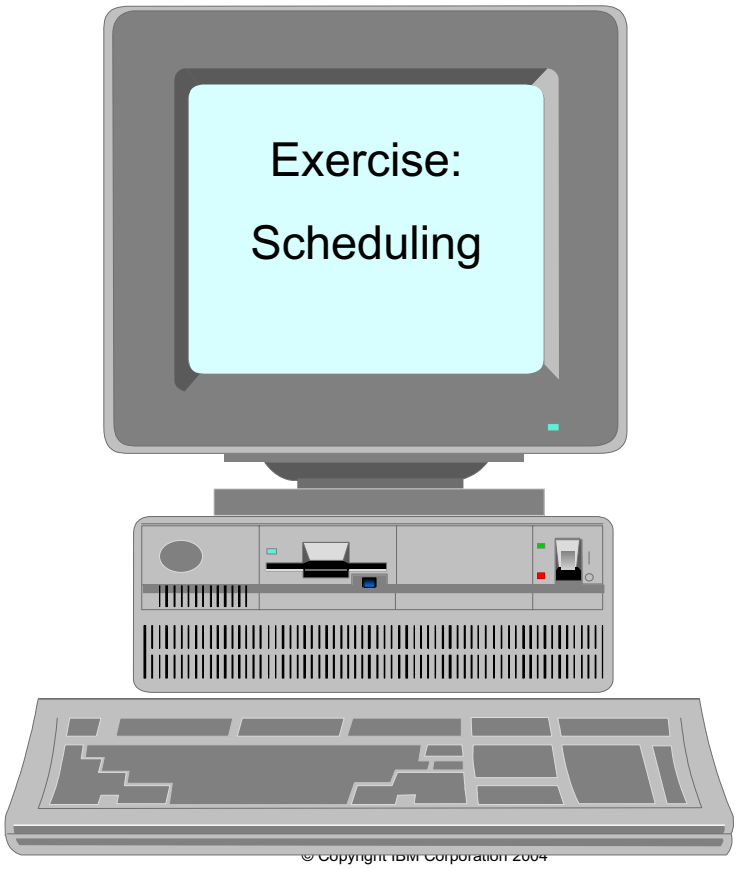


Figure 16-9. Exercise: Scheduling AU1410.0

Notes:

This lab gives you the opportunity to schedule jobs using both at and crontab.

This exercise can be found in your Exercise Guide.

Checkpoint

1. True or false? The **at.allow** and **at.deny** files must be used to specify which users are allowed and denied use of the **at** command.

2. Using **cron**, how would you specify a job to run every Thursday at 10 past and 30 minutes past every hour?

   _____

3. How would you schedule the script "myscript" to run 10 minutes from now?

   _____

Figure 16-10. Checkpoint AU1410.0

Notes:

Unit Summary

- **cron** daemon is responsible for running scheduled jobs.
- **crontab** file holds schedule for recurring jobs.
- The **at** command is used to schedule a command for one time only execution.

Figure 16-11. Unit Summary AU1410.0

Notes:

Unit 17. Printers and Queues

What This Unit Is About

This unit describes the concepts behind the spooling mechanisms in AIX V5.1 and AIX V5.2.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Describe the purpose and the benefits of a queuing system
- Identify the major components that are responsible for processing a print request
- Add a printer queue and device under different circumstances
- Submit jobs for printing
- View the status of the print queues

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Exercise

References

GG24-3570	*Printing for Fun and Profit Under AIX V5L*
Online	*AIX System Management Guide: Operating System and Devices*
Online	*AIX Guide to Printers and Printing*

Unit Objectives

After completing this unit, you should be able to:

- Describe the purpose and the benefits of a queuing system
- Identify the major components that are responsible for processing a print request
- Add a printer queue and device
- Submit jobs for printing
- Manage jobs in the queue

Figure 17-1. Unit Objectives AU1410.0

Notes:

AIX 5.2 Printing Environments

- Print subsystems
  - AIX print subsystem
  - System V print subsystem
- Print directly to local printer device
- Print directly to a remote printer via a socket program
- Infoprint Manager (or similar advanced print management system)

Figure 17-2. AIX 5.2 Printing Environments AU1410.0

Notes:

Introduction

The slide gives an overview of the different approaches that can be taken to printing under AIX 5.2. In the next two slides, we compare System V printing to the traditional AIX print subsystem. The remainder of this unit will focus on using the AIX print subsystem.

Note: You can use either the AIX print subsystem or the System V print subsystem. They will not run concurrently.

Print directly to a local printer device

This is the simplest form of printing. If your printer is directly attached to a serial or parallel port on the local machine, it is possible to print by just sending a file directly to the device. For example:

```
# cat /home/karlmi/myfile > /dev/lp02
```

In this approach, you lose the ability to serialize (spool) print requests. Only one user may print at a time. On the other hand, if a printer is being dedicated to one use, this may be a good solution. Examples might be logging to a printer or printing checks.

Print directly to a remote printer via a socket program

This is similar to printing to a device driver, except that in this case, you are sending the output to a program which makes a connection to the printer over the network.

Print using the System V print subsystem

In this environment, files to be printed are sent to the System V print service daemon (`lpsched`) using the `lp` or `lpr` commands. The print service daemon serializes the jobs so they will be printed in the order in which they were submitted. The print service may filter the file to format the data so that it matches the types of data acceptable to the printer. The print service then sends files, one at a time, to the interface program, which may do additional filtering before sending the file to the local printer driver or network printing application.

Print using the AIX print subsystem

In this environment, files to be printed are sent to the AIX print spooler daemon (`qdaemon`) using any of the AIX print commands (`enq`, `qprt`, `lp`, or `lpr`). The spooler daemon serializes the jobs. The spooler sends jobs, one at a time, to back-end programs that may filter the data and before sending it to the local printer driver or network printing application.

Print using IBM's Infoprint Manager (or similar advanced print management system)

Infoprint Manager provides serialization and filtering similar to the System V or AIX print subsystems. In addition, it adds extra capabilities of security, customization, and control not provided by either System V printing or AIX printing. For additional information, refer to the Infoprint Manager Web site:
`http://www.printers.ibm.com/R5PSC.NSF/Web/ipmgraixhome`

AIX Print Subsystem: Advantages

- Powerful and flexible printer drivers
- System management tools
  - Limits fields and options validation
  - Easy printer customization
  - Single step print device and queue creation
- Customizable spooling subsystem

Figure 17-3. AIX Print Subsystem: Advantages AU1410.0

Notes:

Powerful and flexible printer drivers

AIX printer drivers provide many printing options that can be easily controlled using command line options to the `qprt` command. Printer defaults can be easily managed using SMIT or the command line.

System management tools

The AIX print subsystem includes mature and powerful system management using either WebSM or SMIT, as well as the command line. Some specific system management advantages using the AIX print subsystem are:

- Limits fields and options validation

  Limits fields give the user or administrator a range of valid values for print options and prevent the user from using an invalid value.

- Easy printer customization

Printers can be customized using menu selections or command line options. Under System V printing, customizing printers often requires a knowledge of shell programming.

- Single step print device and queue creation

  Under System V printing, you must first add a print device and then create the print queue.

Customizable spooling subsystem

The AIX print subsystem is specifically designed so that it can be used to serialize other types of jobs beyond just printing.

System V Print Subsystem: Advantages

- Compatibility
- Availability of interface programs
- Security
- Support for forms
- Standard PostScript filters
- Long term strategy

Figure 17-4. System V Print Subsystem: Advantages AU1410.0

Notes:

Compatibility

System administrators with experience in other UNIX variants that use System V printing will find it easy to manage printing under AIX's System V print subsystem.

Availability of interface programs

Many printer manufacturers provide interface shell scripts to support using their products under System V printing. Usually only minor modifications are required for individual UNIX variations. Because the AIX print subsystem is proprietary, an interface program written for another operating system cannot be used in the AIX print subsystem. It must be completely rewritten. This has led to a limited number of printers supported under AIX. With the support of System V printing in AIX V5.1 and AIX V5.2, it is easier for manufacturers to include support for AIX printing.

Security

Controlling user access to printers can be an important issue. For example, you might need to limit access to the printer used to print checks. System V printing includes built-in capabilities for restricting user access to certain printers. Using the AIX print subsystem, the back-end program must be customized to restrict user access.

Support for forms

If you are printing to preprinted forms, it's important that other users not be able to print while the expensive forms are loaded on the printer. The System V print subsystem provides a mechanism for mounting forms on printers and allowing or denying user access based on the form which is mounted. To provide this capability under AIX printing, you must create multiple queues and manage which queues are enabled while a form is mounted.

Standard PostScript filters

The System V print subsystem includes a number of filters for converting a number of different file formats to PostScript. Some formatting and page selection capabilities are also included.

Long term strategy

IBM's long term printing strategy for AIX is to maintain compatibility with other UNIX systems. This means that new features and functions are added to the System V print subsystem in later releases, while the AIX print subsystem is supported, but not enhanced in future releases.

Concepts of Queues

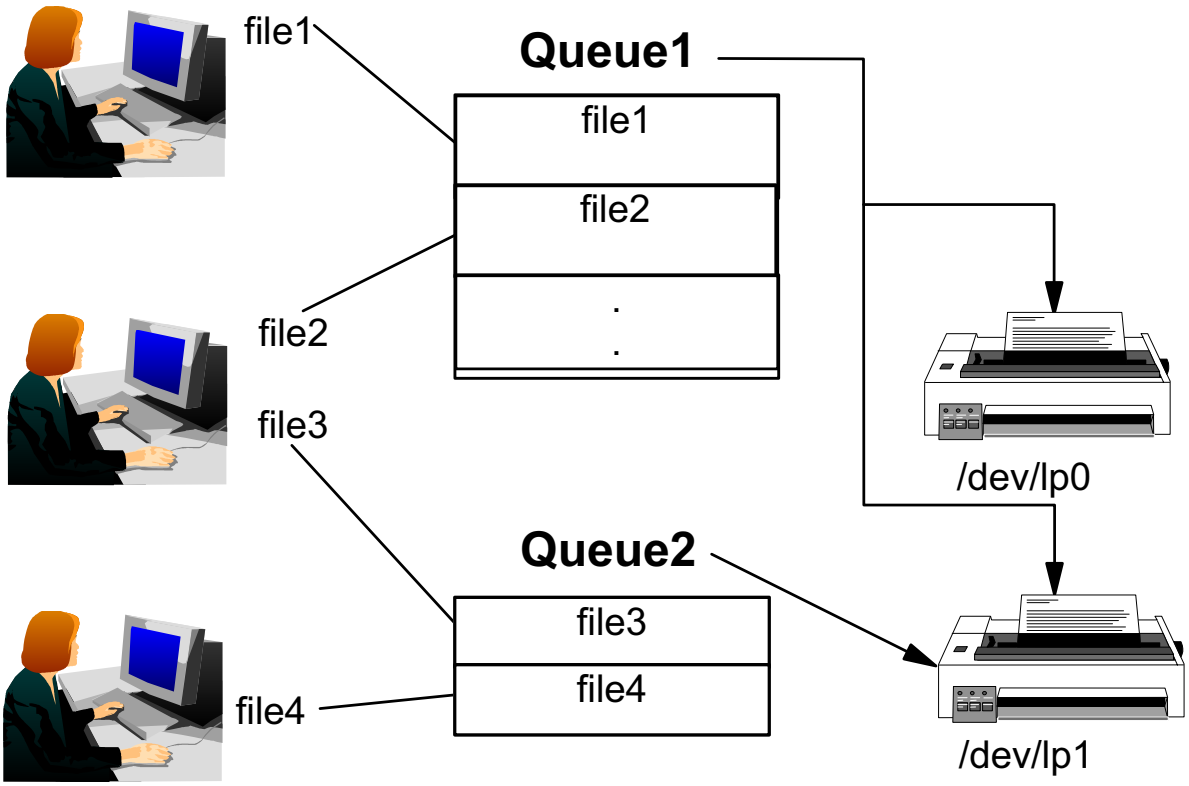


Figure 17-5. Concepts of Queues AU1410.0

Notes:

The purpose of the queuing system is to maintain a queue of jobs that are waiting for their turn to run (that is, use some system resource, like a printer or the CPU). The AIX Version 5.1 queuing system performs this function.

The queues also give control to the system administrator over the queuing mechanism. Therefore, the system administrator can perform tasks like cancelling jobs on queues, changing priorities of jobs, and so forth.

A queue enables the sharing of resources in an ordered fashion.

The diagram above illustrates three important issues:

- One print queue can point to a number of printers (and it is the job of the **qdaemon** to determine the next available printer to print on), for example, Queue1.
- Users may submit their jobs to a number of different queues.
- A printer can have a number of different queues pointing to it, for example, the printer **/dev/lp1** is accessed by both Queue1 and Queue2.

Printer Data Flow

 # qprt -Pps [-c] file

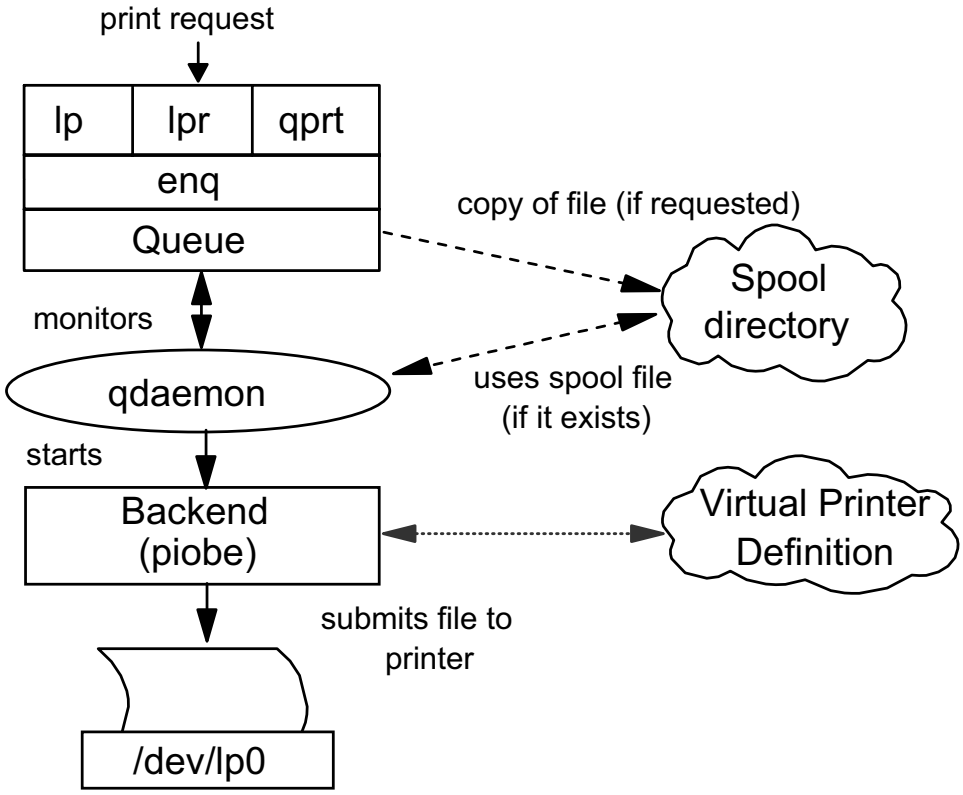


Figure 17-6. Printer Data Flow AU1410.0

Notes:

Local printing is implemented through a queuing mechanism. The user can issue one of the printer commands **qprt, lp, lpr,** or **enq** to submit a print job. Although a user can use any one of these four commands, the true entry point to the spooler is the **enq** command which is responsible for processing the job request, creating a job description file (JDF) and notifying the **qdaemon** of the new job.

The **qdaemon** process is running all of the time. The **qdaemon** maintains a list of all of the defined queues and monitors the queues for newly submitted jobs. **qdaemon** tries to process the job if the destination device is available, otherwise the job remains in the queue and **qdaemon** tries again later.

The flow of the queuing system shown:

- The printing command calls **enq**. **enq** checks to see if the queue name desired is a valid queue and all of the parameters are correct. If so, it continues, if not, an error message is returned to the user.

- An entry is made in the /**var**/**spool**/**lpd**/**qdir** directory identifying the job to be run. If the printer command uses an option to indicate that a copy of the file is to be made, the copy is placed in the spool directory /**var**/**spool**/**qdaemon**.
- The **qdaemon** is notified of a new job in its **qdir** directory.
- When the queue is ready for the job, the **qdaemon** reads information from the /**etc**/**qconfig** file describing the queue.
- The **qdaemon** updates the /**var**/**spool**/**lpd**/**stat** file for the appropriate queue to show that the queue is now working on a new job.
- The **qdaemon** starts the backend program passing the file names and appropriate options on the command line.
- The back end determines the correct data stream characteristics and merges these with the actual file. The data stream characteristics are stored as **virtual printer definitions** in the /**var**/**spool**/**lpd**/**pio**/**@local** directory.
- The back-end program sends its data stream to the device driver for the appropriate printer.

When a file is spooled, a copy of that file is sent to the print spool directory, /**var**/**spool**/**qdaemon**. The copy will remain in that directory until it is printed. This means that if you spool a file to the printer, a user could continue to make revisions to the original since the copy in the print spool directory will not be altered. This ensures that the file that is sent to the printer gets printed in its original form, even if a user edits the original file that is on disk. Spooled files will take up disk space in /**var** until they are printed.

When a file is queued, one line of information is sent to the /**var**/**spool**/**lpd**/**qdir** directory which points back to the original file on disk. If revisions are made to the file on disk before it is pulled from the queue to print, the revised file is printed.

System Files Associated with Printing

/etc/qconfig	queue configuration files
/var/spool/*	spooling directories
/var/spool/lpd/qdir/*	queue requests
/var/spool/qdaemon/*	temporary enqueued files
/var/spool/lpd/stat/*	line printer status information
/var/spool/lpd/pio/@local	virtual printer directories

Figure 17-7. System Files Associated with Printing AU1410.0

Notes:

The /**etc**/**qconfig** file describes the queues and devices available for use by the printing commands.

The /**var**/**spool** directory contains files and directories used by the printing programs and daemons.

The /**var**/**spool**/**lpd**/**qdir** directory contains information about files queued to print.

The /**var**/**spool**/**qdaemon** directory contains copies of the files that are spooled to print.

The /**var**/**spool**/**lpd**/**stat** directory is where the information on the status of jobs is stored. It is used by the **qdaemon** and backend programs.

The /**var**/**spool**/**lpd**/**pio**/**@local** directory holds virtual printer definitions. This is where the attributes of printers are paired with the attributes of corresponding data stream types.

It is recommended that SMIT be used to update these device-related files. In most cases, updating standard system files is not recommended.

qdaemon

- **qdaemon** manages queues
- Started in the **/etc/inittab** file
- Invokes the back-end programs
- Optionally records accounting data

Figure 17-8. qdaemon AU1410.0

Notes:

The **qdaemon** program schedules jobs that have been enqueued.

It is a background process that is usually started at system IPL via the **startsrc** command run from /**etc**/**inittab**.

qdaemon is controlled by the /**etc**/**qconfig** file. /**etc**/**qconfig** contains a stanza for each queue. The stanza identifies any queue management options and points to a queue device stanza which identifies the destination printer, the formatting options, and the backend program. The backend program is called by **qdaemon** to actually process each request. The backend program is determined by how the printer is connected to the RS/6000. For local printing the backend program is /**usr**/**lib**/**lpd**/**piobe.** For a remote printer, it is /**usr**/**lib**/**lpd**/**rembak**.

The **back-end** program uses printer attribute information to prepare the printer and format the data for output. It will also print header and trailer pages if they are enabled.

The /etc/qconfig File

```
lp0:            device = lp0dev                 * 1 queue pointing to 1 device
                up = TRUE
                discipline = fcfs
lp0dev:
                file = /dev/lp0
                backend = /usr/lib/lpd/piobe
                header = group
                trailer = never
                feed = never

lpq:                                            * 1 queue pointing to 2 devices
                device = lpqdev1, lpqdev2
lpqdev1:
                file = /dev/lp1
                backend = /usr/lib/lpd/piobe
lpqdev2:
                file = /dev/lp2
                backend = /usr/lib/lpd/piobe

ps:                                             * 2 queues pointing to 1 device
                device = psdev
psdev:
                file = /dev/lp3
                backend = /usr/lib/lpd/piobe
asc:
                device = ascdev
ascdev:
                file = /dev/lp3
                backend = /usr/lib/lpd/piobe
```

Figure 17-9. The /etc/qconfig File AU1410.0

Notes:

The /**etc**/**qconfig** file is the key to customizing the queues. Although the file can be edited directly, it is recommended it be changed through high-level commands or via SMIT.

The /**etc**/**qconfig** file contains two types of stanzas:

- **Queue stanza**
  This starts with the queue name, which can be up to 20 characters, followed by a colon. The queue name is used by the person submitting a job to indicate the desired queue. The first queue in the /**etc**/**qconfig** file is the default queue, which receives any job requests submitted without a specific queue name. A queue stanza points to a device stanza via the *device*= attribute in the queue stanza.

Attributes that can be found in the queue stanza include:

	Default:	Other:
discipline	fcfs	sjn
acctfile	false	file name
up	TRUE	FALSE

- **Queue Device stanza**
  This starts with the device stanza name, which can be up to 20 characters, followed by a colon.

  Attributes that can be found in the device stanza include:

	Default:	Other:
access	write	both (used for modems or backends needing read capability)
header	never	always group
trailer	never	always group
feed	never	integer
align	FALSE	TRUE

The device stanza must contain an attribute that designates the **backend** program. It may also have an attribute that specifies the pathname of the logical device that serves the queue with which this device stanza is associated.

The function of the **backend** is to manage the printing of the actual job. It also produces the final data stream that goes to the printer. The most common **backend** program for local printing is **piobe**.

If different users desire different default printers, then the PRINTER variable can be set up on a per user basis. The PRINTER variable should be set to the queue that the user wishes to be their own default queue for example:

 # PRINTER=ps ; export PRINTER

Printer Menu

smit spooler_choice

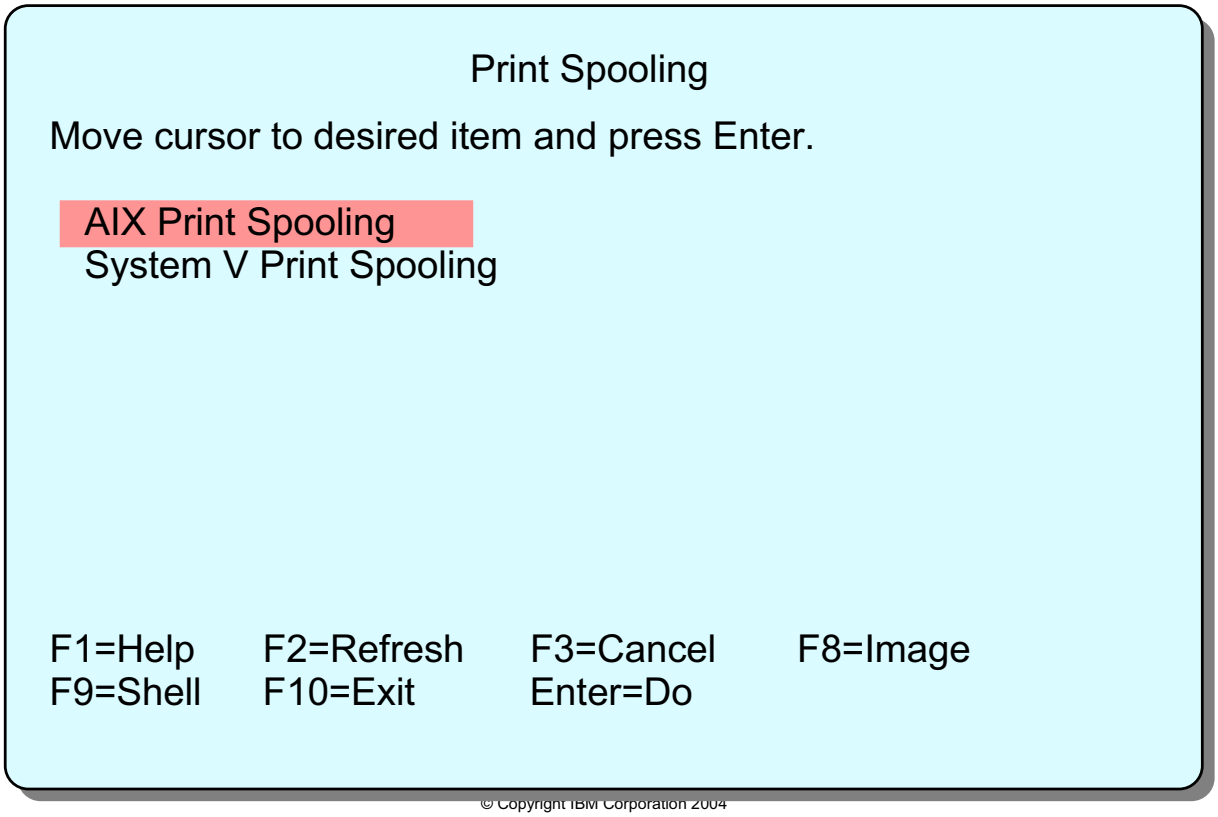


Figure 17-10. Printer Menu AU1410.0

Notes:

AIX Print Spooling as well as System V Print Spooling are supported by SMIT in AIX V5.2. and also WebSM supports both Print Spooling systems.

AIX Printer Menu

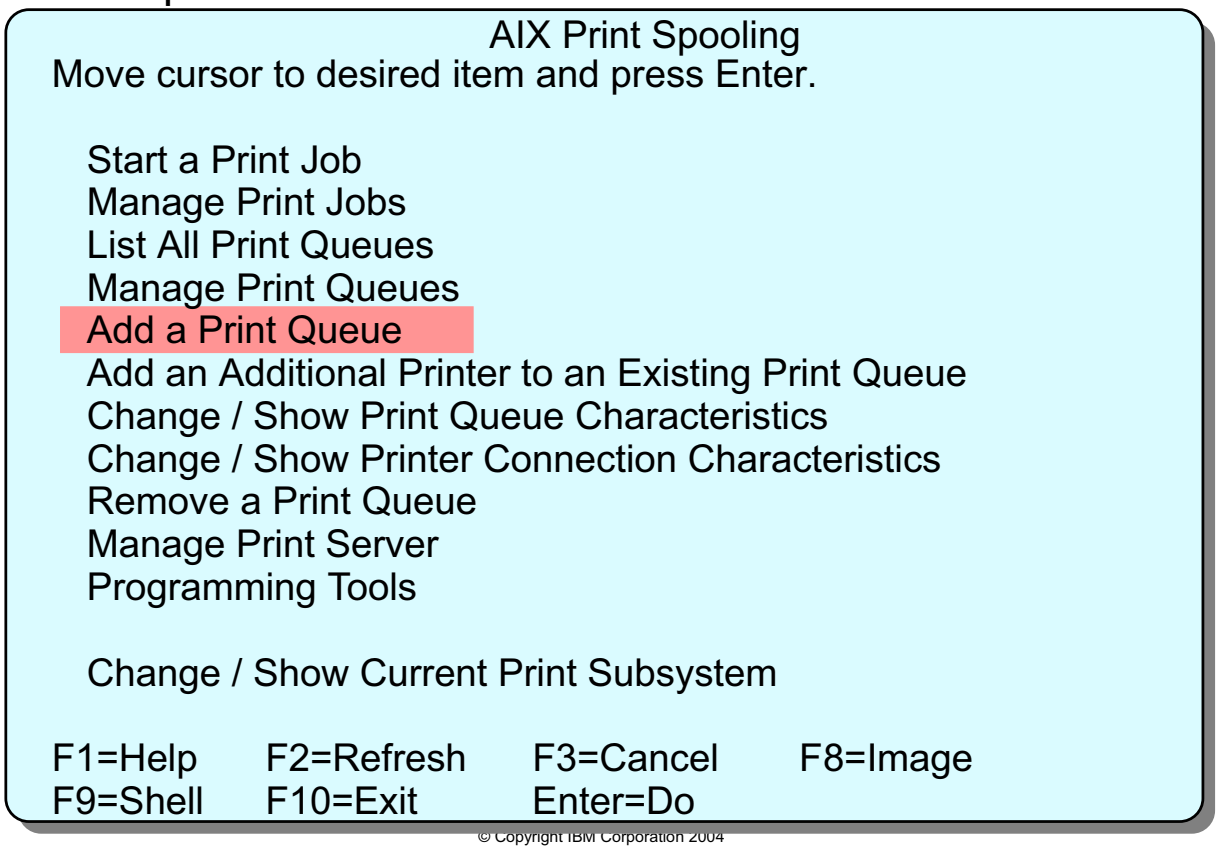


Figure 17-11. AIX Printer Menu AU1410.0

Notes:

Start a Print Job
This option starts a print job by submitting the job to a print queue.

Manage Print Jobs
This option puts you into a submenu which allows you to cancel jobs, show the status of jobs, prioritize jobs, hold and release jobs, and move jobs between print queues.

List All Print Queues
This displays a list of all the print queues and their associated printers.

Manage Print Queues
You can start and stop print queues, show the status of print queues and change the system's default print queue.

Add a Print Queue
This option adds a print queue to the system configuration and creates the associated queue device and printer device definition, if needed.

Add an Additional Printer to an Existing Print Queue
Adds another printer to an existing queue.

Change/Show Print Queue Characteristics
This option will provide access to screens that allow you to change the printer setup, default print job attributes, accounting file setup, and queuing discipline.

Change/Show Printer Connection Characteristics
Changes or shows printer communication and startup characteristics.

Remove a Print Queue
Removes a Print Queue from the system configuration. It also removes the associated spooler queue device and printer device definition. If a print queue has more than one printer associated with it, then all the printers are removed from the print queue.

Manage Print Server
Configures this machine as a print server. Allows you to control which clients have print access to this machine, list clients with print access, add and remove clients, and stop and start the server subsystem.

Programming Tools
Low-level utilities for manipulating databases and filters.

Change/Show Current Print Subsystem
Only one of the two print subsystems at the same time can be active. Per default after installation the AIX printer subsystem is active.

To show current print subsystem
switch.prt -d

To change current print subsystem
switch.prt -s AIX

or

switch.prt -d SystemV

To check if binaries are correct linked
ls -l /usr/bin/lpstat
/usr/bin/lpstat --> /usr/aix/bin/lpstat

or

/usr/bin/lpstat --> /usr/sysv/bin/lpstat

Printers and print queues can also be managed using the Web-based System Manager. To do so, use the fastpath **wsm printers**.

Configuring a Printer with a Queue

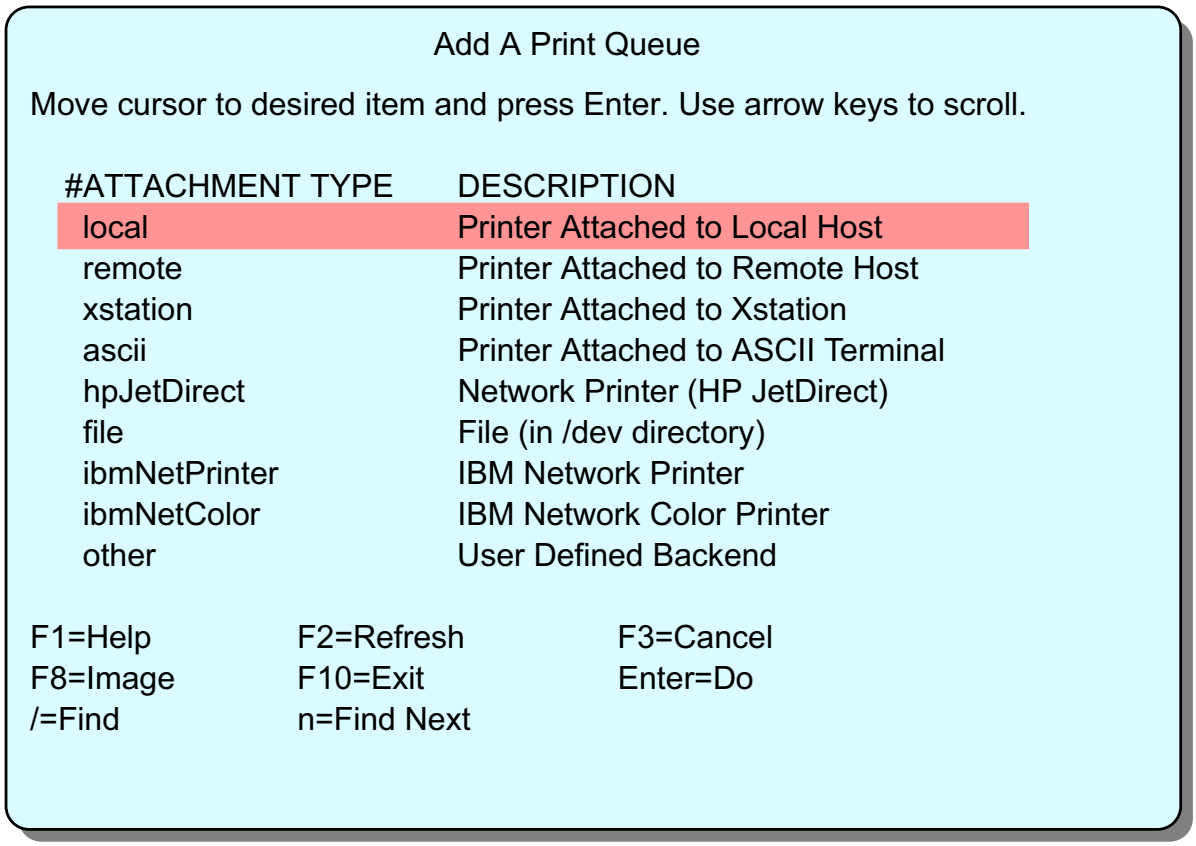


Figure 17-12. Configuring a Printer with a Queue AU1410.0

Notes:

In our example, assume that the printer is directly attached to our RS/6000 system. To configure a printer attached in this way, choose **local**.

Some applications contain their own print control mechanisms and thus require that a printer be configured without a queue. Use the SMIT fastpath **smit pdp** to define a printer without a queue.

Selecting a Printer Type

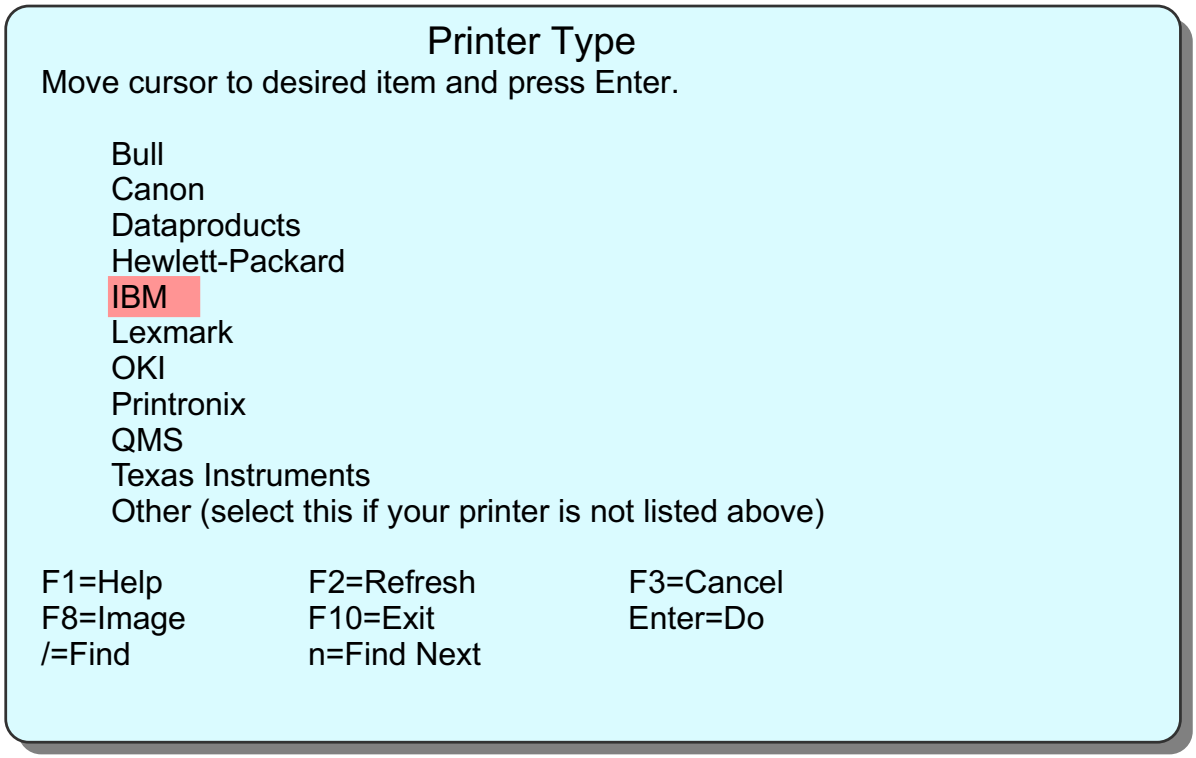


Figure 17-13. Selecting a Printer Type AU1410.0

Notes:

Selecting a Printer Type

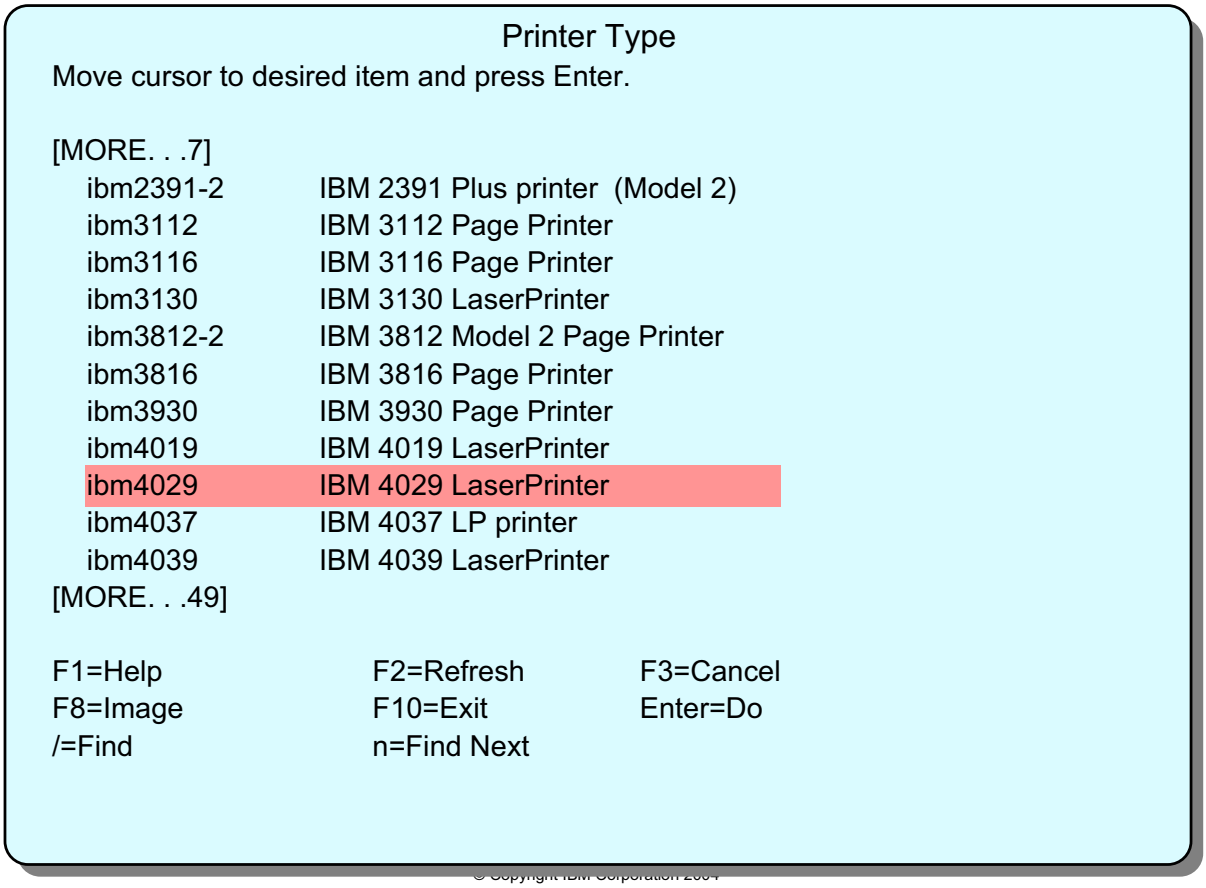


Figure 17-14. Selecting a Printer Type AU1410.0

Notes:

If you do not have the software installed for your printer, you are prompted to insert the media to install the software first before configuring the device and the queue.

The choice of printer determines the queue (or the virtual printer) setup. For example, an IBM 4029 Laser Printer is capable of handling PostScript, ASCII, GL Emulation and PCL Emulation. The SMIT print spooling menus guide you through the creation of up to four separate queues which submit to the same printer.

Printer Attachment

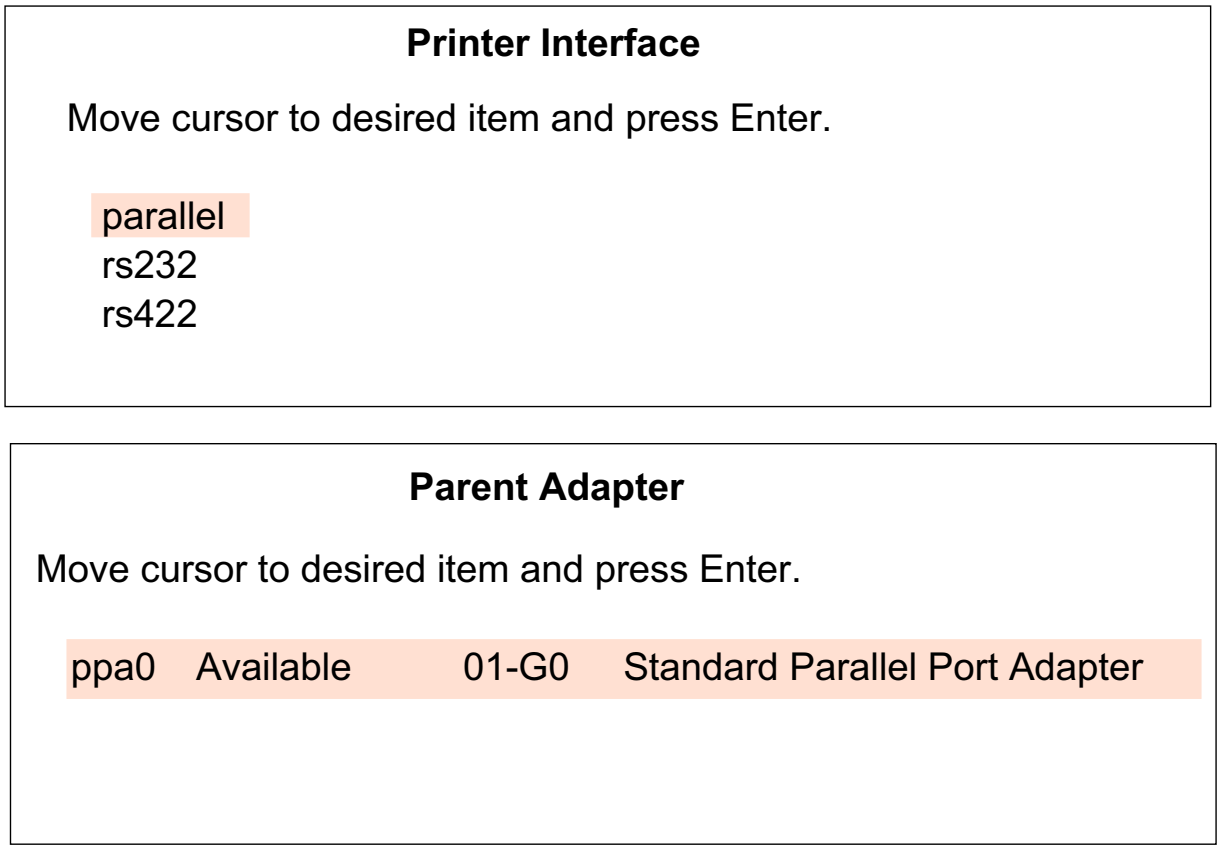


Figure 17-15. Printer Attachment AU1410.0

Notes:

If the device driver is not already installed, SMIT prompts you to install the driver first before carrying on with the configuration.

After selecting a printer type, a pop-up window is displayed where the printer interface must be chosen. Possible values are parallel, RS232 and RS422. Some printers support multiple attachment methods.

Then, a list of installed adapters that support that method of attachment is presented.

Add the Print Queues

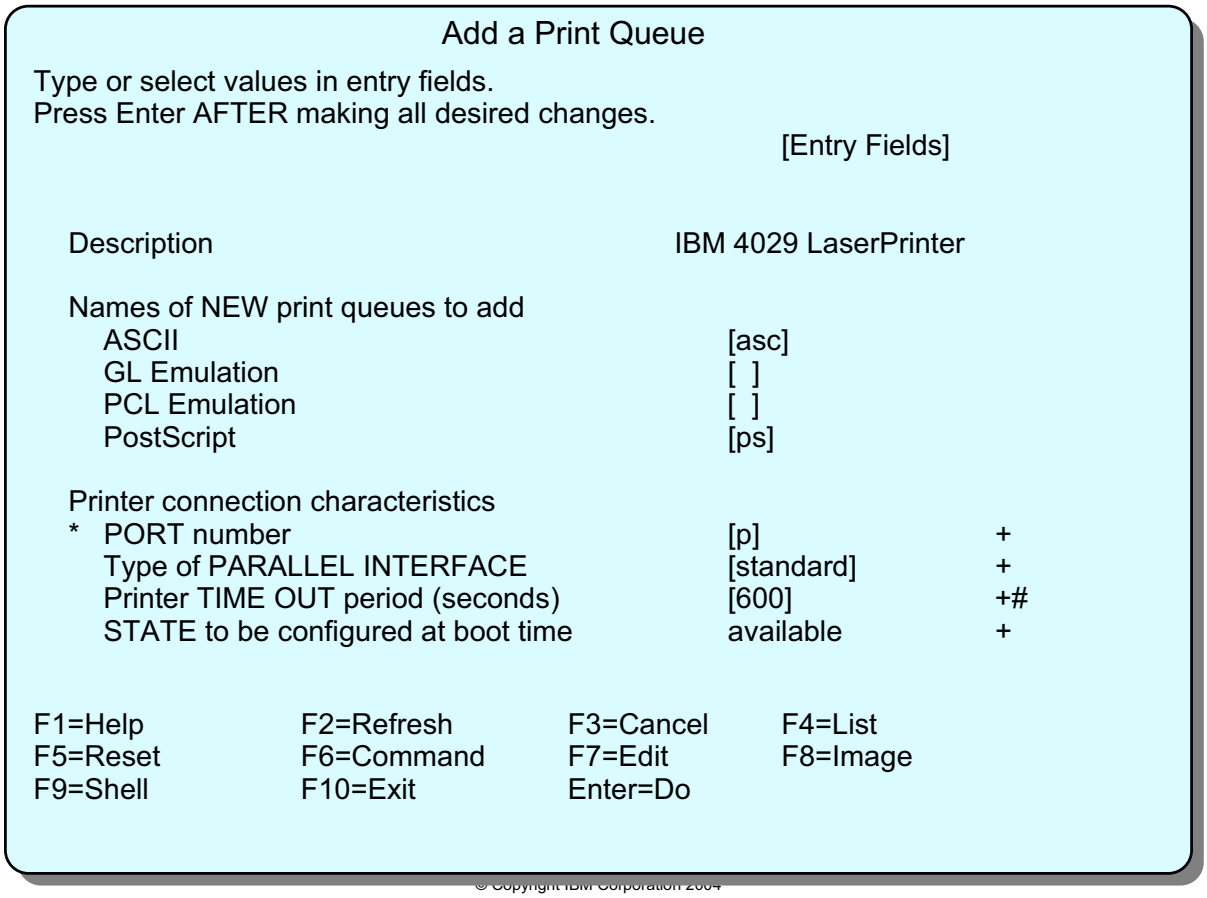


Figure 17-16. Add the Print Queues AU1410.0

Notes:

This menu varies depending on the characteristics of the physical printer. If the printer is capable of two or three different modes or emulations the system prompts you for a separate queue name for each emulation. Once these queues are created, they are sometimes referred to as virtual print devices.

Additional queues can be added to this printer after the initial queues are created.

Remote Printing

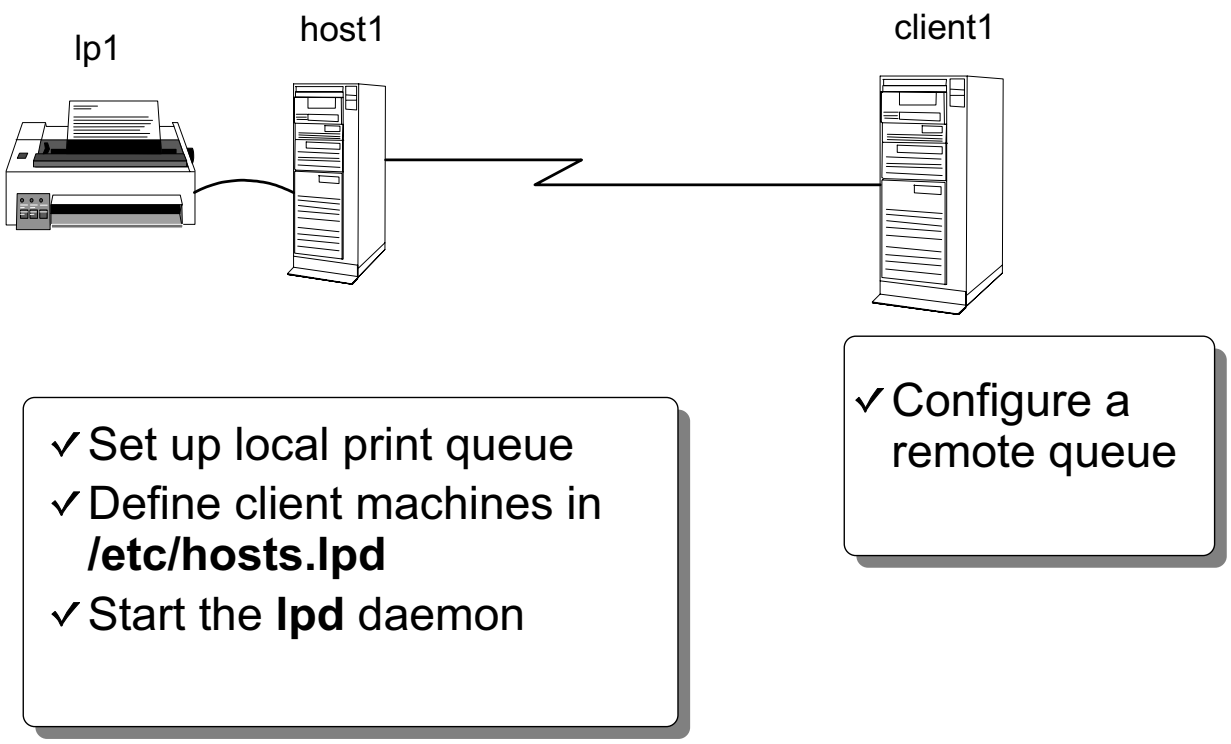


Figure 17-17. Remote Printing AU1410.0

Notes:

Once your system has the local queue set up, any user on that system can print. If the machine is networked, it can also provide printing for client machines by becoming a print server.

To set up a print server, you need to define the client machine names or IP addresses in /**etc**/**hosts.lpd** and then start the **lpd** daemon. Both of these tasks can be done through SMIT. To use SMIT, the fastpath to identify the client system is **smit mkhostslpd**.

The **lpd** daemon is controlled by SRC. You should use SMIT to start it however, because SMIT will also add entries to /**etc**/**inittab** to ensure that it is started on reboot. The fastpath for this screen is smit **mkitab_lpd**.

Client Authorization

smit mkhostslpd

```
                Add Print Access for a Remote Client

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                [Entry Fields]
* Name of REMOTE CLIENT                           [client1]
 (Hostname or dotted decimal address)

F1=Help       F2=Refresh      F3=Cancel       F4=List
F5=Reset      F6=Command      F7=Edit         F8=Image
F9=Shell      F10=Exit        Enter=Do
```


Figure 17-18. Client Authorization AU1410.0

Notes:

This step is done on the print server. On this screen, enter the client machine's name or IP address. A plus sign (+) is also valid. It indicates that this RS/6000 is a print server to all machines.

Start lpd

smit mkitab_lpd

```
                Start the Print Server Subsystem

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                    [Entry Fields]
 Start subsystem now, on system restart, or both       [both]       +
 TRACE lpd daemon activity to syslog?                  [no]         +
 EXPORT directory containing print attributes?         [no]         +

 Note:
 Exporting this print server's directory containing its
 print attributes will allow print clients to mount the
 directory. The clients can use this server's print attributes
 to display and validate print job attributes when starting
 print jobs destined for this print server. Note that the
 Network File System (NFS) program product must be installed
 and running

F1=Help      F2=Refresh      F3=Cancel       F4=List
F5=Reset     F6=Command      F7=Edit         F8=Image
F9=Shell     F10=Exit        Enter=Do
```


Figure 17-19. Start lpd AU1410.0

Notes:

This step is done on the print server. The **lpd** daemon is controlled by the system resource controller (SRC). The commands **startsrc** and **stopsrc** can be used to control **lpd**. By using SMIT, an entry is placed in the /**etc**/**inittab** file to ensure that **lpd** is started each time the machine is booted.

Add a Remote Print Queue

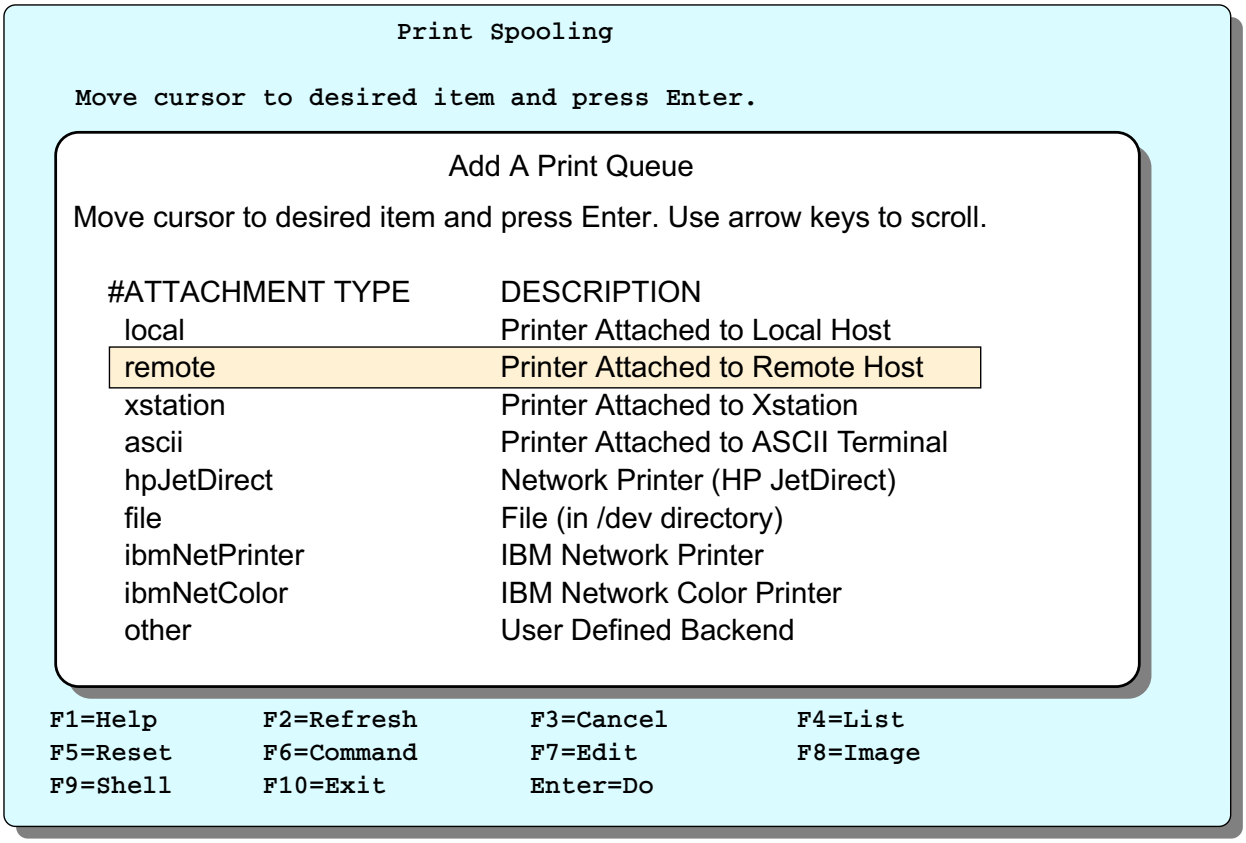


Figure 17-20. Add a Remote Print Queue AU1410.0

Notes:

This step is done on the client machine. The procedure to add remote queue starts the same way as a local queue: **smit spooler -> Add a Print Queue**. This time select **remote** as the attachment type.

You will be prompted to determine if you want to perform any type of filtering or pre-processing to the print job before it is sent. Normally, **Standard Processing** is selected. This just sends the job to the printer server and the print server is responsible for processing the job.

Define the Print Server on the Client

```
                Add a Standard Remote Print Queue

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                       [Entry Fields]
 *Name of QUEUE to add                       [rq1]
 *HOSTNAME of remote server                  [host1]
 *Name of QUEUE on remote server             [lp1]
  Type of print spooler on remote server   AIX Version 3 or 4 +
  Backend TIME OUT period (minutes)         []                  #
  Send control file first?                  no                  +
  TO turn on debugging, specify output      []
   file pathname
  DESCRIPTION of printer on remote server   []

F1=Help      F2=Refresh      F3=Cancel       F4=List
F5=Reset     F6=Command      F7=Edit         F8=Image
F9=Shell     F10=Exit        Enter=Do
```


Figure 17-21. Define the Print Server on the Client AU1410.0

Notes:

Only three lines are required to complete the queue set up. You must name your local (to the client) queue name. Then, provide the name of the printer server. Lastly, name the queue on the print server.

Let's Review

Figure 17-22. Let's Review AU1410.0

Notes:

1. T or F The qdaemon is responsible for printing jobs.
2. To set up remote printing, what daemons are needed and do they run on the server, the client or both?
3. What does the **up = TRUE** indicate in the /**etc**/**qconfig** file?
4. What does **discipline** mean in reference to the /**etc**/**qconfig** file? What are its possible values?

Submitting Print Jobs

- AIX print systems offer compatibility to System V print commands
- To submit a job to a queue:

System V	BSD	AIX
lp	**lpr**	**qprt**

$ lp -d *queuename filename*

- OR-

$ qprt -P *queuename filename*

Figure 17-23. Submitting Print Jobs AU1410.0

Notes:

There are three sets of commands for submitting, listing and cancelling print jobs. They come from either System V, BSD or IBM versions of UNIX and are all available in AIX. The commands have slightly different options.

To submit a print job to a queue, use either **lp**, **lpr**, or **qprt**. All jobs will go to the system default queue unless the **PRINTER** or **LPDEST** variables are set. You can also specify, on the command line, which queue to use. Use **-d** with **lp** or use **-P** with **qprt** and **lpr**.

The commands **lp** and **qprt** both queue without spooling by default. Specify the **-c** option if spooling is desired. The command **lpr** spools and queues by default. The **-c** option will turn off spooling with **lpr**.

To print multiple copies, with **qprt** use the **-N** # option, with **lp** use **-n** # option, and with **lpr** use just a dash followed by the number of copies (- #).

The **lp, lpr** and **qprt** commands create a queue entry in /**var**/**spool**/**lpd**/**qdir** and (depending upon the options specified) copy the file to be printed to the /**var**/**spool**/**qdaemon** directory.

All the print commands, **lp, lpr,** and **qprt**, actually call the **enq** command which places the print request in a queue. **enq** can be used instead of the other commands to submit jobs, view job status, and so forth. To submit a job using **enq**:

$ enq -Pqueuename filename

Ordinarily your request is serviced by the first device on the queue that becomes available. However, if more than one printer services a queue, you can request a specific printer by using the name of the queue followed by a colon (:) and then the name of the printer. For example, if a system with one queue (ps) is serviced by two printers (lp0 and lp1) and a print job needs to be printed on the lp1 printer, use the command:

$ qprt -Pps:lp1 /home/team01/myfile

Listing Jobs in a Queue

- To list jobs in a queue:

SYSTEM V	BSD	AIX
lpstat	**lpq**	**qchk**

For example:

```
$ qchk
Queue Dev   Status  Job   Files  User  PP    %  Blks Cp  Rnk
ps    lp0   DOWN
            QUEUE   569   /etc/motd  root       1   1    1
```


Figure 17-24. Listing Jobs in a Queue AU1410.0

Notes:

Many of the print job control tasks require the user to supply a job number. The job number, along with other queue status information is available by checking the status of print jobs.

The fields from the **qchk** command are as follows:

Queue	Queue name
Dev	Logical device name for the queue
Status	Status of the queue (READY, DOWN, WAITING, RUNNING, and so forth)
Job	The job number assigned by the qdaemon
Files	Files sent to the queue
User	User who sent the print request
PP	Number of pages printed
%	Percent completed
Blks	The number of 512-byte blocks the print job has been split into

Cp	Copies of each job to be printed
Rnk	Order on that queue

Other commands that can be used to view printer status include:

lpstat	Shows status of all queues
lpq	Shows status of the default queue
qchk -A	Shows status of all queues
enq -A	Shows status of all queues
qchk -W	Shows status in wide-form mode. This is helpful if using long queue and device names, and 6-digit job numbers. This option is available with AIX V4.2.1 or later.

Change Characteristics of a Queue

smit chpq

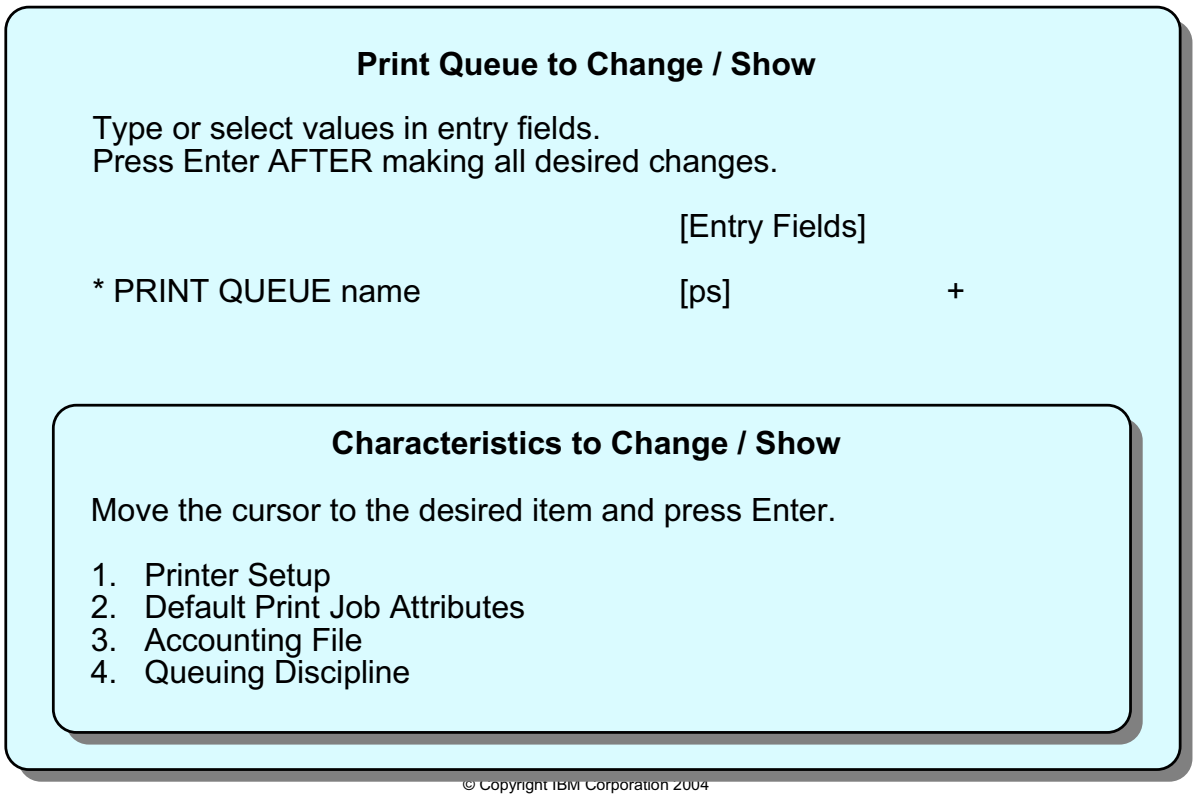


Figure 17-25. Change Characteristics of a Queue AU1410.0

Notes:

The four options contain attributes such as:

1. Printer Setup

   Automatic mode switching to postscript
   Paper size in trays and the manual feeder
   Envelope size
   ID of the font cards
   Paper trays for header and trailer pages
   Formatting flags for the header and trailer pages
   Users to get the intervention messages
   Flags prohibited for all print files
   Mode in which to leave the printer at the end of the job
   Width of printable area on header page

2. Default Print Job Attributes

   Text print options such as emphasized print

Job processing options such as page number where printing should begin
Text formatting options such as top Margin and lines per page
Paper/Page Options such as page orientation
Header/Trailer Page such as separator pages
Messages/Diagnostics

3. Accounting File

   Accounting file name

4. Queuing Discipline

   Queuing discipline

Removing a Queue

smit rmpq

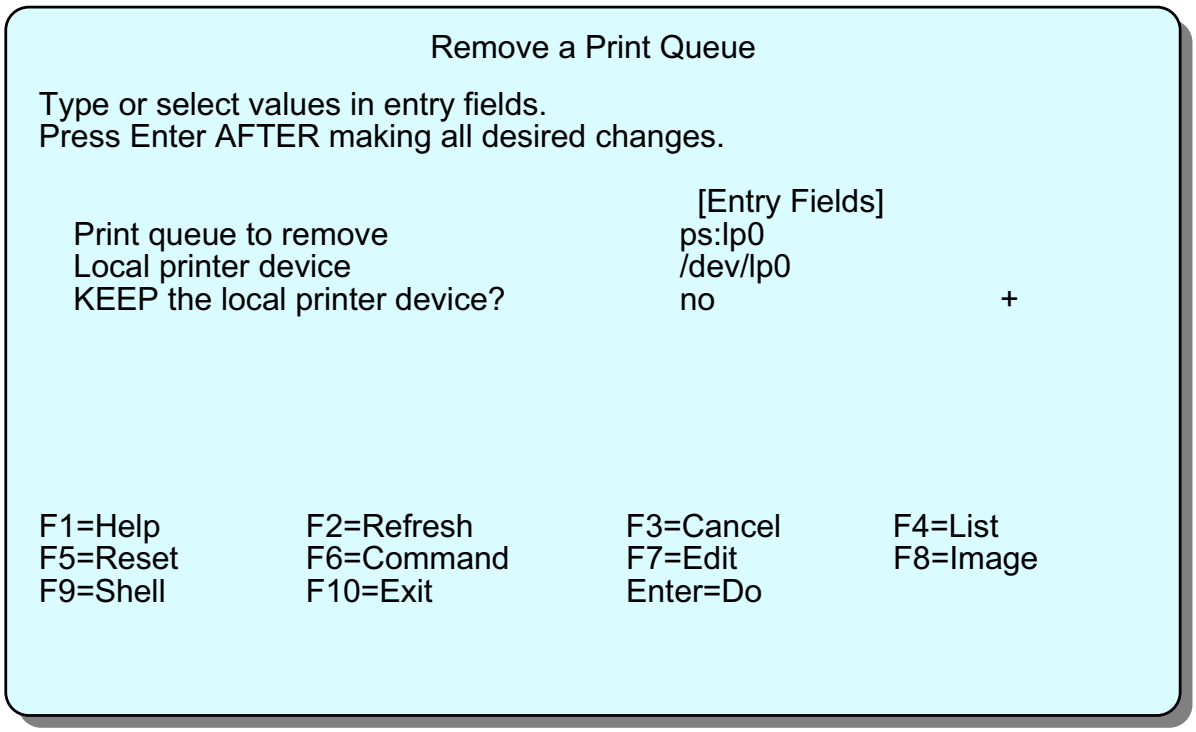


Figure 17-26. Removing a Queue AU1410.0

Notes:

It is not possible to remove a queue containing jobs. The jobs would have to be removed first.

Managing Queues

smit pqmanage

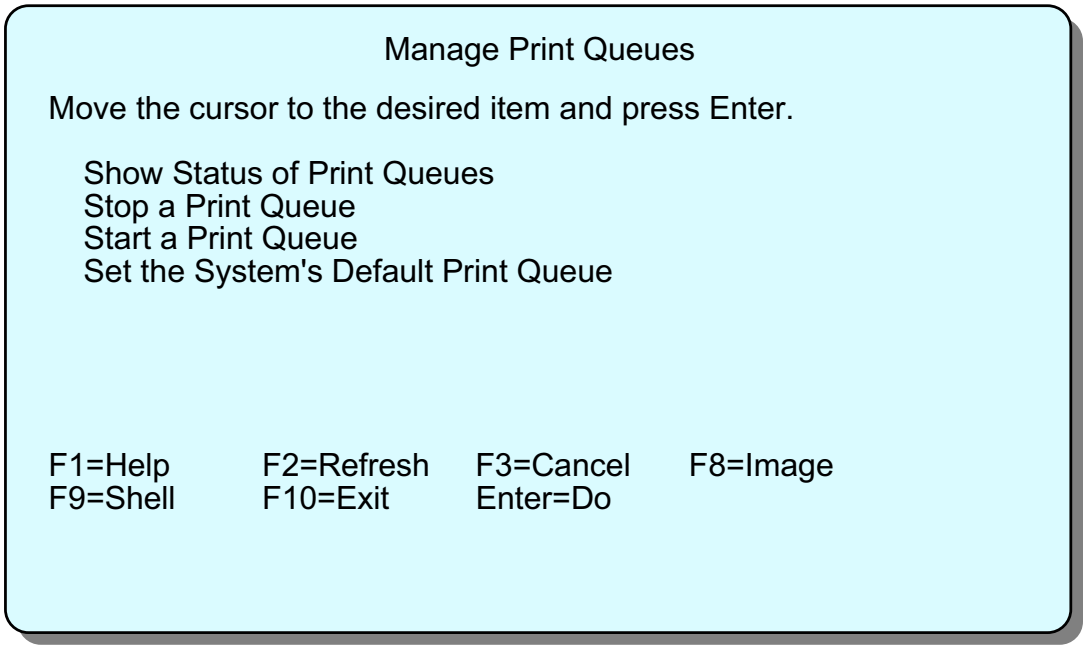


Figure 17-27. Managing Queues AU1410.0

Notes:

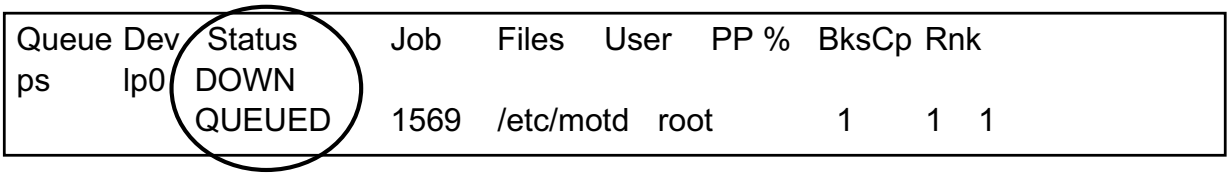
Show Status of Print Queue - give output similar to **qchk** and **lpstat**

Stop a Print Queue - Runs the **disable** command

Start a Print Queue - Runs the **enable** command

Set the System's Default Print Queue - Reorders the /**etc**/**qconfig** file to ensure the default queue is the first queue in the file.

Understanding Queue Status



```
Queue  Dev   Status      Job   Files     User    PP %  BksCp Rnk
ps     lp0   DOWN
             QUEUED      1569  /etc/motd root          1     1   1
```

State	Description
DEV_BUSY	Printer is busy servicing other print requests
DEV_WAIT	Queue is waiting for the printer
DOWN	Queue is down and no jobs will be serviced from this queue until it is brought up
OPR_WAIT	The queue is waiting for operator intervention
QUEUED	Job is queued and waiting
READY	Everything is ready to receive a print request
RUNNING	Print file is printing
UNKNOWN	Problem with the queue - need to investigate further to determine cause

Figure 17-28. Understanding Queue Status AU1410.0

Notes:

The status of the queues and jobs can be displayed with **qchk**, **lpstat** or **lpq**. There are a number of different statuses that may be seen.

DEV_BUSY

This status can occur when more than one queue is defined to a print device and another queue is currently using the print device. It could result when the qdaemon attempts to use the printer port device and another application is currently using that print device. Normal recovery: You have to wait until the queue or application has released the print device, or kill the job or process that is using the printer port.

DEV_WAIT

This status means that the queue is waiting on the printer because the printer is offline, out of paper, jammed, or the cable is loose, bad or wired incorrectly. Normal recovery: Check to see if the printer is offline, out of paper, jammed or loosely cabled. Sometimes the jobs have to be removed from the queue before the problem can be corrected.

DOWN

This status is set when the device driver cannot communicate with the printer after TIME OUT seconds (which can be set through SMIT). This variable indicates the amount of time, in seconds, that the queuing system waits for a printer operation. If the printer is off, the queue will go down. Also, the operator can bring down the queue intentionally, which might be necessary for system maintenance. Normal recovery: Correct the problem that has brought the queue down and then bring the queue up again.

OPR_WAIT

This status is set when the backend program is waiting on the operator to change the paper, change forms and so on. This is usually software related. Normal recovery: Respond appropriately to the request that is made by the queuing system.

QUEUED

This status is set when a print file is queued and is waiting in line to be printed.

READY

This is the status of a queue when everything involved with the queue is ready to queue and print a job.

RUNNING

This status occurs when a print file is printing.

UNKNOWN

This status occurs when a user creates a queue on a device file that another queue is using and its status is DEV_WAIT. The queue cannot get a status from the printer device when it is on hold. Normal recovery: Bring down the other queue or fix the problem with the printer (paper out, jammed, offline and so on). Bring the new queue down and then back up so that the queue will register as READY.

Bringing Queues Up and Down

```
# lpstat

Queue    Dev Status     Job   Files    User  PP %  Bks Cp   Rnk
draft    lp0   DOWN
               QUEUED   132      /etc/motd team01 1    1     1
quality  lp0   READY
```

- To enable a queue whose status is DOWN:

```
# enable draft
```

- To disable a queue whose status is READY:

```
# disable quality
```

You must be a member of the **printq** group or **root**

Figure 17-29. Bringing Queues Up and Down AU1410.0

Notes:

Occasionally, problems with printers can bring a queue down. Once the problem has been fixed it can be brought back up with:

 # enable <queuename>

-OR-

Sometimes, you may wish to bring a queue down. This is recommended if any maintenance is going to be performed on the printer.

 # disable <queuename>

-OR-

 # enq -D -P <queuename>

Managing Print Jobs

smit jobs

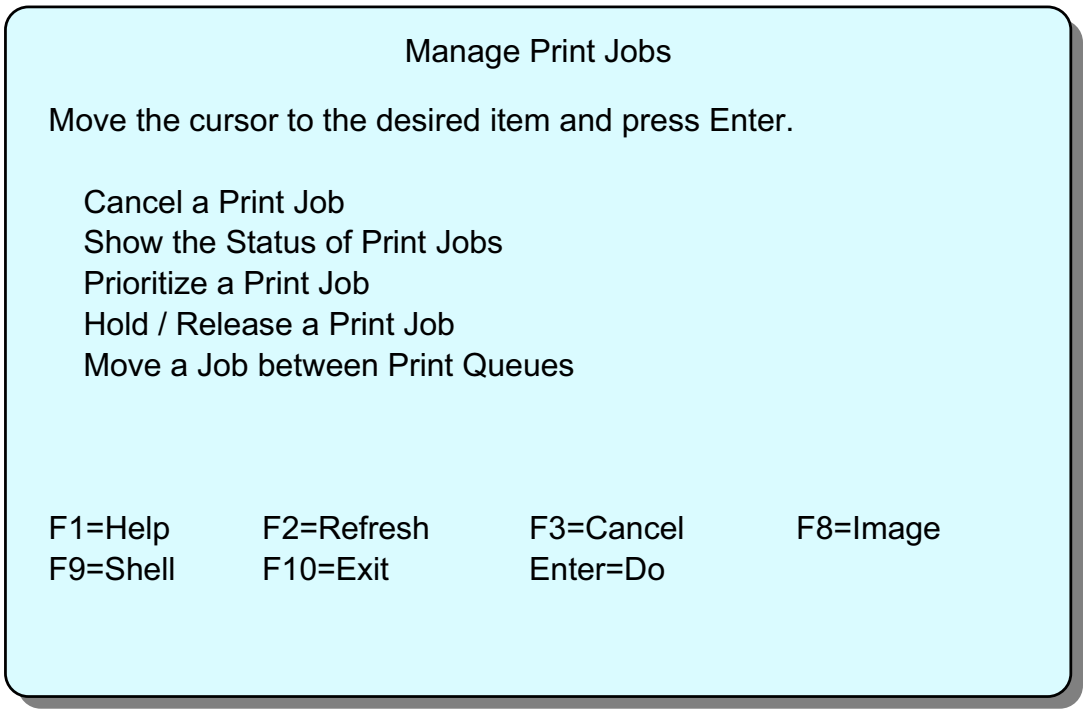


Figure 17-30. Managing Print Jobs AU1410.0

Notes:

The root user or a member of the print group can work with any print request. Normal users can only work with their own print jobs.

Canceling Print Jobs

smit qcan

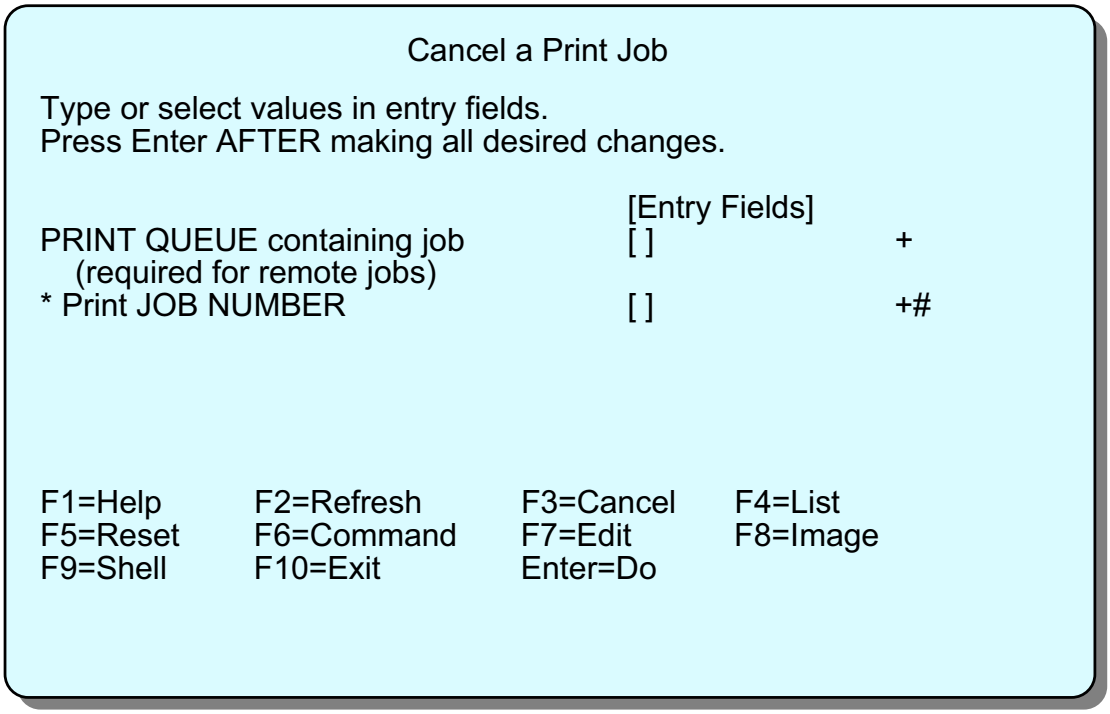


Figure 17-31. Cancelling Print Jobs AU1410.0

Notes:

The **qcan** command cancels either a particular job number or all jobs in a print queue.

Normal users can only cancel their own jobs, whereas root can cancel any job.

To cancel a job you can either use the **smit qcan** fastpath, or use one of the following commands:

	System V	BSD	AIX
To cancel a job:	**cancel**	**lprm**	**qcan**

To cancel Job Number 127 on whatever queue the job is on:

 # qcan -x 127 or **# cancel 127**

To cancel all jobs queued on printer lp0, enter:

 # qcan -X -Plp0 or **# cancel lp0**

Job Priority Example

```
# qchk -L
Queue   Dev     Status  Job                 Name    From            To
______  ___     ______  Submitted           Rnk     Pri     Blks    Cp      PP %
ps      lp0     DOWN
                QUEUED  569    /etc/qconfig root    root
                1/07/03 09:39:25            1       15      2       1
                                /etc/qconfig

                QUEUED  570     /etc/motd   root    root
                1/07/03 09:40:15            2       15      1       1
                            /etc/motd
# qpri -#570 -a 25
# qchk -L
Queue   Dev     Status  Job                 Name    From            To
______  ___     ______  Submitted           Rnk     Pri     Blks    Cp      PP %
ps      lp0     DOWN
                QUEUED  570 /etc/motd       root    root
                1/07/03 09:40:15            1       25      1       1
                            /etc/motd

                QUEUED  569 /etc/qconfig    root    root
                1/07/03 09:39:25            2       15      2       1
                                    /etc/qconfig
```


Figure 17-32. Job Priority Example AU1410.0

Notes:

The discipline line in the /**etc**/**qconfig** file determines the order in which the printer serves the requests in the queue. In the queue stanza the discipline field can either be set to **fcfs** (first-come-first-serve) or **sjn** (shortest-job-next). If there is no discipline in the queue stanza, requests are serviced in **fcfs** order.

Each print job also has a priority that can be changed via SMIT or with the **qpri** command. Print jobs with higher-priority numbers are handled before requests with lower-priority numbers. Only a user who has root authority or who belongs to the printq group can change the priority of a local print request.

Note: you can only set priorities on local print jobs. Remote print jobs are not supported.

The **qprt -R** command can also be used to set job priority.

The example shows that when print jobs are submitted they receive the default priority of 15. The example shows how the **qpri** command can be used to change the priority of job number 570 to 25. Use the **qchk -L** command to show the new job priorities.

SMIT can also be used to change print job priorities (**smit qpri**).

Holding a Job in a Queue

```
# qchk
Queue Dev    Status       Job   Files          User    PP %  Blks   Cp Rnk
ps    lp0    DEV_BUSY
             QUEUED       1493  /etc/qconfig   root          1    1   1

# qhld -#1493
# qchk
Queue Dev    Status       Job   Files          User    PP %  Blks   Cp Rnk
ps    lp0    DEV_BUSY
             HELD         1493  /etc/qconfig   root          1    1   1

# qhld -r -#1493
# qchk
Queue Dev    Status       Job   Files          User    PP %  Blks   Cp Rnk
ps    lp0    DEV_BUSY
             QUEUED       1493  /etc/qconfig   root          1    1   1
```


Figure 17-33. Holding a Job in a Queue AU1410.0

Notes:

The **qhld** command is used to put a temporary hold on a job that is waiting in the queue. The **qhld** command is also the command that is used to release job back in the queue.

The graphics provides a example of using the **qhld** command to hold and then release job # 1493.

This task can also be accomplished through smit - **smit qhld**.

Moving a Job between Queues

 # qchk -A

```
Queue Dev    Status     Job  Files          User     PP % Blks  Cp Rnk
asc   lp0    DOWN
             QUEUE      11  /etc/qconfig            root    2       1    1
ps    lp0    READY
```

 # qmov -mps -#11
 # qchk -A

```
Queue Dev    Status     Job  Files          User     PP % Blks  Cp Rnk
asc   lp0    DOWN
ps    lp0    RUNNING    11  /etc/qconfig            root    2       1    1
```

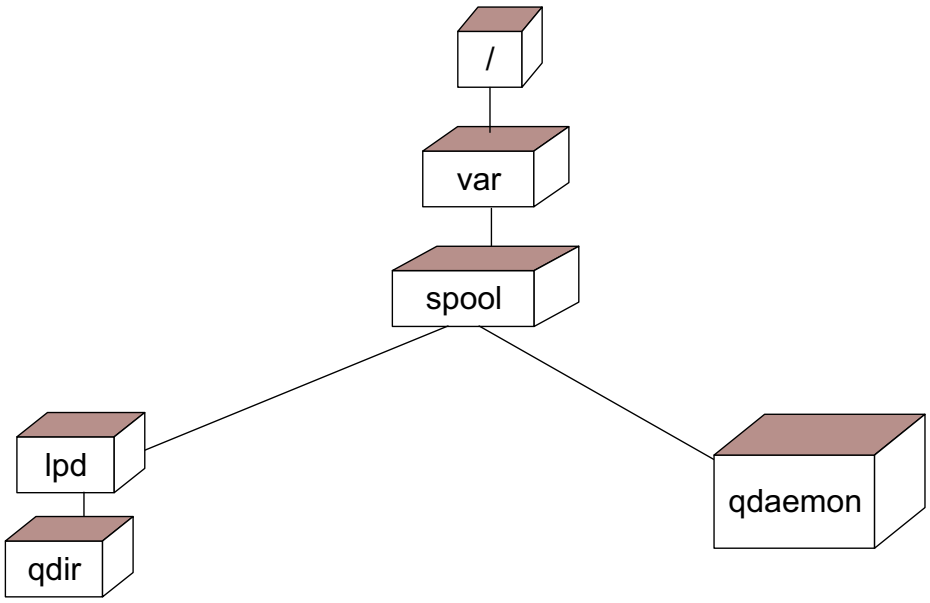

Figure 17-34. Moving a Job between Queues AU1410.0

Notes:

You can move jobs between queues in AIX. The command **qmov** is used. The **-m** option specifies what queue to move the job to and the -# option specifies the job number.

This can be done through smit using **smit qmov**.

Printing-related Directories to Monitor



- Contains queue requests (job description files)
- Temporary copies of enqueued files if spooling

Figure 17-35. Printing-related Directories to Monitor AU1410.0

Notes:

The above directories fill up very quickly if the spooling mechanism encounters a problem. For example, if the queue goes down, or if there are many users submitting jobs there may not be enough room to handle the requests.

Remember, when print jobs are submitted to spooling rather than just queuing, a copy of that file is created and stored in /**var**/**spool**/**qdaemon** directory until that job has printed. At that time, the temporary file is removed. If the queue or multiple queues quit working, jobs don't get through the system. This could cause a full condition in this directory structure.

Printing Problem Checklist

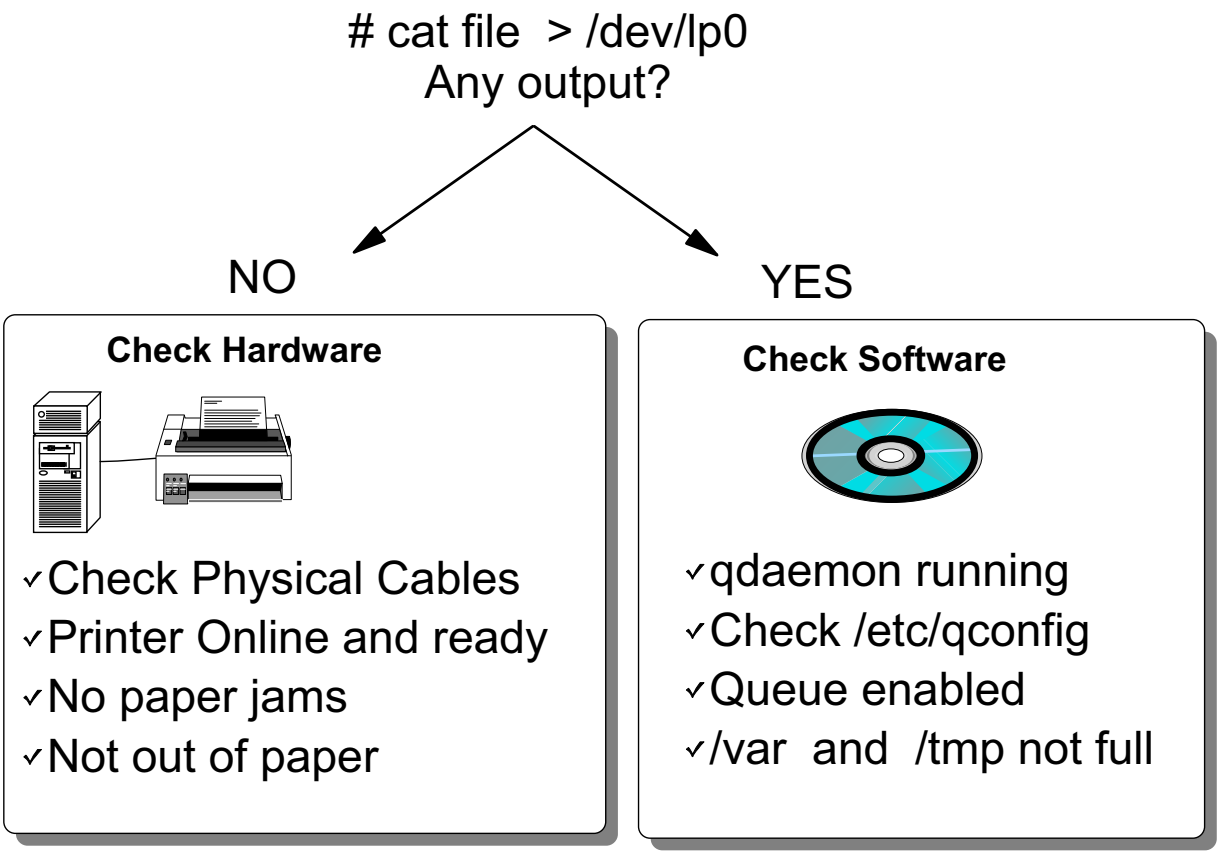


Figure 17-36. Printing Problem Checklist AU1410.0

Notes:

If you experience problems trying to print, start by checking the simple things first.

The easiest test to perform is to **cat** a file and redirect standard output to the printer device file. This by-passes the queuing system and helps to narrow the problem.

After redirecting a file to the print device, if it does not print, the problem is usually hardware-related. Check to make sure the cables are attached securely. Make sure the printer is ready to print (online). Make sure there is paper in the printer and there are no paper jams.

If something does print out using cat but not print out when using **lp**, **qprt**, or **lpr**, the problem is most likely software-related.

Check to make sure the qdaemon is running. If not, start it.

 # lssrc -s qdaemon
 # startsrc -s qdaemon

Look at the contents of /**etc**/**qconfig** to make sure it is not corrupt.

Ensure the queue are enabled. If not, enable them.

 # lpstat
or
 # qprt -A
 # enable *queuename*

Check to make /**tmp** and /**var** are not full.

 # df

Exercise: Printers and Queues

Figure 17-37. Exercise: Printers and Queues AU1410.0

Notes:

This exercise gives you an opportunity to work with the AIX queuing system. If your classroom does not have locally attached printers, your instructor needs to supply you with local modification for this lab.

This exercise can be found in your Exercise Guide.

Checkpoint (1 of 2)

1. True or false? One of the advantages of queues is that each user can have a different default queue set up for them.

2. True or false? The **/etc/qconfig** file is read by the **backend** program to determine what the queue discipline is.

3. True or false? All printer software is automatically installed when you install the base operating system.

4. What is the difference between these two commands?
   # qprt -Pasc file1
   # qprt -c -Pasc file1

Figure 17-38. Checkpoint (1 of 2) AU1410.0

Notes:

Checkpoint (2 of 2)

5. What methods can be used to find out what the system default queue is?

   _____
   _____
   _____
   _____
   _____

6. Can any user bring the print queues down? Name a few people who can.

   _____
   _____

7. True or false? Once the queue is down, no more jobs can be submitted to the printer.

8. Can users hold all their print jobs in a specific queue? If so, how?

   _____
   _____

Figure 17-39. Checkpoint (2 of 2) AU1410.0

Notes:

Unit Summary

- Queues can be added for local or remote printing.
- Queue characteristics can be changed either through SMIT or via high-level commands.
- Queues can be brought up and down by the system administrator.
- The following tasks were considered:
  - Submit and cancel print jobs
  - List the jobs in a queue
  - Hold and release jobs in a queue
  - Move a job from one queue to another
  - Change priorities of a print job

Figure 17-40. Unit Summary AU1410.0

Notes:

Unit 18. Networking Overview

What This Unit Is About

This unit gives an overview of TCP/IP and networking concepts.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Define the basic TCP/IP terminology
- Configure TCP/IP for an Ethernet or Token-Ring connection
- Use some of the standard TCP/IP facilities to:
  - Log in to another system
  - Transfer files
  - Run commands

How You Will Check Your Progress

Accountability:

- Checkpoint question
- Exercise

References

Online	*System Management Guide: Communications and Networks*

Unit Objectives

After completing this unit, you should be able to:

- Define the basic TCP/IP terminology
- Configure TCP/IP for an Ethernet or Token-Ring connection
- Use some of the standard TCP/IP facilities to:
  - Log in to another system
  - Transfer files
  - Run commands

Figure 18-1. Unit Objectives AU1410.0

Notes:

What Is TCP/IP?

- **T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol
- Software to enable different systems to exchange data over a variety of types of network
- The way in which systems are connected and how data is passed between them is transparent to the user
- TCP/IP is vendor-independent. Development is overseen by the Internet Architecture Board

Figure 18-2. What Is TCP/IP? AU1410.0

Notes:

TCP/IP is a networking architecture which defines a mechanism for cooperating computers connected by some sort of network to exchange data. TCP/IP software has been implemented across many platforms from mainframes to personal computers, although it is most commonly associated with UNIX environments.

TCP/IP is a set of protocols which define various aspects of how two computers on a network may communicate with each other. A protocol is a set of rules which describe the mechanisms and data structures involved. Using these definitions, vendors can write software to implement the protocols for particular systems.

TCP/IP stands for Transmission Control Protocol/Internet Protocol. These are the names of the two most important protocols. There are many others. Where possible, the protocols are defined independently of any operating system, network hardware or machine architecture. In order to implement TCP/IP on a system, interface software must be written to allow the protocols to use the available communications hardware.

This means that heterogeneous environments can be created where machines from different manufacturers can be connected together, and different types of networks can be interconnected.

TCP/IP is the result of work commissioned in 1968 by DARPA the US Department of Defense, Advanced Research Projects Agency. Many other research and vendor organizations have contributed to the development of TCP/IP.

DARPA implemented a point-to-point network using leased lines called ARPANET using protocols which eventually evolved into TCP/IP. In 1980, ARPANET became the backbone to the Internet which links many US government, military, research, educational and commercial organizations.

The main popularity of TCP/IP has been due to its association with UNIX systems. In particular DARPA funded University of California, Berkeley to integrate TCP/IP into their versions of UNIX (BSD 4.2, 4.3)

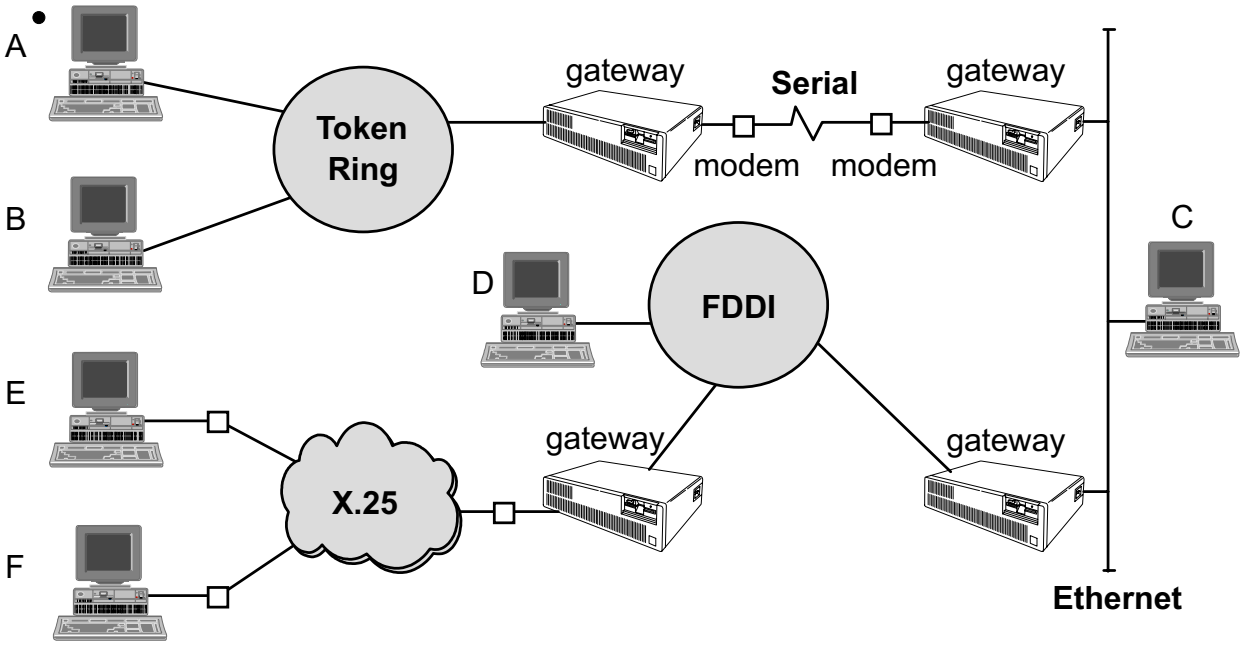
Most TCP/IP development is initiated by an organization called the Internet Architecture Board (IAB) which oversees development of the Internet network and the TCP/IP software it uses. Other TCP/IP development is performed by vendor organizations who write protocols which may become Internet standards.

The IAB distributes documents called Request For Comments (RFC) which describe TCP/IP protocols and other relevant information. RFCs are the primary source of TCP/IP and Internet information and are freely available in the Internet.

There are two subseries of the RFCs of interest. The STD (standards) describe all of the official TCP/IP standard protocols. The FYI (for your information) documents provide useful information about TCP/IP, the Internet and running a TCP/IP network.

An Internet

- A TCP/IP network is often called an **internet**



- Individual machines are called **hosts**. Hosts may vary in size and functionality but have equal standing as far as TCP/IP is concerned
- Hosts which link two or more physical network segments to each other are called **gateways**

Figure 18-3. An Internet AU1410.0

Notes:

TCP/IP works with many different types of networks from slow-speed serial type connections to fast local area networks like Token-Ring or Ethernet or even faster networks like FDDI (using fiber optics) and the SP Switch.

- **Local Area Network (LAN)**

  Networks in a close geographical area. Often high-speeds over short distances

  Computers must connect directly to network media (via a transceiver or tap)

  Token-Ring (4 or 16 mb per second)

  Ethernet (10, 100 or 1000 mb per second)

  FDDI (100 mb per second)

  SP Switch (150 mb per second)

- **Wide Area Network (WAN)**

  Can be far apart

Computers often connected indirectly (modems, public telephone networks)
Generally slower speeds than LANs

An Internet is a term given to a number of TCP/IP networks connected together. An Internet can be a combination of similar networks or heterogeneous networks. In an Internet, data can be transferred transparently from one host to another without the sending host needing to know the route taken or the type or number of connections involved.

There are a number of public Internets worldwide, the largest of which is called The Internet (or the connected Internet). The Internet consists of millions of connected systems.

A host is any computer attached to the network which has a TCP/IP address. This includes machines of any size or functionality. For example, an X-Terminal is a host as far as TCP/IP is concerned. Each host is given a unique name (for users) and address (for software) so that it can be uniquely identified in the interconnection of networks.

A host which has multiple network adapter cards is called a gateway. This can either be a dedicated machine to provide the function of routing data between networks or can be a machine providing applications as well (often called a multihomed host). This is not often recommended because of the extra load that the routing function will add.

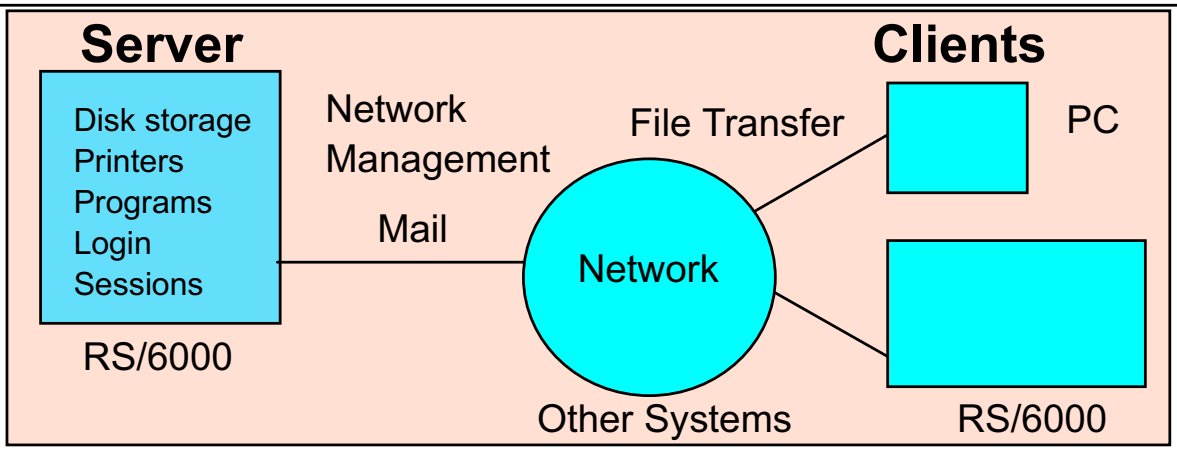
Names and Addresses

- Each system in a TCP/IP network is given a name
  For example: **sys3**
- When contacting another system you only need to know the name
  For example: $ **telnet sys3**
- When contacting another user you need to know the system and user name
  For example: $ **mail fred@sys3**
- Each system has one or more TCP/IP addresses
  For example: **10.0.0.3**
  If you know the address but not the name, you can use some TCP/IP facilities with the address

Figure 18-4. Names and Addresses AU1410.0

Notes:

TCP/IP Network Facilities



Standard TCP/IP facilities include: Mail, File Transfer, Remote Login, Remote Execution, Remote Printing

A number of AIX Applications use TCP/IP:

- Network File System (NFS)
- Network Information Services (NIS)
- Domain Name Service (DNS)
- Dynamic Host Configuration Protocol (DHCP)
- Network Computing System (NCS)
- Distributed Computing Environment (DCE)
- X Windows and AIXWindows
- Tivoli Netview for AIX

Figure 18-5. TCP/IP Network Facilities AU1410.0

Notes:

There are many applications that require or can take advantage of TCP/IP. The ones listed are available from IBM either as standard or as licensed program products. There are many third-party applications (for example databases) that can also use TCP/IP for distributed work.

- Network File System (NFS) allows access of remote files as if they were local.
- Network Information Services (NIS) provides a distributed database of system information.
- Domain Name Service (DNS) provides server support to keep track of host names and addresses in the network.
- Dynamic Host Configuration Protocol (DHCP) allows a host to dynamically obtain a TCP/IP address from a server in the network.
- Network Computing System (NCS) allows applications to be written to run procedures on other systems in a network.

- Distributed Computing Environment (DCE) provides a rich set of facilities for developing and running distributed applications. It is based on NCS with many other services including Security Service, Directory Service, Time Service and management tools.
- X Windows / AIXWindows provide a distributed graphical user interface.
- Tivoli Netview for AIX provides a sophisticated set of management tools for TCP/IP networks. It uses the AIXWindows environment to provide a graphical user interface for the network manager and uses Simple Network Management Protocol (SNMP) to pass management information around the network.
- Network support is also available on WebSM.

Information Needed to Configure TCP/IP

- Addresses
  - ► Each adapter is given a unique **TCP/IP** address and often a **subnet mask.** These are usually assigned by your network administrator
- Names
  - ► Each machine has a unique **hostname**
  - ► Each machine must have access to a table of name to address translations. This can be either:
    - **/etc/hosts** file
    - **Domain Name Server** - You must know:
      Domain Name
      Address of the Name Server
- Routes

  In order to communicate with systems in other networks, you may need to find the **address of the default gateway**

Figure 18-6. Information Needed to Configure TCP/IP AU1410.0

Notes:

Each system in a TCP/IP network must have a unique **TCP/IP address** and **hostname**. Your network administrator centrally manages tables of names and addresses, and assigns these for your system. On some networks a **subnet mask** is also required which is used to determine which network your machine belongs to for routing purposes.

Since version 4.3 AIX provides support for both IPV4 and IPV6 addresses. The IPV6 addresses are 128 bits in length, represented as eight 16-bit fields separated by colons. A technique called tunneling is used to allow systems with IPV4 and IPV6 to coexist. SMIT and the Web-based System Manager provide separate support for IPV6.

Each host in a network is allocated a name which the users find easier to remember. However, the TCP/IP protocols can only use TCP/IP addresses when sending data. Therefore a portion of TCP/IP is responsible for translating the symbolic host names into TCP/IP addresses. This process is called name resolution.

There are two separate mechanisms defined for name resolution:

Flat Network

- Each host in the network has a record of the name and address of every other host it will communicate with. This is in a text file called /**etc**/**hosts**. This is quick but becomes difficult to administer if there are a large number of hosts.

Domain Network (Domain Name System)

- Hosts are grouped together into domains which form a hierarchy (similar to the file directory structure). One (or more) hosts in a domain (called nameservers) have a record of the name and address of all hosts. Client hosts request name to address translations from a nameserver. Use the /**etc**/**resolv.conf** file.

There may be more than one name server in a domain network for backup, but only one will have the primary copy of the database on its local disk. Clients only need to know the **domain name** and the **address of the nameservers**. This mechanism is much more suitable for large networks because administration is centralized on a few machines.

If your network is just part of a larger network then you need to know about the gateway machines which link your network to others. Most network designs only have one gateway, called the default gateway. You need to know the **address of the default gateway** to allow your system to communicate with other systems through the gateway.

Configuring TCP/IP

smit mktcpip

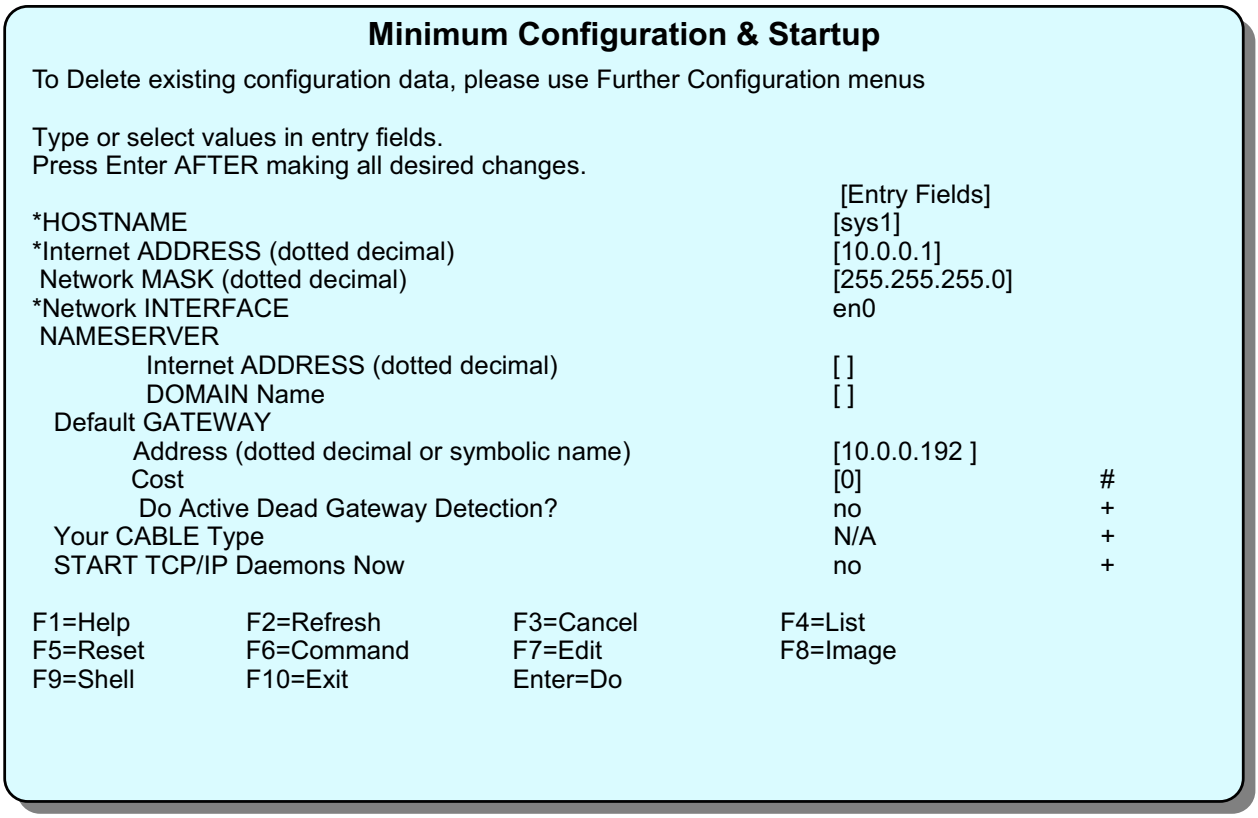


Figure 18-7. Configuring TCP/IP AU1410.0

Notes:

The Web-based System Manager can also be used to configure the network. Use the fastpath **wsm network**.

When the TCP/IP software is installed, a new menu called TCP/IP (fastpath: tcpip) is added to SMIT in Communications Applications and Services and other places.

The SMIT Minimum Configuration & Startup option (fastpath: mktcpip) or the **mktcpip** command can be used to quickly configure TCP/IP on the RS/6000. This initializes TCP/IP (for client services) but further customization will be required.

The minimum information that is required to start TCP/IP is the hostname, and one interface and its Internet address. If subnetting is used then the subnet mask should be specified. A static route can be specified to a default gateway. Also the domain name and name server for a client in a domain network can be specified.

You can decide whether to start the TCP/IP daemons when initializing TCP/IP through this option.

The Further Configuration menu (fastpath: **configtcp**) contains a series of menus for customizing TCP/IP options. For example, hostnames, routes, interfaces, name resolution, server and client services.

Dead gateway detection is a mechanism for hosts to detect a dead gateway or a gateway that is not responding.

The cost is used with dead gateway detection to prioritize routes.

Flat Name Resolution

more /etc/hosts

```
#The format of this file is:
#Internet Address  Hostname  #Comments
#Items are separated by any number of blanks or tabs.  A"#"
#indicates the beginning of a comment; characters up to the end of the
#line are not interpreted by routines which search this file.  Blank lines are
#allowed in this file.

#Internet Address      Hostname      #Comments
127.0.0.1              loopback      localhost
10.0.0.1               sys1          timeserver
10.0.0.2               sys2
10.0.0.3               sys3
10.0.0.4               sys4
```


Figure 18-8. Flat Name Resolution AU1410.0

Notes:

Host names and their Internet addresses are mapped by entries in the **/etc/hosts** file. In a flat network it should have entries for the local machine name, local host and all other hosts known to the system. Typically, **/etc/hosts** is kept consistent between all machines.

In a domain network the **/etc/hosts** file can be empty. Although, usually some hosts can be added for access to other hosts if the name server is down.

On AIX you can use SMIT or the vi command to add entries to **/etc/hosts**. The Hosts Table menu (fastpath: hosts) contains options to list/add/change/delete hosts in the **/etc/hosts** file. To get to this menu from the TCP/IP menu select Further Configuration then Name Resolution. The **/etc/hosts** file can be edited directly if desired.

Identifying the Hostname

hostname Command

```
# hostname
sys3
```

host Command

```
# host  sys3
sys3 is 10.0.0.3,  Aliases: sys3.washington.ibm.com

#host  10.0.0.3
sys3 is 10.0.0.3,  Aliases: sys3.washington.ibm.com
```


Figure 18-9. Identifying the Hostname AU1410.0

Notes:

Two useful commands are **hostname** and **host**.

hostname - used to determine the name of the machine

host - when used with the hostname, determines the IP address. When used with the IP address, determines the hostname.

Basic TCP/IP User Functions

The following commands work with any TCP/IP system (not just UNIX/AIX):

- Test connectivity **ping**
- File Transfer **ftp**
- Remote Login **telnet**
- Remote Execution **rexec**

Figure 18-10. Basic TCP/IP User Functions AU1410.0

Notes:

The **ARPA** commands for File Transfer, Remote Login and Remote Execution are **ftp, telnet, rexec** respectively.

These commands can be used between any TCP/IP system that supports the appropriate protocols, not just UNIX/AIX systems.

In order to ensure security across the network, these commands always require a user name and password to be supplied when you establish a connection.

ping - Tests connectivity with another system

```
$ ping sys2
PING sys2: (192.9.200.2): 56 data bytes
64 bytes from 192.9.200.2: icmp_seq=0 ttl=255 time=15 ms
64 bytes from 192.9.200.2: icmp_seq=1 ttl=255 time=3 ms
64 bytes from 192.9.200.2: icmp_seq=2 ttl=255 time=2 ms
64 bytes from 192.9.200.2: icmp_seq=3 ttl=255 time=2 ms
64 bytes from 192.9.200.2: icmp_seq=4 ttl=255 time=2 ms
^C
----sys2 PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 2/4/15 ms
$
```

rexec - Run a command on another system

- Cannot run interactive commands
- Cannot run commands that run full screen

```
sys1$_ rexec sys2 uname -x
Name (sys2:tom): tom
Password: tom's password
AIX sys2 526332 2 3 000003F41C00
sys1$ _
```

The **rexec** command executes a command on another host. The command format is:
rexec host command

If the command contains metacharacters for the remote system, they must be enclosed in quotes.

The **ftp** command is used to transfer files from one system to another. It is normally an interactive environment and it provides a number of commands for transferring files. It can also be used for batch operation.

ftp will require you to specify a user and password to establish a connection to the remote system. This userid and password can be stored in a file in your home directory called**.netrc**. You can also specify automatic login procedures in this file.

With AIX V5.2 you can now restrict ftp login to specific hosts, restrict what directories users can read or write into, and support login of anonymous restricted users by creating the ftp configuration file /**etc/ftpaccess.ctl**.

Typical tasks that can be carried out by ftp are:

- List/Transfer/Delete Local/Remote Files
- Change Current Local/Remote Directory
- Create/Remove Directories

For example:

```
sys1$ ftp sys2
connected to sys2
220 sys2 FTP Server ready.
Name (sys2:smith): user1
331 Password required for user1
Password (sys2:user1): user1's password
230 User user1 logged in
ftp> binary
200 Type set to I
ftp> put file1 /tmp/f1
200 PORT Command successful.
150 Opening data connection for /tmp/f1 (192.9.200.1,1016)
226 Transfer Complete.
308310 bytes sent in 3.58 seconds (85.71 Kbytes/s)
ftp> quit
221 Goodbye.
sys1$ _
```

There are many **ftp** subcommands. To obtain a list use **?** or **help**. To get help on an individual subcommand use **? *subcommand*** or **help *subcommand***. For example:

```
ftp> help open
open    connect to remote ftp
ftp>
```

To find out what commands are supported on the remote host use **rhelp** or **remotehelp**.

telnet - Remote Login (telnet)

```
sys1$ telnet sys2
Trying . . .
Connected to sys2.
Escape character is '^]'.


AIX telnet (sys2)


login:  tom
password: tom's password
```

```
sys2$   ^]
telnet> ?
```

The **telnet** command implements the client end of the TELNET protocol for remote login.

If you are running **telnet** from one AIX/UNIX system to another, your terminal type is passed correctly. Otherwise, you have to set the TERM variable after you log in.

The Escape character (usually ^]) allows you to escape into a telnet menu from which you can execute local commands or manage connections.

You can use the ^] key to escape to a **telnet** menu from which you can enter subcommands. Use **?** or **help** to list the available subcommands.

You can open or close connections and manipulate connection settings.

Use **z** to execute a shell on the local host.

Exercise: Networking

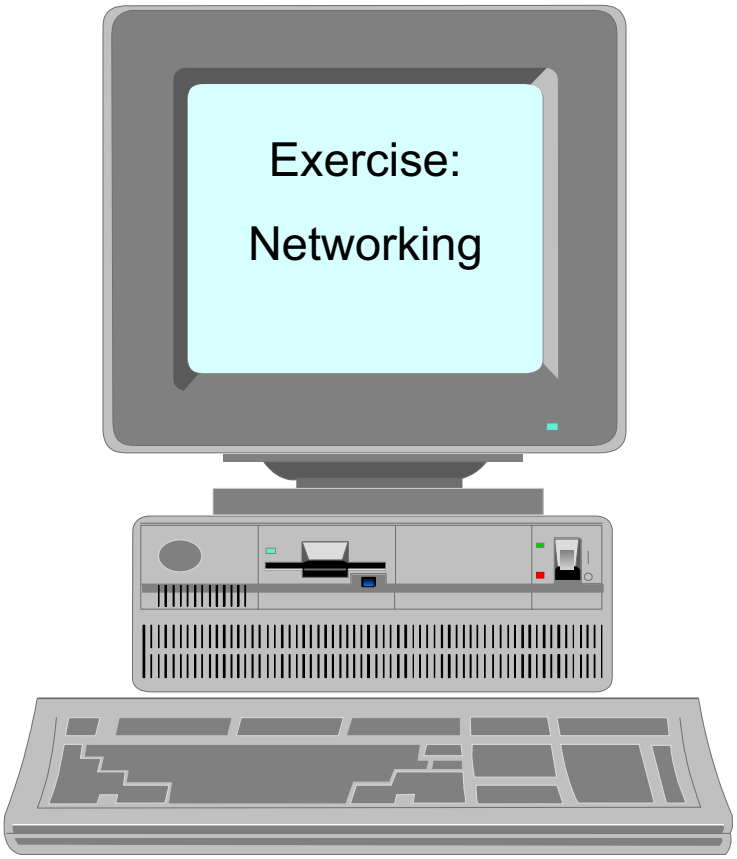


Figure 18-11. Exercise: Networking AU1410.0

Notes:

This lab gives you an opportunity to configure an RS/6000 on a TCP/IP network. This gives you practical application of the concepts presented in this unit.

This exercise can be found in your Exercise Guide.

Checkpoint

1. What are the following commands used for?
   ftp _____
   rexec _____
   telnet _____

2. What is the difference (if any) between a **host** and a **gateway** .
   _____
   _____
   _____

3. True or false? Each machine in a TCP/IP network must have a unique hostname and TCP/IP address.

4. Which file holds the name and the TCP/IP address of each host in a flat network?
   _____

Figure 18-12. Checkpoint AU1410.0

Notes:

Unit Summary

- TCP/IP is a networking architecture which defines a set of rules. These rules describe how computers can communicate with one another over a network.
- A flat TCP/IP network can be configured through SMIT by supplying the following information: addresses, subnet mask and hostnames.
- There are many useful utilities which are provided by TCP/IP, such as **telnet** to login to another system, **ftp** to transfer files and **rexec** to execute a command on a remote system.
- Use the **ping** command to check for connectivity to remote hosts.

Figure 18-13. Unit Summary AU1410.0

Notes:

Appendix A. Configuring AIX Documentation

Configuring AIX V5.2 Documentation

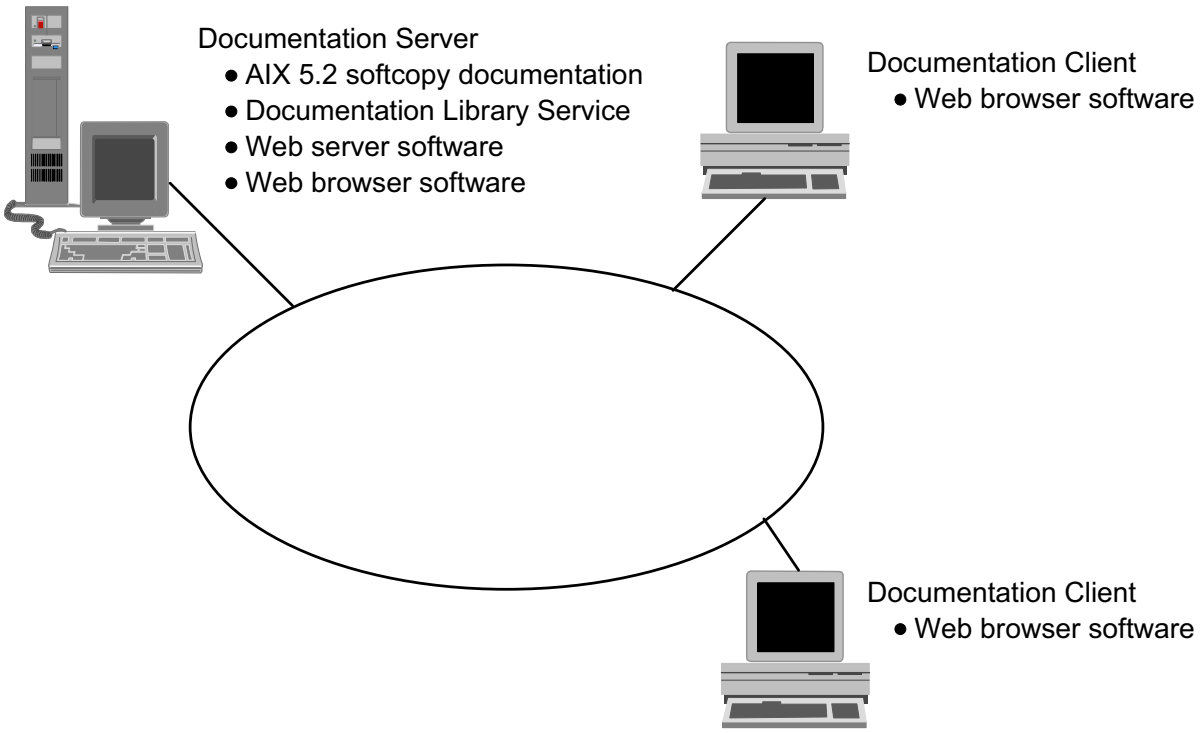


Figure A-1. Configuring AIX V5.2 Documentation AU1410.0

Notes:

In addition to providing SMIT to make system administration tasks easy, beginning with AIX V4.3, softcopy documentation is loaded on a *documentation server*. Any other computer in the network with appropriate Web-browser software (for example, the Netscape Navigator) can then become a *documentation client*.

When users on a client computer request an AIX document, the request is sent to the Web server on a documentation server which then sends back the requested item. When searches are performed, they are done on the server computer and the results are then sent back to the user on the client computer.

Configuring AIX V5.2 Online Documentation

- Configure TCP/IP
- Install the Web server software
- Configure and start the Web server software
- Install the Web browser software
- Install or mount the AIX documentation
- Configure the Documentation Library Service

Figure A-2. Configuring AIX V5.2 Online Documentation AU1410.0

Notes:

The steps outlined above are used to configure an AIX V5.2 documentation server or online documentation for a stand-alone RS/6000 system.

1. Configure TCP/IP on the AIX system. This is discussed later in the course.
2. Install the Web server software. AIX V5.2 includes two products that can be used: the Lite NetQuestion server software and the IBM HTTP Server Web server. Any other Web server software that supports CGI (Common Gateway Interface) can also be used. The Lite NetQuestion server can only be used for local users, not remote users.
3. Configure and start the Web server software. Use IBM HTTP Server Web server for easy set up.
4. Install Web browser software. This is necessary if users on the server wish to access documents. The Netscape Communicator is included with AIX V5.2. Actually, any browser can be used, provided it supports Java 1.3.
5. The AIX V5.2 Documentation includes *User Guides*, *System Management Guides*, *Application Programmer Guides*, *Commands Reference Volumes*, *Files References*,

and *Technical Reference Volumes*. This documentation can be installed to disk or mounted as a CD-ROM file system.

6. Configure the Documentation Library Service (**bos.docsearch**). This is installed by default with the base operating system. To configure it use the **smit web_configure** fastpath or the Web-based System Manager.

Installation of the documentation client involves a subset of the steps outlined above:

1. Install and configure TCP/IP.
2. Install the Web browser software.
3. Configure the Documentation Library Service. Only the **bos.docsearch** client filesets need to be installed on the clients.

Most of the documentation configuration can be done with the Configuration Assistant. The Configuration Assistant is discussed in the AIX Installation unit.

Internet and Documentation Services

smit web_configure

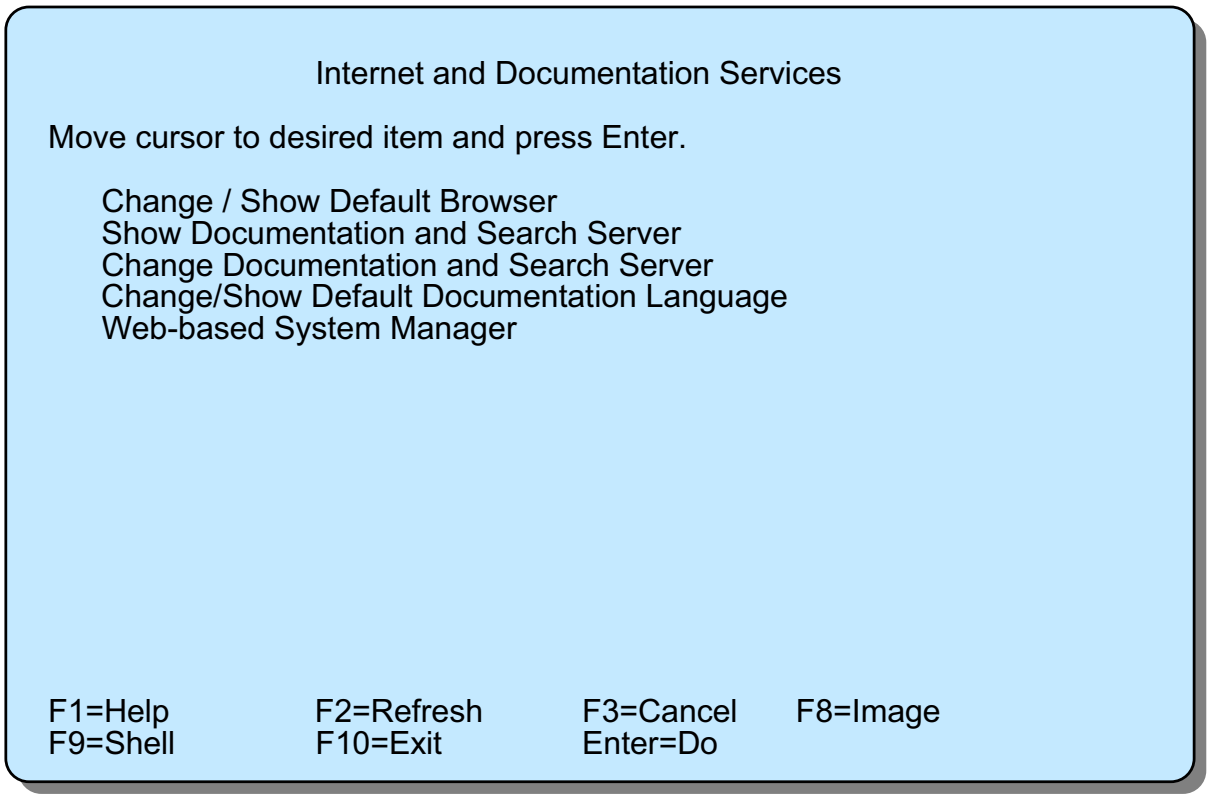


Figure A-3. Internet and Documentation Services AU1410.0

Notes:

Use the SMIT fastpath **smit web_configure** to access this menu. This menu is also accessed via the **System Environments** option on the main SMIT menu.

Choose the first option, **Change/Show Default Browser** to begin configuration of either a documentation server or client.

The Web-based System Manager can also be used to configure the AIX V5.2 online documentation.

Change/Show Default Browser

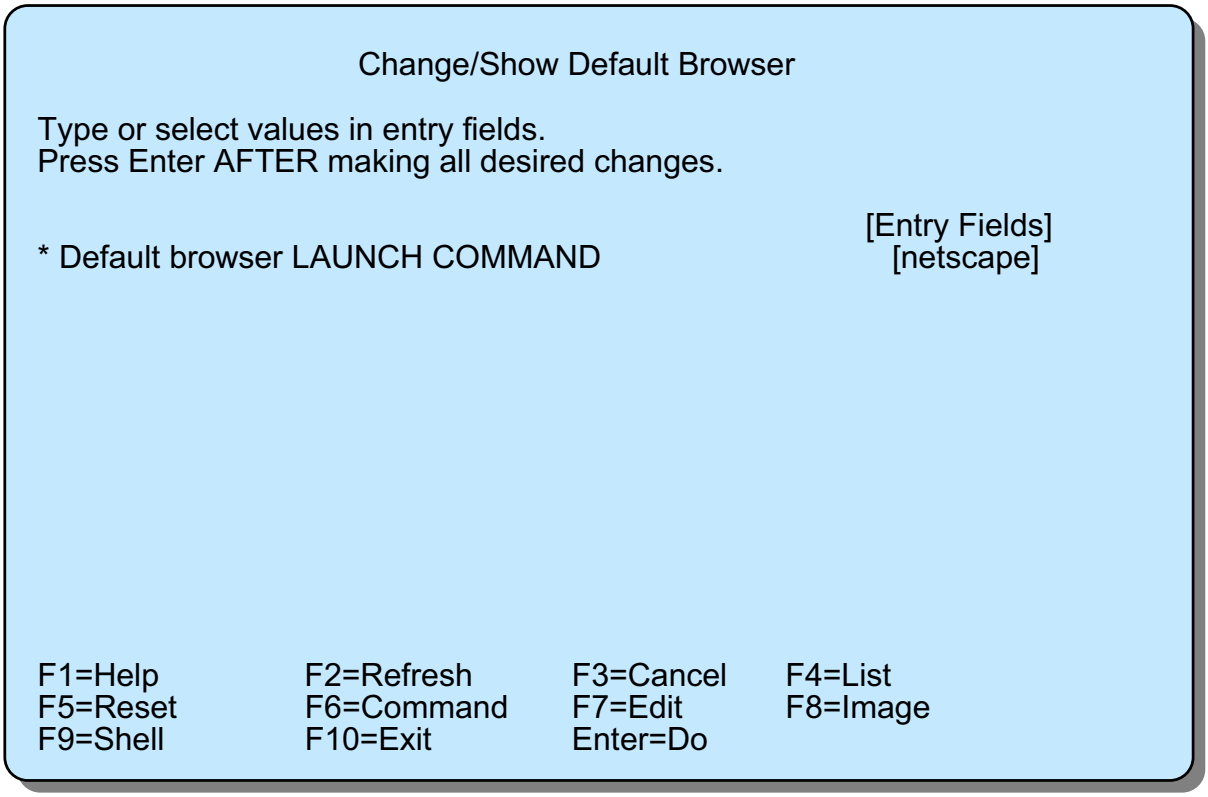


Figure A-4. Change/Show Default Browser AU1410.0

Notes:

Select Change/Show Default Browser from the smit Web-configure screen.

On this screen, type in the command that launches the browser that will be the default browser for users on this system. Indicate the full path name if necessary and any applicable options/flags. Netscape does not require any options/flags.

Use this SMIT screen also on the documentation clients to indicate the default browser.

Change Documentation and Search Server

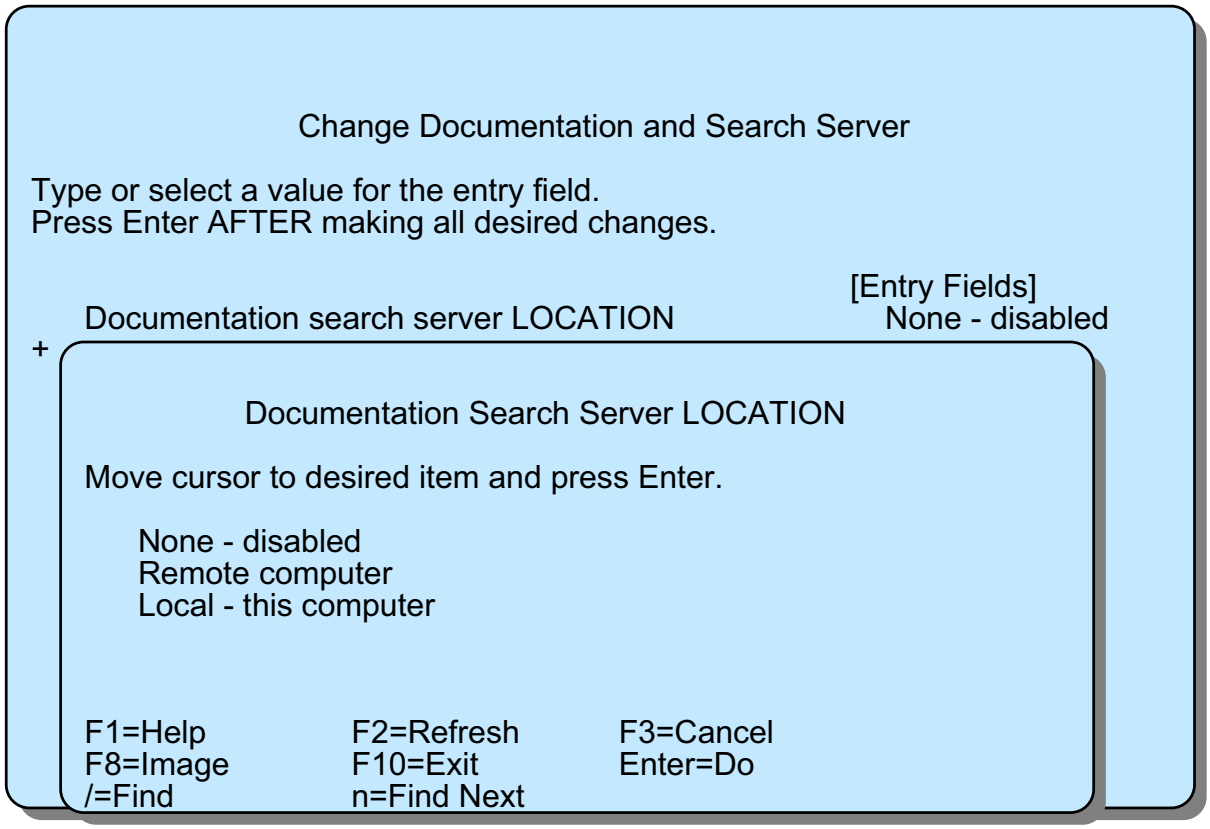


Figure A-5. Change Documentation and Search Server AU1410.0

Notes:

Select **Change Documentation and Search Server** from smit Web-configure screen.

Indicate the location of the documentation server. If configuring the server, choose **Local - this computer**. Choose this option also if using a standalone AIX V5.2 system.

If configuring the client, choose **Remote computer**. If this option is chosen, an additional menu is displayed where the hostname of the server is entered.

Change Local Documentation and Search Server (1 of 2)

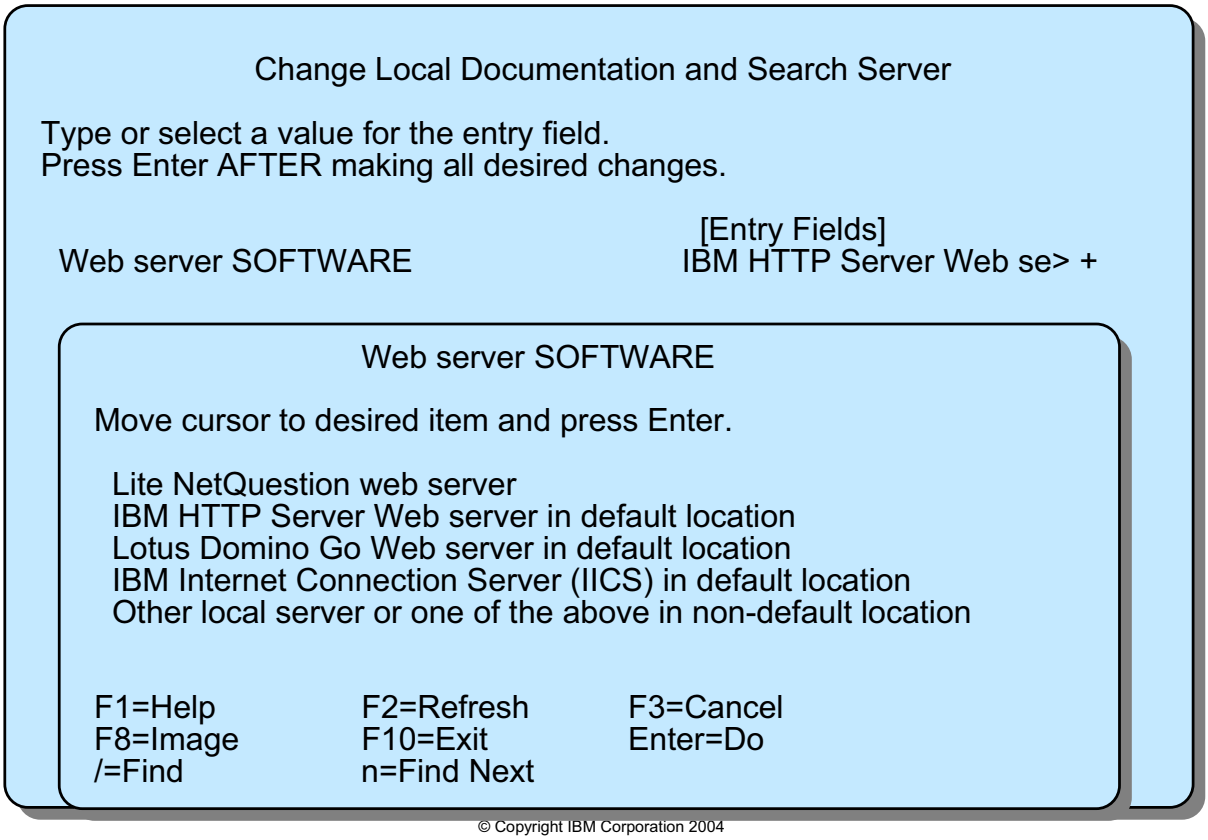


Figure A-6. Change Local Documentation and Search Server (1 of 2) AU1410.0

Notes:

Use this menu to choose the Web server software that is being used. A pop-up menu is available.

Change Local Documentation and Search Server (2 of 2)

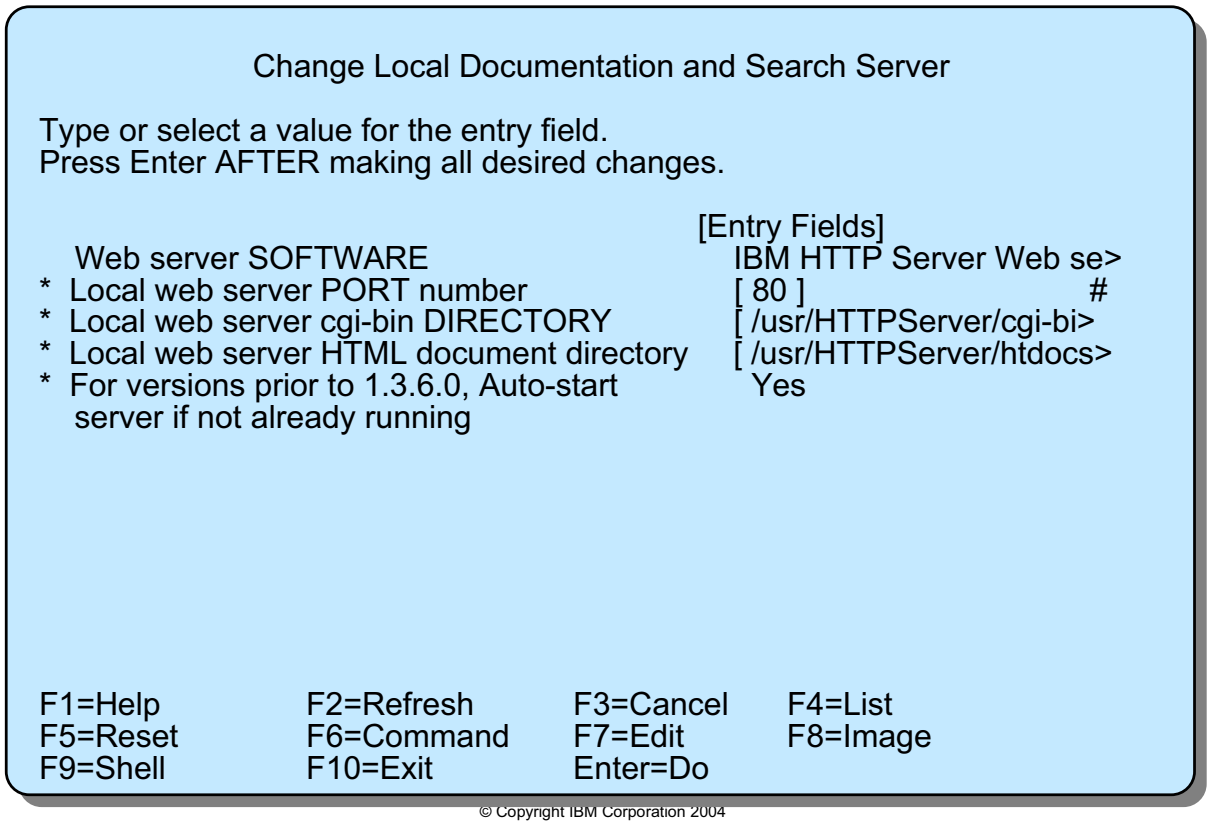


Figure A-7. Change Local Documentation and Search Server (2 of 2) AU1410.0

Notes:

If using the IBM HTTP Server Web server, Lotus Domino Go Web server or the IBM Internet Connection Server, this menu is filled out automatically. Update this screen if changing the defaults or using other Web server software to access the AIX V5.2 online documentation.

Note: When using the IBM HTTP Server Web server to allow other systems to use this system as a documentation server, you must configure the server name manually. Follow these steps to accomplish this:

1. Edit the file: /usr/HTTPServer/conf/httpd.conf
2. Change the line:
   # ServerName new.host.name
   to
   ServerName *YourSystemName*
   (Take out the comment (#) and insert the system's host name for *new.host.name*)
3. Reboot the system or run the command: **/usr/HTTPServer/bin/httpd**

AIX Version 5.2 Documentation

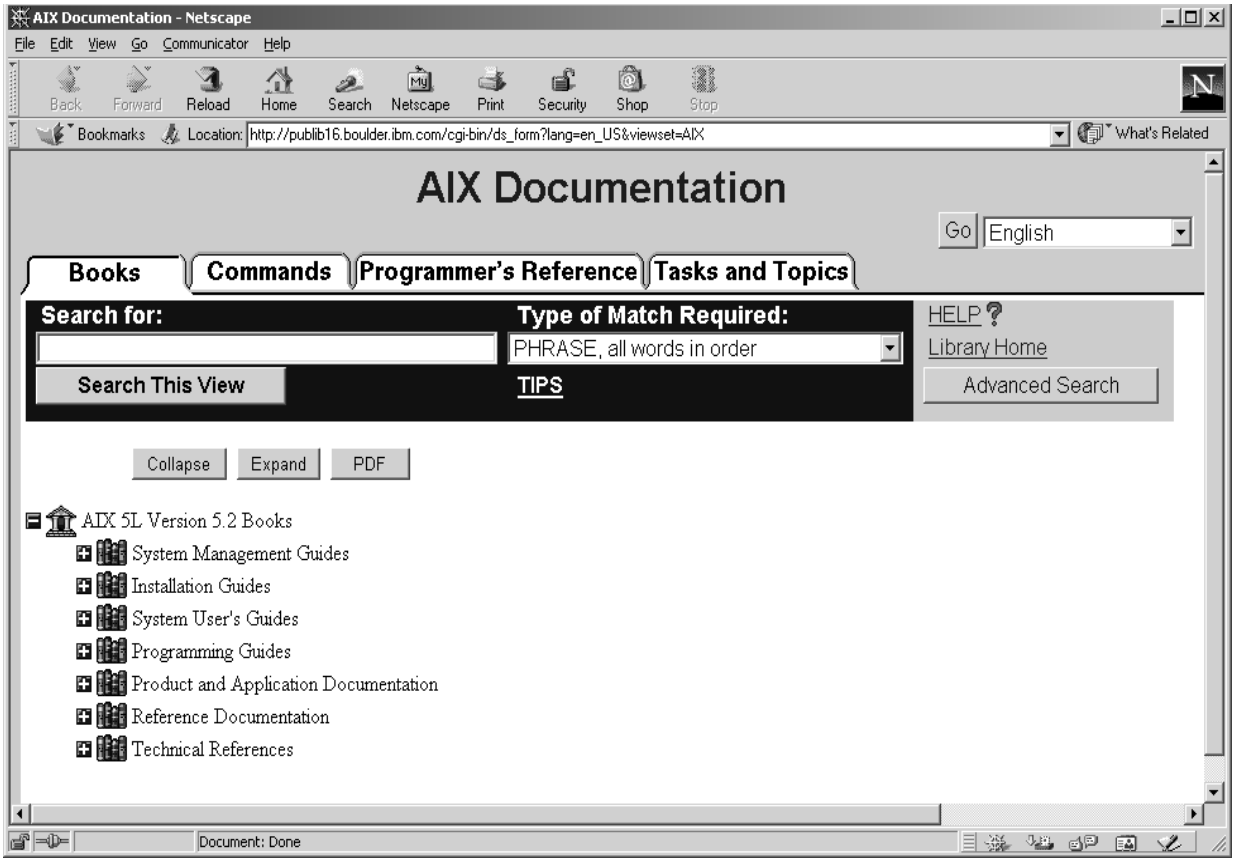


Figure A-8. AIX Version 5.2 Documentation AU1410.0

Notes:

Once the documentation is set up, it can be accessed with:

- Your Web browser (for example, Netscape), using the URL:

  http://<hostname>/cgi-bin/ds_form

  The **<hostname>** is the name of the server as configured to TCP/IP. This hostname must be able to be resolved in the /etc/hosts file or through DNS.

- The Search function from the *Documentation Library* icon using CDE (the Common Desktop Environment)
- The **docsearch** command

Online documentation is also available at: **http://www.ibm.com/servers/aix/library.**

On the library home page, near the top, you are given different methods to look at the documentation. You can view the documents by books, look at command documentation or view it by a topics and task list.

Moving down the screen, the next area allows you to perform a search. This is probably the quickest and easiest way to locate information on a specific item. Just type in a key word and let it find the documents for you.

The last part of the screen shows icons representing the books and category of books that are available. You can click the icons to expand their information.

Print AIX Version 5.2 Documentation

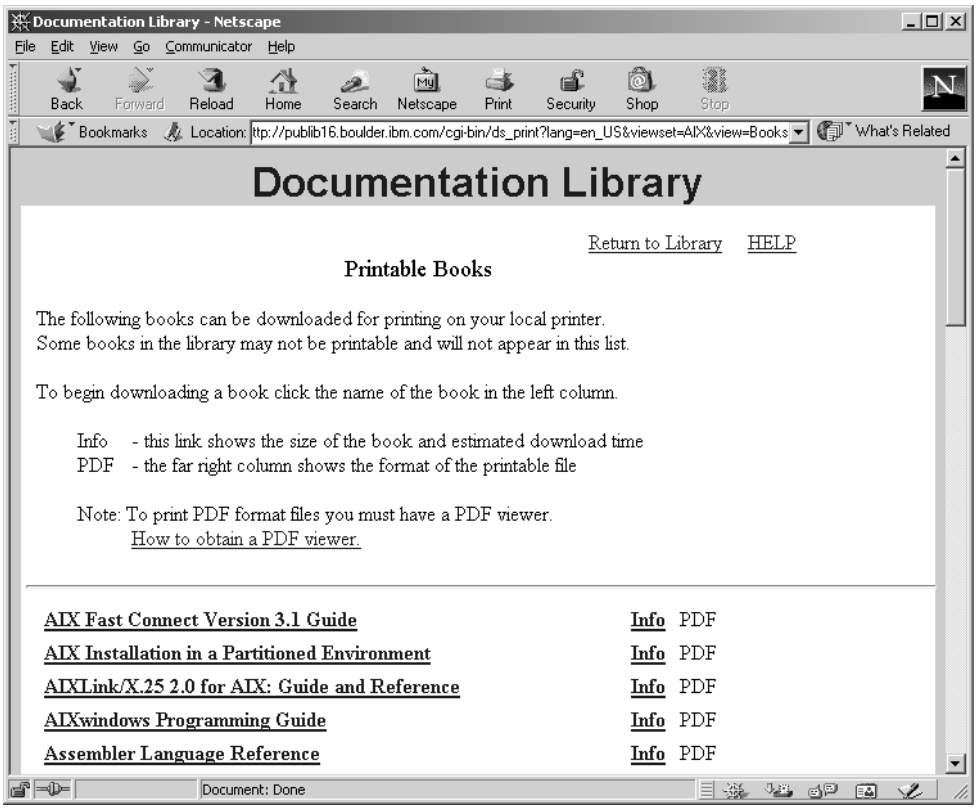


Figure A-9. Print AIX Version 5.2 Documentation AU1410.0

Notes:

The Documentation Library Service contains a Print Tool button. When you click this button, you see a list of books that can be downloaded in a single printable file. You have the option of customizing this list to include your own book for printing.

Search AIX Version 5.2 Documentation

Figure A-10. Search AIX Version 5.2 Documentation AU1410.0

Notes:

Probably the easiest way to find an answer is to search the documentation using the Search window on the Documentation Library screen.

Above are the results of a search. A star system is used to indicate the documents that best match your keywords. Five stars is the best. Clicking the item takes you to that document.

IBM pSeries Information Center

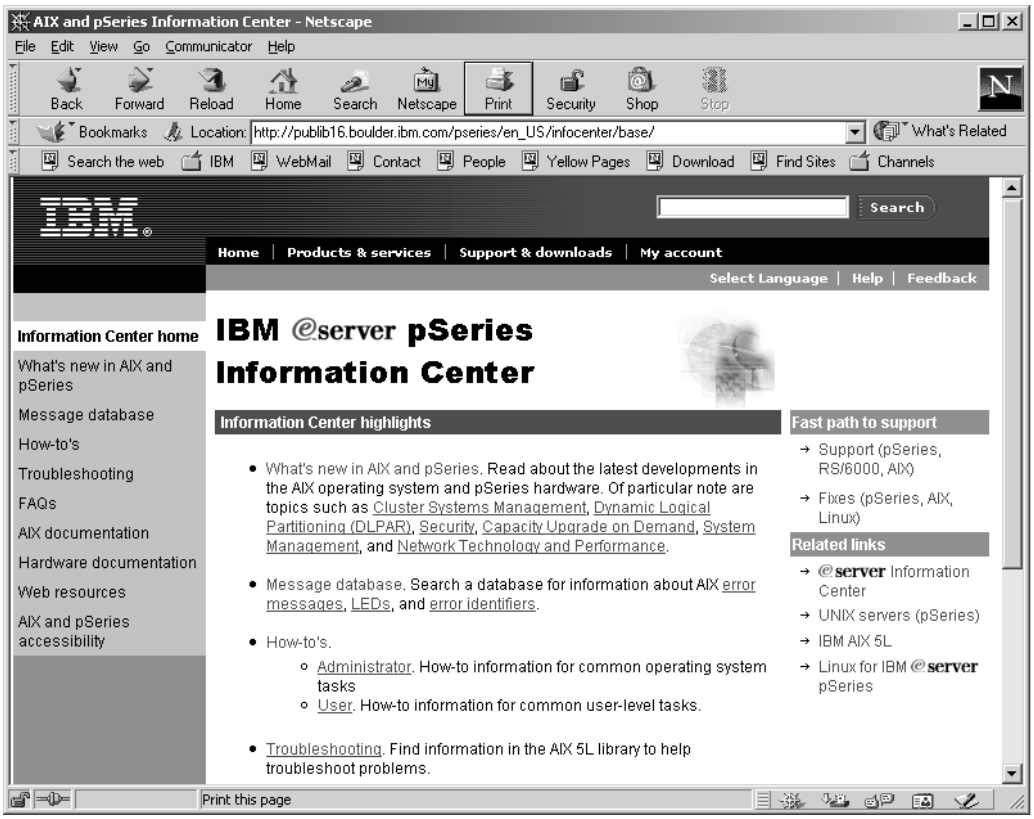


Figure A-11. IBM pSeries Information Center AU1410.0

Notes:

The IBM @server pSeries Information Center is a Web Site that serves as a focal point for all information pertaining to pSeries and AIX. It provides access to the AIX V4.3, V5.1 and V5.2 documentation, as well as access to a message database to search on error numbers, identifiers and LEDs. FAQs, How-To's, and many more features are provided.

- You can access the Information Center by using the URL:

  http://publib16.boulder.ibm.com/pseries/en_US/infocenter/base

- Run the command **infocenter** from the command line. This command starts the default browser with the URL previously mentioned.
- Start the Information Center with the **Information Center icon** located on the Help panel of the CDE desktop.

Activity: Configuring Web-based Documentation

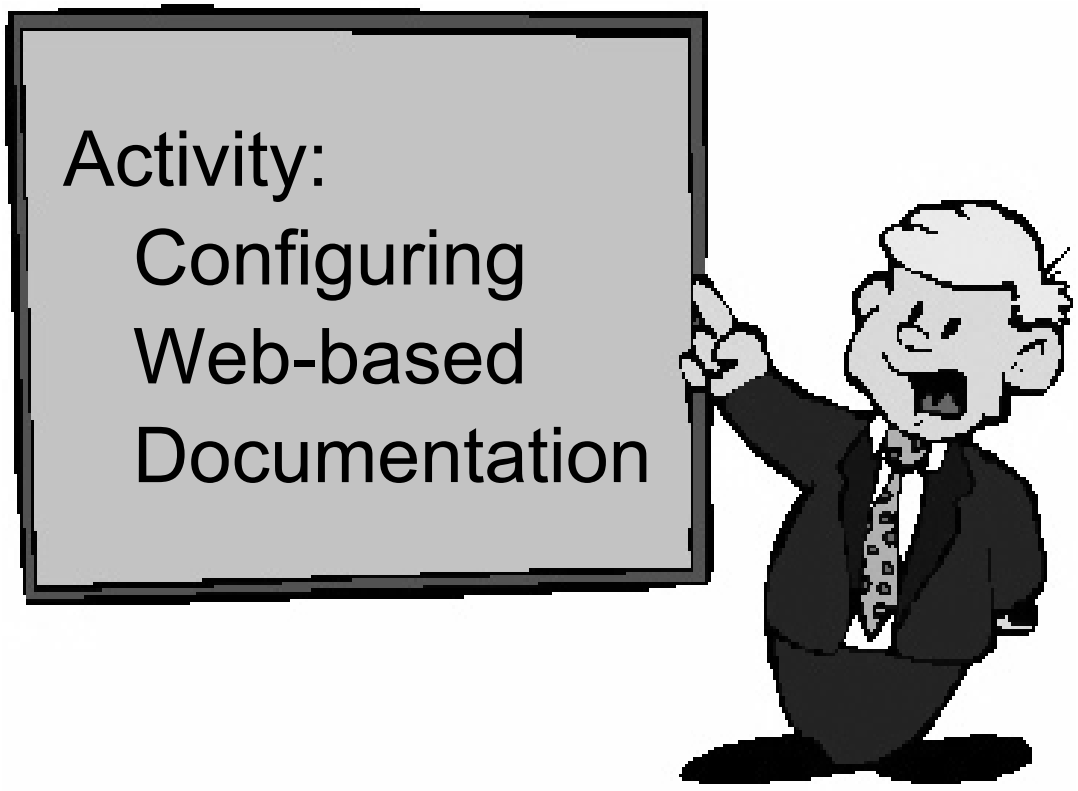


Figure A-12. Activity: Configuring Web-based Documentation AU1410.0

Activity - Configuring Web-based Documentation

Activity Instructions

Configure the Documentation

1. Log in to AIX as **teamxx** and **su** to **root**.
2. Use SMIT to configure the Documentation. This allows you to access the AIX V5.2 online documentation. All the necessary software has been installed; all you have to do is perform the configuration so that you can access the online documentation. Use **IBM HTTP Server Web server**.

Verify the AIX online documentation

3. Since you are accessing the online documentation from a Web server, it is necessary to know your system's TCP/IP host name and IP address. Display this at the command line and record the results._____
4. Access the AIX V5.2 online documentation.

5. Congratulations! You have configured the AIX online documentation. Be sure to add a bookmark with your browser so you don't need to remember the long URL. When you are done, exit from the browser.

   •On the Netscape toolbar, click **Bookmarks -> Add Bookmarks**.
   •On the Netscape toolbar, click **File -> Exit**.

6. A quick way to locate information in the documentation is to do a search. Use the command (from the command line) that starts the Documentation Library Service. As time permits, get familiar with the Web-based documentation by trying a few searches and looking at some of the documentation. When you are done, log out.

END OF ACTIVITY

Activity Instructions with Hints

Configure the Documentation

1. Log in to AIX as **teamxx** and **su** to **root**.
   - From the login window click **Options** and then click **Command Line Login**.
   - When the unformatted message appears, press **Enter** to get the login prompt.
   - Log in as **teamxx**
   - $**su root**
2. Use SMIT to configure the Documentation. This allows you to access the AIX V5.2 online documentation. All the necessary software has been installed - all you have to do is perform the configuration so that you can access the online documentation. Use **IBM HTTP Server Web server**.
   - # **smit web_configure**
   - Choose **Change/Show Default Browser**. The SMIT screen should show *Netscape*. This is the command that is used to launch the Web browser. (In your own environment, if you are using a browser other than Netscape, you need to type in the command that launches that browser, including any applicable options.) Press **Enter**.
   - Press **F3 - Cancel** to return to the **Internet and Documentation Services** menu.
   - Choose **Change Documentation and Search Server**.
   - Press **F4 - List** and then choose **Local - this computer**. Press **Enter**.
   - Press **Enter** again to display the SMIT screen asking for the Web server SOFTWARE. On this screen press F4 and select **IBM HTTP Server Web server**. Press **Enter**.
   - The menu expands to display additional fields. If you are using the IBM HTTP Server Web server, the fields are already be filled in with the correct values. (In your own environment, if you are using some other Web server software, you need to fill in the port number being used, the cgi-bin directory and the HTML document directory).
   - Press **enter** to configure the documentation library service. Verify the results and press **F10** to exit SMIT.

Verify the AIX online documentation

3. Since you are accessing the online documentation from a Web server, it is necessary to know your system's TCP/IP host name and IP address. Display this at the command line and record the results._____
   - # **hostname**
   - # **host** *hostname*

4. Access the AIX V5.2 online documentation.
    - # **xinit** to bring up AIXWindows.
    - From a window: # **netscape** to bring up the Web browser.
    - Click **Accept for the Netscape license agreement**, if asked**.**
    - Once the Netscape window appears, it may be necessary to enlarge the window. If Netscape errors appear, just click **OK** to remove them. At the URL type:

      http://<hostname>/cgi-bin/ds_form

      The <hostname> in the command should be the name displayed by the **hostname** command. Press **Enter**. The AIX V5.2 Base Documentation screen should appear.
5. Congratulations! You have configured the AIX online documentation. Be sure to add a bookmark with your browser so you don't need to remember the long URL. When you are done, exit from the browser.
    - On the Netscape toolbar, click **Bookmarks -> Add Bookmarks**.
    - On the Netscape toolbar, click **File -> Exit.**
6. A quick way to locate information in the documentation is to do a search. Use the command (from the command line) that starts the Documentation Library Service. As time permit, get familiar with the Web-based documentation by trying a few searches and looking at some of the documentation. When you are done, log out.
    - **# docsearch**

END OF ACTIVITY

A.1. WebSM

Web-based System Manager

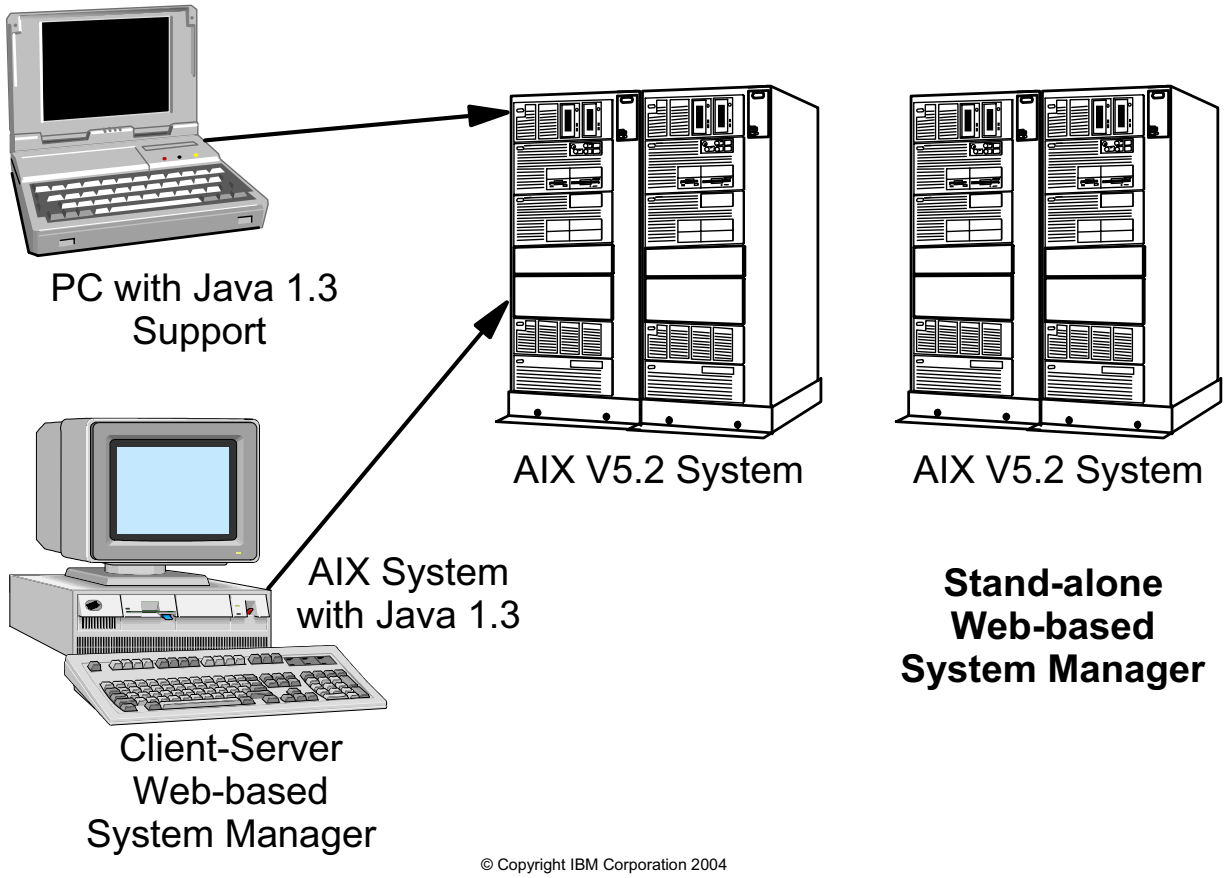


Figure A-13. Web-based System Manager AU1410.0

Notes:

AIX V4.3 introduced the Web-based System Manager, which is the next step in the evolution of AIX system administration tools. There are a lot of enhancements to the Web-based System Manager and since AIX V5.1 it was called the default system administration tool for AIX. The Web-based System Manager can be run in stand-alone mode, that is, you can use this tool to perform system administration functions on the AIX system you are currently running on. However, the Web-based System Manager also supports a client-server environment. In this environment, it is possible to administer an AIX system from a remote PC or from another AIX system using a graphics terminal. In this environment, the AIX system being administered is the *server* and the system you are performing the administration functions from is the *client*.

The client can operate in either application mode on AIX with Java 1.3 or in applet mode on platforms that support Java 1.3. Thus, the AIX system can be managed from another AIX system or from a PC running Microsoft Windows NT/2000/XP.

The objectives of the Web-based System Manager are:

- Simplification of AIX administration by a single interface
- Enable AIX systems to be administered from almost any client platform with a browser that supports Java 1.3 or use downloaded client code from an AIX V5.2 code
- Enable AIX systems to be administered remotely
- Provide a system administration environment that provides a similar look and feel to the Windows NT/2000/XP, LINUX and AIX CDE environments

The Web-based System Manager provides a comprehensive system management environment and covers most of the tasks in the SMIT user interface. The Web-based System Manager can only be run from a graphics terminal, so SMIT needs to be used in the ASCII environment.

To download Web-based System Manager Client code from an AIX host use the address

http://<hostname>/remote_client.html

Supported clients are Microsoft Windows NT/2000/XP and RedHat Linux 7.2 and 7.3.

To download Windows Web-based System Manager Client code from an AIX host and start Install Shield use the address

http://<hostname>/wsmship/pc_client/setup.html

The Windows Web-based System Manager Client installation needs around 64 MB disk space.

Accessing the Web-based System Manager

Stand-Alone
wsm

Client-Server
With browser, URL:
http://<hostname>/wsm.html

As Stand-alone Java application
Double-click on the Web-based SystemManager
Remote Client icon

From AIX client:
wsm -host <hostname>

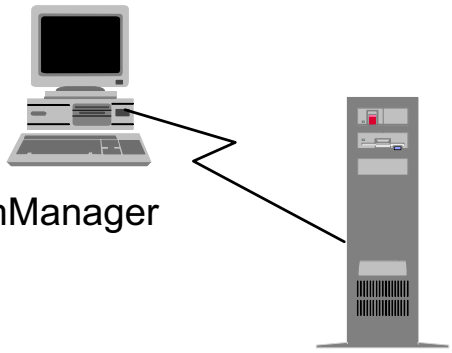


Figure A-14. Accessing the Web-based System Manager AU1410.0

Notes:

In stand-alone mode, to access the Web-based System Manager use the command **wsm**.

- From the CDE Application Manager, you can also access by icons if you are using CDE. Open the **System Admin** folder and double-click on **Management Console** to view icons for each of the Web-based System Manager applications.

If using the Web-based System Manager in client-server mode:

- If the Web-based System Manager client is running as a Java applet in a browser use the appropriate URL to access the tool. The default URL is **http://<hostname>/wsm.html**. Be aware that AIX V5.1 is using Java 1.3.0 and AIX V5.2 is using Java 1.3.1 and that your browser plug-in-version must be compatible to the Java version on the AIX server.
- If the Web-based System Manager client is running as a stand-alone Java application, double click on the Web-based System Manager remote client icon.
- From an AIX V5.1 client, use the command **wsm -host <hostname>**. This will bring up a login box where you enter your ID and password for the remote AIX system.

Using the Web-based System Manager (1 of 3)

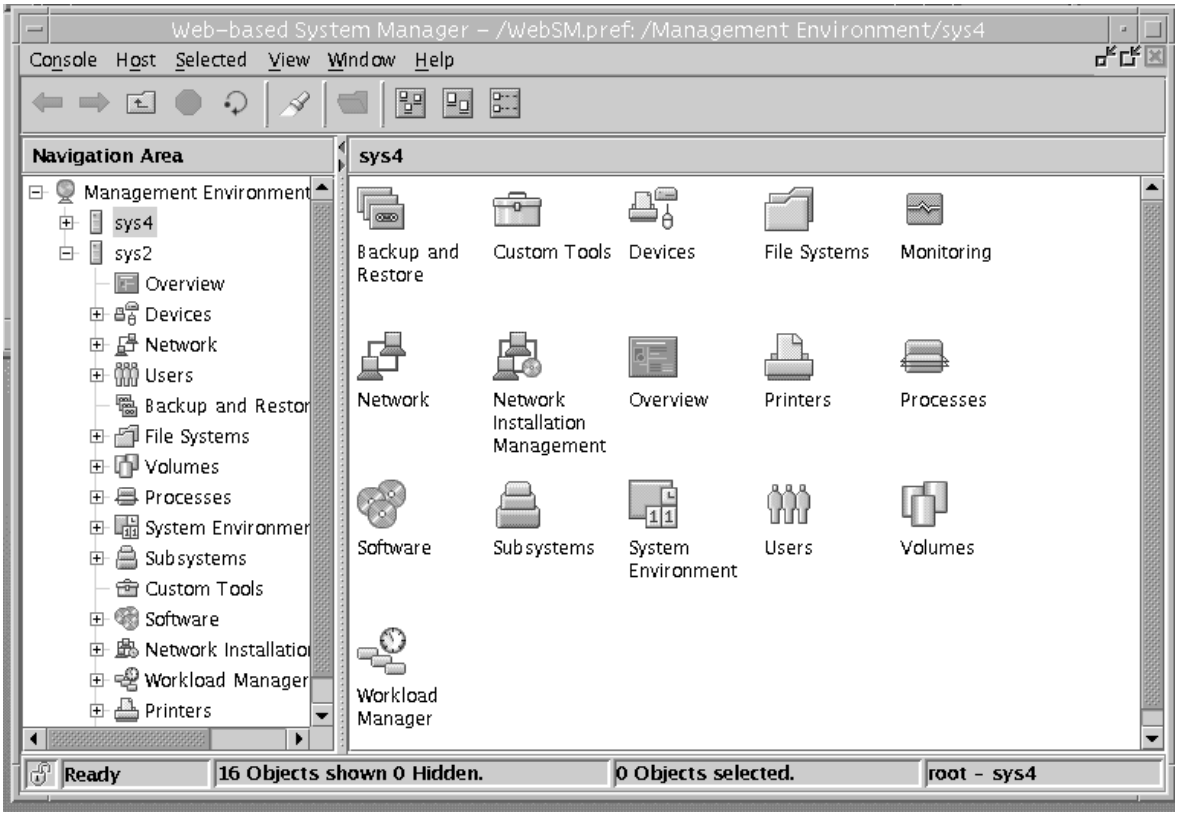


Figure A-15. Using the Web-based System Manager (1 of 3) AU1410.0

Notes:

The graphic above shows the Web-based System Manager Console Window containing two primary panels. The panel on the left displays the machines that you can manage from the Console Window. This panel is referred to as the *Navigation Area*. The panel on the right (the *Contents Area*) displays results based on the item selected in the Navigation Area. You select the machine to perform management operations from the Navigation Area. As you navigate to the desired operation in the Navigation Area, the Contents Area is updated to show the allowable choices.

There is a session log that is a facility of the console. It keeps track of changes made on managed hosts during a Web-based System Manager session.

Using the Web-based System Manager (2 of 3)

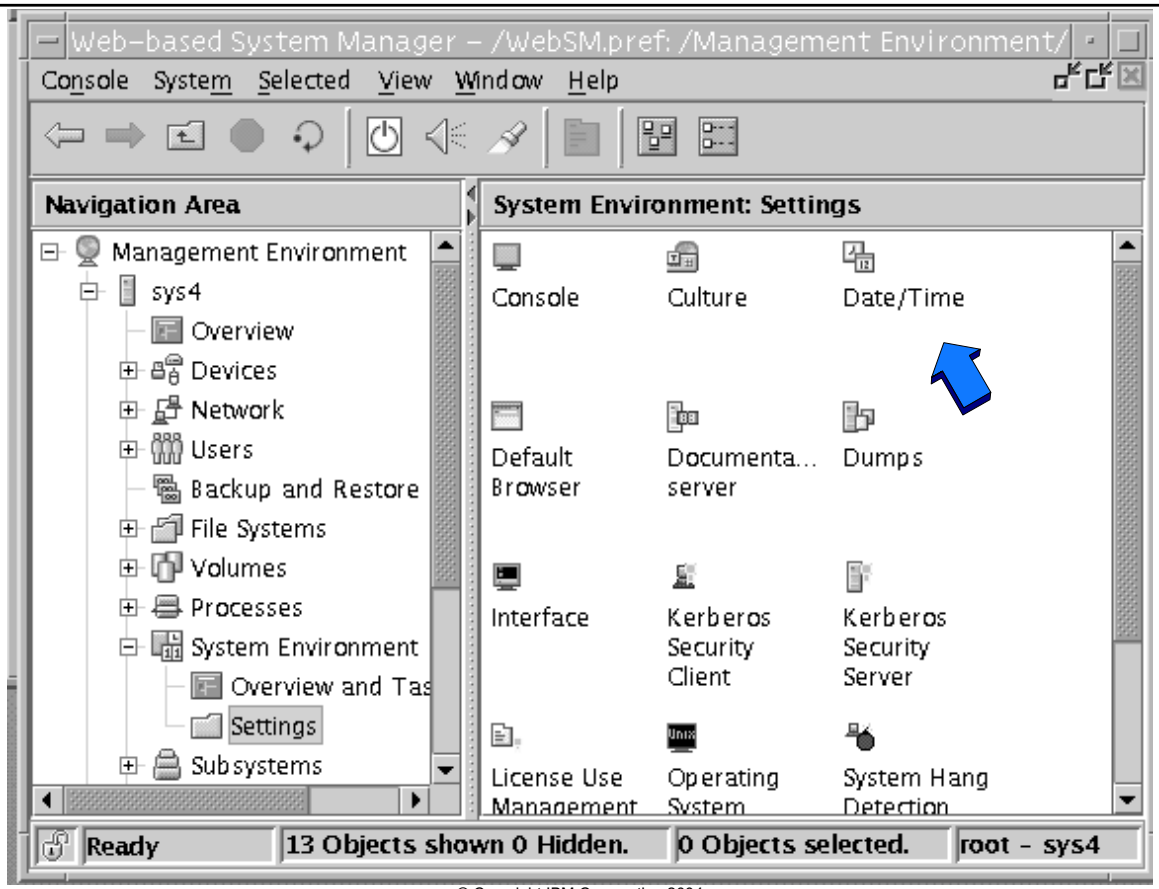


Figure A-16. Using the Web-based System Manager (2 of 3) AU1410.0

Notes:

The graphic shows the **System Environment: Settings** window of the Web-based System Manager. This window contains a toolbar. From left to right, the symbols support the following functions: Back to previous screen, Forward to next screen, Up one level, Stop reloading, Reload now, Shutdown, Broadcast message, Find, Show properties of highlighted object, Icon (to return to icon mode if currently viewing details), Details (which lists each icon and provides an explanation of each). Most of these functions can also be accessed via the **View** option on the menu bar.

If you select the Date and Time icon, this allows you to set the date and time on the system.

Using the Web-based System Manager (3 of 3)

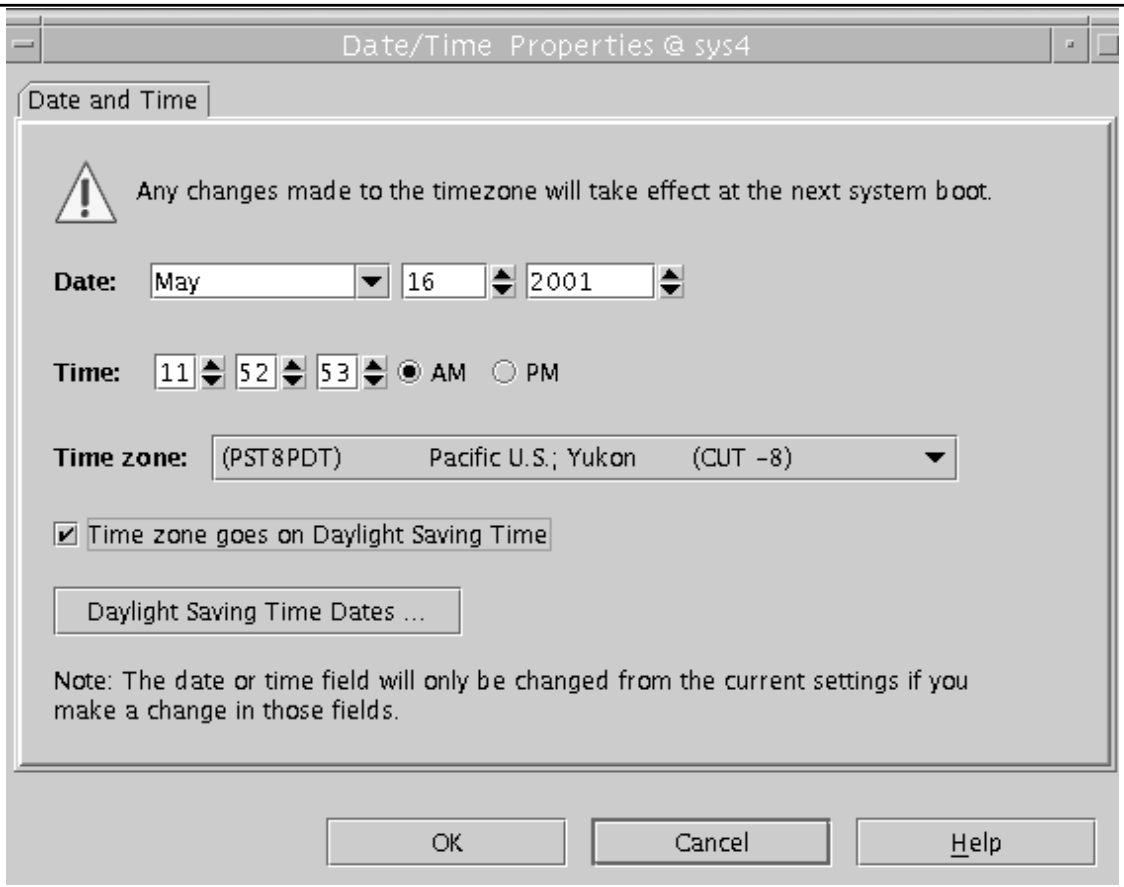


Figure A-17. Using the Web-based System Manager (3 of 3) AU1410.0

Notes:

Note that the Web-based System Manager supports an easy-to-use point-and-click environment where information can be entered. Use this window to set the system date and time (only the root user can perform this function). When finished, click **OK** to apply your change.

Additional information on the Web-based System Manager can be accessed through the Internet using the URL:

http://www-1.ibm.com/servers/aix/wsm/

Configuring Client/Server WebSM

- Install the Web server
- Test the Web server
- Install WebSM (usually done by default with the base)
- Define the Web server document directory

```
# /usr/websm/bin/wsmappletcfg  -docdir directory
```

- Enable WebSM server

```
# /usr/websm/bin/wsmserver  -enable
```


Figure A-18. Configuring Client/Server WebSM AU1410.0

Notes:

These are the steps needed to set up the Web server from scratch. If you already have set up the Web-based documentation, the first two steps (Install the Web server and Test the Web server) are already done.

WebSM is installed by default in AIX V5.1 and V5.2. The following filesets are installed from the AIX 5.2 Base Installation media:

sysmgt.help.en_US.websm
sysmgt.help.msg.en_US.websm
sysmgt.msg.en_US.websm.apps
sysmgt.websm.apps
sysmgt.websm.diag
sysmgt.websm.framework
sysmgt.websm.icons
sysmgt.websm.rte
sysmgt.websm.Webaccess

To set up the documentation directory, you need to know the location of the document directory for the Web server you are using. We are using the IBM HTTP Server Web server in the classroom. The path needed is **/usr/HTTPServer/htdocs.**

Run the following command:
/usr/websm/bin/wsmappletcfg -docdir directory

For example, for IBM HTTP Server Web server, the command would be:
/usr/websm/bin/wsmappletcfg -docdir /usr/HTTPServer/htdocs

Next, enable the WebSM server
/usr/websm/bin/wsmserver -enable

This can also be done through smit using the fastpath
smit web_based_system_manager

Which automatically runs
/usr/websm/bin/wsmserver -enable

To accessing WebSM from the client machine, use the URL:
http://<*hostname*>/wsm.html

Exercise: Configuring WebSM Server

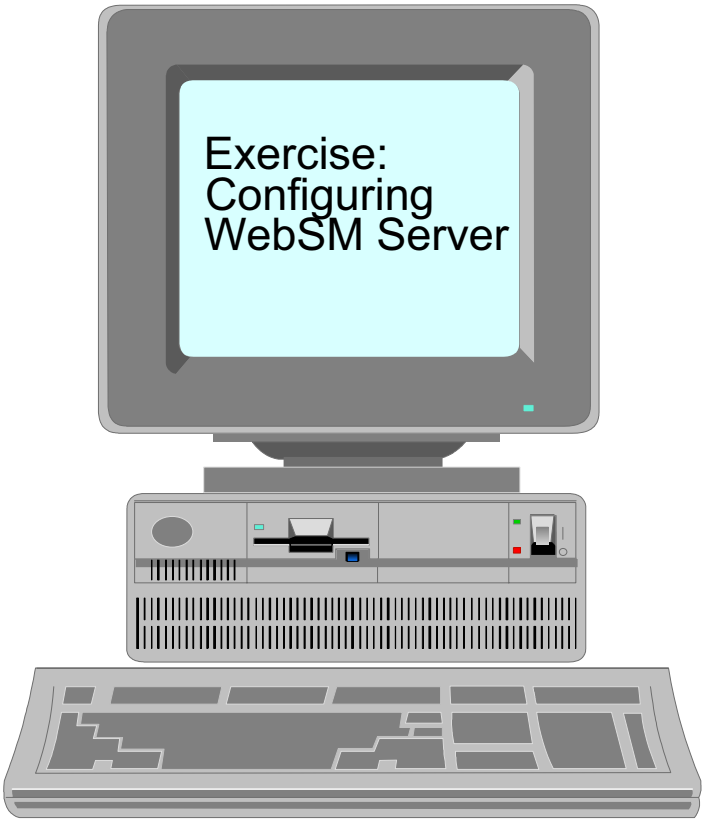


Figure A-19. Exercise: Configuring WebSM Server AU1410.0

Notes:

This lab allows you to set up WebSM and learn how to use this interface. If you have other machines in your classroom that are networked together, you can also try to perform remote administration using WebSM.

The exercise can be found in your Exercise Guide.

Checkpoint (1 of 2)

1. Define the SMIT function keys that can be used for the following:
   List the command that will be run ____
   List the screen name which can be used for the fastpath____
   Take a screen image: ___
   Break out into a shell: ___
   Return to the previous menu: ___
2. T/F AIX Web-based documentation can be used to reference information in different ways, such as searching for a command, searching for a task or viewing information in a book like manner.
3. T/F The AIX V5.2 documentation is viewed using a Web browser.
4. WebSM is available for client access automatically after the BOS is installed. True or False?

Figure A-20. Checkpoint (1 of 2) AU1410.0

Notes:

Checkpoint (2 of 2)

5. Which of the statements are true regarding the Web-based System Manager?

   a. An AIX V5.2 system can be managed from a remote PC with appropriate JAVA and Web-browser code installed.
   b. In stand-alone mode use the **wsm** command to access the Web-based system manager.
   c. It is possible to manage an AIX V5.2 system from a remote AIX V5.2 system using an ascii terminal.
   d. The Web-based System Manager includes TaskGuides that direct the user through complex tasks.

Figure A-21. Checkpoint (2 of 2) AU1410.0

Notes:

Unit Summary

- There are a number of system management tools that can be used by the system administrator, such as SMIT, and the Web-based System Manager.
- SMIT provides graphics or ASCII support for most system administration tasks.
- The Web-based System Manager supports system administration tasks in a stand-alone or client-server environment.
- Use a Web browser to access soft copy documentation with AIX.

Figure A-22. Unit Summary AU1410.0

Notes:

Appendix B. Command Summary

Startup, Logoff, and Shutdown

<Ctrl>d (exit)	log off the system (or the current shell).
shutdown	shuts down the system by disabling all processes. If in single-user mode, may want to use -F option for fast shutdown. -r option will reboot system. Requires user to be root or member of shutdown group.

Directories

mkdir	make directory
cd	change directory. Default is $HOME directory.
rmdir	remove a directory (beware of files starting with ".")
rm	remove file; -r option removes directory and all files and subdirectories recursively.
pwd	print working directory: shows name of current directory
ls	list files -a (all) -l (long) -d (directory information) -r (reverse alphabetic) -t (time changed) -C (multi column format) -R (recursively) -F (places / after each directory name & * after each exec file)

Files - Basic

cat	list files contents (concatenate). Can open a new file with redirection, for example, cat > newfile. Use <Ctrl>d to end input.
chmod	change permission mode for files or directories. • chmod =+- files or directories • (r,w,x = permissions and u, g, o, a = who) • can use + or - to grant or revoke specific permissions. • can also use numerics, 4 = read, 2 = write, 1 = execute. • can sum them, first is user, next is group, last is other.

	• For example, “chmod 746 file1” is user = rwx, group = r, other = rw.
chown	change owner of a files, for example, chown owner file
chgrp	change group of files
cp	copy file
mv	move or rename file
pg	list files content by screen (page) • h (help) q (quit) • <cr> (next pg) f (skip 1 page), • l (next line) d (next 1/2 page) • $ (last page) p (previous file), • n (next file) . (redisplay current page) • /string (find string forward) ?string (find string backward) • -# (move backward # pages) +# (move forward # pages)
.	Current Directory
..	Parent Directory
rm	remove (delete) files (-r option removes directory and all files and subdirectories)
head	print first several lines of a file
tail	print last several lines of a file
wc	report the number of lines (-l), words (-w), characters (-c) in files. No options gives lines, words, and characters.
su	switch user
id	displays your user id environment, user name and id, group names and ids.
tty	displays the device that is currently active. Very useful for XWindows where there are several pts devices that can be created. It's nice to know which one you have active. **who am i** will do the same.

Files - Advanced

awk	programmable text editor / report write
banner	display banner (can redirect to another terminal 'nn' with '> /dev/ttynn')
cal	calendar (cal month year)
cut	cut out specific fields from each line of a file

diff	differences between two files
find	find files anywhere on disks. Specify location by path (will search all subdirectories under specified directory). -name fl (file names matching fl criteria) -user ul (files owned by user ul) -size +n (or -n) (files larger (or smaller) than n blocks) -mtime +x (-x) (files modified more (less) than x days ago) -perm num (files whose access permissions match num) -exec (execute a command with results of find command) -ok (execute a cmd interactively with results of find command) -o (logical or) -print (display results. Usually included) find syntax: find path expression action • For example, find / -name "*.txt" -print • or find / -name "*.txt" -exec li -l {} \; (executes li -l where names found are substituted for {}) ; indicates end of command to be executed and \ removes usual interpretation as command continuation character)
grep	search for pattern, for example, grep pattern files. Pattern can include regular expressions. -c (count lines with matches, but don't list) -l (list files with matches, but don't list) -n (list line numbers with lines) -v (find files without pattern) expression metacharacters • [ ] matches any one character inside. • with a - in [ ] will match a range of characters. • ^ matches BOL when ^ begins the pattern. • $ matches EOL when $ ends the pattern. • . matches any single character. (same as ? in shell). • * matches 0 or more occurrences of preceding character. (Note: ".*" is the same as "*" in the shell).
sed	stream (text) editor. Used with editing flat files.
sort	sort and merge files -r (reverse order); -u (keep only unique lines)

Editors

ed	line editor
vi	screen editor

INed	LPP editor
emacs	screen editor +

Shells, Redirection and Pipelining

< (read)	redirect standard input, for example, "command < file" reads input for command from file.
> (write)	redirect standard output, for example, "command > file" writes output for command to file overwriting contents of file.
>> (append)	redirect standard output, for example, "command >> file" appends output for command to the end of file.
2>	redirect standard error (to append standard error to a file, use "command 2>> file") combined redirection examples: • command < infile > outfile 2> errfile • command >> appendfile 2>> errfile < infile
;	command terminator used to string commands on single line
|	pipe information from one command to the next command. For example, "ls | cpio -o > /dev/fd0" passes the results of the ls command to the cpio command.
\	continuation character to continue command on a new line. Will be prompted with > for command continuation.
tee	reads standard input and sends standard output to both standard output and a file. For example, "ls | tee ls.save | sort" results in ls output going to ls.save and piped to sort command.

Metacharacters

*	any number of characters (0 or more)
?	any single character
[abc]	[ ] any character from the list
[a-c]	[ ] match any character from the list range
!	not any of the following characters (for example, leftbox !abc right box)
;	command terminator used to string commands on a single line
&	command preceding and to be run in background mode
#	comment character

\	removes special meaning (no interpretation) of the following character removes special meaning (no interpretation) of character in quotes
"	interprets only $, backquote, and \ characters between the quotes.
'	used to set variable to results of a command for example, now='date' sets the value of now to current results of the date command.
$	preceding variable name indicates the value of the variable.

Physical and Logical Storage

chfs	changes file system attributes such as mount point, permissions, and size
compress	reduces the size of the specified file using the adaptive LZ algorithm
crfs	creates a file system within a previously created logical volume
extendlv	extends the size of a logical volume
extendvg	extends a volume group by adding a physical volume
fsck	checks for file system consistency, and allows interactive repair of file systems
fuser	lists the process numbers of local processes that use the files specified
lsattr	lists the attributes of the devices known to the system
lscfg	gives detailed information about the RISC System/6000 hardware configuration
lsdev	lists the devices known to the system
lsfs	displays characteristics of the specified file system such as mount points, permissions, and file system size
lslv	shows you information about a logical volume
lspv	shows you information about a physical volume in a volume group
lsvg	shows you information about the volume groups in your system
lvmstat	controls LVM statistic gathering
migratepv	used to move physical partitions from one physical volume to another

migratelp	used to move logical partitions to other physical disks
mkdev	configures a device
mkfs	makes a new file system on the specified device
mklv	creates a logical volume
mkvg	creates a volume group
mount	instructs the operating system to make the specified file system available for use from the specified point
quotaon	starts the disk quota monitor
rmdev	removes a device
rmlv	removes logical volumes from a volume group
rmlvcopy	removes copies from a logical volume
umount	unmounts a file system from its mount point
uncompress	restores files compressed by the compress command to their original size
unmount	exactly the same function as the umount command
varyoffvg	deactivates a volume group so that it cannot be accessed
varyonvg	activates a volume group so that it can be accessed

Variables

=	set a variable (for example, d="day" sets the value of d to "day"). Can also set the variable to the results of a command by the ` character, for example, now=`date` sets the value of now to the current result of the date command.
HOME	home directory
PATH	path to be checked
SHELL	shell to be used
TERM	terminal being used
PS1	primary prompt characters, usually $ or #
PS2	secondary prompt characters, usually >
$?	return code of the last command executed
set	displays current local variable settings
export	exports variable so that they are inherited by child processes

env	displays inherited variables
echo	echo a message (for example, "echo HI" or "echo $d"). Can turn off carriage returns with \c at the end of the message. Can print a blank line with \n at the end of the message.

Tapes and Diskettes

dd	reads a file in, converts the data (if required), and copies the file out
fdformat	formats diskettes or read/write optical media disks
flcopy	copies information to and from diskettes
format	AIX command to format a diskette
backup	backs up individual files. -i reads file names from standard input -v list files as backed up; For example, "backup -iv -f/dev/rmt0 file1, file2" -u backup file system at specified level; For example, "backup -level -u filesystem" Can pipe list of files to be backed up into command. For example, "find . -print | backup -ivf/dev/rmt0 " where you are in directory to be backed up.
mksysb	creates an installable image of the root volume group
restore	restores commands from backup -x restores files created with "backup -i" -v list files as restore -T list files stored of tape or diskette -r restores filesystem created with "backup -level -u"; for example, "restore -xv -f/dev/rmt0"
cpio	copies to and from an I/O device. Destroys all data previously on tape or diskette. For input, must be able to place files in the same relative (or absolute) path name as when copied out (can determine path names with -it option). For input, if file exists, compares last modification date and keeps most recent (can override with -u option). -o (output) -i (input), -t (table of contents) -v (verbose), -d (create needed directory for relative path names) -u (unconditional to override last modification date) for example, "cpio -o > /dev/fd0"

	"file1" "file2" "<Ctrl-d>" or "cpio -iv file1 < /dev/fd0"
tapechk	performs simple consistency checking for streaming tape drives
tcopy	copies information from one tape device to another
tctl	sends commands to a streaming tape device
tar	alternative utility to backup and restore files
pax	alternative utility to cpio and tar commands

Transmitting

mail	send and receive mail. With userid sends mail to userid. Without userid, displays your mail. When processing your mail, at the ? prompt for each mail item, you can: d - delete s - append q - quit enter - skip m - forward
mailx	upgrade of mail
uucp	copy file to other UNIX systems (UNIX to UNIX copy)
uuto/uupick	send and retrieve files to public directory
uux	execute on remote system (UNIX to UNIX execute)

System Administration

df	display filesystem usage
installp	install program
kill (pid)	kill batch process with id or (pid) (find using ps); kill -9 (PID) will absolutely kill process
mount	associate logical volume to a directory; for example, "mount device directory"
ps -ef	shows process status (ps -ef)
umount	disassociate filesystem from directory
smit	system management interface tool

Miscellaneous

banner	displays banner
date	displays current date and time
newgrp	change active groups
nice	assigns lower priority to following command (for example, "nice ps -f")
passwd	modifies current password
sleep n	sleep for n seconds
stty	show and or set terminal settings
touch	create a zero length files
xinit	initiate X-Windows
wall	sends message to all logged in users.
who	list users currently logged in ("who am i" identifies this user)
man,info	displays manual pages

System Files

/etc/group	list of groups
/etc/motd	message of the day, displayed at login.
/etc/passwd	list of users and signon information. Password shown as !. Can prevent password checking by editing to remove !.
/etc/profile	system wide user profile executed at login. Can override variables by resetting in the user's .profile file.
/etc/security	directory not accessible to normal users
/etc/security/environ	user environment settings
/etc/security/group	group attributes
/etc/security/limits	user limits
/etc/security/login.cfg	login settings
/etc/security/passwd	user passwords
/etc/security/user	user attributes, password restrictions

Shell Programming Summary

Variables

var=string	set variable to equal string. (NO SPACES). Spaces must be enclosed by double quotes. Special characters in string must be enclosed by single quotes to prevent substitution. Piping (|), redirection (<, >, >>), and & symbols are not interpreted.
$var	gives value of var in a compound
echo	displays value of var, for example, "echo $var"
HOME	= home directory of user
MAIL	= mail file mane
PS1	= primary prompt characters, usually "$" or "#"
PS2	= secondary prompt characters, usually ">"
PATH	= search path
TERM	= terminal type being used
export	exports variables to the environment
env	displays environment variables settings
${var:-string}	gives value of var in a command. If var is null, uses string instead.
$1 $2 $3...	positional parameters for variable passed into the shell script
$*	used for all arguments passed into shell script
$#	number of arguments passed into shell script
$0	name of shell script
$$	process id (pid)
$?	last return code from a command

Commands

#	comment designator
&&	logical-and. Run command following && only if command preceding && succeeds (return code = 0).
||	logical-or. Run command following || only if command preceding || fails (return code < > 0).

exit n	used to pass return code nl from shell script. Passed as variable $? to parent shell
expr	arithmetic expressions Syntax: "expr expression1 operator expression2" operators: + - * (multiply) / (divide) % (remainder)
for loop	for n (or: for variable in $*); for example,: do command done
if-then-else	if test expression then command elif test expression then command else then command fi
read	read from standard input
shift	shifts arguments 1-9 one position to the left and decrements number of arguments
test	used for conditional test, has two formats. if test expression (for example, "if test $# -eq 2") if [expression] (for example, "if [$# -eq 2]") (spaces req'd) integer operators: -eq (=) -lt (<) -le (=<) -ne (<>) -gt (>) -ge (=>) string operators: = != (not eq.) -z (zero length) file status (for example, -opt file1) -f (ordinary file) -r (readable by this process) -w (writable by this process) -x (executable by this process) -s (non-zero length)
while loop	while test expression do command done

Miscellaneous

sh	execute shell script in the sh shell -x (execute step by step - used for debugging shell scripts)

vi Editor

Entering vi

vi file	edits the file named file
vi file file2	edit files consecutively (via :n)
.exrc	file that contains the vi profile
wm=nn	sets wrap margin to nn. Can enter a file other than at first line by adding + (last line), +n (line n), or +/pattern (first occurrence of pattern).
vi -r	lists saved files
vi -r file	recover file named file from crash
:n	next file in stack
:set all	show all options
:set nu	display line numbers (off when set nonu)
:set list	display control characters in file
:set wm=n	set wrap margin to n
:set showmode	sets display of "INPUT" when in input mode

Read, Write, Exit

:w	write buffer contents
:w file2	write buffer contents to file2
:w >> file2	write buffer contents to end of file2
:q	quit editing session
:q!	quit editing session and discard any changes
:r file2	read file2 contents into buffer following current cursor
:r! com	read results of shell command "com" following current cursor
:!	exit shell command (filter through command)
:wq or ZZ	write and quit edit session

Units of Measure

h, l	character left, character right
k or <Ctrl>p	move cursor to character above cursor
j or <Ctrl>n	move cursor to character below cursor
w, b	word right, word left
^, $	beginning, end of current line
<CR> or +	beginning of next line
-	beginning of previous line
G	last line of buffer

Cursor Movements

Can precede cursor movement commands (including cursor arrow) with number of times to repeat, for example, 9--> moves right nine characters.

0	move to first character in line
$	move to last character in line
^	move to first nonblank character in line
fx	move right to character "x"
Fx	move left to character "x"
tx	move right to character preceding character "x"
Tx	move left to character preceding character "x"
;	find next occurrence of "x" in same direction
,	find next occurrence of "x" in opposite direction
w	tab word (nw = n tab word) (punctuation is a word)
W	tab word (nw = n tab word) (ignore punctuation)
b	backtab word (punctuation is a word)
B	backtab word (ignore punctuation)
e	tab to ending char. of next word (punctuation is a word)
E	tab to ending char. of next word (ignore punctuation)
(	move to beginning of current sentence
)	move to beginning of next sentence
{	move to beginning of current paragraph
}	move to beginning of next paragraph

H	move to first line on screen
M	move to middle line on screen
L	move to last line on screen
<Ctrl>f	scroll forward 1 screen (3 lines overlap)
<Ctrl>d	scroll forward 1/2 screen
<Ctrl>b	scroll backward 1 screen (0 line overlap)
<Ctrl>u	scroll backward 1/2 screen
G	go to last line in file
nG	go to line "n"
<Ctrl>g	display current line number

Search and Replace

/pattern	search forward for "pattern"
?pattern	search backward for "pattern"
n	repeat find in the same direction
N	repeat find in the opposite direction

Adding Text

a	add text after the cursor (end with <esc>)
A	add text at end of current line (end with <esc>)
i	add text before the cursor (end with <esc>)
I	add text before first nonblank char in current line
o	add line following current line
O	add line before current line
<esc>	return to command mode

Deleting Text

<Ctrl>w	undo entry of current word
@	kill the insert on this line
x	delete current character
dw	delete to end of current word (observe punctuation)

dW	delete to end of current word (ignore punctuation)
dd	delete current line
d	erase to end of line (same as d$)
d)	delete current sentence
d}	delete current paragraph
dG	delete current line thru end-of buffer
d^	delete to the beginning of line
u	undo last change command
U	restore current line to original state before modification

Replacing Text

ra	replace current character with "a"
R	replace all characters overtyped until <esc> is entered
s	delete current character and append test until <esc>.
s/s1/s2	replace s1 with s2 (in the same line only)
S	delete all characters in the line and append text
cc	replace all characters in the line (same as S)
ncx	delete "n" text objects of type "x"; w, b = words,) = sentences, } = paragraphs, $ = end-of-line, ^ = beginning of line) and enter append mode
C	replace all characters from cursor to end-of-line.

Moving Text

p	paste last text deleted after cursor (xp will transpose 2 characters)
P	paste last text deleted before cursor
nYx	yank "n" text objects of type "x" (w, b = words,) = sentences, } = paragraphs, $ = end-of-line, and no "x" indicates lines. Can then paste them with "p" command. Yank does not delete the original.
"ayy"	can use named registers for moving, copying, cut/paste with "ayy" for register a (use registers a-z). Can then paste them with "ap" command.

Miscellaneous

.	repeat last command
J	join current line with next line

Appendix C. Sample Shell Scripts Used in Class

The information in this appendix has not been submitted to any formal IBM test and is distributed AS IS. The use of this information or the implementation of any of these techniques is a customer responsibility and depends on the customer's ability to evaluate and integrate them into the customer's operational environment. While each item may have been reviewed by IBM for accuracy in a specific situation, there is no guarantee that the same or similar results are obtained elsewhere. Customers attempting to adapt these techniques to their own environments do so at their own risk.

Shell scripts have been provided to support optional exercises in Exercises 5 and 6, and scripts that support concepts discussed during the class to document the system configuration and backup of VGDA information.

The concept of automatically documenting your system configuration was discussed in class. Creation of the following shell script lists customized devices, vital product data, and attributes for all the devices on your system.

```
for DEV in $(lsdev -CF name)
do
echo $(lsdev -C | $DEV -F "name location") >> /tmp/d.log
lsattr -EH | $DEV >> /tmp/d.log
done
lscfg -v >> /tmp/d.log
```

The following script will save logical volume maps for possible data recovery if a volume group descriptor area (VGDA) is lost:

```
# ! /bin/ksh
# save.map = a simple script to save logical volume maps
# for possible data recovery if a volume group descriptor
# area (VGDA) is lost
# usage: save.map VOLUME_GROUP_NAME
# maps are saved in /tmp/LOGICAL_VOLUME_NAME.map
if ( ( $# < 1 ) )
then
print "Usage: save.map VG_NAME"
exit 1
fi
VG=$1
lsvg  -l  $VG | tail +3 | cut -f1 -d" " | while read LV
do
lslv -m $LV > /tmp/$LV.map
done
```

The following shell script, **lab 6**, was used in the Optional Exercises section in the Printers Exercise, instruction 13:

```
#!/usr/bin/ksh
echo "Working, please wait .\c"
stopsrc -s qdaemon 2> /dev/null 1>/dev/null
echo ".\c"
echo "\n\n: \n" >> /etc/qconfig 2>/dev/null
echo ".\c"
```

The following shell script, **lockvi**, is first used in instruction 4 of the Managing File Systems Exercise:

```
while true # always perform loop unless see a break statement
do
filename='basename $1' # retrieve just the filename, not the directory
if [ -f /tmp/lock${filename} ]
then echo "Someone else is editing $1.  Please wait in the queue."
sleep 2
continue # to top of while loop until lock is removed
else
trap  "rm /tmp/lock${filename}" 1 2 3 15 #  If they try to cut out
#  early, clean up the lock
touch /tmp/lock${filename}
echo "now editing  $1"
sleep 1
/usr/bin/vi $1
rm /tmp/lock${filename}
break     # only when you're done can you break out of while loop
fi
done
```

The following shell script, **mkfile**, is used in instruction 13 of the Managing File Systems Exercise:

```
#!/usr/bin/ksh
# mkfile filesize
usage()
{
clear
echo " "
echo " "
echo " "
echo " "
echo "Usage: mkfile filesize"
echo "       filesize should be in multiples of 512 bytes"
echo " "
echo " "
echo " "
echo " "
exit
}
# Main...
if [ $# != 1 ]
then
usage
fi
filesize=$1
filename="$1"bytefile
integer mod='expr $filesize % 512'
integer div='expr $filesize / 512'
if [ $mod != 0 ]
then
usage
fi
integer i=0;
integer j='expr $div \* 128'
> $filename
echo " "
echo "Creating file \"$filename\". Please wait ... "
while true
do
echo "yes" >> $filename
i=i+1
if ' $i = $j '
then
break
```

```
fi
done
```

The following shell script, **fragcopy**, is used in instruction 14 of the Managing File Systems Exercise:

```
#!/usr/bin/ksh
# fragcopy
usage ()
{
clear
echo " "
echo " "
echo " "
echo " "
echo "Usage: fragcopy numfiles dir/sourcefilename dir/targetfilename"
echo " "
echo " "
echo " "
echo " "
exit
}
# Main...
integer i=0
integer cnt=$1
source=$2
target=$3
if [ $# != 3 ]
then
usage
fi
while true
do
cp $source $target.$i
if [ $? != 0 ]
then
echo " "
exit
fi
i=i+1
echo "  Files copied: \c"
echo "$i\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\b\c"
if [ $i = $cnt ]
then
echo " "
break
fi
done
```

Appendix D. AIX Control Book Creation

AIX Control Book Creation

List the licensed program products	**lslpp -L**
List the defined devices	**lsdev -C -H**
List the disk drives on the system	**lsdev -Cc disk**
List the memory on the system	**lsdev -Cc memory** (MCA)
List the memory on the system	**lsattr -El sys0 -a realmem** (PCI) **lsattr -El mem0**
List system resources	**lsattr -EHl sys0**
List the VPD (Vital Product Data)	**lscfg -v**
Document the tty setup	**lscfg** or **smit** screen capture F8
Document the print queues	**qchk -A**
Document disk Physical Volumes (PVs)	**lspv**
Document Logical Volumes (LVs)	**lslv**
Document Volume Groups (long list)	**lsvg -l vgname**
Document Physical Volumes (long list)	**lspv -l pvname**
Document File Systems	**lsfs fsname** /etc/filesystems
Document disk allocation	**df**
Document mounted file systems	**mount**
Document paging space (70 - 30 rule)	**lsps -a**
Document paging space activation	/etc/swapspaces
Document users on the system	/etc/passwd **lsuser -a id home ALL**
Document users attributes	/etc/security/user
Document users limits	/etc/security/limits
Document users environments	/etc/security/environ
Document login settings (login herald)	/etc/security/login.cfg
Document valid group attributes	/etc/group **lsgroup ALL**
Document system wide profile	/etc/profile
Document system wide environment	/etc/environment
Document cron jobs	/var/spool/cron/crontabs/*
Document skulker changes if used	/usr/sbin/skulker
Document system startup file	/etc/inittab
Document the hostnames	/etc/hosts
Document network printing	/etc/hosts.lpd
Document remote login host authority	/etc/hosts.equiv

Directories to monitor

/var/adm/sulog	Switch user log file (ASCII file). Use **cat**, **pg** or **more** to view it and **rm** to clean it out.
/etc/security/failedlogin	Failed logins from users. Use the **who** command to view the information. Use "**cat** /**dev**/**null** > /**etc**/**failedlogin**" to empty it,
/var/adm/wtmp	All login accounting activity. Use the **who** command to view it use "**cat** /**dev**/**null** > /**var**/**adm**/**wtmp**" to empty it.
/etc/utmp	Who has logged in to the system. Use the **who** command to view it. Use "**cat** /**dev**/**null** > /**etc**/**utmp**" to empty it.
/var/spool/lpd/qdir/*	Left over queue requests
/var/spool/qdaemon/*	temp copy of spooled files
/var/spool/*	spooling directory
smit.log	smit log file of activity
smit.script	smit log of commands and scripts

Appendix E. Serial Devices

What This Unit Is About

This unit introduces the concepts and configuration of serial devices.

What You Should Be Able to Do

After completing this unit, you should be able to:

- Describe a serial device to the system
- Set terminal characteristics
- Describe the purpose of the terminfo database
- Diagnose and solve common problems with terminals

How You Will Check Your Progress

Accountability:

- Checkpoint questions
- Optional Exercise, Appendix B, Student Exercise Guide

Unit Objectives

After completing this unit, you should be able to:

- Define a serial device to the system
- Set terminal characteristics
- Describe the purpose of the terminfo database
- Diagnose and solve common problems with terminals

Figure E-1. Unit Objectives AU1410.0

Notes:

Non-Self-Configuring Devices

Devices not configured automatically at boot up by the configuration manager (cfgmgr):

- ASCII (dumb) terminals
- Printers
- Modems

Figure E-2. Non-Self-Configuring Devices AU1410.0

Notes:

During the bootup of a RS/6000 running AIX, the **cfgmgr** command is run to bring certain devices up and available on the system.

Only devices which have a defined industry standard that describes the way in which they can identify themselves to the system are configured by **cfgmgr**. For example, Micro Channel Architecture (MCA) adapters and the SCSI adapter for CD-ROM disks, tape drives, and so forth, will be made available.

Some devices do not have the mechanism for identifying themselves. These non-self-configuring devices include ASCII terminals and printers. These devices must be manually defined to the operating system.

Adding a Terminal

Questions to be answered before adding TTYs:

- Server Configuration
  - TTY interface
  - Adapter
  - Port number
- ASCII Terminal Configuration
  - Line characteristics
  - Terminal type
  - Keyboard attributes

Figure E-3. Adding a Terminal AU1410.0

Notes:

To add a terminal to the system, you must add a TTY logical device using **Add a TTY** on the TTY menu in SMIT or the **mkdev** high-level command. You can use the SMIT fastpath **maktty** or **mktty** to access this menu.

When adding a TTY, you must know the port where the terminal is plugged into the system, the terminal type (for the TERM variable) and the line characteristics for the port.

Enable/Disable

- Enable Login Attribute:

login=disable	available for dial-out line
login=enable	login prompt on terminal
login=delay	user must press key first
login=share	bi-directional port

- Use SMIT or **chdev** for permanent change

Figure E-4. Enable/Disable AU1410.0

Notes:

Appropriate values for the login attribute are:

disable	The port is still defined, but it is only available as a dial-out port for an asynchronous connection to another machine
enable	The port is enabled for login, a getty process runs on the port when not in use
delay	The port is enabled for login, but the login prompt is not displayed until the user presses a key
share	The port can be used in either direction upon demand.

Port Attributes

Various attributes play an important role during communication between the computer and the serial device.

These include:

- bps/Baud Rate
  The speed of the line in bits per second.
- The number of stop bits
  A signal to a receiving mechanism to wait for the next signal.
- bits per character
  The number of bits per character to be transmitted.
- Parity
  A simple error detection mechanism.

Figure E-5. Port Attributes AU1410.0

Notes:

Baud Rate:

The speed of an asynchronous communications line is usually expressed in bits per second (bps). Sometimes the term Baud Rate is used to mean the same thing although the Baud Rate actually means the number of possible voltage changes on the line per second.

Stop bit:

During communication, the voltage on one of the lines (the receive/transmit line) is normally set to high. When a system starts to send a byte, the voltage is set to low for 1.5 clock pulses. This is called a start bit. Similarly, at the end of the transmission of the byte, (that is, after the last bit), the voltage is set high for a further clock pulse. This is called a stop bit.

Using two stop bits on low-speed lines or poor quality lines will improve communications.

Bits per character:

Serial communications standards allow for the transmission of different lengths of characters, or words. When communications software asks you to select word length, it is

asking whether you want to send seven-bit characters or eight-bit characters. Others lengths such as 5 or 6 can be used, but this is rare.

Parity:

Parity is a method of detecting transmission errors. If enabled, a parity bit is appended to each character transmitted. Types of parity checking are:

EVEN	If there are an odd number of ones in the binary representation of the character sent, the parity bit is set to one so that an EVEN number of ones is always transmitted.
ODD	The parity bit ensures that the number of ones transmitted is always odd.
MARK	The parity bit is always set to 1.
SPACE	The parity bit is always set to 0.
NONE	No parity.

SMIT TTY Menu

smit tty

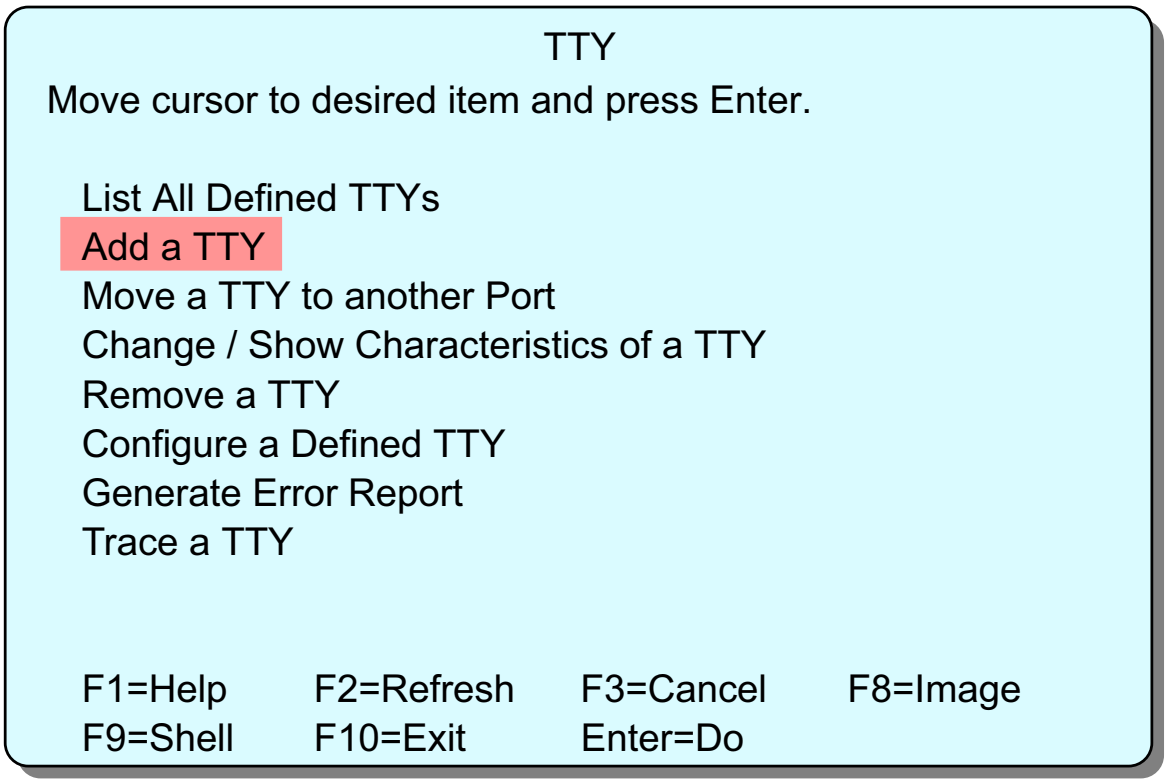


Figure E-6. SMIT TTY Menu AU1410.0

Notes:

The SMIT TTY menu is used to manage the configuration of asynchronous terminals and other TTY devices in the system. These are typically TTY devices attached directly to either RS232 or RS422 communication adapters. TTY devices attached to network terminal servers or serial printers are not generally configured using this method for performance reasons.

TTY devices can be listed, added to the system, made unavailable/available, removed and have their characteristics changed using these menus.

Attachment

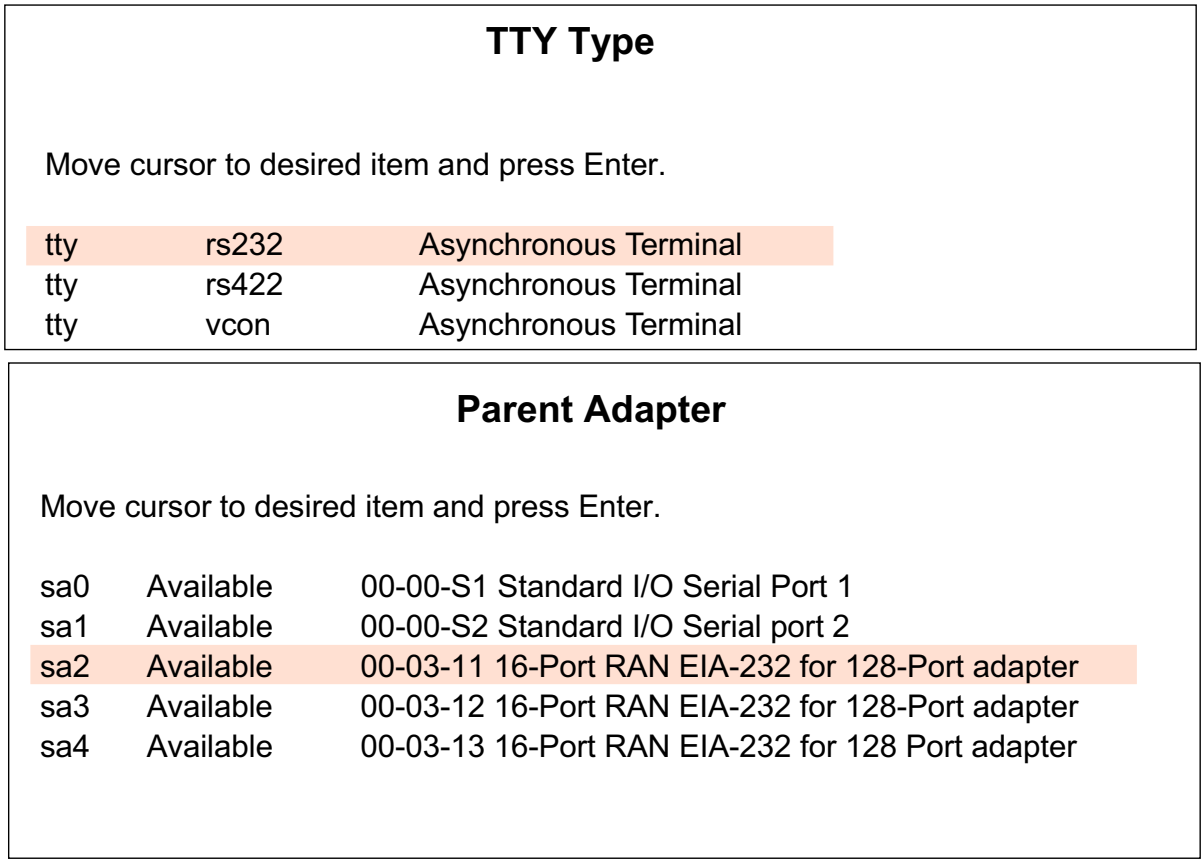


Figure E-7. Attachment AU1410.0

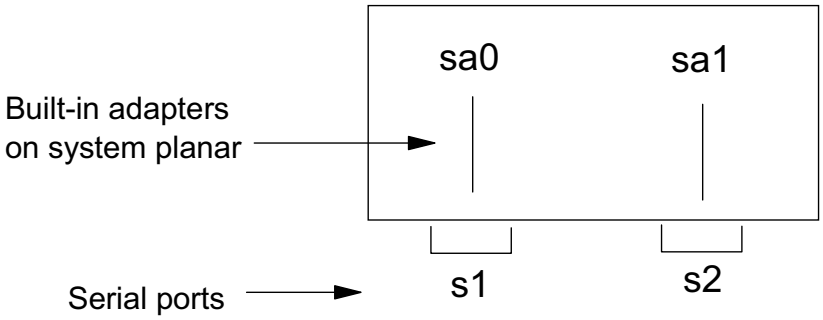
Notes:

When you select **Add a TTY** from the TTY menu you are presented with two pop-ups to select the TTY type and adapter.

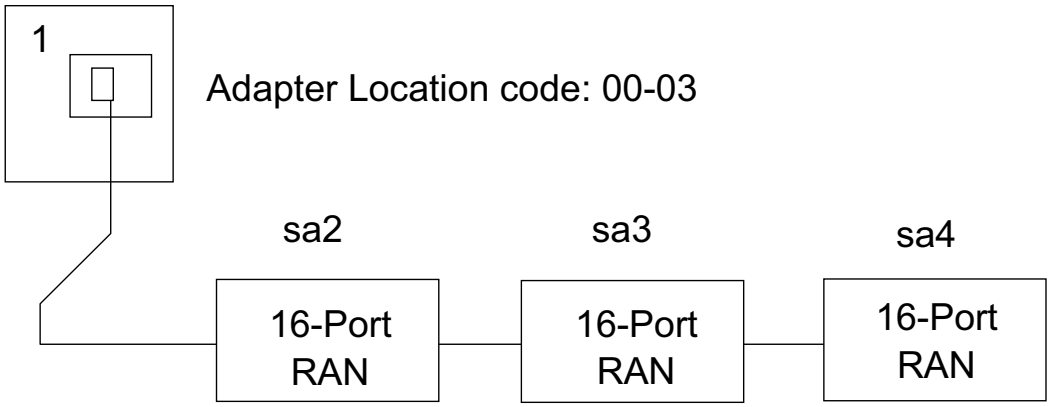
TTYs can either be connected to an RS232 or RS422 adapter.

Once a type has been selected, you are presented with a list of installed adapters that support that method of attachment.

For the built-in serial connections the nomenclature looks like this:



For the 128-port adapter the nomenclature looks like this:



Add a TTY

smit mktty

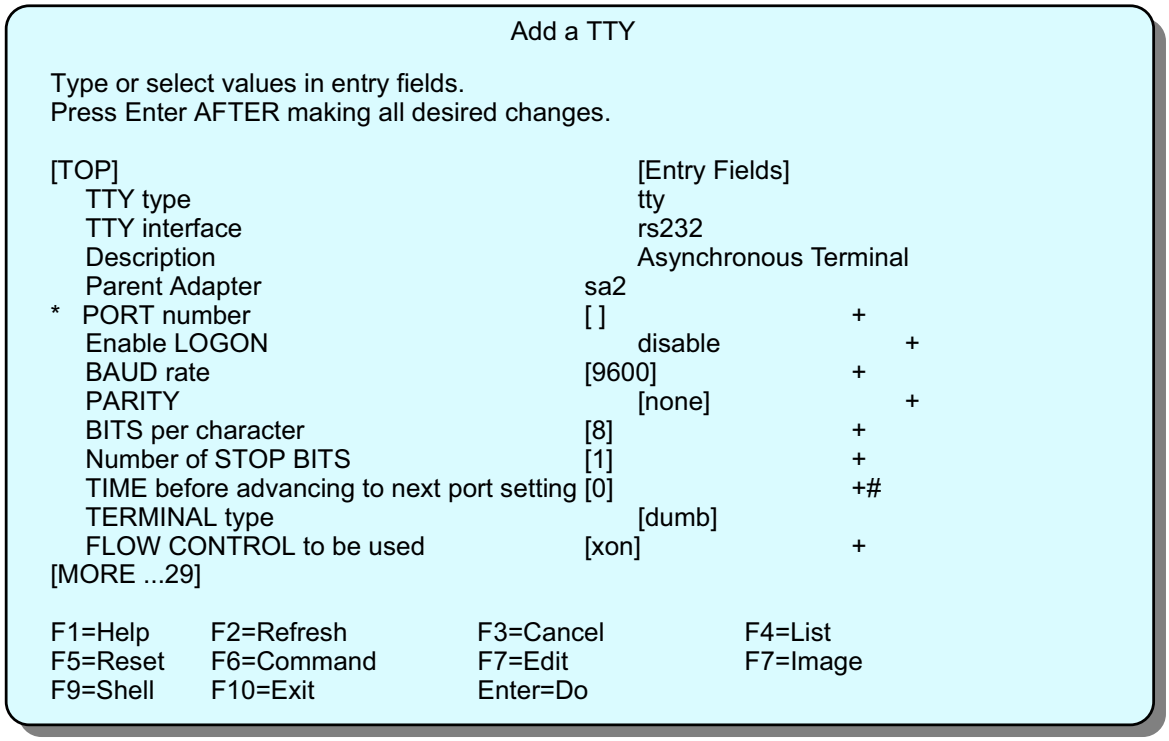


Figure E-8. Add a TTY AU1410.0

Notes:

There is only one mandatory field on this screen and that is the PORT number. The F4 key provides a list of possible port numbers. For the first built-in serial port it is s1, for the second it is s2. On a 16-port RAN, the choices are 0-15. Select the one to which the terminal is connected. The combination of the appropriate RAN selected on the Parent Adapter selector screen and the port number shown here provides the system with the correct location code.

You must supply the port number to uniquely locate the device. The value required depends upon the adapter specified. For example:

Built-in serial port S1	s1
Built-in serial port S2	s2
8-Port Adapter	0-7
16-Port Adapter	0-15
Each 16-PORT RAN	0-15

The Enable LOGIN attribute is set to disable by default. If you are adding a terminal that should have a login prompt, you should change this to enable.

The asynchronous line characteristics must be specified: baud rate, parity, bits per character, stop bits. In a national language environment you must use 8 bits with no parity (the default). Set the speed appropriately for the terminal device or modem you are using, up to 38400.

The TERMINAL type attribute is used to assign the TERM environment variable when a user logs in on the device. There is no list available for this entry. The easiest way to find out the required values is to refer to the terminfo database, which is discussed shortly.

terminfo

- Database of terminal capabilities
- Required by full screen programs
  TERM variable
  /usr/share/lib/terminfo/?/$TERM
- IBM, DEC and Wyse terminals supported
- Sample files for many other terminal types
  /usr/share/lib/terminfo/*.ti

Figure E-9. terminfo AU1410.0

Notes:

When a function key is pressed on the keyboard a sequence of characters (escape sequence) is sent to the system. When the system needs to display a special terminal feature such as reverse video or clear screen, the system must send a sequence of characters to the terminal.

Because there are a large number of ASCII terminals on the market which all offer a variety of functions, there is no standard for how these functions are implemented. The solution has been to build a terminal-independent set of programming interfaces which get the terminal information from a database of known terminals.

The terminfo database is this kind of facility. Another example is the termcap facility on Berkeley systems. (This is also available in AIX Version 5 through the file /etc/termcap.)

The way in which programs know what your terminal type is, and what characters to send, is controlled by the TERM environment variable. This is set to a default value when a terminal is added ('TERMINAL type'). The TERM variable points to a file **/usr/share/lib/terminfo/?/$TERM** where the **?** is the first letter of the TERM value. This is

a binary file containing the definitions for that terminal type. For example: TERM=ibm3151 means use /**usr**/**share**/**lib**/**terminfo**/**i**/**ibm3151**.

There are a number of terminal types supported by default on AIX Version 5, including IBM, DEC and Wyse terminals. There are also a number of sample definition files (/**usr**/**share**/**lib**/**terminfo**/***.ti**) for many of the common ASCII terminals available. These can be used to create the binary definition files.

Note: Not all applications use the terminfo database for their terminal support. Some provide their own termcap/terminfo facility which may restrict the number of supported terminals (for example, INed).

Ensure that the package bos.terminfo.* is installed. This package contains the terminal descriptions for various terminals. These descriptions are used by libraries such as curses to obtain information about the terminal's capabilities.

Before making changes to source terminfo files to support application requirements, it is a good idea to see if your terminal will emulate another terminal whose functions are supported by the application. Many ASCII terminals have this ability.

Change the Characteristics of a TTY

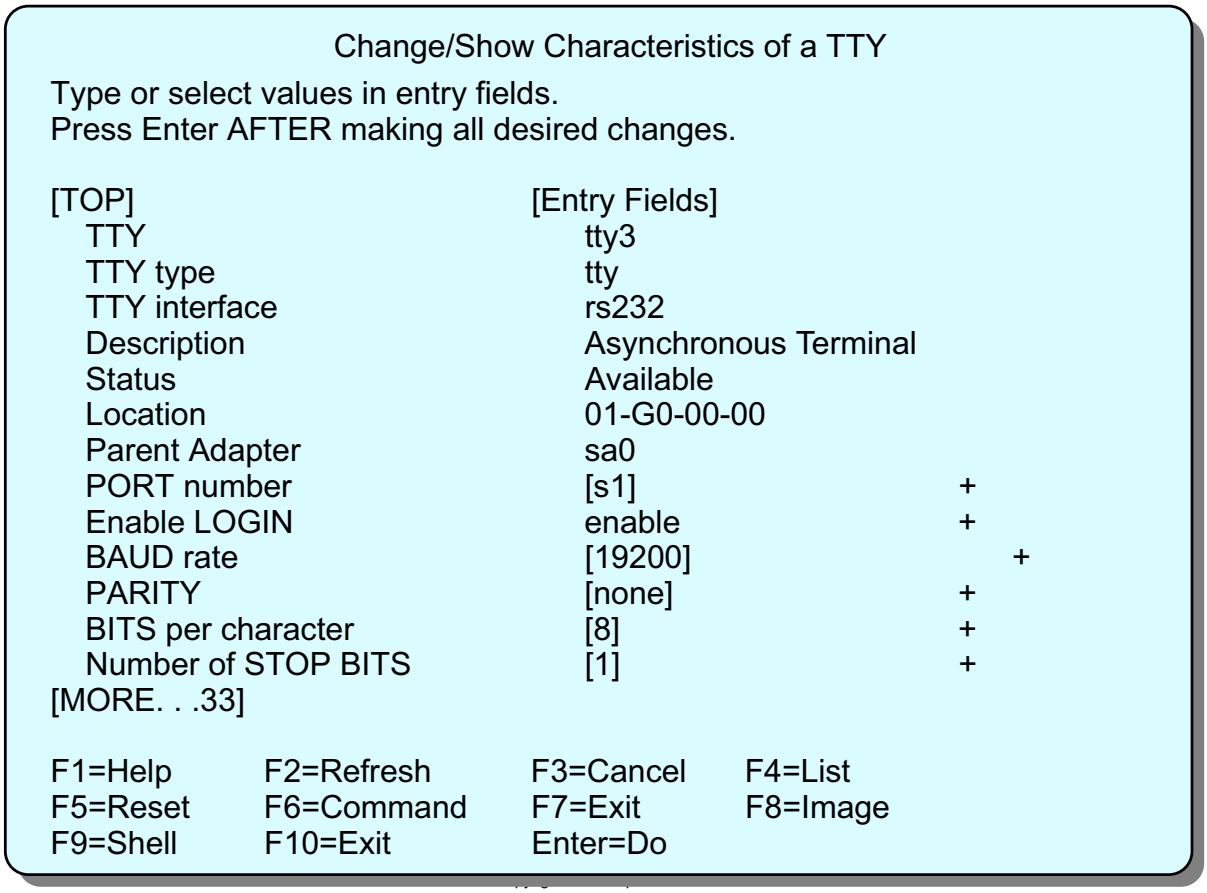


Figure E-10. Change the Characteristics of a TTY AU1410.0

Notes:

TTY characteristics cannot be adjusted or changed while the port or the device is busy. The device has to be temporarily disabled (for example, **pdisable** command) before proceeding and subsequently enabled again (using the **penable** command) before use.

IBM 3151 Setup Menus (1 of 2)

General	Communication	Keyboard/Printer	Function
Code Page	CP 850	Forcing Insert	Both
Screen	NORMAL	Tab	Field
Row & Column	24 x 80	Characters	
Scroll	Jump		
Auto LF	Off		
CRT Saver	Off	Term.id	_____
Line Wrap	On	Alarm Volume Level	7
Message Type	NON-DISPLAY	Cursor	Steady-block

General	Communication	Keyboard/Printer	Function
Operation Mode	ECHO	Interface	RS-232C
Line Speed (bps)	19200	Line Control	IPRTS
Word length (bits)	8	Break Signal	500ms
Parity	NO	Send Null Suppress	ON
Stop Bit	1	Pacing	XON/XOFF
Turnaround Character	CR		

Figure E-11. IBM 3151 Setup Menus (1 of 2) AU1410.0

Notes:

The example shows the settings for the UK-English AIX Multiuser Enhancement Cartridge to work with AIX Version 5. The menus appear different depending on the cartridge. A cartridge is not necessary to operate in US-English mode.

To access the setup menus on an IBM 3151 press **<Ctrl+Setup>**. Use the cursor keys to move between fields and the space bar to toggle values. To go to the next menu press the **<Send>** key.

IBM 3151 Setup Menus (2 of 2)

General	Communication	Keyboard/Printer	Function

KEYBOARD		PRINTER	
General Code set	ASCII	Line Speed (bps)	19200
Enter	RETURN	Word Length (bits)	8
Return	NEW LINE	Parity	NO
New Line	CR	Stop Bit	1
Send	PAGE	DTR Pacing	OFF
Insert Character	SPACE		
NUM Message	ON		

General	Communication	Keyboard/Printer	Function

Recall Save Default

Reset Terminal

[EMBKB]

- This information is stored in the terminal in NVRAM
- On many terminals the menus are dependent on the options cartridge

Figure E-12. IBM 3151 Setup Menus (2 of 2) AU1410.0

Notes:

Most modern ASCII terminals store their characteristics in non-volatile memory and provide some setup menus to modify these characteristics.

The IBM 3151 ASCII terminal has different capabilities depending upon a cartridge which is plugged in the back. This will provide different emulation modes and national language support.

The FUNCTION menu provides options to Recall the previous values, Save the current values, reset to the Default values, or Reset Terminal. To exit without updating the values press **<Ctrl+Setup>** again.

Deleting TTYs

smit rmvtty

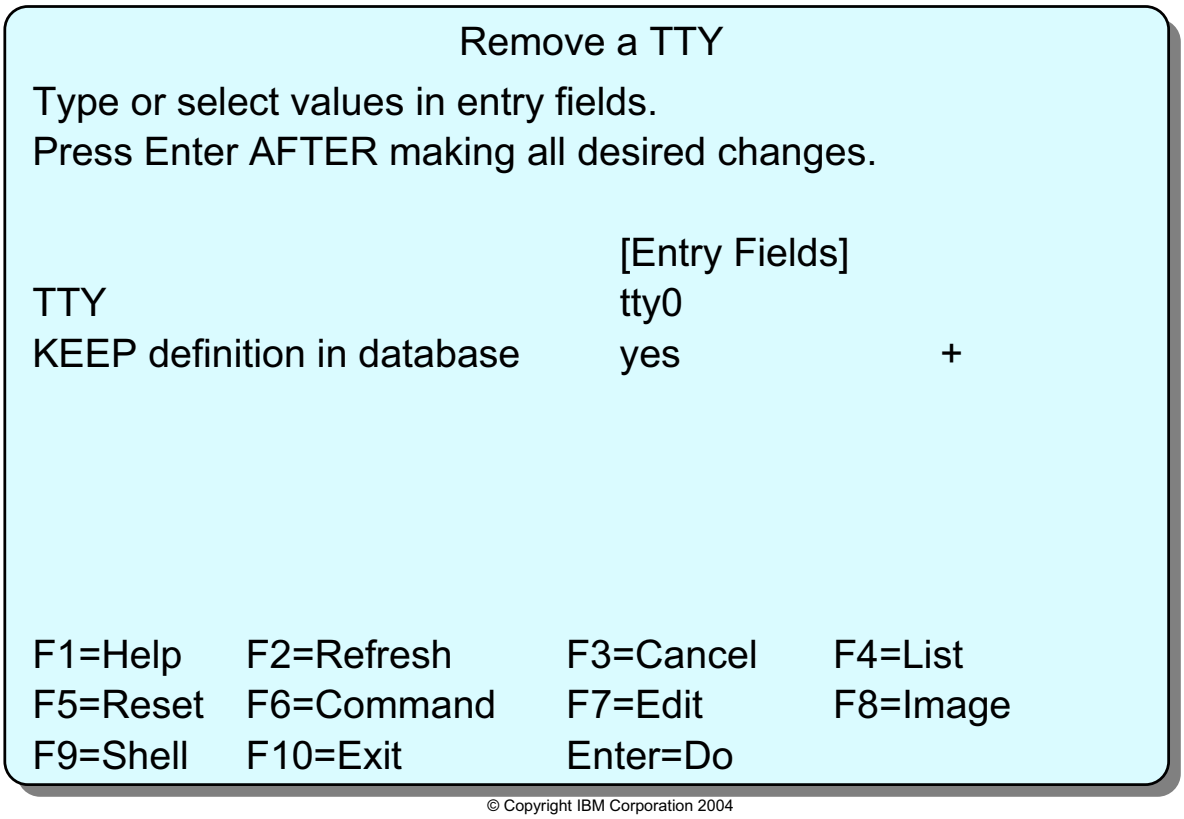


Figure E-13. Deleting TTYs AU1410.0

Notes:

You cannot remove a TTY if it is in use, either with a user logged in or a getty process running. So, if a user is using the TTY and you wish to remove it, the user needs to log out. Then, disable the TTY either by changing its attributes (through SMIT or with the **chdev** command directly) or using the **pdisable** command.

If a TTY has been disabled, a user may still be able to use it if they were already logged in to that TTY. The user needs to log out before you attempt to delete the TTY, otherwise problems may occur. When they log out a new getty process is NOT run on the terminal because it is disabled.

Now you can delete the TTY using either SMIT or the **rmdev** command.

penable/pdisable

- To enable terminals, run the **penable** command.

  penable [-a] [device_name]

- To disable terminals, run the **pdisable** command.

  pdisable [-a] [device_name]

- **penable** and **pdisable** by themselves, list all the terminals enabled or disabled respectively
- Only the console cannot be disabled in this manner.

Figure E-14. penable/pdisable AU1410.0

Notes:

The **penable** command enables asynchronous ports and allows users to log in. The system enables the port by updating the getty entry in the /**etc**/**inittab** file, and then sending a signal to the init process. This process then starts the getty placing the logon herald (logon prompt) on the terminal allowing user access.

The **pdisable** command works in a similar fashion to the **penable** command, by again updating the /**etc**/**inittab** file and informing the init process.

Use the **-a** option with the commands to enable or disable all ports excluding the console.

When a fault exists in the cabling between a TTY and the system, quite often the /**etc**/**sbin**/**getty** program, which displays the login prompt, gets killed and is restarted by init. If this respawning takes place too often, the message tty respawning too rapidly is displayed on the console. Temporarily disable the TTY while you check and repair the cabling.

TTY Problems

- Incorrect terminal type/settings
  - Change attributes (SMIT)
  - Terminal setup menu
  - TERM variable/terminfo database
- Hung terminal (crashed program or **cat** binary file)

From terminal:
- Try start key **<ctrl-q>**
- Reset terminal from setup menu
- Try interrupt, quit keys
- **<ctrl-j> stty sane <ctrl-j>** then log off/on again

From another terminal:

stty -a < /dev/ttyn

then **stty sane </dev/ttyn**

or **kill -9 *pid_of_login_shell***

Figure E-15. TTY Problems AU1410.0

Notes:

When approaching a terminal problem, there are several issues to investigate:

1. Can the system communicate with the terminal? Try the command **echo hello > /dev/ttyn** and check if any output is sent to the tty.
2. Are cabling, power, brightness, contrast correct?
3. Are there any processes running on the terminal? Verify this using the **fuser -u /dev/ttyn** command

These questions normally produce a resolution to the problem.

Other things to try:

- **<Ctrl+q>** (release screen)
- **<Ctrl+c>** (kill current process)
- Power off, then power on the terminal
- Check the NVRAM setup
- Is there a getty process running on the device? If so, **pdisable** the tty, then **penable** it.

If the backspace key does not work correctly, it needs to be remapped. Use the **stty** command to do this:

stty erase (press backspace key)

Documenting TTY Setup

- Always have a map of the concentrator boxes to the physical terminals, so that port numbers can be easily identified
- Physical labels on the cables help to identify location codes and tty numbers
- Document the settings for the setup menus
- Run **lscfg** (if you have not already done so previously) and keep a hardcopy of the output

Figure E-16. Documenting TTY Setup AU1410.0

Notes:

Checkpoint

1. True or false? If a device, like a TTY, is left for cfgmgr to configure automatically, it picks up the default values which might not be desirable.

2. True or false? If TTYs are connected via concentrator boxes, they must all be connected in sequence on the concentrator box otherwise they are not configured.

3. True or false? /dev/tty0 indicates that the TTY is connected to port 0, /dev/tty1 to port 1 and so on.

4. What environment variable holds the terminal type for a terminal?

Figure E-17. Checkpoint AU1410.0

Notes:

Unit Summary

- Serial devices, such as TTYs and modems must be configured manually, either through SMIT or by the high-level command
- To ensure the correct operation of devices such as TTYs, certain characteristics, such as the terminal type and baud rate must be set
- The terminfo database stores all the terminal characteristics
- Enable and disable TTYs using the **penable** and **pdisable** commands

Figure E-18. Unit Summary AU1410.0

Notes:

Appendix F. The System V Print Subsystem

What This Unit Is About

This unit describes the features of the System V print subsystem which is now part of AIX V5.1 and AIX V5.2.

What You Should Be Able to Do

After completing this unit, students should be able to:

- List two advantages of the System V print subsystem
- List two advantages of the AIX print subsystem
- Switch between the AIX and System V print subsystems
- Describe the process of printing a file using the System V print subsystem, including the following components:
  - Print service daemon (`lpsched`)
  - Printer configuration file
  - Terminfo database
  - Interface programs
  - Slow and fast filters
- Configure a local printer using the System V print subsystem and print to it
- Describe the steps to configure a remote System V printer

How You Will Check Your Progress

Accountability:

- In-line activities
- Checkpoint
- Machine exercises

References

Online	*AIX Guide to Printers and Printing, Chapter 6. System V Printer Configuration*
SG24-6018	*Printing for Fun and Profit under AIX 5L* (`http://www.redbooks.ibm.com`)

Online *AIX Commands Reference*

Unit Objectives

After completing this unit, you should be able to:

- List two advantages of the *System V print subsystem*
- List two advantages of the *AIX print subsystem*
- *Switch* between the AIX and System V print subsystems
- Describe the process of printing a file using the System V print subsystem, including the following components:
  - *Print service daemon*
  - *Printer configuration file*
  - *Terminfo database*
  - *Interface programs*
  - *Slow and fast filters*
- Configure a *local* printer using the System V print subsystem and print to it
- Describe the process of configuring a *remote* System V printer

Figure F-1. Unit Objectives AU1410.0

Notes:

AIX 5.2 Printing: What's New?

- System V print subsystem
- Changes to traditional AIX print subsystem
- Administration
- System management tools

Figure F-2. AIX 5.2 Printing: What's New? AU1410.0

Notes:

System V print subsystem

The classic AIX print subsystem was designed to combine the features of the System V and the Berkeley Software Distribution (BSD) printing standards, along with some unique features found only in AIX. However, these same features made the AIX print subsystem less compliant to widely used standards. With the development of AIX 5.1, a more standard print subsystem was needed. The System V print subsystem was chosen because of its wide use across many different UNIX systems.

The addition of System V printing allows system administrators with System V printing experience to easily transition to printing using AIX. Also, since the System V print subsystem is the de facto standard printing environment for UNIX systems, it will be easier for printer manufacturers to add support for AIX printing. System V printing also adds new features, such as enhanced security and support for using preprinted forms.

Traditional AIX print subsystem changes

Both the traditional AIX print subsystem and the new System V print subsystem are available on Power-based systems. In order to support two print subsystems at the same time, some minor changes to AIX print subsystem file locations have been made (these will be described in “Print Commands Overview” on page 16).

Administration

A new user (`lp`) and group (`lp`) have been added to support System V printing.

System V print administrators need to belong to the `lp` group.

AIX print administrators need to belong to the `printq` group.

Users who belong to the `printq` group can add printer devices which can be used by either print subsystem.

System management tools

The System V print subsystem includes system management using WebSM, SMIT or the command line.

AIX 5.2 Printing Environments

- Print directly to local printer device
- Print directly to a remote printer via a socket program
- *System V print subsystem*
- AIX print subsystem
- Infoprint Manager (or similar advanced print management system)

Figure F-3. AIX 5.2 Printing Environments AU1410.0

Notes:

Introduction

The slide gives an overview of the different approaches that can be taken to printing under AIX 5.2. In the next two slides, we compare System V printing to the traditional AIX print subsystem. The remainder of this unit focuses on using the System V print subsystem.

Print directly to a local printer device

This is the simplest form of printing. If your printer is directly attached to a serial or parallel port on the local machine, it is possible to print by just sending a file directly to the device. For example:

```
# cat /home/karlmi/myfile > /dev/lp02
```


In this approach, you lose the ability to serialize (spool) print requests. Only one user may print at a time. On the other hand, if a printer is being dedicated to one use, this may be a good solution. Examples might be logging to a printer or printing checks.

Print directly to a remote printer via a socket program

This is similar to printing to a device driver, except that in this case, you are sending the output to a program which makes a connection to the printer over the network.

Print using the System V print subsystem

In this environment, files to be printed are sent to the System V print service daemon (`lpsched`) using the `lp` or `lpr` commands. The print service daemon serializes the jobs so they will be printed in the order in which they were submitted. The print service may filter the file to format the data so that it matches the types of data acceptable to the printer. The print service then sends files, one at a time, to the interface program, which may do additional filtering before sending the file to the local printer driver or network printing application.

Print using the AIX print subsystem

In this environment, files to be printed are sent to the AIX print spooler daemon (`qdaemon`) using any of the AIX print commands (`enq`, `qprt`, `lp`, or `lpr`). The spooler daemon serializes the jobs. The spooler sends jobs, one at a time, to back-end programs that may filter the data and before sending it to the local printer driver or network printing application.

Print using IBM's Infoprint Manager (or similar advanced print management system)

Infoprint Manager provides serialization and filtering similar to the System V or AIX print subsystems. In addition, it adds extra capabilities of security, customization, and control not provided by either System V printing or AIX printing. For additional information, refer to the Infoprint Manager Web site:
`http://www.printers.ibm.com/R5PSC.NSF/Web/ipmgraixhome`

System V Print Subsystem: Advantages

- Compatibility
- Availability of interface programs
- Security
- Support for forms
- Standard PostScript filters
- Long term strategy

Figure F-4. System V Print Subsystem: Advantages AU1410.0

Notes:

Compatibility

System administrators with experience in other UNIX variants that use System V printing find it easy to manage printing under AIX's System V print subsystem.

Availability of interface programs

Many printer manufacturers provide interface shell scripts to support using their products under System V printing. Usually only minor modifications are required for individual UNIX variations. Because the AIX print subsystem is proprietary, an interface program written for another operating system cannot be used in the AIX print subsystem. It must be completely rewritten. This has led to a limited number of printers supported under AIX. With the support of System V printing since AIX V5.1, it is easier for manufacturers to include support for AIX printing.

Security

Controlling user access to printers can be an important issue. For example, you might need to limit access to the printer used to print checks. System V printing includes built-in capabilities for restricting user access to certain printers. Using the AIX print subsystem, the back-end program must be customized to restrict user access.

Support for forms

If you are printing to preprinted forms, it's important that other users not be able to print while the expensive forms are loaded on the printer. The System V print subsystem provides a mechanism for mounting forms on printers and allowing or denying user access based on the form which is mounted. To provide this capability under AIX printing, you must create multiple queues and manage which queues are enabled while a form is mounted.

Standard PostScript filters

The System V print subsystem includes a number of filters for converting a number of different file formats to PostScript. Some formatting and page selection capabilities are also included.

Long term strategy

IBM's long term printing strategy for AIX is to maintain compatibility with other UNIX systems. This means that new features and functions are added to the System V print subsystem in later releases, while the AIX print subsystem is supported, but not enhanced in future releases.

AIX Print Subsystem: Advantages

- Powerful and flexible printer drivers
- System management tools
  - Limits fields and options validation
  - Easy printer customization
  - Single step print device and queue creation
- Customizable spooling subsystem

Figure F-5. AIX Print Subsystem: Advantages AU1410.0

Notes:

Powerful and flexible printer drivers

AIX printer drivers provide many printing options that can be easily controlled using command line options to the `qprt` command. Printer defaults can be easily managed using SMIT or the command line.

System management tools

The AIX print subsystem includes mature and powerful system management using either WebSM or SMIT, as well as the command line. Some specific system management advantages using the AIX print subsystem are:

- Limits fields and options validation

  Limits fields give the user or administrator a range of valid values for print options and will prevent the user from using an invalid value.

- Easy printer customization

  Printers can be customized using menu selections or command line options. Under System V printing, customizing printers often requires a knowledge of shell programming.

- Single step print device and queue creation

  Under System V printing, you must first add a print device and then create the print queue.

Customizable spooling subsystem

The AIX print subsystem is specifically designed so that it can be used to serialize other types of jobs beyond just printing.

Software Packaging

- *Power* systems
  - Both print subsystems are installed as part of BOS installation
  - AIX print subsystem is enabled by default
- *System V* print subsystem filesets
  - bos.svprint.rte
  - bos.svprint.fonts
  - bos.svprint.hpnp
  - bos.svprint.ps
  - bos.terminfo.svprint.data
  - bos.msg.en_US.svprint
- *AIX* print subsystem filesets
  - bos.rte.printers
  - printers.*

Figure F-6. Software Packaging AU1410.0

Notes:

Power-based systems

Both print subsystems are installed. Only one subsystem can be active at a time. The AIX print subsystem is enabled by default.

System V print subsystem filesets

The slide shows the six filesets which comprise the System V print subsystem.

AIX print subsystem filesets

Default installation includes the base AIX print subsystem and only a few printers. When you add a printer that is not on the base install list, you are prompted to install additional printer support from the installation media.

Switching between Print Systems

- *Only one* print subsystem can be active at a time
- Status
  - `switch.prt -d`
  - SMIT or WebSM
- Switching
  - `switch.prt -s AIX`
  - `switch.prt -s SystemV`
  - SMIT or WebSM
- What happens during the switch

Figure F-7. Switching between Print Subsystems AU1410.0

Notes:

Introduction

Either the AIX print subsystem or the System V subsystem can be active on a Power-base system, but not both at once.

Status

Use SMIT, the Web-based System Manager, or the `switch.prt` command to display the active print subsystem.

Switching

Use SMIT, the Web-based System Manager, or the `switch.prt` command to switch subsystems.

Switching from AIX to System V printing

When you switch from AIX to System V, the **switch.prt** command performs the following actions:

Step	Action
1.	Checks for active print jobs. If there are, exits with error message: `All print jobs must be terminated.`
2.	Stops **qdaemon**, **writesrv**, and **lpd** daemons.
3.	Modifies /etc/inittab so that the AIX daemons will not be started on next boot and so that the System V daemon will be started on next boot.
4.	Disables AIX printing SMIT menus as much as possible (some AIX printing menus are removed; others give an error message if you try to use them).
5.	Switches Web-based System Manager plug-ins.
6.	Changes lock files from AIX to System V.
7.	Removes AIX links and add System V links for the common commands (This will be described in “Print Commands Overview” on page 16).
8.	Launches the System V print daemon (**/usr/lib/lp/lpsched**).

Switching from System V to AIX printing

When you switch from System V to AIX, the **switch.prt** command performs the following actions:

Step	Action
1.	Checks for active print jobs. If there are, exits with error message: `All print jobs must be terminated.`
2.	Stops **lpsched** using the **lpshut** command.
3.	Modifies /etc/inittab so that **lpsched** will not be started on next boot and so that the AIX daemons will be started on next boot.
4.	Enables AIX printing SMIT menus.
5.	Switches Web-based System Manager plug-ins.
6.	Changes lock files from System V to AIX.
7.	Removes System V links and add AIX links for the common commands. (This will be described in “Print Commands Overview” on page 16).
8.	Launches the AIX print daemons.

Disabled queues or printers

If there are disabled queues or printers with waiting jobs, they remain disabled if the print subsystem is switched. If the original print subsystem is reactivated, they remain disabled. If the queue or printer is then enabled, the jobs are printed.

User submits job using `enq` or `qprt` when System V printing is active

If a user submits a job using the AIX print commands when the System V print subsystem is active, the user will receive this error message:

```
Cannot awaken qdaemon (request accepted anyway)
```

If the AIX print subsystem is reactivated, the jobs are queued and print.

Print Commands Overview

- *Common commands* in /usr/bin
  - `-cancel`
  - `-disable`
  - `-enable`
  - `-lp`
  - `-lpq`
  - `-lpr`
  - `-lprm`
  - `-lpstat`
- AIX print subsystem active
  - Common commands linked to /usr/*aix*/bin
- System V print subsystem active
  - Common commands linked to /usr/*sysv*/bin
- *Man pages cover both versions*

Figure F-8. Print Commands Overview AU1410.0

Notes:

Introduction

Both print subsystems share a number of commands, but command behavior and option flags differ for the same command, depending on which subsystem is active. AIX handles this by linking commands from /usr/bin to either /usr/aix/bin or /usr/sysv/bin.

Man pages

The man page for each common command includes information about both versions of the command. You need to make sure you are reading the correct part of the man page for the print subsystem you are using.

AIX print subsystem command information

The portion of the man page pertaining to the AIX print subsystem version of the command begins with the following heading:

```
<command_name> Command on PowerPC Platform
```

System V print subsystem command information

The portion of the man page pertaining to the System V print subsystem version of the command begins with the following heading:

```
<command_name> Command on PowerPC and IA-64 Platforms

    Note: This is a System V Print Subsystem command.
```

System V Printing Overview

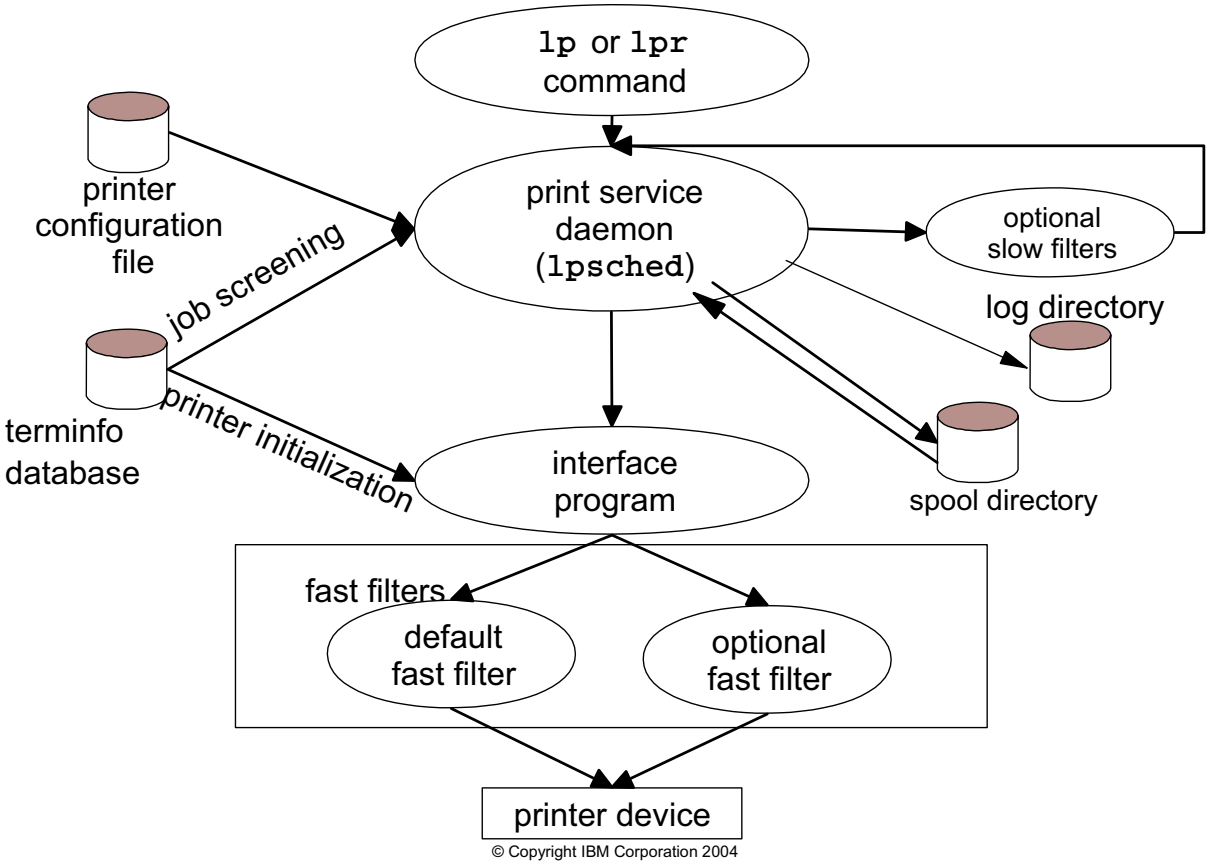


Figure F-9. System V Printing Overview AU1410.0

Notes:

Introduction

This slide provides an overview of the System V printing process. In the following pages, we provide additional details.

Job submission (`lp` or `lpr`)

Print jobs can be submitted using either the `lp` or `lpr` commands. Users can specify the printer or class of printers they want to use and a number of attributes which control how the job is printed.

`lpsched`

`lpsched` is the print service daemon. It is started at boot time from the /etc/inittab file if the System V print subsystem is active.

Job screening (lpsched)

When **lpsched** receives a print job, the first task is to screen the job to see if it can be printed. This includes checking to see if the requested printer is accepting jobs and if the printer is capable of printing the type of job with the attributes requested by the user. **lpsched** uses the printer configuration file and information from the terminfo database for this purpose. If the job cannot be printed as requested by the user, it will be rejected.

Printer configuration file

When you create (or modify) a System V printer, printer configuration file is created (or modified). This file describes the printer, including:

- Content types this printer accepts
- Device name
- Source of interface script
- Printer type in the terminfo database
- Banner and form feed requirements

terminfo database

The terminfo database contains data describing characteristics of different printer types. This data is used in two ways. **lpsched** uses the data to determine if the job can be printed. Later in the process, the interface program uses this same information to initialize the printer.

Job spooling (lpsched)

If the job can be printed, **lpsched** assigns it a unique *request ID* and creates a request file (which describes the print job) in the spool directory.

The request ID is formed using the printer name and a unique number. For example, a request ID for a printer named `hqps` might be `hqps-01`. The request ID is used when requesting status or canceling a job.

Printers can be grouped into *classes*. If the user has requested printing to a class, **lpsched** sends it to the queue for the first available printer in the class that is capable of printing the job.

Filters

Filters are used by the System V print subsystem to perform three functions:

- Converting file content:
  This could include tasks such as adding carriage returns to line feeds, mapping one set of control characters to another set, and so forth. For example, converting a simple text file to PostScript so that it can be printed by a PostScript printer.
- Interpreting special print modes requested by the user:
  This could include print modes such as landscape page orientation, reverse page order, and so forth.
- Detecting printer faults.

There are two types of filters:

- Slow filters are filters that incur a lot of overhead and do not need to be connected to the printer while they run. `lpsched` runs slow filters in the background so that the printer is not tied up while they perform file conversion.
- Fast filters interact directly with the printer. They can control the printer and receive status back from the printer, Some fast filters also perform file conversion tasks like slow filters.

Filtering

`lpsched` determines which filters must be used based on:

- Printer type
- Content of the file to be printed (as specified by the user)
- Types of content the printer will accept (from the printer configuration file)
- Any special mode options requested by the user
- Capabilities of the available filters (registered using the `lpfilter` command)

`lpsched` may decide to use a combination of several filters. Slow filters are run directly by `lpsched`. Fast filters are run by the interface program, as directed by `lpsched`. Several filters may be piped together to achieve the desired file format.

Printing (`lpsched` and the interface program)

When a job moves to the top of a queue, `lpsched` passes the job to the interface program which has been defined for that printer.

interface program

The interface program is a shell script that manages the printer. When you create a System V printer, you specify which interface script you wish to use. Two interface scripts are provided with the System V print subsystem or you can write your own interface scripts. In addition, some printer manufacturers provide interface scripts specifically for their printers.

The interface script performs the following tasks:

- Initializes the printer port, if necessary, and printer hardware using terminfo data
- Invokes the fast filter to print a banner page, if required
- Invokes the fast filter to print requested number of copies of the file to be printed

Logging

`lpsched` is responsible for monitoring job status and updating files in the log directory.

System V Terminology

Term	Description	Examples
Printer device	The *device driver* this printer queue uses	/dev/lp01
System V printer	The printer *queue*	myprinter
Printer type	The *terminfo entry* used for this printer	PS
Content type	The *types of files* this printer can handle	postscript
Interface type	The *interface script* to use with this printer	/usr/lib/lp/model/PS
Class	A class is a *group of printers*	bldg5

Sample command to create a printer:

```
# lpadmin -p myprinter -v /dev/lp01 -c bldg5 -T PS \
-I postscript -m PS
```


Figure F-10. System V Terminology AU1410.0

Notes:

Introduction

One of the most confusing things about System V printing is the terminology. For example, many different things are referred to as ypes. The table in the slide describes some System V terms. The **lpadmin** command at the bottom of the slide shows how these terms are used when defining a System V printer.

Printer device

The term *printer device* usually refers to the actual printer device driver. Printer devices are created using **mkdev** and associated with a System V printer using the **-v *device_name*** flag to the **lpadmin** command.

In the example, the printer `myprinter` is configured to use printer device `/dev/lp01`.

System V printer

The term *System V printer*, or even just *printer* by itself, usually refers to the printer queue, which is defined using the **-p *printer_name*** flag to the **lpadmin** command.

In the example, the System V printer is named `myprinter`.

Printer type

The *printer type* associates a printer to an entry in the terminfo database. Use the **-T *printer_type*** flag to **lpadmin** to specify the printer type. The information in the terminfo database is used by the interface program to initialize the printer.

In the example, the printer type is `PS`, which is one of several terminfo entries for PostScript printers.

Content type

The content type identifies what kind of content the printer can handle. This can be a list of content types. For example, some laser printers can accept both PostScript and PCL (Printer Command Language). Use the **-I *content_type*** flag to **lpadmin** to specify printer content types.

In the example, the content type is `postscript`.

Content type of files to be printed

The user specifies the content type of a file to be printed using the **-T *content_type*** flag to the **lp** command. If a content type is not specified, the default content type is `simple`. (See the man page for **lpadmin** for a definition of the `simple` content type.) When you submit a print job, **lpsched** screens the job to see if the requested printer accepts the content of the file to be printed. If not, it checks to see if there are registered filters which can be used to convert the file to a content type the printer can handle. If the printer cannot accept the content directly and there are no registered filters which can convert the content, the print job is rejected.

Interface or model type

The *interface* specifies which interface program is used by the printer. You specify the interface using one of the following `lpadmin` flags:

Flag	Description
`-i` ***`interface_path`***	Copy the script specified by ***`interface_path`*** (full path name) and use it as the interface script for this printer.
`-e` ***`printer_name`***	Copy the interface script already defined for ***`printer_name`*** and use it for this printer.
`-m` ***`model`***	Copy the file ***`model`*** in /usr/lib/lp/model and use it as the interface script for this printer.

In the example, `lpadmin` copy the /usr/lib/lp/model/PS interface script to be used for `myprinter`.

Class

Printers can be grouped into *classes*. A class is an arbitrary group of printers. If a user submits a job to a class of printers, the print service prints it on the first available printer that can handle the job. Printers are added to a class using the `-c` ***`class_name`*** flag to `lpadmin`. If the class does not exist, it is created.

In the example, `myprinter` is added to class `bldg5`.

Let's Review (1)

1. What command is used to display which print subsystem is active? _____
2. When the System V print subsystem is active, /usr/bin/cancel is linked to _____.
3. The _____ or _____ commands can be used to submit print jobs to the System V print service.
4. _____ is the System V print service daemon.
5. _____ filters are executed by `lpsched` and do NOT interact with the printer.
6. _____ filters are executed by the interface program and DO interact with the printer.
7. The printer type associates a printer with an entry in _____.

Figure F-11. Let's Review (1) AU1410.0

Notes:

Adding a System V Printer

- Create printer device
  - **mkdev**
  - SMIT
  - WebSM
- Create System V printer
  - **lpadmin**
  - SMIT
  - WebSM

Figure F-12. Adding a System V Printer AU1410.0

Notes:

Introduction

Creating a System V printer is done in two steps:

- Creating the printer device
- Creating the System V printer

Printer Device Overview

- Exact match of printer to printer device is *not critical*
- List *defined* printer devices

```
-# lsdev -Cc printer
-lp0 Available 00-00-0P-00 Lexmark Optra Color 1200 printer
```

- List *supported* printer devices

```
-# lsdev -Pc printer
-...
-printer lexOptraC1200  parallel Lexmark Optra Color 1200 printer
-printer lexOptraC1200  rs232    Lexmark Optra Color 1200 printer
-...
```

- Printer *device attributes are not used* when printing from AIX or System V print subsystem

```
-# splp lp0
-device = /dev/lp0      (+ yes     ! no)
-CURRENT FORMATTING PARAMETERS (ignored by qprt, lpr, and lp commands)
-Note: -p + causes the other formatting parameters to be ignored.
--p !    pass-through?                  -c +    send carriage returns?
--l 64   page length (lines)            -n +    send line feeds?
--w 80   page width (columns)           -r +    carriage rtn after line feed?
--i 0    indentation (columns)          -t !    suppress tab expansion?
--W !    wrap long lines?               -b +    send backspaces?
--C !    convert to upper case?         -f +    send form feeds?
-CURRENT ERROR PROCESSING PARAMETERS
--T 300  timeout value (seconds)        -e !    return on error?
```


Figure F-13. Printer Device Overview AU1410.0

Notes:

Introduction

Printer devices can be used by either print subsystem. Printer devices may be added using SMIT, the Web-based System Manager, or the command line (**mkdev**).

Connecting printers

Local printers may be connected in one of two ways: serial or parallel. Network-attached printers may be connected directly to the network, or they may be connected to a remote print server host that is accessed over the network.

Choosing a printer device

The printer device that you choose determines the buffer size and some timing parameters for the device driver. However, it is not critical that you find an exact match between your printer and the printer device driver software. You should chose a printer device that is:

- A similar kind of printer, for example: laser, ink jet, and so forth
- Similar in speed to your actual printer

In the example in the visual, lp0 has been configured using the parallel port and the Lexmark Optra Color 1200 printer device driver; however, the physical printer is actually a Canon Bubble Jet. These printers are similar enough that the printer device operates correctly for the Canon printer.

Listing printer devices

Use `lsdev -Cc printer` to list printer device which have already been defined.

Use `lsdev -Pc printer` to list supported printer devices. If you do not find an appropriate device for the printer you want to add, you may need to install additional printer software. Use `smit install_package` fastpath.

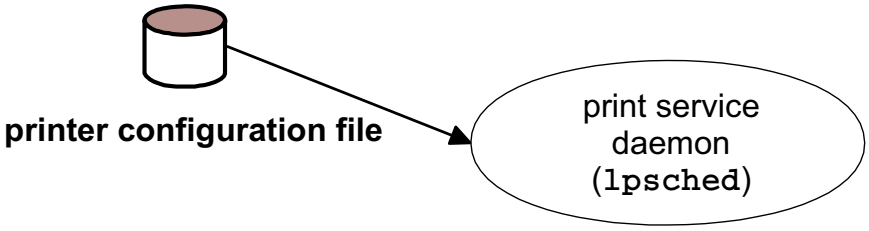
Printer device attributes

You can list printer device attributes using `lsattr -El` ***`printer_device_name`*** or using `splp` ***`printer_device_name`*** as shown in the slide. However, the printer device attributes shown (such as page length, page width, indentation, and so forth) are only used when printing by sending a file directly to the printer device. If you are using the System V or AIX print subsystem, the printer device is put into pass-through mode. The print subsystem now controls how the printer will operate.

For System V printers, defaults for these attributes are usually defined by the terminfo entry (printer type). Depending on the printer, it may be possible to override the defaults when submitting a print job using the `-o` flag to the `lp` command.

Creating a Local System V Printer

```
# lpadmin -p myprinter -v /dev/lp0 -T bj-300
```



- Printer configuration file

```
# cat /etc/lp/printers/myprinter/configuration
Banner: on:Always
Content types: simple
Device: /dev/lp0
Interface: /usr/lib/lp/model/standard
Printer type: bj-300
Modules: default
Form feed: on
```


Figure F-14. Creating a Local System V Printer AU1410.0

Notes:

Introduction

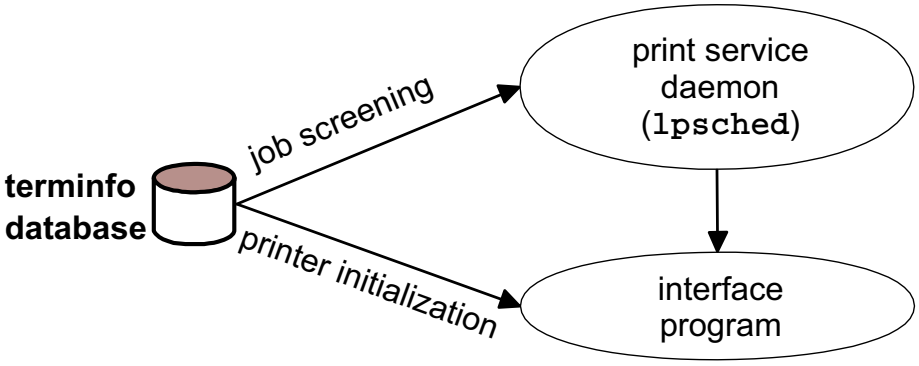
System V printers are added, or modified, using **lpadmin** or the Web-based System Manager. This slide shows a printer created using **lpadmin**. Refer to the **lpadmin** man page for a complete description of the many options to this command.

Printer configuration file

The printer configuration file is created by **lpadmin** when you create a printer. This file defines the printer to **lpsched**.

In the example, the printer name, printer device and printer type were specified. The other attributes in the printer configuration file were not specified, so the defaults were used.

Printer Types



- terminfo *source* for printers:
  `/usr/share/lib/terminfo/svprint.ti`
- *Compiled* terminfo file for a Canon Bubble Jet (printer type bj-300):
  `/usr/share/lib/terminfo/b/bj-300`
- *To compile* terminfo source:
  `# tic svprint.ti`
- *To view* bj-300 terminfo entry:
  `# infocmp bj-300`

Figure F-15. Printer Types AU1410.0

Notes:

Introduction

System V printer types are defined in the terminfo database. Printer types are similar in function to the virtual printer definition files used by the AIX print subsystem. Unlike AIX virtual printer definitions, one terminfo entry may be used for a number of different System V printers.

Purpose

Printer type information is used by `lpsched` to perform job screening and by the interface program to initialize the printer.

Organization

Terminfo entries are binaries which are compiled from terminfo source files. The database resides at /usr/lib/terminfo. By convention, source files reside in /usr/share/lib/terminfo and are named *.ti. For example, the source file for the System V printer types supplied with AIX 5.1 is svprint.ti. Each compiled terminfo entry is a separate file which resides in /usr/lib/terminfo/*X*, where *X* is the first letter of the terminfo name. For example, the terminfo entry for printer type bj-300, is /usr/lib/terminfo/b/bj-300.

Commands

Use the **tic** command to compile a terminfo source file. Use **infocmp** to display a terminfo entry, or to compare two entries.

Contents of a terminfo entry

Terminfo entries contain information about the printer. For example, a terminfo entry might include:

- Printer characteristics, such as:
  buffer size, number of pins in the print head, vertical and horizontal resolution, and so forth
- Printer control characters, such as the characters required to perform:
  carriage return, form feed, line feed, set underline mode, as so forth

No printer type

If you do not specify a printer type, it defaults to `unknown`. Depending on how you are using the printer, this may not be a problem. It does mean that:

- Your printer is not initialized by the interface program.
- Any `-o` options on the **lp** command line (such as **-o cpi**, **-o width**, **-o length**, and so forth) cannot be used.
- Some simple control characters may not function correctly.

The exception to this would be if you have a printer specific interface script which generates the command sequences internally in the script without consulting terminfo.

Listing available printer types

You can view available printer types in the /usr/share/lib/terminfo/svprint.ti file. Or if you are using the Web-based System Manager, you are presented with a list of printer types. You can also view the /usr/lpp/sysmgt.websm/inst_root/var/websm/data/model.stz file. This is a stanza-format file which associates a printer model with terminfo entry (printer type), interface script, and content type.

Choosing a printer type

It is not critical that you find an exact match for your printer model, but it should be a similar kind of printer. Here are some guidelines:

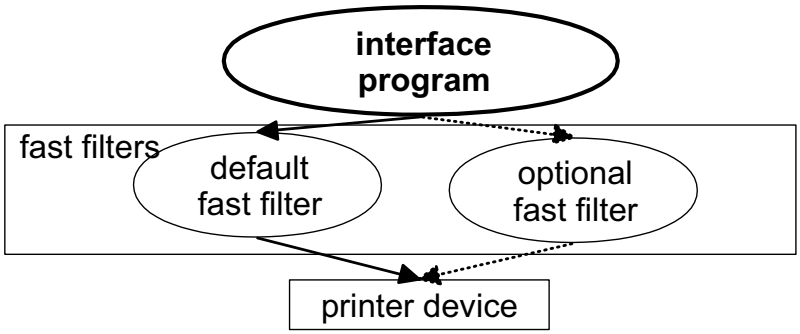
- If you are using a PCL printer, you can usually use the `hplaserjet` printer type. Set the content type to `pcl`.
- If you are using a PostScript printer, set the content type to `postscript` and choose one of the following printer types:
  - For serial connected printers: `PS`, `PSR`, or `PS-r`
  - For parallel connected printers: `PS-b` or `PS-br`
  - Use the -r types (`PS-r` or `PS-br`) to print pages in reverse order, with the banner page last.

  In the case of these PostScript printer types, **`lpsched`** uses the printer type to chose the correct fast filter.

More information

If you believe that you need to create a new terminfo entry for your printer, see *Printing for Fun and Profit under AIX 5L* (Redbook), *Appendix C. Virtual printer colon files and System V terminfo*.

Interface Programs



- Available interface programs
  - /usr/lib/lp/model/standard
  - /usr/lib/lp/model/PS
  - Manufacturer or user created
- Copied to: /etc/lp/interfaces/printer_name
- Functions
  - Initialize printer port
  - Initialize printer hardware
  - Print banner, if requested
  - Print number of copies requested
  - Return exit status to `lpsched`

Figure F-16. Interface Programs AU1410.0

Notes:

Introduction

The interface is responsible for performing the functions as listed in the slide:

- Initialize the printer port - using `stty`.
- Initialize the printer hardware - using commands from terminfo.
- Print the banner page.
- Print copies of the print job - using filter.
- Handle any printer errors from the filter and return exit status (success or failure) back to `lpsched`.

lpsched

lpsched calls the printer's interface program for local print requests. **lpsched** passes information to the interface program. Some of the information sent to the interface program includes:

- Terminfo entry to use
- Fast filter to use
- Character set (optional)
- Number of copies
- Files to print

Note: Interface programs are sometimes mistakenly referred to as "print drivers".

Available interface programs

The System V print subsystem includes two interface scripts: `standard` and `PS`. Some manufacturers supply printer specific interface scripts, or you can create your own.

Choosing an interface program

Unless you have a manufacturer's interface for your printer, in general, you can use the `PS` interface for PostScript printers and the `standard` interface for all other printers. If you do not specify an interface, **lpadmin** selects the `standard` script.

Administrative concerns

When a printer is created, a copy is made of the interface script for that printer. For example, if printer `myprinter` is defined to use the `PS` interface, the /usr/lib/lp/model/PS file is copied to /etc/lp/interfaces/myprinter.

If you need to modify a printer's interface script, modify the copy in /etc/lp/interfaces. If you want to change the template for all future printers created, modify the source file.

More information

If you need to create a custom interface script, you can use the `standard` or `PS` script as a template. For more information, refer to:
Printing for Fun and Profit under AIX 5L (Redbook),
Chapter 4. System V advanced printing.

Spool and Log Files

```
$ lp -d canon /etc/motd
request id is canon-10 (1 file)
$ lp -d canon -c /etc/passwd
request id is canon-11 (1 file)
$ su -
# cd /var/spool/lp/tmp/kca48
# ls -l
total 5
-rw-r--r--   1 root     system      11 Mar 16 16:18 .SEQF
-rw-------   1 lp       lp             87 Mar 16 16:08 10-0
-rw-------   1 lp       lp            109 Mar 16 16:18 11-0
-rw-------   1 lp       lp            366 Mar 16 16:18 11-1
-rw-------   1 lp       lp             88 Mar 16 13:43 8-0
# cat 10-0
C 1
D canon
F /etc/motd
O locale=C flist='/etc/motd:880'
. . .
# cat 11-0
C 1
D canon
F /var/spool/lp/tmp/kca48/11-1
O locale=C flist='/etc/passwd:366'
. . .
```


Figure F-17. Spool and Log Files AU1410.0

Notes:

Introduction

Each time a user sends a print job to a printer, the print service creates one or more files in the spool directory (/var/spool/lp/tmp/*<hostname>)* that describe the job request. These files remain in this directory while the job is in the queue waiting to be printed. When the job is finished printing, information in the files is appended to the log file /var/lp/logs/requests and the files are removed from the spool directory.

Copying files

Normally, if you send a file to the print service using the `lp` command, the print service does not copy your file to the spool directory, but instead just reads from the original. This means that if you delete the original copy after you submit the print request, but before it is printed, the print request fails. In some circumstances a copy is created. It is also possible to request that the print service create a copy of the print file in the spool directory before printing. Files are copied under the following circumstances:

- The job is submitted using `lp -c`. (The default for the `lp` command is NOT to copy.)
- The job is submitted using `lpr`, without the `-s` flag. (The default for the `lpr` command IS to copy.)
- The job is received from a remote system. (In this case, the file does not exist on the print server system, and so must be copied.)
- Copying files has been enabled as the default by issuing the `lpadmin -o copy` command.

  Note: this flag sets the value of the `copy-files` parameter in the /etc/default/lp file to `on`.

Files in /var/spool/lp/tmp/<hostname>

This directory contains the following files:

File	Description
.SEQF	This file is used to keep track of the next job number.
X-0	These files are the actual request files, where *X* is the job number. Notice that the printer name is not part of the request file name, but rather is stored within the file.
X-N	If files are being copied to the spool directory, there may be additional files (*X*-1, *X*-2 and so forth) that contain the actual data to be printed.

Example

In the example in the slide on page 35, job 10 was created without copying while copying was requested for job 11. Excerpts from the request files are shown in the slide. In the request file:

- `C` indicates the number of copies requested.
- `D` indicates the name of the printer.
- `F` indicates the name of the file to print.
- `O` indicates additional information. In this case, the locale and the name and size of the original file (`flist=`).

Notice that for job 11, /var/spool/lp/tmp/kca48/11-1 is the file to print. This would be a copy of the original file, in this case: /etc/passwd.

Log file (/var/lp/logs/requests)

Each time a print job completes, information from the request file is appended to /var/lp/logs/requests. This file grows until it fills the file system unless you manage it.

Syntax reference

For a complete description of the syntax used in the request and log files, refer to:
AIX 5L Version 5.1 Guide to Printers and Printing,
Chapter 6. System V Printer Configuration.

File system size

If your machine is a print server for remote clients or if users are routinely copying files to the spool directory, you may need to increase the size of the var file system.

Alternatively, you could create a new file system dedicated to print spooling and link /var/spool/lp/tmp to the new file system.

Managing Printers

- **`enable`** ***`printer`***
  - start printing
- **`disable [-c] [-r`** ***`reason`***`] [-W]` ***`printer`***
  - stop printing
- **`accept`** ***`printer`***
  - start queueing
- **`reject [-r`** ***`reason`***`]`** ***`printer`***
  - stop queueing
- Creating and enabling a new printer
  - mkdev
  - lpadmin
  - accept
  - enable

Figure F-18. Managing Printers AU1410.0

Notes:

Introduction

The System V print subsystem allows you to control queueing and printing separately.

`enable` / `disable`

The **`enable`** and **`disable`** commands control whether jobs in the queue are printed. For example, if you need to perform service on the physical printer, or need to mount a form, use **`disable`** to stop printing. This allows users to continue to submit jobs, but nothing is printed while you perform service on the printer. When service is complete, use **`enable`** to restart printing and jobs from the queue are again printed.

`disable` syntax

The table shows options to **`disable`**.

Option	Description
`-c`	Cancel any requests currently printing on any of the designated printers. Cannot be used with **`-W`**.
`-r` ***`reason`***	Assign a reason for disabling the printers. The reason is reported by **`lpstat -p`**. *reason* must be quoted if it includes spaces.
`-W`	Wait for any currently printing job to complete before disabling printers. Cannot be used with **`-c`**.

`accept` / `reject`

The **`accept`** and **`reject`** commands control whether the printer adds print requests to the printer queue. For example, use **`reject`** to stop queueing for a printer if you need to change queue parameters. Any jobs remaining in the queue are printed. When the queue is empty, make the desired changes and then use **`accept`** to restart the queue using the new parameters.

`reject` syntax

The table shows options to **`reject`**.

Option	Description
`-r` ***`reason`***	Assign a reason for rejecting requests. The reason is reported by **`lpstat -a`**. *reason* must be quoted if it includes spaces.

Creating a new printer

After you create a new System V printer, you must remember to use **`accept`** ***`printer`*** to turn on queueing and **`enable`** ***`printer`*** to turn on printing.

If you create a class, you must turn on queueing to the class using **`accept`** ***`class`***.

Using the Print Service

- *Submit* print jobs

```
-# lp -d dest [print-options] file_list
```

- *Modify* print jobs

```
-# lp -i request-id [print-options]
```

- *Cancel* print jobs

```
-# cancel request-id-list
-# cancel printer
-# cancel -u user-list [printer-list]
```

- *Check* status

```
-# lpstat [flags] [object-list]
```


Figure F-19. Using the Print Service AU1410.0

Notes:

Introduction

This slide summarizes the commands (accessible by any user) to utilize the System V print service. Refer to the respective man page for detailed information on the many options available.

Submit print jobs

The basic syntax to submit jobs is shown in the slide. ***dest*** can be either a printer or a class of printers. If a class is specified, the print service chooses the first available printer in the class that can handle all the print options requested.

Modify existing print jobs

This form of the `lp` command can be used to change the options for a previously submitted print request. You can get the request-id using `lpstat`. If the job has not

yet started printing, the changes are accepted, if the printer can handle them. If the job has started printing, it is stopped and restarted from the beginning. If the job has finished, the change is rejected.

Cancel print jobs

The **cancel** command is used to cancel print jobs, as shown in the table. Regular users can only cancel their own jobs. `root` or `lp` can cancel any user's jobs.

Command	Description
`cancel` ***request-id-list***	Cancel the jobs specified. You can get the request-ids using **lpstat**.
`cancel` ***printer-list***	The user's currently printing job for the requested printer will be cancelled.
`cancel -u` ***user-list*** [***printer-list***]	Cancel all jobs for specified users. If ***printer-list*** is specified, only cancel the users' jobs for the listed printers.

Check status

Use **lpstat** to check status. There are many options. Several of the most useful ones are shown in the table. Options can be combined to get the output you need. If the *list* argument is omitted, **lpstat** reports on all of that type of object. If you have many printers, omitting *list* may make the output of **lpstat** unreasonably long.

Option	Description
-o [*list*] [-l]	Reports the status of print requests. *list* can be printers, classes, or request-ids. if **-l** is used, additional status for each job is reported.
-p [*list*] [-D] [-l]	Reports printing status: • Enabled/disabled • What is currently printing • Device status (available/defined) With **-D**, a brief description of each printer is included. With **-l**, a full description is included. *list* is a list of printers.
-a [*list*]	Reports queue status (accepting/rejecting). *list* can be printers or classes.
-u [*list*]	Reports status for users in *list*.
-t [*list*]	Reports total status (similar to combined output of **-o**, **-p**, and **-a**).

Let's Review

1. A _____ is a group of printers.
2. Use the _____ command to enable a printer to begin accepting print requests.
3. Use the _____ command to enable a printer to begin printing print requests.
4. AIX 5.2 includes two interface programs _____ and _____.
5. If a user wants the print service to copy her file to the spool directory, she should use the _____ option to the lp command.
6. Use _____ to display status of outstanding print requests.
7. The System V print log file is _____.

Figure F-20. Let's Review (2) AU1410.0

Notes:

Using Filters

- *Purpose*
  - Convert file content
  - Interpret special print modes
  - Handle printer faults
- Filter *types*
  - Slow filters run in background
  - Fast filters interact with printer
- *Using* filters
  - Filters must be registered
  - Printer content must be set
  - File content must be set
- *Managing* filters
  - Filter definition files
    - /etc/lp/fd/*.fd
  - Registering a filter
    - `# lpfilter -f filter_name -F filter_definition_filename`
  - Listing filters
    - `# lpfilter -f [ filter_name | all ] -l`
  - Removing a filter
    - `# lpfilter -f filter_name -x`

Figure F-21. Using Filters AU1410.0

Notes:

Purpose

We'll start by reviewing the purpose of using filters. Filters are used by the System V print subsystem to perform three functions:

- Converting file content:
  For example, converting a simple text file to PostScript so that it can be printed on a PostScript printer.
- Interpreting special print modes requested by the user:
  This could include print modes such as landscape page orientation, reverse page order, and so forth.
- Detecting printer faults:
  Printer faults include such things as printer out of paper or printer off line.

Filter types

There are two types of filters:

- Slow filters are filters that incur a lot of overhead and do not need to be connected to the printer while they run.
- Fast filters interact directly with the printer. They can control the printer and receive status back from the printer, Some fast filters also perform file conversion tasks like slow filters.

Using filters

In order for filters to work correctly, a number of things need to be taken care of:

- Filters must be registered
  While the System V print subsystem includes a number of useful filters, the print service will not use them until they are registered. Use `lpfilter` to register a filter.
- Printer content must be set
  The printer content types must be set correctly
  (using `lpadmin -I` ***`content_type_list`***) so that the print service knows what types of files the printer can accept without filtering. If not set, printer content type defaults to `simple`.
- File content must be set
  If a print job contains content other than `simple`, the file content must be set when the print job is submitted (using `lp -T` ***`content_type`***) so that the print service knows what the file's content type is. If not set, the print service assumes the file content is `simple`.

Filter definition files

The filter definition file describes the filter's capabilities and how it can be used. The following is a partial list of the information that can be included in this file.

Item	Description
Command	File name of the filter program
Input types	Content this filter accepts as input
Output types	Content this filter can provide as output
Printer types	Printer types that may use this filter
Printers	Normally a filter would work with all printers that accept the output type, however you can restrict which printers may use a filter if this is desirable

Standard filters

The AIX 5.1 System V print subsystem includes a number of filters. Filter definitions for these filters are /etc/lp/fd/*.fd.

Managing filters

Use the `lpfilter` command to register a filter. For example, the dpost filter is used to convert troff files to PostScript. The dpost filter definition file is /etc/lp/fd/dpost.fd. To register the dpost filter, enter:

```
# lpfilter -f dpost -F /etc/lp/fd/dpost.fd
```

Registered filter definitions are stored in the /etc/lp/filter.table file, however, you should not directly edit this file. Use `lpfilter` to manage the registered filters.

If you wish to change how a filter is used, edit the filter definition file and re-enter the `lpfilter` command.

To list a registered filter (for example to list the dpost filter):

```
# lpfilter -f dpost -l
```

To list all registered filters:

```
# lpfilter -f all -l
```

To remove a registered filter (for example to remove the dpost filter):

```
# lpfilter -f dpost -x
```

More information

For more information on managing filters or creating your own filters, see:

- *Printing for Fun and Profit under AIX 5L* (Redbook), *Chapter 4. System V advanced printing*
- *AIX 5L Version 5.1 Guide to Printers and Printing, Chapter 6. System V Printer Configuration*
- man page for `lpfilter` command

Using Forms

- *Registering* forms with the print service
- *Requesting* a form for a print job
- *Alerting* the operator to mount a form
- *Mounting* a form
- *Unmounting* a form
- *Controlling access* to forms
- *Displaying information*

Figure F-22. Using Forms AU1410.0

Notes:

Introduction

A form is a preprinted sheet of paper which can be loaded into a printer in place of plain paper. Some examples are company letterhead, checks, invoices, receipts, and so forth.

The System V print subsystem facilitates printing to forms by providing the functions shown in the slide. We summarize the procedures for using forms here. For complete details, see:

Printing for Fun and Profit under AIX 5L (Redbook)

Note: The print service does not position print output on a form; this is the responsibility of the application.

Registering forms with the print service

Forms are managed in a similar way as filters. The first step to using forms is to create a form definition file and register the form with the print service. The definition file describes the form, including page length, page width, number of pages, line pitch, character pitch, alignment pattern, and so forth. The alignment pattern is sample output that can be used to correctly position the form when it is mounted. Once you have created the definition file, register the form using:

```
# lpforms -f form_name -F form_definition_file
```

Requesting a form for a print job

Users can request that a print job use a particular form using the `-f` flag to `lp`, for example:

```
# lp -f form_name -d printer file_to_print
```

The print job is queued, but is not printed until the form has been mounted on the requested destination.

Alerting the operator to mount a form

To configure the print service to notify the operator when jobs requesting a form have been queued:

```
# lpforms -f form_name -A alert_type [-Q number] [-W interval]
```

The table explains the options.

Option	Description
`-A` ***alert_type***	Send alerts to user `lp` when *form_name* is requested. *alert_type* can be: • `mail`: Send mail to user `lp`. • `write`: Send message to terminal where `lp` is logged in. • `none`: Do not alert. • *shell-command*: Execute named command. • `quiet`: Do not send any more messages for current form request.
`-Q` ***number***	Send alerts after *number* of form requests have accumulated in the queue. Default is one.
`-W` ***interval***	Repeat alert every interval minutes. Default is zero, which indicates alerting once.

Mounting a form

Mounting a form lets the print service know that the specified form is now loaded onto the printer. Any queued jobs using that form can now proceed. Use the following steps to mount a form:

Step	Action
1.	Disable the printer. `# disable printer_name`
2.	Physically load the form in the printer
3.	Inform the print service that the form is ready: `# lpadmin -p printer -M -f form_name [-a] [-o filebreak]`

Option	Description
`-M -f form_name`	Informs print service that *form_name* is mounted.
`-a`	Prints the alignment pattern (if defined in the form definition file). The operator can then adjust the form and press <Enter> for another alignment pattern. This can be repeated as many times as needed to get the alignment right. Type <q> to quit printing alignment patterns.
`-o filebreak`	Inserts a form feed at the end of each alignment pattern. If not specified, no form feed is added.

Step	Action
4.	Align the form, if required. (See `-a` option in table above.)
5.	Physically load the form in the printer
6.	Enable the printer. Queued jobs for this form will now be printed. `# enable printer_name`

Unmounting a form

To unmount a form, follow these steps:

Step	Action
1.	Disable the printer. `# disable printer_name`
2.	Physically remove the form from the printer.
3.	Inform the print service that the form is removed: `# lpadmin -p printer -M -f none`

Step	Action
4.	Enable the printer. `# enable printer_name`

Controlling access to forms

Use the following commands to control which users can submit print requests for a particular form:

```
# lpforms -f form_name -u allow:user_list
```

```
# lpforms -f form_name -u deny:user_list
```

Where ***user_list*** is a comma-separated list of AIX users. The allow and deny lists function in the same way as the cron.allow and cron.deny files. See the `lpforms` man page for details.

Displaying form information

Two commands are available for displaying information about a form:

- For user `root` or `lp`
  `# lpforms -f form_name -l`
  This command displays all the information in the form definition file, including the alignment pattern and user allow/deny lists.
- For any user
  `# lpstat -f form_name -l`
  This command displays information in the form definition file, excluding the alignment pattern and user allow/deny lists.

Planning a Local System V Printer

- Printer name
- Printer device
- Printer type
- Class
- Content types and filters
- Alerts
- Banner pages
- Forms
- Access policy

Figure F-23. Planning a Local System V Printer AU1410.0

Notes:

Introduction

This slide lists a number of issues which need to be considered when defining a local System V printer.

Printer name

The printer name should make it easy for users to identify the printer. You can use any name you wish, with the following restrictions:

- The name must be a valid file name for the file system you are using
- The name cannot begin with a dash (-), although a dash can be used in other positions in the name

Printer device

If you are configuring a local printer, you must decide what printer device driver to use. If AIX or your printer manufacturer does not provide a printer device specific to your printer, you can probably use a printer device for a similar printer. This is discussed in “Choosing a printer device” on page 28.

Printer type

This is discussed in “Choosing a printer type” on page 32. In general, it is not critical that you find an exact match for your printer model, just that it be a similar kind of printer.

Class

Do you want to include this printer in an existing printer class or define a new class? Classes can give users flexibility. By printing to a class of printers, any of which meet their requirements, they may be able to get their job printed more quickly.

Content types and filters

Questions to consider are:

- What types of content are you sending to this printer?
- What types of content can this printer accept?
- If you have a need to print content that the printer can’t handle, are there filters available and registered?

Alerts

When there is a problem with a printer, how should the print service alert the print administrator? Printer alerts are configured on a per printer basis using the `-A` flag to `lpadmin`. The alert options are similar to the options for form alerts discussed in “Alerting the operator to mount a form” on page 47. Refer to the `lpadmin` man page for complete details.

Forms

Do you require any special forms? If so, consider these questions:

- How should the print service alert the print administrator?
- Do you need to control access to any forms?

These issues are discussed in “Using Forms” on page 46.

Banner pages

The System V print subsystem allows you to control the printing of banner pages. The default is to print a banner page with every print job. Users can request no banner page. The print service rejects this request unless enabled to allow skipping the banner using the `-o nobanner` option to `lpadmin`. The table summarizes the relevant command options.

Option	Description
`lpadmin -o banner`	Banners are required (default).
`lpadmin -o nobanner`	Users are allowed to request that the banner not be printed.
`lp -o nobanner`	Request print job be printed without a banner.

Access policy

Do you need to control access to a printer? The System V print subsystem allows you to control access to printers using an allow-list, a deny-list, or both. These lists can be created using the `-u allow:`*`user-list`* or `-u deny:`*`user-list`* options to `lpadmin` and function similarly to the cron.allow and cron.deny files. Refer to the `lpadmin` man page for complete details.

System V Network Printing

- Print server:
  - *Serving print requests* from remote clients using LPD protocol (RFC 1179)
- Print client:
  - Printing to remote *LPD printers or servers*
    - network attached printers running LPD
    - local printers on a server running LPD
- `lpNet`
- /etc/lp/Systems and `lpsystem`
- Printing to *JetDirect-attached printers*

Figure F-24. System V Remote Printing AU1410.0

Notes:

Introduction

This slide provides an overview of the network printing capabilities of the System V print subsystem. More details about configuring a AIX system as a print server or print client are provided in the next two slides.

Print server

The System V print subsystem can be configured so that a locally attached printer on your system (the *print server)* can be used to print requests from remote machines (the *print clients*) which are running the LPD protocol as defined in Request for Comments (RFC) 1179.

Print client

You can configure the System V print subsystem to print to any network destination that supports LPD as defined in Request for Comments (RFC) 1179. A network destination in this sense can be a:

- Printer (directly connected to the network) that is running LPD
- System (with locally attached printers) that is running LPD

`lpNet`

The `lpNet` daemon is used by both network printing clients and servers. `lpNet` is automatically started by `lpsched`.

On client machines, `lpsched` sends the print request to `lpNet` for transmission to the print server. No formatting or filtering is done on the client side.

On server machines, `lpNet` receives the remote print request and sends it to `lpsched`. If the request can be printed, `lpsched` processes the print request as it would any local request. Printer type, filtering for content and other formatting is all done on the server.

/etc/lp/Systems and `lpsystem`

Remote systems with which you want the print service to communicate (client or server) must be registered in the /etc/lp/Systems file. The `lpsystem` command is used to manage entries in this file.

JetDirect-attached printers

The System V print subsystem also supports printing to printers that attach to the network using the Hewlett-Packard JetDirect interface. Configuring the print subsystem for JetDirect printers is not included in this class. Refer to *Printing for Fun and Profit under AIX 5L* (Redbook) for additional information about this capability.

Configuring a Network Print Server

- Register remote systems

```
-# lpsystem [-T timeout] [-R retry] [-y comment]
 system_name
```

- Grant or deny access

```
-# lpadmin -p printer -u allow:user_list | -u
 deny:user_list
```


Figure F-25. Configuring a Network Print Server AU1410.0

Notes:

Introduction

Configuring a network print server is done in two steps:

1) Registering the remote systems (clients) allowed to use the server
2) Granting or denying access to individual remote users or groups of remote users

Register remote systems

Use the `lpsystem` command to register the remote systems.

lpsystem syntax

```
# lpsystem [-T timeout] [-R retry] [-y comment] system_name
# lpsystem -l system_name
# lpsystem -r system_name
```

The table explains the usage of the various options.

Option	Description
system_name	This parameter specifies the name or IP address of the remote system. *System_name* can be * to allow access from any system.
-T *timeout*	This option specifies the length of time the print service will allow a network connection to be idle. If idle time exceeds *timeout*, the connection is dropped. It will be re-established if there are more requests. *timeout* can be: • n: never timeout. This is the default. • 0: timeout immediately. • *N*: timeout after *N* minutes.
-R *retry*	This option specifies the length of time to wait to re-establish a connection if the connection was abnormally dropped. *retry* can be: • n: do not retry until there is more work. • 0: try to reconnect immediately. • *N*: try to reconnect after *N* minutes. The default is 10.
-y comment	This option allows you to add a free form comment. The comment must be quoted if it contains spaces.
-l system_name	This option lists the parameters defined for *system_name*, including any comment.
-r system_name	This option removes *system_name* from the list of registered systems.

Grant or deny access

Use `lpadmin` to control access for a user on a remote client as you would for a local user. The difference is that ***user_list*** can contain the remote system name.

Syntax

`# lpadmin -p` ***printer*** `-u allow:`***user_list*** `| -u deny:`***user_list***

The table shows the syntax for this usage of the `lpadmin` command.

Option	Description
`-p` ***printer***	Specifies the name of the printer on the server.
`-u allow`	This parameter specifies the users who are allowed access.
`-u deny`	This parameter specifies the users who are denied access.
user_list	This is a comma or space separated (must be quoted if space separated) list of users to allow or deny. The list can include any of the following: • ***userID***: a user on the local system • ***system_name*`!`*userID***: a user on system_name • ***system_name*`!all`**: all users on system_name • `all!`***userID***: a user on all systems • `all!all`: all users on all systems

Configuring a Remote Print Client

- Register the server system
  `-# lpsystem [-T timeout] [-R retry] [-y comment] server_name`
- Define the printer queue on the client
  `-# lpadmin -p local_name -s server_name[!server_printer_name]`
- `accept` and `enable` the printer queue on the client

Figure F-26. Configuring a Remote Print Client AU1410.0

Notes:

Introduction

Configuring your system to print using a remote LPD printer is done in three steps:

- Register remote system (the printer or print server) on the client
- Define the printer queue on the client
- `accept` and `enable` the printer queue on the client

Of course the print server or network attached printer must already have been configured to accept your requests.

Register the server system

Registering the server system is done using `lpsystem` as explained in “Configuring a Network Print Server” on page 56, except that in this case you use the name or IP address of the server system.

Define the printer queue on the client

Use the following command to define the print queue on the client system:

```
# lpadmin -p local_name -s server_name[!server_printer_name]
```

The table shows the syntax for this usage of the `lpadmin` command.

Option	Description
`-p` ***local_name***	Specifies the name of the print queue on the client.
`-s` ***server_name***	Specifies the name or IP address of the remote print server. This could be a remote system or a printer directly connected to the network.
server_printer_name	Specifies the name of the printer on the server. The ***local_name*** and the ***server_printer_name*** do not have to agree.

Name of printer on the server

In the case of a remote system, this is the name of the remote print queue on the server. In the case of a network-attached printer running LPD, this is the name of the print queue within the printer. Consult your printer's documentation for details.

Printer type and content type

Printer type (`-T` ***printer_type***) and content type (`-I` ***content_type***) may be specified when defining a remote printer on the client. However, this information is not used by the client. Printer type and content type are only used by `lpsched` when printing to local printers. This work is done on the print server. However, you may still want to define these values on the client system so that `lpstat` on the client system gives users a correct understanding of the purpose and usage of this printer.

The Web-based System Manager requires that you enter printer type and content type when defining a remote printer. These values are not actually used, so you can enter anything. However, as mentioned above, entering correct values for the remote printer makes status listings more useful to users.

`accept` and `enable`

Use `accept` to cause the print queue on the client to begin accepting requests.

Use `enable` to cause `lpNet` on the client to begin sending requests to the remote printer.

System V Administrative Command Summary

Command	Description
`accept/ reject`	Permits jobs to be queued for specified destination (printer or class). Prevents jobs from being queued for specified destination.
`enable/ disable`	Activates the named printers so they will print from the queue. Deactivates named printers.
`cancel`	Cancels print jobs.
`lpadmin`	Create or modify printer configuration.
`lpfilter`	Manages filters.
`lpforms`	Manages forms. (Use `lpadmin` to mount a form.)
`lpmove`	Move print jobs to another destination.
`lpsched/ lpshut`	Start the print service. Stop the print service.
`lpsystem`	Register remote systems with the print service.
`lpusers`	Manages default priority and priority limits for printer service users.
`lpstat`	Report print service status.

Figure F-27. System V Administrative Command Summary AU1410.0

Notes:

Introduction

This slide provides a brief summary of all the System V administrative commands. A summary of the options to `lpadmin` is included on the next page. Refer to the relevant man page for complete information.

For a comparison of the commands for the System V print subsystem and the AIX print subsystem, refer to:

Printing for Fun and Profit under AIX 5L (Redbook)
Appendix A. Print Tasks and Commands

lpadmin syntax

The most frequently used administrative command is **lpadmin**. The following table summarizes the command syntax. Again, see the man page for a complete description.

Adding or changing a printer:
```
# lpadmin -p printer [options]
```

Removing a destination (printer or class):
```
# lpadmin -x destination
```

Option	Description
-p *printer*	Specifies the name of the printer. When adding a printer, you must specify either: **-v** (for a local printer) or **-s** (for a remote printer)
-v *device*	Used to configure a local printer. Associates a device with a printer.
-s *server* **[!*server_printer_name*]**	Used to configure a remote printer. ***server*** specifies the name or IP address of the remote print server. This could be a remote system or a printer directly connected to the network. ***server_printer_name*** specifies the name of the printer queue on the server.
-x *destination*	Remove ***destination*** (which can be a printer or a class) from the print service.
-i *interface* **-m *model*** **-e *printer_name***	Used to specify the printer interface. Only one of these options can be specified. If none of these are specified, the **standard** interface is used. **-i *interface*** specifies a full file path. **-m *model*** specifies one of the supplied interface programs (a file in /usr/lib/lp/model). **-e *printer_name*** directs **lpadmin** to copy the interface used for ***printer_name*** to the printer being added or changed (specified with **-p *printer***).
-T *printer_type*	Identifies an entry in the terminfo database, which is used by the interface program and some filters.
-I *content_type_list*	Identifies one or more types of content that this printer can handle without filtering. If not specified, default is **simple**.

Option	Description
`-c` ***class***	Add ***printer*** to ***class***. Create ***class*** if it does not already exist.
`-r` ***class***	Remove ***printer*** from ***class***. If ***printer*** is the last member of ***class***, then remove ***class***.
`-O {copy|nocopy}`	`-O copy` specifies that files should always be copied to the spool directory. `-O nocopy` specifies that files should not be copied to the spool directory unless requested by user or otherwise required (for example: a remote print request or input piped to the `lp` command). This flag sets the value of the `copy-files` parameter in the /etc/default/lp file to `on` (**copy**) or `off` (**nocopy**).
`-A` ***alert_type*** `[-W` ***minutes***`]`	Specifies the type of alert used to notify the administrator of printer faults. The default is to send the alert message via mail. `-W` ***minutes*** specifies the interval between alerts. `0` or `once` is the default, which indicates sending only one alert for a fault.
`-M -f` ***form_name*** `[-o filebreak]`	Mount ***form_name*** on ***printer***. `-o filebreak` specifies that a form feed be inserted between each copy of the alignment pattern.
`-f allow:`***form_list*** `-f deny:`***form_list***	Allow or deny the forms in ***form_list*** to be printed on ***printer***. By default, all forms are denied.
`-u allow:`***user_list*** `-u deny:`***user_list***	Allow or deny the users in ***user_list*** to access ***printer***.

System V User Command Summary

Command	Description
`cancel`	Cancels print jobs
`lp`	Submit a print job to a printer
`lpstat`	Report print service status

Figure F-28. System V User Command Summary AU1410.0

Notes:

Introduction

This slide provides a brief summary of the System V user commands. Options for the `lp` command are summarized on the next page. Refer to the relevant man page for complete information.

`cancel`

A summary of the `cancel` command is shown in “Cancel print jobs” on page 41.

`lpstat`

A summary of the `lpstat` command is shown in “Check status” on page 41.

lp syntax

Use the lp command to submit jobs to the System V print service. There are many options. The following table summarizes the most commonly used options.

Options can be entered in any order, however the files to be printed must occur at the end of the command line.

```
# lp -d destination [options] files
```

Option	Description
-d *destination*	Specifies the printer destination (printer or class) where the job is to be printed.
files	Specifies one or more files to be printed. Files are printed in the order specified. Use - to specify standard input.
-c	Copy files to spool directory before printing. Default is not to copy unless lpadmin -o copy has been used.
-n *number*	Print *number* copies. Default is one.
-T *content_type*	Specifies content type of the file. If the requested printer destination cannot handle this content, the print service looks for a filter to convert the file. If no acceptable combination of filter/printer can be found, the job is rejected.
-f *form_name*	Print the job on form *form_name*. If the requested printer destination is not allowed to use this form, the job is rejected. If the form is not mounted, an alert is sent to the administrator. (How form alerts are handled is configured by the lpform command.)
-o *options*	-o specifies a printer-dependant list of options. Supported options are defined by the printer type (terminfo entry). Options can include items such as: page length, page width, line pitch, character pitch, and so forth.
-m	Send notification via mail when job has been printed. Default is no mail.

Option	Description
`-y` ***mode_list***	Print the job according to the modes in ***mode_list***. This option may only be used if there is a filter available to handle the requested modes; otherwise the print job is rejected. The allowed modes are locally defined (in the filter definition files). Modes can include such items as: reverse order, landscape mode, print only selected page numbers, and so forth.

Checkpoint

1. List two advantages of the System V print subsystem.
   _____
2. List two advantages of the AIX print subsystem.
   _____
3. What command is used to switch from AIX to System V printing?
   _____
4. `lpsched` uses information in _____ and _____ to screen print jobs.
5. The interface program uses commands in _____ to initialize the printer.
6. _____ are used to convert file content.
7. Use the _____ command to manage filters.
8. _____ is used to create or modify a System V printer.
9. _____ is used to create a printer device.

Figure F-29. Checkpoint AU1410.0

Notes:

Unit Summary

- AIX V5.1 and AIX V5.2 supports both the AIX print subsystem and the System V subsystem
- Either System V or AIX (not both) can be active on Power-based systems
- The System V print subsystem provides compatibility with printing solutions on many other UNIX variants
- The System V print subsystem provides the capability of supporting a wide range of printers and printing needs, but system management is somewhat complex

Figure F-30. Unit Summary AU1410.0

Notes:

Appendix G. Checkpoint Solutions

Unit 1: Introduction to pSeries/AIX System Administration

1. What type of adapter are you likely to require for a single-user graphics workstation?

Correct Answer:

C, Graphics

2. What is the difference between UP and SMP machines?

Correct Answer:

Uniprocessors only have on microprocessor. SMP-symmetric Multiprocessing machines have multiple microprocessors.

3. **T**/ **F** The **su** command allows you to get root authority even if you signed on using another userID.

Correct Answer:

True, but you must still know the root password.

Unit 2: AIX V5.3 Installation

1. AIX can be installed from which of the following: (select all that are correct)

Correct Answer:

b

2. **T**/**F** A Preservation Install preserves all data on the disks.

Correct Answer:

False. Preserves SOME of the existing data on the disk selected for installation. Warning: This method overwrites the usr (/usr), variable (/var), temporary (/tmp), and root (/) file systems. Other product (application) files and configuration data are destroyed.

3. What is the console used for during the installation process?

Correct Answer:

The console is used to display all the system messages and interact with the installation.

Unit 3: System Management Interface Tool (SMIT)

1. Define the SMIT function keys that can be used for the following:
   a. List the command that will be run **F6**
   b. List the screen name which can be used for the fastpath **F8**

c. Take a screen image: **F8**

d. Break out into a shell: **F9**

e. Return to the previous menu: **F3**

2. How do you request the ascii character version of SMIT from an Xwindows environment command prompt?

   Correct Answer: smitty or smit -C

Unit 4: AIX Software Installation and Maintenance

1. Which of the following states can your software be in, in order for you to be able to use it? (select all that apply)

Correct Answer:

a, d

2. What command is used to list all installed software on your system?

Correct Answer:

lslpp -l

3. Which of the following can you install as an entity? (select all that apply)

Correct Answer:

a, b, c, d

4. What is the difference between the SMIT menus: **Install Software** and **Update Installed Software to Latest Level (Update All)?**

Correct Answer:

Install Software by default installs everything from the installation media (except printer and devices) onto the system.

Update Installed Software to Latest Level (Update All) installs only updates to filesets already installed on your system.

Unit 5: Configuring AIX Documentation

1. **T/F:** AIX Web-based documentation can be used to reference information in different ways, such as searching for a command, searching for a task or viewing information in a book like manner.

Correct Answer:

True

2. T/F: The AIX 5L documentation is viewed using a Web browser.

Correct Answer:

True

3. T/F The Information Center requires the prior installation of Web Server software (such as HTTPServer) in order to provide remote client access.

Correct Answer: False. infocenter has its own built-in Eclipse based web server function.

Unit 6: Web-based System Management

1. **T/F** WebSM is available for client access automatically after the BOS is installed.

Correct Answer:

False. The WebSM server must be configured and enabled for client access.

2. Which of the statements are true regarding the Web-based System Manager?
   a. An AIX V5.2 system can be managed from a remote PC with appropriate JAVA and Web-browser code installed.
   b. In stand-alone mode use the wsm command to access the Web-based System Manager.
   c. It is possible to manage an AIX 5.2 system from a remote AIX 5.2 system using an ASCII terminal.
   d. The Web-based System Manager includes TaskGuides that direct the user through complex tasks.

Correct Answer:

a, b, d

C is false. However, it is possible with a graphics terminal, to manage different systems simultaneously by adding the remote systems in the Navigation window of WebSM.

Unit 7: System Startup and Shutdown

1. What is the first process that is created on the system and which file does it reference to initiate all the other processes that have to be started?

Correct Answer:

The first process is init and it looks in the /etc/inittab file

2. Which AIX feature can be used to stop and start groups of daemons or programs?

Correct Answer:

The System Resource Controller (SRC)

3. **T/F** You can only execute the shutdown command from the console.

Correct Answer:

False. It is not where you type the command as much as who you are. Ordinary users cannot run the shutdown command.

Unit 8: Devices

1. Is it possible to use SCSI ID 7 for a new tape drive?

Correct Answer:

No. The SCSI adapter itself uses ID 7. So, it cannot be used for other devices.

2. What will happen if we attempt to add another device with the SCSI address set to 4?

Correct Answer:

The operation will fail as there is already a device (SCSI Disk Drive) configured at this location.

3. Can the 8 mm tape drive be currently used? Why?

Correct Answer:

No, because it is in the defined state. You have to first make it available by either using SMIT or the mkdev command.

4. Where is the printer connected?

Correct Answer:

The parallel port.

5. The token-ring adapter is installed in what slot?

Correct Answer:

It is installed in slot 4 on the PCI bus.

Unit 9: System Storage Overview

1. How many different PP sizes can be set within a single VG?

Correct Answer:

One

2. By default, how big are PPs?

Correct Answer:

4 MB

3. How many VGs can a PV belong to?

Correct Answer:

b.

4. **T/F** All VGDA information on your system is identical, regardless of how many VGs exist.

Correct Answer:

False. All VGDAs within a VG are the same.

5. With which logical volume is the /home file system associated?

Correct Answer:

/dev/hd1

6. What type of file systems are being displayed?

Correct Answer:

Journaled file systems (jfs), enhanced journaled file systems, and CD-ROM (cdrfs)

7. What is the mount point for the file system located on the /dev/lv00 logical volume?

Correct Answer:

/home/john

8. Which are the system supplied logical volumes and their associated file systems?

Correct Answer:

/dev/hd4	/
/dev/hd1	/home
/dev/hd2	/usr
/dev/hd9var	/var
/dev/hd3	/tmp

9. Which file system is used primarily to hold user data and home directories?

Correct Answer:

/home

10. Which of the logical volumes above are examples of logical volumes with journaled file systems on them?

Correct Answer:

hd9var,hd3,lv00

Unit 10: Working with the Logical Volume Manager

1. **T/F** An LV can span more than one physical volume.

Correct Answer:

TRUE

2. **T/F** An LV can span more than one volume group.

Correct Answer:

FALSE

3. **T**/**F** The contents of a PV can be divided between two VGs.

Correct Answer:

FALSE

4. **T**/**F** If mirroring LVs, it is not necessary to perform a backup.

Correct Answer:

FALSE. You still need to back up to external media.

5. T/F: SMIT can be used to easily increase or decrease the size of a logical volume.

Correct Answer:

FALSE. SMIT can only be used to increase a file system. Decreasing one requires backing up the file system, removing it, recreating it, and then restoring.

6. **T**/**F** Striping is done at a logical partition level.

Correct Answer:

FALSE. It is done at a stripe unit level.

Unit 11: Working with File Systems

1. Do the size of the file system change when the size of the logical volume it is on is increased?

Correct Answer:

No

2. If a file system is the same size as the logical volume on which it sits, does the size of the logical volume increase when the size of the file system that is sitting on it increases?

Correct Answer:

Yes

3. If you remove a logical volume, is the file system that is sitting on it removed as well?

Correct Answer:

The contents are removed, but the information about the file system contained in /etc/filesystems is not.

Unit 12: Managing File Systems

1. What command can you use to determine if a file system is full?

Correct Answer:

df

2. What two commands can be used to find the files and users that are taking the most disk space?

Correct Answer:

du and ls -l

3. **T/F** It is good practice to run fsck -y on all file systems, even if they mounted.

Correct Answer:

False

Unit 13: Paging Space

1. What problems can you conclude from the following listing?

Correct Answer

Obviously it is difficult to come to any conclusion regarding the state of this system just by looking at a snapshot picture as above. However, at a first glance the following potential problems can be noticed:

paging00 is underutilized and it is too large.
This needs to be reduced in size.

paging01 is overutilized and the size seems to be too small.
This needs to be increased.

Both user-defined paging spaces are on the same disk.
It would be better if one of them is moved onto a disk which is less utilized.

2. **T/F** The size of paging00 (in the above example) can be dynamically decreased. Why?

Correct Answer

True. In AIX V5.2, you can use the chps -d command to dynamically decrease the size of a paging space.

Unit 14: Backup and Restore

1. What is the difference between A and B?

   A: find /home/fred | backup -ivf /dev/rmt0

   B: cd /home/fred; find . -print | backup -ivf /dev/rmt0

   Correct Answer:

   A will backup the files using the full path names, whereas B will backup the file names using the relative path names, and so B's files can be restored into any directory.

2. On a **mksysb** tape if you entered **tctl rewind** and then **tctl -f/dev/rmt0.1 fsf 3** which element on the tape could you look at?

Which command could you use to restore these files?

Correct Answer:

You would be at the start of the backed up images of the files, having skipped over the boot portion of the tape. The files are backed up using the **backup** command so you would have to use the **restore** command.

3. SMIT **mksysb** backs up all file systems, provided they are mounted.

Correct Answer:

False. **mksysb** only backs up rootvg file systems. To back up other VGs, you must use the **savevg** command.

Unit 15: Security and User Administration

1. What are the benefits of using the **su** command to switch user to **root** over logging in as **root**?

Correct Answer

A log is kept in the sulog file of all the users executing the su command, which can be monitored

2. Why is a umask of 027 recommended?

Correct Answer

This value removes all permission bits for the others section, which is desirable

3. As a member of the security group, which password command would you use?

Correct Answer

pwdadm as this does not prompt for root's password or the user's old password.

4. Which password change command does SMIT use?

Correct Answer

.passwd command

5. **T/F** When you delete a user from the system, all the user's files and directories are also deleted.

Correct Answer

False. You must remember to delete them if they are obsolete.

6. If an ordinary user forgets their password, can the system administrator find out by querying the system as to what the user's password was set to? Why?

Correct Answer

No, because the passwords are held on the system in encrypted format, so even the system administrator cannot tell what the password was set to.

7. Password restrictions are set in which of the following files?

   a. /etc/passwd
   b. /etc/security/passwd
   c. /etc/security/restrictions
   d. /etc/security/user

Correct Answer

d

8. Which of the following statements are true?

   a. A user can only belong to one group.
   b. A member of the security group can administer user accounts.
   c. An admin user is a user whose account cannot be administered by any member of the security group.
   d. The **chmod g+s** command sets the SUID permission of a file.
   e. The root user, commonly known as the superuser has UID=0 and GID=0.

Correct Answer

b, c, e

Unit 16: Scheduling

1. **T/F** The **at.allow** and **at.deny** files must be used to specify which users are allowed and denied use of the **at** command.

Correct Answer

False. These files are mutually exclusive and only one or the other should be used.

2. Using **cron,** how would you specify a job to run every Thursday at 10 past and 30 minutes past every hour?

Correct Answer

10,30 ***

3. How would you schedule the script myscript to run 10 minutes from now?

Correct Answer

```
#at now +10 mins
myscript
ctrl -d
#
```

Unit 17: Printers and Queues

1. **T/F** One of the advantages of queues is that each user can have a different default queue set up for them.

Correct Answer:

True. This can be accomplished using the PRINTER environment variable.

2. The /**etc/qconfig** file is read by the **backend** program to determine what the queue discipline is.

Correct Answer:

False, it is read by **qdaemon**.

3. All printer software is automatically installed when you install the base operating system.

Correct Answer:

False, only a handful of printer software is installed by default.

4. What is the difference between these two commands?

 # qprt -Pasc file1
 # qprt -c -Pasc file1

Correct Answer:

The -c flag produces a spool file.

5. What methods can be used to find out what the system default queue is?

Correct Answer:

a) First entry in /etc/qconfig file

b) The output from the qchk command with no options is for the default queue

c) The first queue listing from the lpstat command is for the default queue

6. Can any user bring the print queues down? Name a few people who can.

Correct Answer:

No, only system administrators, or root or members of the printq group can.

7. **T/F** Once the queue is down, no more jobs can be submitted to the printer.

Correct Answer:

False. Jobs can be submitted to the queue. However, they will not be printed until the queue is brought up again.

8. Can users hold all their print jobs in a specific queue? If so, how?

Correct Answer:

Yes, they can by only specifying a queue name and not individual job numbers.

Unit 18: Networking Overview

1. What are the following commands used for?

Correct Answer:

ftp transfer files from one machine to another
rexec execute a command on a remote system
telnet login to another system

2. What is the difference (if any) between a **host** and a **gateway**.

Correct Answer:

A host is an individual machine connected to a network, whereas a gateway is a special kind of host which links two or more physical network segments together.

3. **T**/**F** Each machine in a TCP/IP network must have a unique hostname and TCP/IP address.

Correct Answer:

True

4. Which file holds the name and the TCP/IP address of each host?

Correct Answer:

/etc/hosts

Appendix A: Configuring AIX Documentation

1. Define the SMIT function keys that can be used for the following:
   a. List the command that will be run **F6**
   b. List the screen name which can be used for the fastpath **F8**
   c. Take a screen image: **F8**
   d. Break out into a shell: **F9**
   e. Return to the previous menu: **F3**
2. T/F: AIX Web-based documentation can be used to reference information in different ways, such as searching for a command, searching for a task or viewing information in a book like manner.

Correct Answer:

True

3. T/F: The AIX V5.2 documentation is viewed using a Web browser.

Correct Answer:

True

4. T/F: WebSM is available for client access automatically after the BOS is installed.

Correct Answer:

False. The WebSM server must be configured and enabled for client access.

5. Which of the statements are true regarding the Web-based System Manager?
   a. An AIX V5.1 and V5.2 system can be managed from a remote PC with appropriate Java and Web-browser code installed.
   b. In stand-alone mode use the wsm command to access the Web-based System Manager.
   c. It is possible to manage an AIX V5.1 and V5.2 system from a remote AIX V5.1 and V5.2 system using an ASCII terminal.
   d. The Web-based System Manager includes TaskGuides that direct the user through complex tasks.

Correct Answer:

a, b, d

C is false. However, it is possible with a graphics terminal, to manage different systems simultaneously by adding the remote systems in the Navigation window of WebSM.

Appendix E: Serial Devices

Review Solution One:

1. **T/F** If a device, like a TTY, is left for **cfgmgr** to configure automatically, it picks up the default values which might not be desirable.

Correct Answer:

False, TTYs and other serial devices are not self-configurable and so are not detected by **cfgmgr**.

2. **T/F** If TTYs are connected via concentrator boxes, they must all be connected in sequence on the concentrator box otherwise they will not be configured.

Correct Answer:

False, TTYs can be connected in any order on the concentrator boxes. However, the management of these obviously more difficult.

3. **T/F** /dev/tty0 indicates that the TTY is connected to port 0, /dev/tty1 to port 1 and so on.

Correct Answer:

False, When a TTY is added to the system, you have to specify to which port the TTY is connected. As they can be connected in any order on the concentrator boxes, there is no relationship between the /dev/tty name, which is the name allocated to the device by

the operating system (and is always the lowest number not allocated) and the port number which you specify. So, for example, tty1 can be connected to port 15.

4. What environment variable holds the terminal type for a terminal?

   TERM

Appendix F: The System V Print Subsystem

1. List two advantages of the System V print subsystem.

Correct Answer:

Compatibility, Availability of interface programs, Security, Support for Forms, Standard PostScript filters, Long term direction

2. List two advantages of the AIX print subsystem.

Correct Answer:

Powerful and flexible printer drivers, mature system management tools, Customizable spooling subsystem

3. What command is used to switch from AIX to System V printing?

Correct Answer:

switch.prt -s SystemV

4. **lpsched** uses information in _____ and _____ to screen print jobs.

Correct Answer:

the printer configuration file
terminfo

5. The interface program uses commands in _____ to initialize the printer.

Correct Answer:

terminfo

6. _____ are used to convert file content.

Correct Answer:

Filters

7. Use the _____ command to manage filters.

Correct Answer:

lpfilter

8. _____ is used to create or modify a System V printer.

Correct Answer:

lpadmin

9. _____ is used to create a printer device.

Correct Answer:

mkdev

Glossary

This glossary includes terms and definitions from:

- The *American National Standard Dictionary for Information Systems*, ANSI X3.172-1990, copyright 1990 by the American National Standards Institute (ANSI). Copies may be purchased from the American National Standards Institute, 11 West 42nd Street, New York, New York 10036. Definitions are identified by the symbol (A) after the definition.
- The ANSI/EIA Standard— 440-A, *Fiber Optic Terminology*. Copies may be purchased from the Electronic Industries Association, 2001 Pennsylvania Avenue, N.W., Washington, DC 20006. Definitions are identified by the symbol (E) after the definition.
- The *Information Technology Vocabulary*, developed by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions of published parts of this vocabulary are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers being developed by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.
- The Network Working Group Request for Comments: 1208.

The following cross-references are used in this glossary:

Contrast with: This refers to a term that has an opposed or substantively different meaning.
Synonym for: This indicates that the term has the same meaning as a preferred term, which is defined in its proper place in the glossary.
Synonymous with: This is a backward reference from a defined term to all other terms that have the same meaning.
See: This refers the reader to multiple-word terms that have the same last word.
See also: This refers the reader to terms that have a related, but not synonymous, meaning.
Deprecated term for: This indicates that the term should not be used. It refers to a preferred term, which is defined in its proper place in the glossary.

A

access mode A matrix of protection information stored with each file specifying who may do what to a file. Three classes of users (owner, group, all others) are allowed or denied three levels of access (read, write, execute).

access permission See **access mode**.

access privilege See **access mode**.

address space The address space of a process is the range of addresses available to it for code and data. The relationship between real and perceived space depends on the system and support hardware.

AIX Advanced Interactive Executive. IBM's implementation of the UNIX Operating System.

AIX Family Definition IBM's definition for the common operating system environment for all members of the AIX family. The AIX Family Definition includes specifications for the AIX Base System, User Interface, Programming Interface, Communications Support, Distributed Processing, and Applications.

alias The command and process of assigning a new name to a command.

ANSI American National Standards Institute. A standards organization. The United States liaison to the International Standards Organization (ISO).

application program A program used to perform an application or part of an application.

argument An item of information following a command. It may, for example, modify the command or identify a file to be affected.

ASCII American Standard Code for Information Interchange. A collection of public domain character sets considered standard throughout the computer industry.

awk An interpreter, included in most UNIX operating systems, that performs sophisticated text pattern matching. In combination with shell scripts, awk can be used to prototype or implement applications far more quickly than traditional programming methods.

B

background (process) A process is “in the background” when it is running independently of the initiating terminal. It is specified by ending the ordinary command with an ampersand (&). The parent of the background process does not wait for its “death”.

backup diskette A diskette containing information copied from another diskette. It is used in case the original information is unintentionally destroyed.

Berkeley Software Distribution Disseminating arm of the UNIX operating system community at the University of California at Berkeley; commonly abbreviated “BSD”. Complete versions of the UNIX operating system have been released by BSD for a number of years; the latest is numbered 4.3. The phrase “Berkeley extensions” refers to features and functions, such as the C shell, that originated or were refined at UC Berkeley and that are now considered a necessary part of any fully configured version of the UNIX operating system.

bit bucket The AIX file “/dev/null” is a special file which will absorb all input written to it and return no data (null or end of file) when read.

block A group of records that is recorded or processed as a unit.

block device A device that transfers data in fixed size blocks. In AIX, normally 512 or 1024 bytes.

block special file An interface to a device capable of supporting a file system.

booting Starting the computer from scratch (power off or system reset).

break key The terminal key used to unequivocally interrupt the foreground process.

BSD Berkeley Software Distribution.

- BSD 2.x - PDP-11 Research
- BSD 4.x - VAX Research
- BSD 4.3 - Current popular VAX version of UNIX.

button

1. A word, number, symbol, or picture on the screen that can be selected. A button may represent a command, file, window, or value, for example.
2. A key on a mouse that is used to select buttons on the display screen or to scroll the display image.

byte The amount of storage required to represent one character; a byte is 8 bits.

C

C The programming language in which the UNIX operating system and most UNIX application programs are written. The portability attributed to UNIX operating systems is largely due to the fact that C, unlike other higher level languages, permits programmers to write systems-level code that will work on any computer with a standard C compiler.

change mode The **chmod** command will change the access rights to your own files only, for yourself, your group or all others.

character I/O The transfer of data byte by byte; normally used with slower, low volume devices such as terminals or printers.

character special file An interface to devices not capable of supporting a file system; a byte oriented device.

child The process emerging from a fork command with a zero return code, as distinguished from the parent which gets the process id of the child.

client User of a network service. In the client/server model, network elements are defined as either using (client) or providing (server) network resources.

command A request to perform an operation or run a program. When parameters, arguments, flags, or other operands are associated with a command, the resulting character string is a single command.

command file A data file containing shell commands. See **shell file**, or **shell script**.

command interpreter The part of the operating system that translates your commands into instructions that the operating system understands. **command** or **previous command** key.

concatenate The process of forming one character string or file from several. The degenerate case is one file from one file just to display the result using the **cat** command.

console The only terminal known explicitly to the Kernel. It is used during booting and it is the destination of serious system messages.

context The hardware environment of a process, including:

- CPU registers
- Program address
- Stack
- I/O status

context The entire context must be saved during a process swap.

control character Codes formed by pressing and holding the **control** key and then some other key; used to form special functions like **End Of File**.

control-d See **eof** character.

cooked input Data from a character device from which backspace, line kill, and interrupt characters have been removed (processed). See **raw input**.

current directory The currently active directory. When you specify a file name without specifying a directory, the system assumes that the file is in your current directory.

current subtree Files or directories attached to the current directory.

curses A C subroutine library providing flexible screen handling. See **Termlib** and **Termcap**.

cursor A movable symbol (such as an underline) on a display, usually used to indicate to the operator where to type the next character.

customize To describe (to the system) the devices, programs, users, and user defaults for a particular data processing system.

D

DASD Direct Access Storage Device. IBM's term for a hard disk.

device driver A program that operates a specific device, such as a printer, disk drive, or display.

device special file A file which passes data directly to/from the device.

directory A type of file containing the names and controlling information for other files or other directories.

directory pathname The complete and unique external description of a file giving the sequence of connection from the root directory to the specified directory or file.

diskette A thin, flexible magnetic plate that is permanently sealed in a protective cover. It can be used to store information copied from the disk.

diskette drive The mechanism used to read and write information on diskettes.

display device An output unit that gives a visual representation of data.

display screen The part of the display device that displays information visually.

E

echo To simply report a stream of characters, either as a message to the operator or a debugging tool to see what the file name generation process is doing.

editor A program used to enter and modify programs, text, and other types of documents.

environment A collection of values passed either to a C program or a shell script file inherited from the invoking process.

escape The backslash "\" character specifies that the single next character in a command is ordinary text without special meaning.

Ethernet A baseband protocol, invented by the XEROX Corporation, in common use as the local area network for UNIX operating systems interconnected via TCP/IP.

event One of the previous lines of input from the terminal. Events are stored in the (Berkeley) History file.

event identifier A code used to identify a specific event.

execution permission For a file, the permission to execute (run) code in the file. A text file must have execute permission to be a shell script. For a directory, the permission to search the directory.

F

field A contiguous group of characters delimited by blanks. A field is the normal unit of text processed by text processes like sort.

field separator The character used to separate one field from the next; normally a blank or tab.

FIFO "First In, First Out". In AIX, a FIFO is a permanent, named pipe which allows two unrelated processes to communicate. Only related processes can use normal pipes.

file A collection of related data that is stored and retrieved by an assigned name. In AIX, files are grouped by directories.

file index Sixty-four bytes of information describing a file. Information such as the type and size of the file and the location on the physical device on which the data in the file is stored is kept in the file index. This index is the same as the AIX Operating System i-node.

filename expansion or generation A procedure used by the shell to generate a set of filenames based on a specification using metacharacters, which define a set of textual substitutions.

file system The collection of files and file management structures on a physical or logical mass storage device, such as a diskette or minidisk.

filter Data-manipulation commands (which, in UNIX operating systems, amount to small programs) that take input from one process and perform an operation yielding new output. Filters include editors, pattern-searchers, and commands that sort or differentiate files, among others.

fixed disk A storage device made of one or more flat, circular plates with magnetic surfaces on which information can be stored.

fixed disk drive The mechanism used to read and write information on a fixed disk.

flag See **Options**.

foreground (process) An AIX process which interacts with the terminal. Its invocation is not followed by an ampersand.

formatting The act of arranging text in a form suitable for reading. The publishing equivalent to compiling a program.

fsck A utility to check and repair a damaged file structure. This normally results from a power failure or hardware malfunction. It looks for blocks not assigned to a file or the free list and puts them in the free list. (The use of blocks not pointed at cannot be identified.)

free list The set of all blocks not assigned to a file.

full path name The name of any directory or file expressed as a string of directories and files beginning with the root directory.

G

gateway A device that acts as a connector between two physically separate networks. It has interfaces

to more than one network and can translate the packets of one network to another, possibly dissimilar network.

global Applying to all entities of a set. For example:

- A global search - look everywhere
- A global replace - replace all occurrences
- A global symbol - defined everywhere.

grep An AIX command which searches for strings specified by a regular expression. (Global Regular Expression and Print.)

group A collection of AIX users who share a set of files. Members of the group have access privileges exceeding those of other users.

H

hardware The equipment, as opposed to the programming, of a system.

header A record at the beginning of the file specifying internal details about the file.

heterogeneous Descriptor applied to networks composed of products from multiple vendors.

hierarchy A system of objects in which each object belongs to a group. Groups belong to other groups. Only the “head” does not belong to another group. In AIX this object is called the “Root Directory”.

highlight To emphasize an area on the display screen by any of several methods, such as brightening the area or reversing the color of characters within the area.

history A list of recently executed commands.

home (directory). 1. A directory associated with an individual user.

home (directory). 2. Your current directory on login or after issuing the cd command with no argument.

homogeneous Descriptor applied to networks composed of products from a single vendor.

hypertext Term for on-line interactive documentation of computer software; to be included with AIX.

I

IEEE Institute of Electrical and Electronics Engineers. A professional society active in standards work, the IEEE is the official body for work on the POSIX (Portable Operating System for Computer Environments) open system interface definition.

index See **file index**.

indirect block A file element which points at data sectors or other indirect blocks.

init The initialization process of AIX. The ancestor of all processes.

initial program load The process of loading the system programs and preparing the system to run jobs.

i-node A collection of logical information about a file including owner, mode, type and location.

i number The internal index or identification of an i-node.

input field An area into which you can type data.

input redirection The accessing of input data from other than standard input (the keyboard or a pipe).

interoperability The ability of different kinds of computers to work well together.

interpreter A program which “interprets” program statements directly from a text (or equivalent) file. Distinguished from a compiler which creates computer instructions for later direct execution.

interrupt A signal that the operating system must reevaluate its selection of which process should be running. Usually to service I/O devices but also to signal from one process to another.

IP Internet Protocol.

ipl See **initial program load**.

ISO International Standards Organization. A United Nations agency that provides for creation and administration of worldwide standards.

J

job A collection of activities.

job number An identifying number for a collection of processes devolving from a terminal command.

K

kernel The part of an operating system that contains programs that control how the computer does its work, such as input/output, management and control of hardware, and the scheduling of user tasks.

keyboard An input device consisting of various keys allowing the user to input data, control cursor and pointer locations, and to control the user/work station dialogue.

kill To prematurely terminate a process.

kill character The character which erases an entire line (usually @).

L

LAN Local Area Network. A facility, usually a combination of wiring, transducers, adapter boards, and software protocols, which interconnects workstations and other computers located within a department, building, or neighborhood. Token-Ring and Ethernet are local area network products.

libc A basic set of C callable routines.

library In UNIX operating systems, a collection of existing subroutines that allows programmers to make use of work already done by other programmers. UNIX operating systems often include

separate libraries for communications, window management, string handling, math, and so forth.

line editor An editor which processes one line at a time by the issuing of a command. Usually associated with sequential only terminals such as a teletype.

link An entry in an AIX directory specifying a data file or directory and its name. Note that files and directories are named solely by virtue of links. A name is not an intrinsic property of a file. A file is uniquely identified only by a system generated identification number.

lint A program for removing “fuzz” from C code. Stricter than most compilers. Helps former Pascal programmers sleep at night.

Local Area Network (LAN) A facility, usually a combination of wiring, transducers, adapter boards, and software protocols, which interconnects workstations and other computers located within a department, building, or neighborhood. Token-Ring and Ethernet are local area network products.

login Identifying oneself to the system to gain access.

login directory See **home directory**.

login name The name by which a user is identified to the system.

logout Informing the system that you are through using it.

M

mail The process of sending or receiving an electronically delivered message within an AIX system. The message or data so delivered.

make Programming tool included in most UNIX operating systems that helps “make” a new program out of a collection of existing subroutines and utilities, by controlling the order in which those programs are linked, compiled, and executed.

map The process of reassigning the meaning of a terminal key. In general, the process of reassigning the meaning of any key.

memory Storage on electronic memory such as random access memory, read only memory, or registers. See **storage**.

message Information displayed about an error or system condition that may or may not require a user response.

motd “Message of the day”. The login “billboard” message.

MotifT The graphical user interface for OSF, incorporating the X Window System. Behavior of this interface is compatible with the IBM/Microsoft Presentation Manager user interface for OS/2. Also called OSF/Motif.

mount A logical (that is, not physical) attachment of one file directory to another. “remote mounting” allows files and directories that reside on physically separate computer systems to be attached to a local system.

mouse A device that allows you to select objects and scroll the display screen by means of buttons.

move Relinking a file or directory to a different or additional directory. The data (if any) is not moved, only the links.

multiprogramming Allocation of computer resources among many programs. Used to allow many users to operate simultaneously and to keep the system busy during delays occasioned by I/O mechanical operations.

multitasking Capability of performing two or more computing tasks, such as interactive editing and complex numeric calculations, at the same time. AIX and OS/2 are multi-tasking operating systems; DOS, in contrast, is a single-tasking system.

multiuser A computer system which allows many people to run programs “simultaneously” using multiprogramming techniques.

N

named pipe See **FIFO**.

Network File System (NFST) A program developed by SUN Microsystems, Inc. for sharing files among systems connected via TCP/IP. IBM's AIX, VM, and MVS operating systems support NFS.

NFST See **Network File System**.

NIST National Institute of Science and Technology (formerly the National Bureau of Standards).

node An element within a communication network.

- Computer
- Terminal
- Control Unit

null A term denoting emptiness or nonexistence.

null device A device used to obtain empty files or dispose of unwanted data.

null string A character string containing zero characters.

O

object-oriented programming Method of programming in which sections of program code and data are represented, used, and edited in the form of “objects”, such as graphical elements, window components, and so forth, rather than as strict computer code. Through object-oriented programming techniques, toolkits can be designed that make programming much easier. Examples of object-oriented programming languages include Pareplace Systems, Inc.'s Smalltalk-80T, AT&T's C++T, and Stepstone Inc.'s Objective-CR.

oem original equipment manufacturer. In the context of AIX, OEM systems refer to the processors of a heterogeneous computer network that are not made or provided by IBM.

Open Software FoundationT (OSF) A non-profit consortium of private companies, universities, and research institutions formed to conduct open

technological evaluations of available components of UNIX operating systems, for the purpose of assembling selected elements into a complete version of the UNIX operating system available to those who wish to license it. IBM is a founding sponsor and member of OSF.

operating system The programs and procedures designed to cause a computer to function, enabling the user to interact with the system.

option A command argument used to specify the details of an operation. In AIX an option is normally preceded by a hyphen.

ordinary file Files containing text, programs, or other data, but not directories.

OSFT See **Open Software Foundation**.

output redirection Passing a programs standard output to a file.

owner The person who created the file or his subsequent designee.

P

packet switching The transmission of data in small, discrete switching “packets” rather than in streams, for the purpose of making more efficient use of the physical data channels. Employed in some UNIX system communications.

page To move forward or backward on screen full of data through a file usually referring to an editor function.

parallel processing A computing strategy in which a single large task is separated into parts, each of which then runs in parallel on separate processors.

parent The process emerging from a Fork with a non#zero return code (the process ID of the child process). A directory which points at a specified directory.

password A secret character string used to verify user identification during login.

PATH A variable which specifies which directories are to be searched for programs and shell files.

path name A complete file name specifying all directories leading to that file.

pattern-matching character Special characters such as * or ? that can be used in a file specification to match one or more characters. For example, placing a ? in a file specification means that any character can be in that position.

permission The composite of all modes associated with a file.

pipes UNIX operating system routines that connect the standard output of one process with the standard input of another process. Pipes are central to the function of UNIX operating systems, which generally consist of numerous small programs linked together into larger routines by pipes. The “piping” of the list directory command to the word count command is ls | wc. The passing of data by a pipe does not (necessarily) involve a file. When the first program generates enough data for the second program to process, it is suspended and the second program runs. When the second program runs out of data it is suspended and the first one runs.

pipe fitting Connecting two programs with a pipe.

pipeline A sequence of programs or commands connected with pipes.

portability Desirable feature of computer systems and applications, referring to users' freedom to run application programs on computers from many vendors without rewriting the program's code. Also known as “applications portability”, “machine-independence”, and “hardware-independence”; often cited as a cause of the recent surge in popularity of UNIX operating systems.

port A physical I/O interface into a computer.

POSIX “Portable Operating Systems for Computer Environments”. A set of open standards for an operating system environment being developed under the aegis of the IEEE.

preprocessor The macro generator preceding the C compiler.

process A unit of activity known to the AIX system, usually a program.

process 0 (zero) The scheduler. Started by the “boot” and permanent. See **init**.

process id A unique number (at any given time) identifying a process to the system.

process status The process's current activity.

- Non existent
- Sleeping
- Waiting
- Running
- Intermediate
- Terminated
- Stopped.

profile A file in the users home directory which is executed at login to customize the environment. The name is **.profile**.

prompt A displayed request for information or operator action.

protection The opposite of permission, denying access to a file.

Q

quotation Temporarily cancelling the meaning of a metacharacter to be used as a ordinary text character. A backslash (\) “quotes” the next character only.

R

raw I/O I/O conducted at a “physical” level.

read permission Allows reading (not execution or writing) of a file.

recursive A recursive program calls itself or is called by a subroutine which it calls.

redirection The use of other than standard input (keyboard or pipe output) or standard output (terminal display or pipe). Usually a file.

regular expression An expression which specifies a set of character strings using metacharacters.

relative path name The name of a directory or file expressed as a sequence of directories followed by a file name, beginning from the current directory.

RISC Reduced Instruction Set Computer. A class of computer architectures, pioneered by IBM's John Cocke, that improves price#performance by minimizing the number and complexity of the operations required in the instruction set of a computer. In this class of architecture, advanced compiler technology is used to provide operations, such as multiplication, that are infrequently used in practice.

root directory The directory that contains all other directories in the file system.

S

scalability Desirable feature of computer systems and applications. Refers to the capability to use the same environment on many classes of computers, from personal computers to supercomputers, to accommodate growth or divergent environments, without rewriting code or losing functionality.

SCCS Source Code Control System. A set of programs for maintaining multiple versions of a file using only edit commands to specify alternate versions.

scope The field of an operation or definition. Global scope means all objects in a set. Local scope means a restriction to a subset of the objects.

screen See **display screen**.

scroll To move information vertically or horizontally to bring into view information that is outside the display screen or pane boundaries.

search and replace The act of finding a match to a given character string and replacing each occurrence with some other string.

search string The pattern used for matching in a search operation.

sed Non-interactive stream editor used to do “batch” editing. Often used as a tool within shell scripts.

server A provider of a service in a computer network; for example, a mainframe computer with large storage capacity may play the role of database server for interactive terminals. See **client**.

setuid A permission which allows the access rights of a program owner to control the access to a file. The program can act as a filter for user data requests.

shell The outermost (user interface) layer of UNIX operating systems. Shell commands start and control other processes, such as editors and compilers; shells can be textual or visual. A series of system commands can be collected together into a “shell script” that executes like a batch (.BAT) file in DOS.

shell program A program consisting of a sequence of shell commands stored in an ordinary text file which has execution permission. It is invoked by simply naming the file as a shell command.

shell script See **shell program**.

single user (mode) A temporary mode used during “booting” of the AIX system.

signal A software generated interrupt to another process. See kill.

sockets Destination points for communication in many versions of the UNIX operating system, much as electrical sockets are destination points for electrical plugs. Sockets, associated primarily with 4.3 BSD, can be customized to facilitate communication between separate processes or between UNIX operating systems.

software Programs.

special character See **metacharacter**.

special file A technique used to access I/O devices in which “pseudo files” are used as the interface for commands and data.

standard error The standard device at which errors are reported, normally the terminal. Error messages may be directed to a file.

standard input The source of data for a filter, which is by default obtained from the terminal, but which may be obtained from a file or the standard output of another filter through a pipe.

standard output The output of a filter which normally is by default directed to the terminal, but which may be sent to a file or the standard input of another filter through a pipe.

stdio A “Standard I/O” package of C routines.

sticky bit A flag which keeps commonly used programs “stick” to the swapping disk for performance.

stopped job A job that has been halted temporarily by the user and which can be resumed at his command.

storage In contrast to memory, the saving of information on physical devices such as fixed disk or tape. See **memory**.

store To place information in memory or onto a diskette, fixed disk, or tape so that it is available for retrieval and updating.

streams Similar to sockets, streams are destination points for communications in UNIX operating systems. Associated primarily with UNIX System V, streams are considered by some to be more elegant than sockets, particularly for interprocess communication.

string A linear collection of characters treated as a unit.

subdirectory A directory which is subordinate to another directory.

subtree That portion of an AIX file system accessible from a given directory below the root.

suffix A character string attached to a file name that helps identify its file type.

superblock Primary information repository of a file system (location of i-nodes, free list, and so forth).

superuser The system administration; a user with unique privileges such as upgrading execution priority and write access to all files and directories.

superuser authority The unrestricted ability to access and modify any part of the Operating System. This authority is associated with the user who manages the system.

SVID System V Interface Definition. An AT&T document defining the standard interfaces to be used by UNIX System V application programmers and users.

swap space (disk) That space on an I/O device used to store processes which have been swapping out to make room for other processes.

swapping The process of moving processes between main storage and the “swapping device”, usually a disk.

symbolic debugger Program for debugging other programs at the source code level. Common symbolic debuggers include sdb, dbx, and xdbx.

sync A command which copies all modified blocks from RAM to the disk.

system The computer and its associated devices and programs.

system unit The part of the system that contains the processing unit, the disk drive and the disk, and the diskette drive.

System V AT&T's recent releases of its UNIX operating system are numbered as releases of “UNIX System V”.

T

TCP Transmission Control Protocol. A facility for the creation of reliable bytestreams (byte-by-byte, end#to#end transmission) on top of unreliable datagrams. The transmission layer of TCP/IP is used to interconnect applications, such as FTP, so that issues of re-transmission and blocking can be subordinated in a standard way. See **TCP/IP**.

TCP/IP Transmission Control Protocol/Internet Protocol. Pair of communications protocol considered defacto standard in UNIX operating system environments. IBM TCP/IP for VM and IBM TCP/IP for MVS are licensed programs that provide VM and MVS users with the capability of participating in networks using the TCP/IP protocol suite.

termcap A file containing the description of several hundred terminals. For use in determining communication protocol and available function.

termlib A set of C programs for using **termcap**.

tools Compact, well designed programs to perform specific tasks. More complex processes are performed by sequences of tools, often in the form of pipelines which avoid the need for temporary files.

two-digit display Two seven-segment light-emitting diodes (LEDs) on the operating panel used to track the progress of power-on self-tests (POSTs).

U

UNIX Operating System A multi-user, multi-tasking interactive operating system created at AT&T Bell Laboratories that has been widely used and developed by universities, and that now is becoming increasingly popular in a wide range of commercial applications. See Kernel, Shell, Library, Pipes, Filters.

user interface The component of the AIX Family Definition that describes common user interface functions for the AIX PS/2, AIX/RT, and AIX/370 operating systems.

/**usr**/**grpR** One of the oldest, and still active, user groups for the UNIX operating systems. IBM is a member of /usr/grp.

uucp A set of AIX utilities allowing

- Autodial of remote systems
- Transfer of files
- Execution of commands on the remote system
- Reasonable security.

V

vi Visual editor. A character editor with a very powerful collection of editing commands optimized for ASCII terminals; associated with BSD versions of the UNIX operating system.

visual editor An optional editor provided with AIX in which changes are made by modifying an image of the file on the screen, rather than through the exclusive use of commands.

W

wild card A metacharacter used to specify a set of replacement characters and thus a set of file names. For example "*" is any zero or more characters and "?" is any one character.

window A rectangular area of the screen in which the dialog between you and a given application is displayed.

working directory The directory from which file searches are begun if a complete pathname is not specified. Controlled by the cd (change directory) command.

workstation A device that includes a keyboard from which an operator can send information to the system, and a display screen on which an operator can see the information sent to or received from the computer.

write Sending data to an I/O device.

write permission Permission to modify a file or directory.

X

X/OpenT An international consortium, including many suppliers of computer systems, concerned with the selection and adoption of open system standards for computing applications. IBM is a corporate sponsor of X/Open. See **Common Application Environment**.

X Windows IBM's implementation of the X Window System developed at the Massachusetts Institute of Technology with the support of IBM and DECT, that gives users “windows” into applications and processes not located only or specifically on their own console or computer system. X-Windows is a powerful vehicle for distributing applications among users on heterogeneous networks.

Y

yacc “Yet Another Compiler# Compiler”. For producing new command interfaces.

Z

zeroeth argument The command name; the argument before the first.