

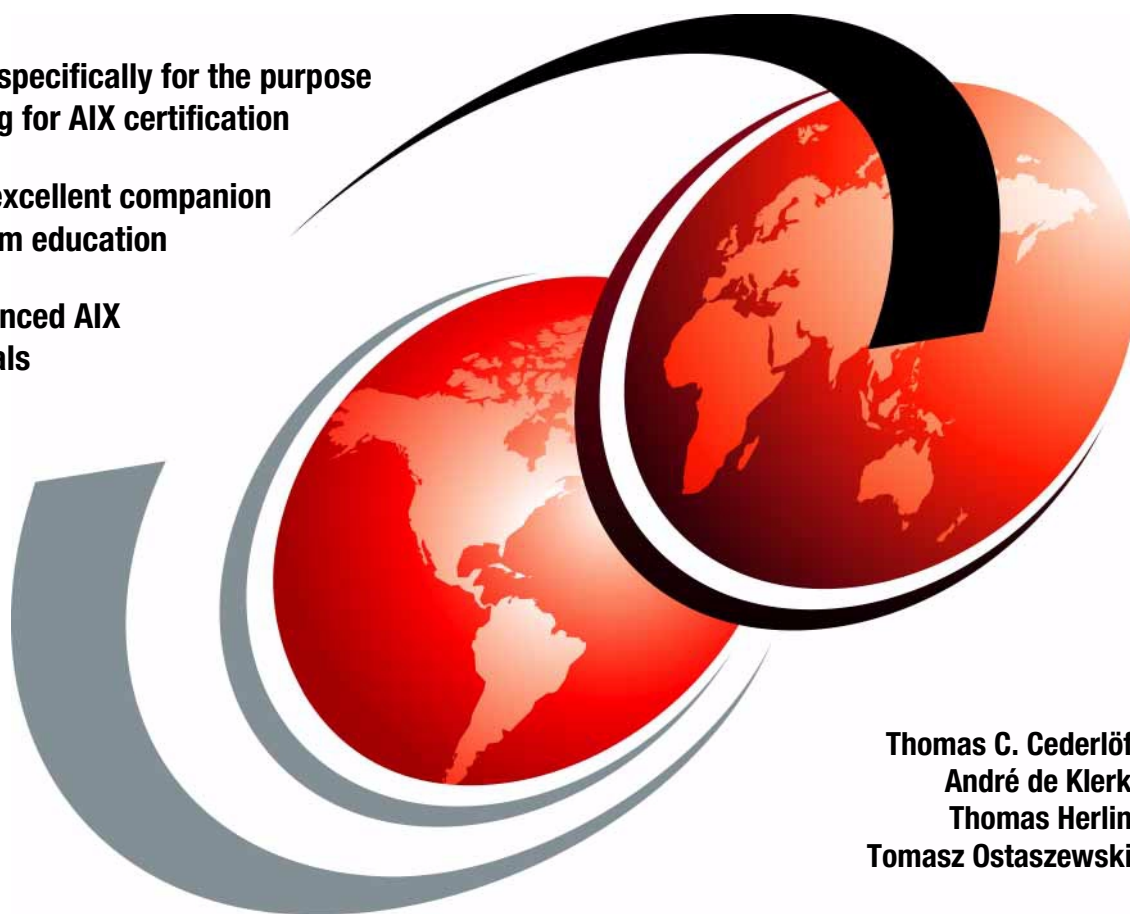


IBM Certification Study Guide AIX Installation and System Recovery

Developed specifically for the purpose
of preparing for AIX certification

Makes an excellent companion
to classroom education

For experienced AIX
professionals



Thomas C. Cederlöf
André de Klerk
Thomas Herlin
Tomasz Ostaszewski

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International Technical Support Organization

**IBM Certification Study Guide
AIX Installation and
System Recovery**

December 2000

Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix B, "Special notices" on page 193.

First Edition (December 2000)

This edition applies to AIX Version 4.3 (5765-C34) and subsequent releases running on an RS/6000 or pSeries server.

Comments may be addressed to:
IBM Corporation, International Technical Support Organization
Dept. JN9B Building 003 Internal Zip 2834
11400 Burnet Road
Austin, Texas 78758-3493

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Preface

The AIX and RS/6000 certifications offered through the Professional Certification Program from IBM are designed to validate the skills required of technical professionals who work in the powerful, and often complex, environments of AIX and RS/6000. A complete set of professional certifications are available. They include:

- IBM Certified AIX User
- IBM Certified Specialist - AIX System Administration
- IBM Certified Specialist - AIX System Support
- IBM Certified Specialist - AIX HACMP
- IBM Certified Specialist - Business Intelligence for RS/6000
- IBM Certified Specialist - Domino for RS/6000
- IBM Certified Specialist - RS/6000 Solution Sales
- IBM Certified Specialist - RS/6000 SP and PSSP V3
- IBM Certified Specialist - RS/6000 SP
- RS/6000 SP - Sales Qualification
- IBM Certified Specialist - Web Server for RS/6000
- IBM Certified Advanced Technical Expert - RS/6000 AIX

Each certification is developed by following a thorough and rigorous process to ensure the exam is applicable to the job role and is a meaningful and appropriate assessment of skill. Subject matter experts who successfully perform the job participate throughout the entire development process. They bring a wealth of experience into the development process, making the exams much more meaningful than the typical test that only captures classroom knowledge and ensuring the exams are relevant to the *real world*. Thanks to their effort, the test content is both useful and valid. The result of this certification is the value of appropriate measurements of the skills required to perform the job role.

This IBM Redbook is designed as a study guide for professionals wishing to prepare for the AIX Installation and System Recovery certification exam as a selected course of study in order to achieve the IBM Certified Advanced Technical Expert - RS/6000 AIX certification.

This IBM Redbook is designed to provide a combination of theory and practical experience needed for a general understanding of the subject matter. It also provides sample questions that will help in the evaluation of personal progress and provide familiarity with the types of questions that will be encountered in the exam.

This publication does not replace practical experience, nor is it designed to be a stand alone guide for any subject. Instead, it is an effective tool that, when combined with education activities and experience, can be a very useful preparation guide for the exam.

For additional information about certification and instructions on *How to Register* for an exam, call IBM at 1-800-426-8322 or visit the Web site at: <http://www.ibm.com/certify>

The team that wrote this redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization, Austin Center.

Thomas C. Cederlöf is an Education Specialist at IBM Learning Services in Sweden. After working various professions, he was hired as a System Support Specialist in April 1997 at the Nordic AIX Competence Center. After earning his Advanced Technical Expert Certification in 1998, he worked with level 2 support in Scandinavia and the Baltic States and also participated in the itrans program in 1999. Since January 2000, he has been the main instructor for the AIX curriculum in Sweden.

André de Klerk is a Senior IT Specialist at IBM Global Services in South Africa. He has been working for IBM since May 1996. He started his career as a field technician in 1991 and has performed various support roles, including application support and customer consulting. Currently, he is team leader for the Midrange UNIX team at IGS SA.

Thomas Herlin is an Advisory IT Specialist at IBM Global Services in Denmark. He has been working for IBM since May 1998. Before joining IBM, he worked as a Software Engineer designing and developing programs on UNIX platforms. His areas of expertise include system architecture and system integration of AIX based solutions. He is also a certified SAP technical consultant.

Tomasz Ostaszewski is a computer network architect. He works for Prokom Software SA in Poland - IBM Business Partner. Prokom is the largest IT solution provider in Poland. They offer total solutions, which include application development or third party vendor support. He has three years of experience in RS/6000 and AIX. Currently, he is working on a network project for an insurance company.

The project that produced this publication was managed by:

Scott Vetter IBM Austin

Special thanks to:

Darin Hartman Program Manager, AIX Certification

Thanks to the following people for their invaluable contributions to this project:

Jesse Alcantar IBM Austin

Greg Althaus IBM Austin

Erwin Behnen IBM Austin

Karl Borman ILS Austin

Larry Brenner IBM Austin

Malin Cederberg ILS Sweden

Greg Flaig IBM Austin

Adnan Ikram IBM Pakistan

MATSUBARA, Keigo IBM Japan

Yun-Wai Kong IBM Australia

Peter Mayes IBM U.K.

Shawn Mullen IBM Austin

Brian Nicholls IBM Austin

Robert Olsson ILS Sweden

Michelle Page-Rivera IBM Atlanta

Christopher Snell IBM Raleigh

Lindsey Thomson IBM Austin

Ronald Van der Knaap IBM Netherlands

Darrin Woodard IBM Toronto

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- Send your comments in an Internet note to redbook@us.ibm.com

Chapter 1. Certification overview

This chapter provides an overview of the skill requirements needed to obtain an IBM AIX Specialist certification. The following chapters are designed to provide a comprehensive review of specific topics that are essential for obtaining the certification.

1.1 IBM Certified Advanced Technical Expert - RS/6000 AIX

This level certifies an advanced level of AIX knowledge and understanding, both in breadth and depth. It verifies the ability to perform in-depth analysis, apply complex AIX concepts, and provide resolution to critical problems, all in a variety of areas within RS/6000 AIX.

To attain the IBM Certified Advanced Technical Expert - RS/6000 AIX certification, you must pass four tests.

One test is the prerequisite in either AIX System Administration or AIX System Support. The other three tests are selected from a variety of AIX and RS/6000 topics. These requirements are explained in greater detail in the sections that follow.

1.1.1 Required prerequisite

Prior to attaining the IBM Certified Advanced Technical Expert - RS/6000 AIX certification, you must be certified as either an:

- IBM Certified Specialist - AIX System Administration
- or
- IBM Certified Specialist - AIX System Support

1.1.2 Recommended prerequisite

A minimum of six to twelve months experience in performing in-depth analysis and applying complex AIX concepts in a variety of areas within RS/6000 AIX is a recommended prerequisite.

1.1.3 Registration for the certification exam

For information about *How to Register* for the certification exam, visit the following Web site:

<http://www.ibm.com/certify>

1.1.4 Core requirement (select three of the following tests)

You will receive a Certificate of Proficiency for tests when passed.

1.1.4.1 AIX Installation and System Recovery

The following objectives were used as a basis when the certification test 183 was developed. Some of these topics have been regrouped to provide better organization when discussed in this publication.

Preparation for this exam is the topic of this publication.

Section 1 - Installation and software maintenance

- Install or migrate the operating system
- Install a licensed program product
- Remove an LPP from the system
- Update a system
- Apply a selective fix
- Identify and resolve network install problems

Section 2 - System backup and restore

- Perform a complete backup of the system
- Implement backup using relative and absolute path
- Create a mksysb
- Understand advanced mksysb concepts
- Restore files

Section 3 - System initialization (boot) failures

- Understand concepts of system initialization
- Diagnose the cause of a system initialization failure
- Resolve a system initialization failure

Section 4 - File systems and LVM recovery

- Perform problem determination on a file system
- Determine a suitable procedure for replacing a disk
- Resolve problems caused by incorrect actions taken to change a disk drive
- Create a new volume group
- Create a logical volume

- Understand LVM concepts
- Resolve a complex LVM problem

1.1.4.2 AIX Performance and System Tuning

The following objectives were used as a basis when the certification test 184 was developed.

Preparation for this exam is the topic of *IBM Certification Study Guide - AIX Performance and System Tuning*, SG24-6184.

Section 1 - Performance tools and techniques

- Use the `iostat` command
- Use the `filemon` command
- Use the `tprof` command
- Use the `netpmn` command
- Interpret `iostat` output
- Interpret `lspv` output
- Interpret `netstat` output
- Interpret `vmstat` output
- Know about `perfpmr`
- Know about performance diagnostic tool
- Look at run queue
- Look at system calls

Section 2 - Correcting performance problems

- Correct disk bottlenecks
- Correct NFS bottlenecks
- Correct network bottlenecks
- Correct communications adapter bottlenecks
- Understand random write-behind concepts
- Understand async I/O performance concepts
- Understand VMM I/O pacing
- Understand file fragmentation
- Understand logical volume fragmentation

Section 3 - VMM

- Identify and correct VMM performance problems
- Correct paging problems
- Know about tuning file memory usage
- Know about memory load control
- Understand page space allocation issues

Section 4 - Multiprocessor and process scheduling

- Know SMP commands
- Use the `bindprocessor` command
- Enable, disable, and show status of processors
- List CPU utilization per processor
- Know about `ps` command and threads
- Understand locking issues in SMP
- Know about process scheduling
- Understand priority calculations
- Understand the effect of `schedtune` on priorities

Section 5 - Tuning and customization

- Tune a system for optimum performance
- Use the `no` command
- Customize a LV for optimum performance
- Configure system parameters
- Tune network parameters
- Determine when application tuning is needed
- Understand real-time tuning
- Understand disk striping
- Tune I/O performance with `vm tune`
- Understand RAID performance issues
- Perform capacity planning
- Understand memory usage

1.1.4.3 AIX Problem Determination Tools and Techniques

The following objectives were used as a basis when the certification test 185 was developed.

Preparation for this exam is the topic of *IBM Certification Study Guide - AIX Problem Determination Tools and Techniques*, SG24-6185.

Section 1 - System dumps

- Create a system dump
- Understand valid system dump devices
- Determine the location of system dump data
- Identify the status of a system dump by the LED codes
- Identify appropriate action to take after a system dump
- Determine if a system dump is successful
- Use the `snap` command

Section 2 - Crash

- Understand the use and purpose of the `crash` command
- Verify the state of a system dump
- Show the stack trace using `crash`
- Use the `stat` subcommand in `crash`
- Manipulate data in the process table
- Interpret crash stack trace output
- Interpret crash process output
- Interpret crash TTY output

Section 3 - Trace

- Start and stop trace
- Run trace
- Report trace information
- Interpret trace output
- Use trace to debug process problems

Section 4 - File system and performance PD tools

- Use tools to identify and correct corrupted file systems
- Understand file system characteristics

- Resolve file system mounting problems
- Repair corrupted file systems
- Use `vmstat` command
- Use `iostat` command
- Use `filemon` command

Section 5 - Network problem determination

- Use PD tools to identify network problems
- Resolve a network performance problem
- Correct problem with host name resolution
- Diagnose the cause of a problem with NFS mounts
- Diagnose the cause of a routing problem
- Resolve a router problem

Section 6 - Error logs and diagnostics

- Use error logging
- Interpret error reports
- Invoke and use diagnostic programs

Section 7 - Other problem determination tools

- Set breakpoints using `dbx`
- Step through a program using `dbx`
- Run a program with arguments using `dbx`
- Read core files and locate traceback
- Debug problem using core files
- Read shell scripts
- Debug shell script problems

1.1.4.4 AIX Communications

The following objectives were used as a basis when the certification test 186 was developed.

Preparation for this exam is the topic of *IBM Certification Study Guide - AIX Communications*, SG24-6186.

Section 1 - TCP/IP implementation

- Know TCP/IP concepts

- Understand TCP/IP broadcast packets
- Use and implement name resolution
- Understand TCP/IP protocols
- Know IP address classes
- Use interfaces available in LAN communications
- Understand the relationship between an IP address and the network interface
- Log into remote hosts using telnet and rlogin
- Construct /etc/hosts.equiv and ~/.rhosts for trusted users
- Transfer files between systems using ftp or tftp
- Run commands on remote machines

Section 2 - TCP/IP: DNS implementation

- Set up a primary name server
- Set up a secondary name server
- Set up a client in a domain network

Section 3 - Routing: implementation

- Apply knowledge of the IP routing algorithm
- Setup and use the routing table and routes
- Implement and use subnet masking

Section 4 - NFS: implementation

- Manipulate local and remote mounts using the automounter
- Understand NFS daemons and their roles
- Configure and tune an NFS server
- Configure and tune an NFS client
- Setup a file system for mounting
- Understand the /etc/exports file
- Invoke a predefined mount.

Section 5 - NIS: implementation

- Understand the various NIS daemons
- Implement NIS escapes
- Create NIS map files

- Transfer NIS maps

Section 6 - Network problem determination

- Diagnose and resolve TCP/IP problems
- Diagnose and resolve NFS problems
- Diagnose and resolve NIS problems

Section 7 - Hardware related PD (modems)

- Determine appropriate diagnostic approach to resolve a modem connection problem
- Resolve communication configuration problems

1.1.4.5 HACMP for AIX V4.2

The following objectives were used as a basis when the certification test 167 was developed.

Preparation for this exam is the topic of *IBM Certification Study Guide - AIX HACMP*, SG24-5131.

Section 1 - Pre-installation

- Conduct a planning session
 - Set customer expectations at the beginning of the planning session
 - Gather customer's availability requirements
 - Articulate tradeoffs of different HA configurations
 - Assist customer in identifying HA applications
- Evaluate customer environment and tailorable components
 - Evaluate configuration and identify Single Points of Failure (SPOF)
 - Define and analyze NFS requirements
 - Identify components affecting HACMP
 - Identify HACMP event logic customizations
- Plan for installation
 - Develop disk management modification plan
 - Understand issues regarding single adapter solutions
 - Produce a test plan

Section 2 - HACMP implementation

- Configure HACMP solutions

- Install HACMP code
- Configure IP Address Takeover (IPAT)
- Configure non IP heartbeat paths
- Configure network adapter
- Customize and tailor AIX
- Set up shared disk (SSA)
- Set up shared disk (SCSI)
- Verify a cluster configuration
- Create an application server
- Set up event notification
 - Set up event notification and pre/post event scripts
 - Set up error notification
- Post configuration activities
 - Configure client notification and ARP update
 - Implement test plan
 - Create a snapshot
 - Create a customization document
- Testing and Troubleshooting
 - Troubleshoot failed IPAT failover
 - Troubleshoot failed shared volume groups
 - Troubleshoot failed network configuration
 - Troubleshoot failed shared disk tests
 - Troubleshoot failed application
 - Troubleshoot failed pre/post event scripts
 - Troubleshoot failed error notifications
 - Troubleshoot errors reported by cluster verification

Section 3 - System management

- Communicate with customer
 - Conduct turnover session
 - Provide hands-on customer education
 - Set customer expectations of their HACMP solution's capabilities

- Perform systems maintenance
 - Perform HACMP maintenance tasks (PTFs, adding products, replacing disks, adapters)
 - Perform AIX maintenance tasks
 - Dynamically update cluster configuration
 - Perform testing and troubleshooting as a result of changes

1.1.4.6 RS/6000 SP and PSSP V2.4

The following objectives were used as a basis when the certification test 178 was developed.

Preparation for this exam is the topic of *IBM Certification Study Guide - RS/6000 SP*, SG24-5348.

Section 1 - Implementation and planning

- Validate software/hardware capability and configuration
 - Determine required software levels (for example, version, release, and modification level)
 - Determine the size, model, and location of the control workstation
 - Define disk, memory, and I/O including disk placement
 - Determine disk space requirements
 - Understand multi-frame requirements and switch partitioning
 - Determine the number and type of nodes needed (including features)
 - Determine the number of types of I/O devices (for example, SCSI, RAID, SSA, and so on) needed
 - Configure external I/O connections
 - Determine additional network connections required
 - Create the logical plan for connecting into networks outside the SP
 - Identify the purpose and bandwidth of connections
- Plan implementation of key aspects of TCP/IP networking in the SP environment
 - Create specific host names (both fully qualified and aliases) and TCP/IP address, netmask value, and default routes
 - Determine the mechanism (for example, /etc/hosts, NIS, DNS) by which name resolution will be made across the system
 - Choose the IP name/address resolver

- Determine the appropriate common, distributed, and local files/file systems
 - Determine the physical locations of the file system and home directories
 - Determine the number of types of I/O devices (for example, SCSI, RAID, SSA, on so on) needed
 - Configure internal I/O
 - Determine the mechanism (for example, NFS, AFS, DFS, local) by which file systems will be made across the system
- Configure and administer the Kerberos Authentication subsystem and manage user IDs on the SP system
 - Define administrative functions
 - Determine the Kerberos administration ID
 - Define administrative functions
 - Understand the options of end-user management
 - Understand how to administer authenticated users and instances
- Define a backup/recovery strategy for the SP which supports node images, control workstation images, applications, and data
 - Determine backup strategy and understand the implications of multiple unique mksysb images

Section 2 - Installation and configuration

- Configure an RS/6000 as an SP control workstation
 - Verify the control workstation system configuration
 - Configure TCP/IP network on the control workstation
 - Install PSSP
 - Load the SDR with SP configuration information
 - Configure the SP System Data Repository
 - Verify control workstation software
 - Configure TCP/IP name resolution (for example, /etc/hosts, DNS, NIS)
- Perform network installation of images on nodes, using any combination of boot/install servers
 - Install the images on the nodes
 - Create boot/install servers

- Exercise the SP system resources to verify the correct operation of all required subsystems
 - Verify all network connections
 - Verify internal and external I/O connections
 - Verify switch operations

Section 3 - Application enablement

- Determine whether LoadLeveler would be beneficial to a given SP system configuration
 - Understand the function of LoadLeveler.
- Define and implement application specific FS, VG, and VSDs for a parallel application
 - Define application-specific file systems, logical volumes, volume groups, or VSDs
 - Implement application-specific file systems, logical volumes, volume groups, or VSDs
- Install and configure problem management tools (for example, event manager, problem manager, perspectives)
 - Install and configure user-management tools

Section 4 - Support

- Utilize Problem Determination methodologies (for example, HOSTRESPONDS, SWITCHRESPONDS, error report, log files, DAEMONS, GUIs)
 - Handle resolution of critical problems
 - Conduct SP-specific problem diagnosis
 - Interpret error logs that are unique to SP
- Isolate cause of degraded SP performance, and tune the system accordingly
 - Understand performance analysis and tuning requirements

1.1.4.7 RS/6000 SP and PSSP V3

The following objectives were used as a basis when the certification test 188 was developed.

Preparation for this exam is the topic of *IBM Certification Study Guide - RS/6000 SP*, SG24-5348.

Section 1 - Implementation planning

- Validate software/hardware capability and configuration
 - Determine required software levels (for example, version, release, and modification level)
 - Determine the size, model, and location of the control workstation
 - Define disk, memory, and I/O including disk replacement
 - Define disk space requirements
 - Understand multi-frame requirements and switch partitioning
 - Determine the number and types of nodes needed (including features)
 - Determine the number and types of I/O devices (for example, SCSI, RAID, SSA, and so on) needed.
 - Configure external I/O connections
 - Determine additional network connections required
 - Create the logical plan for connecting into networks outside the SP
 - Identify the purpose and bandwidth of connections
 - Determine if boot/install servers are needed and, if needed, where they are located
- Implement key aspects of TCP/IP networking in the SP environment
 - Create specific host names (both fully qualified and aliases), TCP/IP address, netmask value, and default routes
 - Determine the mechanism (for example, /etc/hosts, NIS, DNS) by which name resolution will be made across the system
 - Determine SP Ethernet topology (segmentation, routing)
 - Determine TCP/IP addressing for switch network
- Determine the appropriate common, distributed, or local files and file systems
 - Determine the physical locations of the file system and home directories
 - Determine the mechanism (for example, NFS, AFS, DFS, local) by which file systems will be made across the system
- Define a backup/recovery strategy for the SP which supports node image(s), control workstation images, applications, and data
 - Determine backup strategy including node and CWS images
 - Determine backup strategy and tools for application data

Section 2 - Installation and configuration

- Configure an RS/6000 as an SP control workstation
 - Verify the control workstation system configuration
 - Configure TCP/IP network on the control workstation
 - Install PSSP
 - Configure the SDR with SP configuration information
 - Verify control workstation software
- Perform network installation of images on nodes, using any combination of boot/install servers
 - Install the images on the nodes
 - Define and configure boot/install servers
 - Check SDR information
 - Check RSCT daemons (hats, hags, haem)
- Thoroughly exercise the SP system resources to verify correct information of all required subsystems
 - Verify all network connections
 - Verify switch operations
- Configure and administer the Kerberos Authentication subsystem and manage user IDs
 - Plan and configure Kerberos functions and procedures
 - Configure the Kerberos administration ID
 - Understand and use the options of end-user management
- Define and configure system partition and perform switch installation

Section 3 - Application enablement

- Determine whether additional SP-related products (for example, Loadleveler, PTPE, HACWS, NetTAPE, CLIOS) would be beneficial
- Understand the function of additional SP-related products
- Define and implement application-specific file systems, logical volumes, VGs and VSDs
- Install and configure problem management tools (for example, event manager, problem manager, perspectives)
 - Define and manage monitors

Section 4 - Ongoing support

- Perform software maintenance
 - Perform system software recovery
 - Upgrade and migrate system software (applying PTFs, migration)
- Perform SP reconfiguration
 - Add frames
 - Add nodes
 - Migrate nodes
 - Add/replace switch
- Utilize Problem Determination methodologies (for example, HOSTRESPONDS, SWITCHRESPONDS, error report, log files, DAEMONS, GUIs)
 - Interpret error logs that are unique to the SP
 - Diagnose networking problems
 - Diagnose host response problems
 - Diagnose switch-specific problems
- Isolate cause of degraded SP performance and tune the system accordingly
 - Understand performance analysis and tuning requirements

1.2 Certification education courses

Courses are offered to help you prepare for the certification tests. Figure 1 and Figure 2 on page 17 provide a roadmap of useful courses. These courses are recommended, but not required, before taking a certification test. At the publication of this guide, the following courses are available. For a current list, visit the following Web site <http://www.ibm.com/certify>

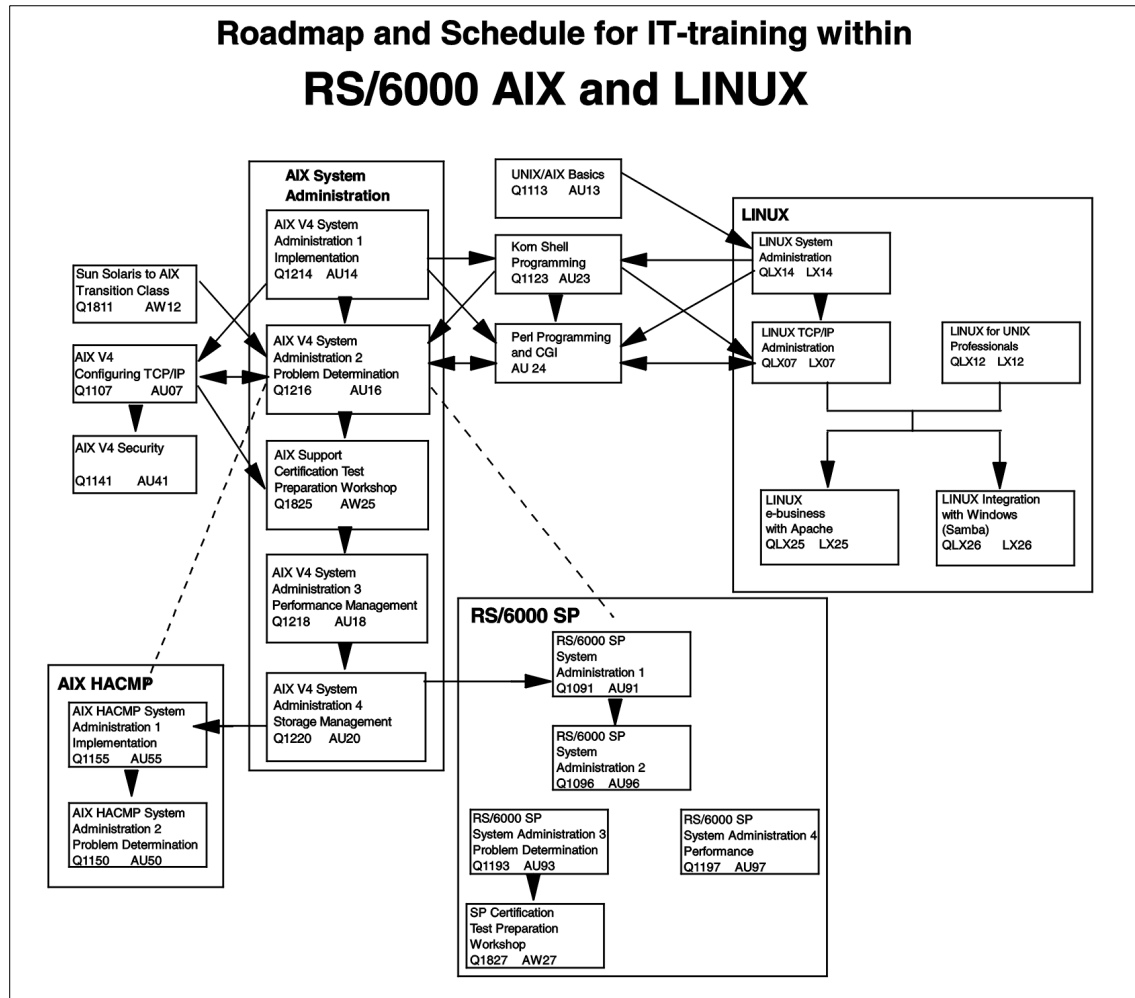


Figure 1. AIX and UNIX education roadmap

Certification Roadmaps for RS/6000 - AIX and UNIX

Courses/Cert Test* ...that prepare for...	Certification tests* ...which lead to...	Professional Title
AU13 Q1113	160	IBM Certified AIX User
AU07+AU14 Q1107+Q1214	181	IBM Certified Specialist - AIX System Administration
AU07+AU14+AU16 Q1107+Q1214+Q1216	189	IBM Certified Specialist - AIX System Support
Cert 181 or 189+AU55+AU50 Q1155+Q1150	167	IBM Certified Specialist - AIX HACMP
Cert 181 or 189+AU91+AU96 Q1091+Q1096	188	IBM Certified Specialist - RS/6000 SP and PSSP V3
Cert 181 or 189+AU91+AU96 Q1091+Q1096	178+188	IBM Certified Specialist - RS/6000 SP
Cert 181 or 189 + three of the following certification tests: 163, 164, 165, 166, 178, 188		IBM Certified Advanced Technical Expert - RS/6000 AIX
AU14+AU16+AU08 Q1214+Q1216+Q1108	163	
AU28/AU18 Q1216/Q1218	164	
AU16+AU18 Q1216+Q1218 AU23+AU05/AU07 Q1123+Q1107	165	
AU05/AU07+AU28/AU18 Q1107+Q1218	166	
LX12 or LX14+LX07 QLX14+QLX07	117-1A	
LX16+ (not fixed yet) QLX16	117-102	LPI Certification, level 2

Figure 2. Certification roadmaps

1.3 Education on CD: IBM AIX Essentials

The new IBM AIX Essentials series offers a dynamic training experience for those who need convenient and cost-effective AIX education. The series consists of five new, content rich, computer-based multimedia training courses based on highly acclaimed, instructor-led AIX classes that have been successfully taught by IBM Education and Training for years.

To order, and for more information and answers to your questions, refer to the following:

- In the U.S., call 800-IBM-TEACH (426-8322) or use the online form at the following URL: <http://www.ibm.com/services/learning/aix/#order>
- Outside the U.S., contact your IBM Sales Representative or
- Contact an IBM Business Partner

Chapter 2. System installation and installation options

This chapter covers the following topics:

- An overview of the AIX installation methods
- Installation of additional hardware
- Highlight the typical post installation problems
- Installation of online documentation

System installation is an important part of system administration of new RS/6000 systems as well as older systems, which need to be upgraded.

2.1 Installations methods

AIX provides three types of installation methods:

- New and Complete Overwrite Install

Use this installation method on a new machine or if you want to completely overwrite an existing version of the base operating system (BOS) that is installed on your system.

- Migration Install

Use this installation method to upgrade AIX between versions and releases while preserving the existing root volume group.

- Preservation Install

Use this installation method when a version of BOS is installed on your system and you want to preserve the user data in the root volume group.

The following sections describe the installation methods in more detail.

2.1.1 Installation startup

Note

Before you start installing AIX Version 4.3, make sure that your system has enough disk space. Check the *AIX Version 4.3 Installation Guide*, SC23-4112, for the space requirements. If not enough disk space is available, then the installation will fail.

To start the installation of AIX, your system needs to first start up on the CD-ROM or tape. In order to force a boot from these media, you have to

perform the following sequence. If you have an older RS/6000 system (non-PCI) with a system key present, turn the key to the **Service** position:

1. Insert the media CD-ROM or tape into the corresponding devices.
2. Power the system on.
3. When the keyboard indicator is shown on the screen (the word `keyboard` on an ASCII terminal or the keyboard icon on a graphical display), press **F5** on the directly attached keyboard or **5** on the ASCII terminal. This will temporarily alter the bootlist. You can ignore this step if you have an older system (non-PCI) with a system key.
4. At this stage, the system boots up using the media (CD-ROM or tape). If the system does not boot up but enters SMS (Figure 18 on page 69), there is a problem with the media. Check if it is correctly inserted or undamaged. Reinsert media or replace media and restart at step 1.
5. Select the system console by pressing **F1** and **Enter** on the attached keyboard or **1** and **Enter** on the ASCII terminal.
6. Select installation language. The default is English.
7. On the Welcome to Base Operating System Installation and Maintenance screen press **2** to select **Change/Show Installation Settings and Install** to change the installation method. A screen similar to the one shown in Figure 3 will present the different installation options.

```

                                Installation and Settings

Either type 0 and press Enter to install with current settings, or type the
number of the setting you want to change and press Enter.

  1 System Settings:
    Method of Installation.....New and Complete Overwrite
    Disk Where You Want to Install....hdisk0

  2 Primary Language Environment Settings (AFTER Install):
    Cultural Convention.....English (United States)
    Language .....English (United States)
    Keyboard .....English (United States)
    Keyboard Type.....Default

  3 Install Trusted Computing Base..... No

>>> 0 Install AIX with the current settings listed above.

      88 Help ?           | -----
      99 Previous Menu  | WARNING: Base Operating System Installation will
                        | destroy or impair recovery of ALL data on the
                        | destination disk hdisk0.
>>> Choice [0]:
```

Figure 3. Installations and Settings screen

8. At this point, you can select the method of your installation, the disk for rootvg, set up language environments, and the installation of Trusted Computing Base (TCB).

Depending on the current system, the default installation method varies. In the following sections, the different installation methods are individually described.

The primary language environment can be set up for: Cultural Convention, Language, and Keyboard, by choosing a language that fits the actual requirements. Different set of languages are supported (see *AIX Version 4.3 Installation Guide*, SC23-4112, for additional information).

TCB provides an additional level of security by installing trusted path, the trusted shell, and system integrity checking. Note that you cannot enable the TCB at a later time; it must be at the installation time. Further information on TCB can be found in the *AIX Version 4.3 Installation Guide*, SC23-4112.

9. Select **0** once you are satisfied with the settings, and the installation will start.
10. On older non-PCI models with a system key, you must, at this point, switch the key back to **Normal** position.

2.1.2 New and Complete Overwrite Installation

The New and Complete Overwrite Installation method installs the BOS by overwriting all data on the selected destination disk.

In following scenarios, a New and Complete Overwrite Installation should be used:

- A new machine without AIX installed.
- An existing system must be reinstalled with the BOS because:
 - rootvg has become corrupted, and a backup does not exist.
 - rootvg is spread over several hard disks, and you want to reassign it to fewer hard disks to make your rootvg smaller.
- The pre-installed system is not TCB enabled. If you need the features provided by TCB, you must re-install the system using this method.

After the installation is complete, the system will reboot and start the Installation Assistant for post installation tasks. See the Section 2.2, “Configuration Assistant Taskguide” on page 25.

2.1.3 Migration Installation

The Migration Installation method is used to upgrade AIX to a different version or release while preserving the existing root volume group. This is the default setting for a machine installed with AIX Version 4.1 or AIX Version 4.2.

Migration Installation preserves all logical volumes and file systems on rootvg except /tmp. Other volume groups are not effected.

During a Migration Installation, the installation process determines which optional software products must be installed on AIX Version 4.3. Components from AIX Version 3.2, AIX Version 4.1, or AIX Version 4.2 software that exists on the system and has been replaced by new AIX Version 4.3 level software are installed at the AIX Version 4.3 level.

Previously installed software products remain on the system.

When migrating from AIX Version 3.2, all files in /usr/lib/drivers, /usr/lib/microcode, /usr/lib/methods, and /dev are removed from the system; so software support for non-IBM device drivers must be reinstalled. Furthermore, a set of software products are removed. See complete list in *AIX Version 4.3 Installation Guide*, SC23-4112.

Note

Before performing any Migration Installation, make sure that you have a complete backup of your system as well as your data.

2.1.3.1 Steps when performing a Migration Installation

At the beginning of a Migration Installation, the system verifies that there will be enough space to attempt the migration. If there is not, a message is printed explaining how much extra space is needed.

At this point, you must reboot the machine from the disk AIX Version 3.2, 4.1, or 4.2 installed, and make some space available in the rootvg volume group to do the migration. This can be done by either adding another disk to the rootvg or moving user data from rootvg to another volume group. Consult the *AIX Version 4.3 Installation Guide*, SC23-4112, for more information on this issue.

If the additional space could not be found to match the requirement, you might consider performing a Preservation Installation, (see Section 2.1.4, "Preservation Installation" on page 24).

When enough free space is found, reboot from your installation media and try the Migration Installation again. To complete the Migration Installation, you must have at least 8 MB of free disk space.

If there is insufficient space to complete the Migration Installation during the BOS installation process, a message similar to the following is displayed at the end of the installation:

```
An error occurred while migrating packages.  
Some packages have not been installed.  
Please see /var/adm/ras/devinst.log for details or perform an overwrite or  
preservation install.
```

When you are migrating to AIX Version 4.2 or later, a confirmation screen will appear and enable you to do the following:

- List the software on your system that is incompatible with AIX Version 4.3 and that will be installed at the new level.
- List the saved base system configuration files that will not be merged into the system. These files are saved in /tmp/bos.
- List the filesets that will be removed and not replaced.
- Reboot the system without completing the migration. This selection cancels the installation.
- Continue with the installation.

If you, at this point, press **0** and **Enter**, the Migration Installation will begin.

If you are migrating AIX Version 3.2 programs, a BOS Migration Installation only migrates those optional software products that can run on AIX Version 4.3. If you are migrating AIX Version 4.1 or AIX Version 4.2 programs, and there is a newer level of a previously installed fileset on the installation media, a BOS Migration Installation will try to install the newer level. Any previously installed products that can run on BOS Version 4.3 will not be altered during the Migration Installation.

After the Migration Installation is finished, check the migration by listing the filesets in your system and compare them with the previous. As an example, look for committed filesets of the previous version. If you were migrating from AIX Version 4.2 to AIX Version 4.3 use:

```
# ls1pp -l | grep 4.2
```

Any AIX filesets that are listed in the committed state should be removed. An exception to this might be third party software products.

You might also check previous configuration files saved by the Migration Installation with the new ones created and resolve the possible differences.

2.1.3.2 Missing Migration Installation option

If the Migration Installation option is not selectable as you would expect when migrating from one AIX version to another (for example 4.2 to 4.3), there is an incorrect pad string in the boot logical volume (BLV). This wrong system information can happen, for example, if a migration attempt was canceled or did not succeed.

A way to overcome this is to use the `blvset` command, which resets the pad string. Use the `-g` flag to get the pad string and the `-p` flag to put the pad string.

For 4.X systems, use `blvset` in the following way:

```
# /usr/lpp/bosinst/blvset -d /dev/hdisk0 -p level
```

The `blvset` program is expecting a version string from the standard input. Enter the version number, for example **4.2**, and press **Enter**.

This example illustrates a pad string reset from a broken 4.2 to 4.3 migration, where the rootvg is located on `hdisk0`.

After you have updated the pad strings, you can retry the Migration Installation.

2.1.3.3 When Migration Installation fails

There are times when your Migration Installation fails and you need to recover the system. You should have a system backup available and if you do, restore your system from it. If your system backup does not exist, or is corrupted, the best way recover is to perform a Preservation Installation. This will disrupt some information, such as network configuration, but it is much better than overwriting your entire system including user data.

2.1.4 Preservation Installation

The Preservation Installation method is chosen when a version of BOS is installed on a system where you want to preserve the user data in the root volume group. It is the default installation setting for a machine already installed with AIX Version 4.3.

Note

Preservation Installation overwrites the /usr, /tmp, /var, and / (root) file systems by default; so any user data in these directories is lost. These file systems are removed and re-created; so any other LPPs or filesets that you installed on the system will also be lost.

A preservation installation will only save all the *non-system* logical volumes and file systems on rootvg, for example, /home, or any user created logical volumes.

In order to preserve, data the Preservation Installation uses the /etc/preserve.list file to list the system files to be copied and saved during the installation. The /etc/filesystems file is listed by default. Add the full path names of any additional files that you want to save during the Preservation Installation to the preserve.list file. This file does not exist on systems prior to AIX Version 4.1; so, in this case, you must explicitly create it.

You can modify the preserve.list file and copy it to a diskette to be used during BOS installation. Information on how to create this diskette is found in the *AIX Version 4.3 Installation Guide*, SC23-4112. If a preserve.list file exists on diskette, the installation program uses this information instead of the default /etc/preserve.list file.

Ensure that you have sufficient disk space in the /tmp file system to store all the files listed in the /etc/preserve.list file.

A system configuration must be re-done after performing a Preservation Installation. Additionally, you must reinstall any applications that were installed in your rootvg after the preservation install has completed.

After a Preservation Installation, you must also reconfigure devices as well as re-create users and groups.

2.2 Configuration Assistant Taskguide

After the installation is completed, the system reboots, and the Configuration Assistant Taskguide program, /usr/sbin/install_assist, is automatically started. In previous versions of AIX, the Configuration Assistant Taskguide was referred to as the Installation Assistant.

The Configuration Assistant Taskguide program allows you to set up basic configuration, such as the following:

- Setting date, time, and timezone
- Setting the root password
- Adjusting system storage and paging space
- Configuring TCP/IP
- Updating installed software after Migration Installation
- Configuring Web-based System Management (websm)
- Configuring online documentation and search

On a Version 4.3.1 system with a graphical display attached, the Installation Assistant will be similar as the screen shown in Figure 4.

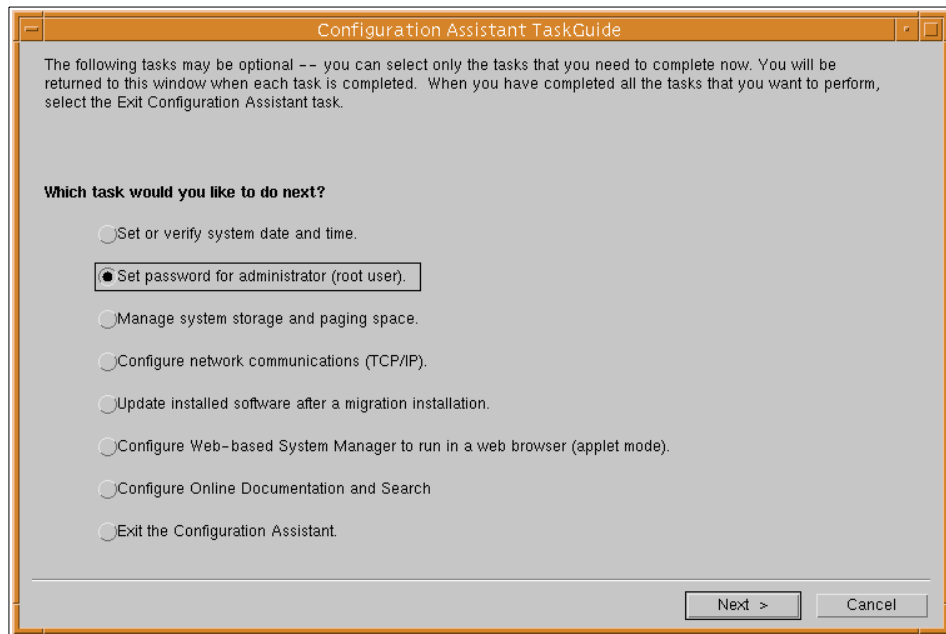


Figure 4. Configuration Assistant Taskguide

On a system installed from a ASCII terminal, a similar task list will appear, just alphanumeric.

After you completed these tasks using the Configuration Assistance Taskguide, then you should disable the automatic restart of the Configuration Assistance Taskguide. Otherwise it might appear on the system console invoked by the init process on every reboot. To disable the automatic restart, you can select from the following menu item.

- Exit the Configuration Assistant.
- Finish now, and do not start Configuration Assistant when restarting AIX.

2.3 Determining maintenance levels

The `oslevel` command reports the level of the operating system using a subset of all filesets installed on your system. The `oslevel` command also prints information about maintenance levels, including which filesets are not at a specified maintenance level.

If your system, after an update, is not showing the new maintenance level, but the previous use of the `-l` flag to determine what filesets need to be updated to match the new BOS level.

Note

Never use the newly installed AIX system for production use, without proper filesets update installed from the AIX Update CD. Every AIX media shipments are accompanied with AIX Update CDs, which provides necessary filesets update for the target hardware system support. To install or update of the AIX filesets, please refer to Chapter 3, “Additional software installation” on page 39.

AIX operating system software component is divided into four levels, the first three of these levels are referred as V.R.M (each are correspond to version and revision and modification level number). For example, AIX Version 4.3.3 means, Version 4 Release 3 modification level 3. These component levels are examined by `oslevel` command.

The fourth component level is the *preventive maintenance level* delivered as a *pack* of the filesets update (PTF) from the IBM software support. The AIX preventive maintenance levels are usually distributed on the internet (using the `fixdist` client on AIX), or by the AIX Update CD CD-ROM media.

To confirm the AIX preventive maintenance level on your system, you can use the `instfix` command as in the following example.

```
# instfix -i | grep ML
All filesets for AIX43ML were found.
All filesets for 4.3.0.0_AIX_ML were found.
All filesets for 4.3.1.0_AIX_ML were found.
All filesets for 4.3.2.0_AIX_ML were found.
All filesets for 4320-01_AIX_ML were found.
All filesets for 4320-02_AIX_ML were found.
```

```
All filesets for 4.3.3.0_AIX_ML were found.
All filesets for 4330-01_AIX_ML were found.
All filesets for 4330-02_AIX_ML were found.
All filesets for 4330-03_AIX_ML were found.
All filesets for 4330-04_AIX_ML were found.
All filesets for 4330-05_AIX_ML were found.
Not all filesets for 4330-06_AIX_ML were found.
```

In this case, the last AIX preventive maintenance level 4330-06_AIX_ML is not fully installed on this system. To find what filesets update are missing to fulfill the requirements of the specified AIX preventive maintenance level, you can use the following method.

```
# instfix -ivk 4330-06_AIX_ML | grep not | grep ':'
Fileset bos.mp:4.3.3.26 is not applied on the system.
Fileset bos.net.tcp.client:4.3.3.26 is not applied on the system.
Fileset bos.rte.serv_aid:4.3.3.26 is not applied on the system.
Fileset bos.up:4.3.3.26 is not applied on the system.
Fileset devices.isa_sio.chrp.ecp.diag:4.3.1.25 is not applied on the
system.
```

You can apply these filesets update from the Update CD or AIX BOS, Bonus Pack CDs. If you can not find necessary filesets in there, you should ask it for IBM software service or download it from the fixdist service.

2.4 Alternate disk installation

On systems where the downtime is critical, AIX Version 4.3 offers an additional way to install a system. The alternate disk installation available in AIX Version 4.3 allows installing a system while it is still up and running, thus decreasing the installation or upgrade down time considerably.

Alternate Disk Installation is used for:

- Installation of a mksysb image on another disk. For example, a mksysb from a machine with similar hardware that already has been upgraded.
- Cloning an existing rootvg on another disk. Optionally, the cloning offers the possibility of installing updates and new filesets to the cloned rootvg.

Using the Alternate Disk Installation method allows larger installations to prepare all the machines that need to be upgraded and perform the switch to the new version at the same time.

The command used for Alternate Disk Installation is: `alt_disk_install`

The command creates an `altinst_rootvg` volume group on the destination disk and prepares the same logical volume groups as in the `rootvg`, except the names are prepended with `alt_` for example `alt_hd1`. Similar are the file systems renamed to `/alt_inst/<filesystemname>`, and the original data (`mksysb` or `rootvg`) is copied.

After this first phase, a second phase begins where an optional configuration action can be performed, either a custom script or update of software, when cloning `rootvg`.

The third phase unmounts the `/alt_inst/` file systems and renames the file systems and logical volumes by removing the `alt` names. When this is done, the `altinst_rootvg` is varied off, and the bootlist is altered to boot from the new disk.

After the system is rebooted, the original `rootvg` is renamed to `old_rootvg`.

Note

The Alternate Disk Installation requires the filesets `bos.alt_disk_install.boot_images` and `bos.alt_disk_install.rte` to be installed.

Instead of using the `alt_disk_install` command directly, the SMIT menu's `smitty alt_mksysb` and `smitty alt_clone` are provided for `mksysb` installation and cloning, respectively.

2.4.1 Cloning a running rootvg

The following example shows the use of the `alt_disk_install` command performing a cloning of a running `rootvg` on `hdisk0` to the unused `hdisk1`:

```
# lspv
hdisk0      000fa17debb9c93a   rootvg
hdisk1      000fa17dc9bf376f   None

# alt_disk_install -C hdisk1
Calling mkszfile to create new /image.data file.
Checking disk sizes.
Creating cloned rootvg volume group and associated logical volumes.
Creating logical volume alt_hd5
Creating logical volume alt_hd6
Creating logical volume alt_hd8
Creating logical volume alt_hd4
Creating logical volume alt_hd2
Creating logical volume alt_hd9var
Creating logical volume alt_hd3
Creating logical volume alt_hd1
Creating /alt_inst/ file system.
Creating /alt_inst/home file system.
```

```

Creating /alt_inst/tmp file system.
Creating /alt_inst/usr file system.
Creating /alt_inst/var file system.
Generating a list of files
for backup and restore into the alternate file system...
Backing-up the rootvg files and restoring them to the
alternate file system...
Modifying ODM on cloned disk.
Building boot image on cloned disk.
forced unmount of /alt_inst/var
forced unmount of /alt_inst/usr
forced unmount of /alt_inst/tmp
forced unmount of /alt_inst/home
forced unmount of /alt_inst
forced unmount of /alt_inst
Changing logical volume names in volume group descriptor area.
Fixing LV control blocks...
Fixing file system superblocks...
Bootlist is set to the boot disk: hdisk1

# lspv
hdisk0          000fa17debb9c93a    rootvg
hdisk1          000fa17dc9bf376f    altinst_rootvg
#

```

Notice the difference in the `lspv` command before and after performing the `alt_disk_install`. The cloning example shown previously does not perform any update or customizing.

Additional to creation of the Alternate Disk Installation, the `alt_disk_install` program can also be used for operations on the `altinst_rootvg`.

To access the `altinst_rootvg`, use the `-W` flag of `alt_disk_install` to *wake-up* the alternate volume group. This is useful if you have to synchronize data on both `rootvg` and `altinst_rootvg`. Respectively, the `altinst_rootvg` can be put to sleep using the `-S` flag of `alt_disk_install`.

For further information on Alternate Disk Installation, refer to the *AIX Version 4.3 Installation Guide*, SC23-4112 as well as the man pages for `alt_disk_install`.

2.5 Installing additional hardware

When the system is installed, only the drivers and software related to the current hardware and adapters are installed. When you add additional hardware, for example, new adapter to your system, additional software, such as drivers and software related to the adapter, might be needed.

When the system boots after you have installed the new hardware, `cfgmgr` is automatically running trying to configure the new hardware. This will typically

succeed if similar hardware is already present. For example, you added an additional SCSI device, such as a tape drive.

If the new hardware is not listed using the `lsdev` command, for example: `lsdev -Cc adapter`, you can determine the missing software by running `cfgmgr` from a command window. The `cfgmgr` command will display a warning and indicate the missing driver filesets.

For example:

```
# cfgmgr
cfgmgr: 0514-621 WARNING: The following device packages are required for
        device support but are not currently installed.
devices.pci.token-ring:devices.pci.14101800:devices.pci.IBM.42H0658:devices.pci.
IBM.25H3037:devices.pci.IBM.38H5818
```

Install the missing fileset from the AIX CDs using standard fileset installation procedures. Re-run the `cfgmgr` command, and if no warnings are displayed, then the new hardware is installed. Alternatively, you can use the `-i` flag of `cfgmgr` to install the missing driver software directly.

Depending on the type of hardware, continue with the setup of the hardware following the provided instructions. For third party hardware, the necessary drivers are normally provided with the product.

Some hardware might require additional software in order to be used. For example, when adding a graphics card on a server that originally has been installed without an graphic adapter, graphic software, such as the X11/CDE software, is not installed (at least not by default). Install this software by using the Graphics-Startup installation bundle. A bundle is a collection of packages, products, or individual filesets.

To install this, use the SMIT command:

```
# smitty install_bundle
```

and select the Graphics-Startup bundle. The list of system bundles in AIX Version 4.3 are located in `/usr/sys/inst.images/sys_bundles`.

When finished installing the new hardware, remember to reconnect all parts (keyboard, mouse, and so on) you detached from the system. Some RS/6000 systems are critical about missing components and will stop in the SMS menu when you boot the system.

2.5.1 Post installation problems

After installation, the Installation Assistant allows you to configure the basic system settings; however, a common set of problems can occur.

2.5.1.1 TCP/IP Problems

Communication problems with TCP/IP are, in itself, a large topic, and detailed coverage is beyond the scope of this publication. However, following set of problems are quite common with systems that have just been installed.

- If either the DNS is missing or not configured correctly, you will not be able to ping other computers by hostname, provided that you do not want to use the `/etc/hosts` file. Check the DNS setting by either looking in `/etc/resolv.conf` or check the DNS setting using the SMIT `mktcpip` fastpath.
- A similar problem occurs when the system hangs if you log in using the CDE. As the hostname is used in the DISPLAY environment a connection cannot be established to the X-Server. This is especially critical for logins over the network from X-Terminals.

2.5.1.2 Common problems with CDE

Typical for new installations is that user accounts are established and customized with environment settings in the `.profile` read by the korn shell. When a user logs into the system using the common desktop environment (CDE), these environment settings are *not* performed; however, if the user performs a telnet login it works. This is due to the fact that, per default, the CDE session does not source the `.profile`. In the `.dtprofile`, you have to uncomment the setting of the `DTSOURCEPROFILE` flag. The following is extracted from the `.dtprofile` file:

```
#
# If $HOME/.profile (.login) has been edited as described above, uncomment
# the following line.
#
DTSOURCEPROFILE=true
```

The CDE is known for weakness of the name resolution disturbance, since it use the INET domain socket instead of the UNIX domain socket to setup the necessary connection. For example, if you configure the DNS client configuration on the system, and pull off the ethernet cable to move the system physically, you have to wait so long to get login panel on the CDE.

If you using the DNS for name resolution mechanism, you should consider to apply the following method, to avoid this well known situation.

1. Create the local host file (`/etc/hosts`), at least contains your hostname, local host as FQDN.

```
# /etc/hosts -- local host table
127.0.0.1 localhost.yourdomain.com localhost loopback.yourdomain.com loopback
XX.YY.ZZ.AA yourhost.yourdomain.com yourhost
```

2. Create the `/etc/netsvc.conf` file, which alter the system default name resolution order.

```
hosts = local4,bind4
```

3. Confirm the file owner and permission (should be set to permission 0644, and owned by user root, group system).

```
# ls -l /etc/hosts
-rw-r--r-- 1 root system 807 Jun 20 18:13 /etc/hosts
# ls -l /etc/netsvc.conf
-rw-r--r-- 1 root system 21 Jun 20 18:13 /etc/netsvc.conf
```

For further reading on post installation problem determination, use the redbook *Problem Solving and Troubleshooting in AIX Version 4.3*, SG24-5496-00.

2.6 Installing online documentation

The AIX documentation is *not* automatically installed when you install the BOS. The documentation is contained on two CD-ROMs, *AIX Version 4.3 Base Documentation CD* and *AIX Version 4.3 Extended Documentation CD*.

For information about installing the AIX online documentation and setting up the Documentation Search Service, see the IBM Certification Study Guide, *AIX V4.3 System Administration*, SG24-5129 and *AIX Version 4.3 Installation Guide*, SC23-4112.

Note

Note that the traditional man pages presented with the man command in AIX Version 4.3 are pages converted from the HTML pages (filesets `bos.html.en_US.cmds.*`). These are part of the commands reference on the Base Documentation CD.

2.7 Command summary

The following section provides a list of the key commands discussed in this chapter. For a complete reference of the following commands, consult the AIX product documentation.

2.7.1 The blvset command

Reset the pad string in the boot logical volume (BLV). The command has the following syntax:

```
/usr/lpp/bosinst/blvset -d Device -p [level | menu ]
```

```
/usr/lpp/bosinst/blvset -d Device -g [level | menu ]
```

The commonly used flags of the `blvset` command are provided in Table 1.

Table 1. Commonly used flags of the `blvset` command

Flag	Description
-d device	Device location of the rootvg, for example <code>/dev/hdisk0</code> .
-p	Put pad string to the BLV. Use <code>level</code> option for AIX Version 4.x. Use <code>menu</code> option for AIX Version 3.2
-g	Get pad string from the BLV. Use <code>level</code> option for AIX Version 4.x. Use <code>menu</code> option for AIX Version 3.2

2.7.2 The cfgmgr command

The `cfgmgr` command configures devices and optionally installs device software. The command has the following syntax:

```
cfgmgr [ -f | -s | -p Phase ] [ -i Device ] [ -l Name ] [ -v ]
```

The commonly used flags of the `cfgmgr` command are provided in Table 2.

Table 2. Commonly used flags of the `cfgmgr` command

Flag	Description
-i device	This flag enables the installation of additional software needed by the hardware identified by <code>cfgmgr</code> .

2.7.3 The alt_disk_install command

The `alt_disk_install` command installs an alternate disk with a mksysb install image or clones the currently running system to an alternate disk. The command has the following syntax:

Creation of Alternate Disk Installation:

```
alt_disk_install { -d device | -C } [ -i image.data ] [ -s script ] [ -R  
resolv_conf ] [ -D ] [ -B ] [ -V ] [ -r ] [ -p platform ] [ -L mksysb_level  
] [ -b bundle_name ] [ -I installp_flags ] [ -l images_location ] [ -f  
fix_bundle ] [ -F fixes ] [ -e exclude_list ] [ -w filesets ] [ -n ] [ -P  
phase_option ] target_disks
```

Operation on existing Alternate Disk Installation:

```
alt_disk_install { -X [ volume group ] | -q disk | -S | -W disk | -v  
new_volume_group_name disk }
```

The commonly used flags of the `alt_disk_install` command are provided in Table 3.

Table 3. Commonly used flags of the `alt_disk_install` command

Flag	Description
-C	Clone the rootvg.
-d device	Install mksysb from device, for example /dev/rmt0.
-W disk	Wake-up a volume group for data access.
-S	Put the alternate volume group to sleep.
-X	Removes the altinst_rootvg volume group.

2.8 Quiz

The following assessment questions will help verify your understanding of the topics discussed in this chapter.

1. By default, which of the following AIX Version 4 installation methods will retain existing user data in the root volume group (excluding user data in /usr, /tmp, /var, and / (root) file systems)?
 - A. Migration Installation
 - B. Preservation Installation
 - C. User data is not retained by default
 - D. Both Migration Installation and Preservation Installation

2. A system administrator is attempting to recover a system from a failed migration. However, there is no current backup of the system. Which of the following procedures should be performed to recover the system with minimum loss of data?
 - A. Install the system by using the Migration option.
 - B. Install the system by using the Preservation option.
 - C. Install the system by using the New and Complete Overwrite option.
 - D. Boot the system in maintenance mode and copy the ODM from ram fs to the ODM disk.
3. A graphics card has been added and the system rebooted. When running the `lsdev -Cc adapter` command the graphics card is not listed in the output. Which of the following actions should be performed?
 - A. Reboot system using `run mkdev -l`
 - B. Install device support using the `cfgmgr` command
 - C. Use SMIT console to redirect the console
 - D. Use SMIT devices and choose the correct adapter
4. A graphics card has been added. After rebooting, the system hangs on login with a blue screen indicating "CDE please wait". Which of the following procedures should be performed next?
 - A. Reinstall CDE software.
 - B. Check name resolution.
 - C. Uncomment last line in `.dtprofile`.
 - D. Boot in maintenance mode and perform file system checks.
5. After upgrading the operating system, the man pages are missing. Which of the following procedures should be performed to access the man pages?
 - A. Re-install infoexplorer.
 - B. Re-link `/usr/lpp/info/data/ispaths` to `ispaths.full`.
 - C. Re-install the man fileset from the third AIX Version 4.3.2 CD-ROM.
 - D. Re-install the commands reference from the Base Documentation CD-ROM.

6. After booting from the CD-ROM, the migration is not offered as an option for the installation type. Which of the following procedures should be performed to activate the migration as an option?
 - A. Continue using the Preservation Installation option.
 - B. Run `installp` to clean up after a failed installation.
 - C. Run `syncvodm` to synchronize the ODM information.
 - D. Run `/usr/lpp/bosinst/blvset` to reset the pad string in the boot logical volume.

2.8.1 Answers

The following are the preferred answers to the questions provided in this section.

1. B
2. B
3. B
4. B
5. D
6. D

2.9 Exercises

The following exercises provide sample topics for self study. They will help ensure comprehension of this chapter.

1. Perform a New and Complete Overwrite BOS installation on a dedicated test system. If no available systems exists, try to add a new hard disk and perform the BOS installation on this new disk. If you do, remember to change the bootlist to point to the new disk.
2. If an old AIX Version 3.1, AIX Version 4.1, or AIX Version 4.2 spare system is available, try an Migration Installation.

After the migration, check the system and have a look at the LPPs installed.
3. Install the filesets `bos.html.en_US.cmds.cmds1` to `bos.html.en_US.cmds.cmds6` and afterwards try the `man` command.
4. *Advanced Exercise:* On a 4.3.3 test system, install to a new unallocated (additional) disk using the Alternate Disk Installation method and the corresponding `alt_disk_install` command.

Chapter 3. Additional software installation

The following topics are discussed in this chapter:

- What can be installed
- How software can be installed
- How you can remove or fix filesets after a failed installation

After installing the base operating system, you will normally install some additional software. Such additional software can include anything between a database or a single freeware command. This chapter will explain the differences in the installation methods.

3.1 What can be installed

AIX provides a variety of software installation options. The challenge is to select the right option for the right purpose.

A preview of the software is always a good place to start. SMIT provides a panel to do this, as shown in Figure 5.

```
                List Software on Media and Related Information
Move cursor to desired item and press Enter.
List Filesets in a Bundle
List Software on Installation Media
List Software Fixes (APARs) on Installation Media
List Supplemental Fileset Information on Installation Media
Show License Agreements on Installation Media

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

Figure 5. List Software on Media and Related Information menu

An overview of the installation options is provided in the following sections.

3.1.1 Installation options

Understanding what you are to install, and what is meant by the word *install*, will help you to choose the right command. In order to better understand this, a brief description of the available installation packaging options is provided in the following sections.

3.1.1.1 Files

When working with files, remember that an ordinary file cannot be installed through the `smitty installp` dialog, which uses the `installp` or the `instfix` command. The most common scenario when you want to install a single file is probably restoring a file from a backup tape. For example, if the RS/6000 LED code indicates a syntax error in `/etc/inittab` (LED code 553) you could choose to fix the problem by reinstalling `/etc/inittab` from a `mksysb` tape or any other available backup media that has the file. The way to do this depends on the backup procedure used. If SMIT was used for generating the tape, the `backup` command has been used. In this case, the corresponding command to restore a file is `restore`.

3.1.1.2 Fileset

Fileset installation is probably the most common installation once a system installation is completed. A fileset is the smallest installable base unit for the AIX operating system. A fileset includes all files which constitute either a complete product, such as `bos.net.uucp`, or a separately installable part of a product, such as `bos.net.nfs.client`. More information on how to work with filesets can be found in 3.2.2, “Filesets” on page 47.

3.1.1.3 Bundle

A bundle is a list of filesets that are suited for a particular use. The bundle is only used as a template; you still have to define the media where the install image files are placed. The templates are placed in `/usr/sys/inst.data/sys_bundles` and in `/usr/sys/inst.data/user_bundles`. The templates are command text files; so, this gives you an opportunity to manipulate the content of the system defined bundles as well as create your own bundles as shown in 3.2.1, “Bundle” on page 45. The system defined bundles are:

- App-Dev
- Client
- Server
- Media-Defined
- Pers-Prod
- Graphics-Startup

3.1.1.4 Licensed Program Package

Licensed Program Packages (LPPs) are complete software products, including all packages associated with the licensed programs. A good example of an LPP is the base operating system (BOS).

3.1.1.5 PTFs and emergency fixes (e-fix)

PTF is the acronym for program temporary fix. A PTF is an updated, or fixed, fileset. The e-fix, or emergency fix, is a temporary solution to a unique problem. Each fix has an Authorized Program Analysis Report (APAR) number. The `instfix` command and the `smitty update_by_fix` allows you to install a fix or set of fixes without knowing any information other than the APAR number or other unique keywords that identify the fix. Emergency fixes will eventually, after testing and verification, become PTFs. The `installp` command can also be used because PTFs are just regular filesets. More on how to work with APARs is discussed in Section 3.1.2.3, “instfix” on page 43.

3.1.2 Installation methods

As discussed earlier in this chapter, you need to have an understanding of what you are to install. This will decide what command to use. The two commands mentioned so far are the `installp` command, which is to be used for fileset, LPP, and bundle installation, and the `instfix` command, which is to be used when AIX Support asks you to install a fix.

When either the `installp` or `instfix` commands are used, AIX usually expands the necessary file system (for example `/usr`) space automatically, if you instruct it do not so by command line option. This ability is based upon the information provided by the installable package. In a rare case, you will receive an error message such as "insufficient disk space", then you can increase the target file system explicitly to avoid failure of the installation.

3.1.2.1 SMIT installation menus

SMIT installation menus provide all the tools you need to install software. Under the fastpath, `smitty installp`, you will find menus that either use the `installp` command or the `instfix` command. All menus, except the highlighted one shown in Figure 6, use the `installp` command. The highlighted one uses the `instfix` command.

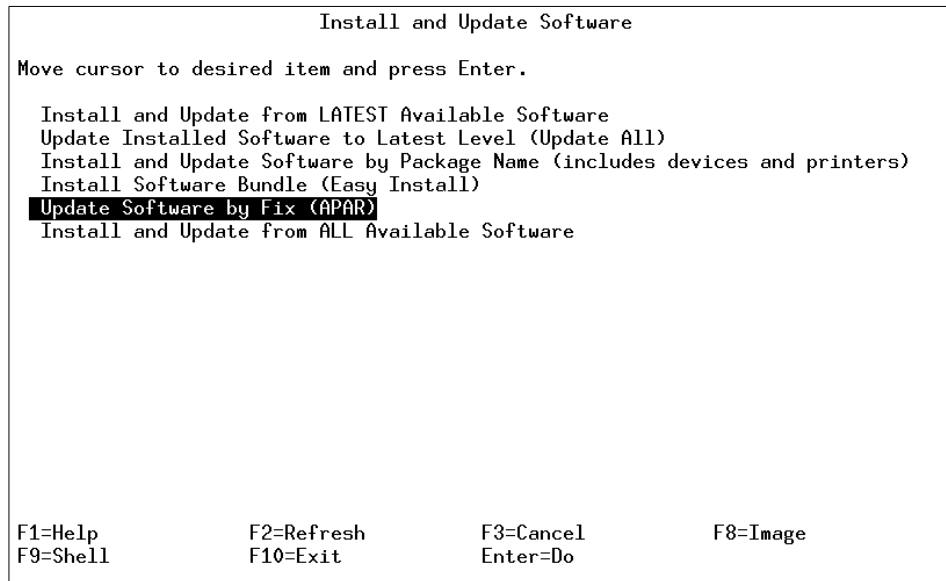


Figure 6. SMIT installation menus

3.1.2.2 installp

The `installp` command is used for various installation tasks. One of the most useful features is the possibility to choose the state of the installed fileset, applied or committed. This is defined by the `-a` flag for apply and `-ac` for commit. After you have installed a fileset in applied state, you can choose to commit the fileset by using the `-c` flag.

Another useful function the `installp` command provides is the possibility to look at the media for installable fileset. This is done with the `-l` flag.

Table 4 on page 42 lists some commonly used `installp` flags and their descriptions.

Table 4. Flags used at installation with the `installp` command

Flag	Description
<code>installp -ad /dev/cd0 <fileset></code>	Installation of fileset in applied state
<code>installp -acd /dev/cd0 <fileset></code>	Installation of fileset in committed state
<code>installp -c <fileset></code>	Committing an applied fileset
<code>installp -ld /dev/cd0</code>	Listing of installable filesets on media

Finally, the `installp` command can also be used to clean up or reject an applied fileset and to uninstall a product as discussed in Section 3.2.2.3, “How to reject applied software” on page 51 through Section 3.2.2.6, “How to clean up after a failed or interrupted installation” on page 54.

To examine the current fileset level, or installed fileset status, use the `lslpp` command.

To display the installation and update history information for the `bos.sysmgt.trace` fileset, use:

```
# lslpp -h bos.sysmgt.trace
  Fileset          Level      Action      Status      Date        Time
-----
Path: /usr/lib/objrepos
  bos.sysmgt.trace
                4.3.3.0    COMMIT      COMPLETE    06/15/00    09:57:28
                4.3.3.11   COMMIT      COMPLETE    06/16/00    11:19:13

Path: /etc/objrepos
  bos.sysmgt.trace
                4.3.3.0    COMMIT      COMPLETE    06/15/00    09:57:33
                4.3.3.11   COMMIT      COMPLETE    06/16/00    11:19:14
```

As shown, the fileset `bos.sysmgt.trace` was once updated. It is now in the committed state at the fix level 4.3.3.11.

3.1.2.3 instfix

As mentioned in Section 3.1.1.5, “PTFs and emergency fixes (e-fix)” on page 41, the `instfix` command provides the function discussed in this section.

- Specified APARs are already installed or not
- Viewing the abstraction text on the specified APAR on installation media or installed system
- List the included fileset updates in APARs

To examine specified APARs are already installed on the system or not, you can use the following command (multiple APAR keywords can be specified, if you quote them in double quote).

For example:

```
# instfix -ik "IX71385 IX71988"
  There was no data for IX71385 in the fix database.
  All filesets for IX71988 were found.
```

In this case, the APAR IX71988 is already applied in this system, though the APAR IX71385 is not applied in this system.

The `instfix` command can be also used to extract information about fixes (called APAR description) already installed and fixes on a media (if you specified the install source media or directory using the `-d` flag).

For example:

```
# instfix -aik IY01781
IY01781 Abstract: Behavior of ptf_discard has changed
```

IY01781 Symptom Text:

```
ptf_discard() behavior has changed from 43D to 43K and
causes problem with unmount file systems.
```

```
-----
All filesets for IY01781 were found.
```

To confirm the contents of the specified APARs, you can use the `instfix` command like this.

For example:

```
# instfix -ivk IY01781
IY01781 Abstract: Behavior of pft_discard has changed
```

```
Fileset bos.mp:4.3.2.10 is applied on the system.
Fileset bos.up:4.3.2.10 is applied on the system.
All filesets for IY01781 were found.
```

In this case, the APAR IY01781 include the fileset updates for bos.mp with both 4.3.2.10 level.

Note

The e-fix (emergency fix) is not installable via `instfix` command, since they are not provided installable bff format yet. To install the e-fixes, certainly you will receive the appropriate installation instruction from IBM software service personnel. This instruction usually states, how to examine the integrity of the e-fix package, how to stop your application instance, how to replace modules, how to confirm the installation results.

3.1.3 Installation reports

Previously, the use of `smitty installp` menus, the `installp` command, and the `instfix` command were discussed. Depending on what you choose, the installation reports have to be handled in different ways.

3.1.3.1 SMIT

Most SMIT tasks create or add to the `smit.log` and `smit.script` files in your home directory. (These are the same files appended when you run a SMIT session.) The time, name of the task, and the command (flags and parameters included) are added to the end of the `smit.script` file in a format that can easily be used to create executable shell scripts.

The `installp` or the `instfix` command used by SMIT, will be logged in `$HOME/smit.log`.

3.1.3.2 installp

If you choose to use the `installp` command from the command line, you have the possibility to use redirection as in the example with `instfix`, or you can use the `-e` flag to specify a log file. For example:

```
# installp -ae /tmp/thomasc/installp.log -d /dev/cd0 "bos.dosutil 4.3.3.0"
```

This command would install `bos.dosutil` in an applied state and send all the familiar installation messages to the log file specified as well as report the command syntax used and the time the installation started and finished. Another option is to export the `INST_DEBUG` environment variable and set it to `YES`.

The target `all` when used in the `installp` command line means all available filesets on the media.

3.1.3.3 instfix

If you choose to use the `instfix` command from the command line, remember that `instfix` uses `stdout` and `stderr` by default. So, you have to manipulate these if you want an installation report. For example:

```
# instfix -k IY07536 -d /tmp/thomasc > /tmp/thomasc/inst.log 2>&1
```

3.2 How to install - Different scenarios

As pointed out in the previous text, software is divided into smaller and more manageable parts. The following discusses the different methods used.

3.2.1 Bundle

As mentioned before, there are several system-defined bundles that are used to make the installation process easier. The system-defined bundles are `Server`, `Client`, `App-Dev`, `Media-Defined`, `Graphics-Startup`, `Pers-Prod`. Each of the `App-Dev`, `Client`, and `Server` bundles has two files each in the

/usr/sys/instdata/sys_bundle directory. The first one defines the default definition of the bundle, which has the name extension of .def. The second file is the actual bundle file that is recognized by `smitty easy_install` menus. This file has the file extension of .bnd. If `cfgmgr -f` finds a graphical adapter at IPL, the Graphics-Startup bundle will be used for installation of filesets required for use of the graphical console.

By editing the .bnd file for the respective bundle, you can include or exclude filesets in the bundle installation. If, after an installation, you want to remove only a single product that was installed with the bundle, you can do this by using `smitty remove`, or:

```
# installp -u bos.dosutil 4.3.3.0
```

Since the bundle is defined as the collection of the installable filesets, there is no easy way to un-install complete filesets included in bundle.

3.2.1.1 Media defined bundle

Another bundle is the Media-defined bundle. This bundle is used when a bundle definition is available on the installation media. This feature can be used by application developers to prepare for an `easy_install`.

3.2.1.2 How to manipulate bundles

You have the option to create your own bundles. It is as simple as creating a file with an editor, for example `vi`, and list the filesets to be installed. The file must have .bnd as the extension. When using the `smitty easy_install` menu (Figure 7), you will find your bundle in the list. In this example, it is named `my_own_bundle`.

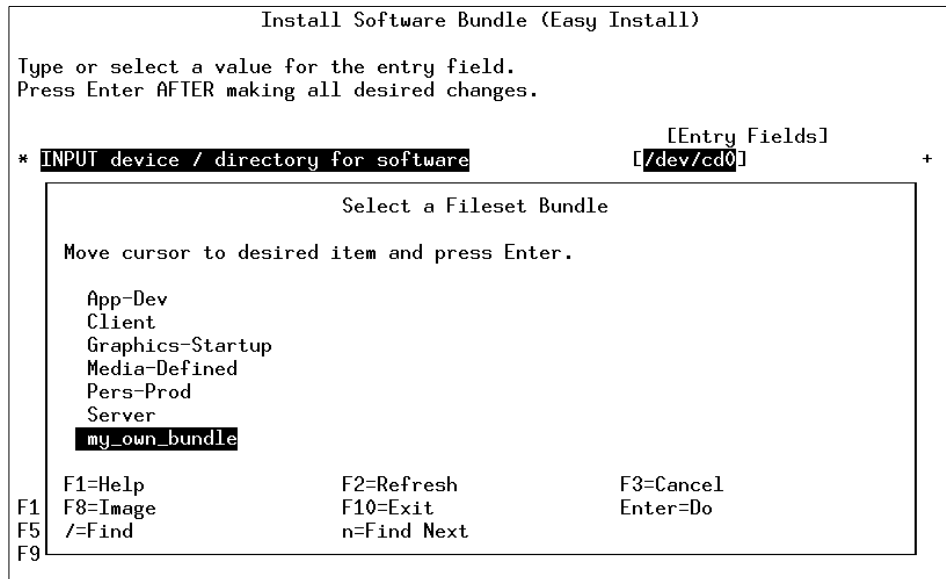


Figure 7. Installing user defined bundle

3.2.2 Filesets

To install the fileset `bos.dosutil`, the following command can be used:

```
# installp -acd /dev/cd0 -X bos.dosutil
```

In this case, the installation will be in *committed* mode, defined by the `-ac` flags. The installation media is `/dev/cd0`, as defined by the `-d` flag, and finally, the `-X` flag attempts to expand any file systems where there is insufficient space to do the installation. If you use SMIT installation menus for your installation with default settings in the menu, then the syntax used will appear as follows:

```
# installp -acgNqWXd /dev/cd0 bos.dosutil
```

The options and flags, as shown in Table 5, are good to recognize and to use when needed.

Table 5. Flags for `installp` used by SMIT

Flag	Description
-ac	Commit
-B	Consider updates only (does not install base fileset)

Flag	Description
-g	Includes requisites
-N	Overrides saving of existing files
-q	Quiet mode
-w	Does not place a wildcard at end of fileset name
-X	Attempts to expand file system size if needed
-d	Input device

The commit state should only be used at a base level installation. The reason to use the apply state when updating software will be covered in Section 3.2.2.2, “How to update a fileset” on page 49.

SMIT and the `installp` command only handles filesets in the bff format. All filesets on the AIX installation media are, by default, in the bff format. If you want to copy installation image files from a installation media to disk for future use, you need to use the `bffcreate` command to make the files usable for the `installp` command. The `bffcreate` command calls the `inutoc` command, which creates a table of content file (.toc) in the specified directory.

For example:

```
# bffcreate -d /dev/cd0 -t /tmp/thomasc -w tmp/thomasc bos.dosutil
```

In this example, the `bffcreate` command takes the install image file, `bos.dosutil` from `/dev/cd0` and places it in the `/tmp/thomasc` directory, defined by the `-t` flag. While doing this, `bffcreate` creates temporary files, and the `-w` flag indicates that the `/tmp/thomasc` directory can be used for this. Finally, the `inutoc` command will be automatically called to generate a table of content file. The contents of the directory will appear as follows:

```
# ls -la
total 136
drwxr-xr-x  2 root    system    512 Jun 14 09:56 .
drwxrwxrwt 11 bin     bin      1024 Jun 14 10:17 ..
-rw-r--r--  1 root    system    202 Jun 14 09:56 .toc

-rw-r--r--  1 root    system   57344 Jun 14 09:56 bos.dosutil.4.3.3.0.I
```

There are several other useful flags for the `bffcreate` command, which can be found in *Commands Reference, Volume 1*, SC23-4115, as well as a SMIT menu, `smitty bffcreate`.

3.2.2.1 The preview function

One of the most valuable features of the `installp` command, and the SMIT menus using the `installp` command, is the possibility to perform a preview of an action by running all pre-installation checks for the specified action. This `-p` flag is only valid with `apply`, `commit`, `reject`, and `remove` (`-a`, `-c`, `-r`, and `-u`) flags. The pre-installation check includes verifying prerequisites and checking if the amount of needed space in the target file system is sufficient. To preview an apply of `bos.dosutil`, the command would look as follows:

```
# installp -ape /tmp/thomasc/installp.log -d /dev/cd0 "bos.dosutil 4.3.3.0"
```

In SMIT, the choice is done by changing the PREVIEW only to **yes** (Figure 8 on page 49).

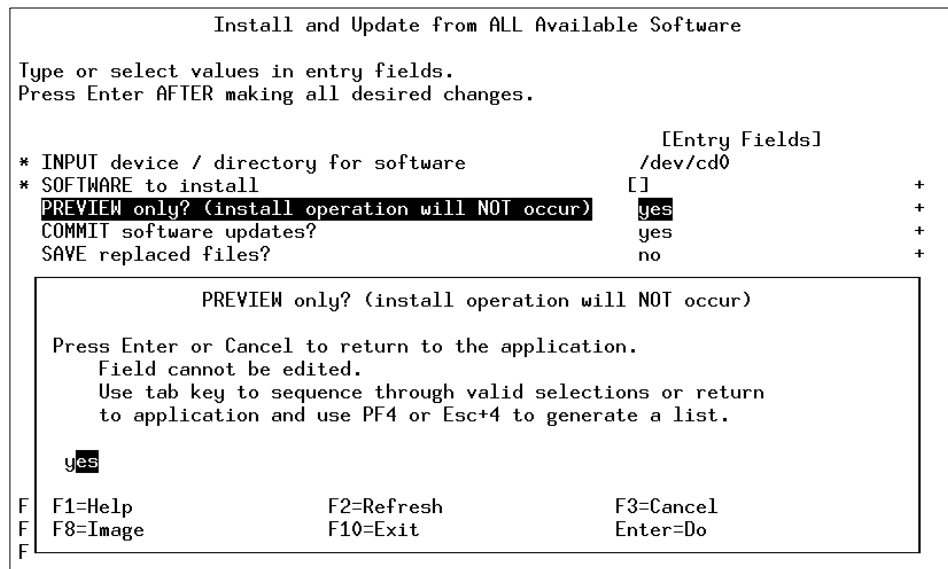


Figure 8. Preview option in SMIT

3.2.2.2 How to update a fileset

During and after installation, there are four major actions that can be taken with optional software products and service updates. Optional software and service updates can be *applied*, *committed*, *rejected*, and *removed*. Whether a particular action can be taken depends on whether actions have previously been taken.

You can use the `ls1pp` command to check the actual status value of a fileset, for example, the `-h` flag which will provide us with the installation history of the specified fileset.

```

# lslpp -h bos.sysmgt.trace
Fileset          Level  Action      Status      Date      Time
-----
Path: /usr/lib/objrepos
bos.sysmgt.trace
      4.3.3.0    COMMIT     COMPLETE    06/15/00    09:57:28
      4.3.3.11   APPLY     COMPLETE    06/15/00    09:58:54

Path: /etc/objrepos
bos.sysmgt.trace
      4.3.3.0    COMMIT     COMPLETE    06/15/00    09:57:33
      4.3.3.11   APPLY     COMPLETE    06/15/00    09:58:57

```

The use of Commit or Apply has been mentioned so far. As mentioned before, you cannot install a base level of a fileset in any other mode than Commit. The installation will not take any notice of the use of -a flag with the `installp` command. It will automatically use the -ac flags, see Section 3.1.2.2, “installp” on page 42 for further example usage of `installp -a` and `installp -ac`. Table 6 provides assistance in the Commit or Apply decision.

Table 6. Commit or apply?

Fileset level	Install options	Removal	Status after removal
Base level fileset	commit	remove / reinstall	removed
update of fileset	commit	remove / reinstall	removed
	apply	reject	rejected

By using the Apply option when upgrading a fileset, you keep the former version of that software product in the `/usr/lpp/PackageName` directory so that if you want to return to the former version, you can do so without having to reinstall it. When doing this through SMIT, you need to remember the mutual dependencies in the SMIT menu. When applying a fileset, you should change the SAVE replaced files to **yes** as shown in Figure 9.

To enable the SAVE replaced fileset to **yes** is safer option in production use. But, it also consumes additional disk space to store the older level fileset modules. Keep it mind, if you use these option frequently, after some weeks or months normal operations, these saved older level fileset modules should be removed by committing the applied status filesets update, before applying newer filesets updates.

```

Install and Update from ALL Available Software

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                [Entry Fields]
* INPUT device / directory for software      /dev/cd0
* SOFTWARE to install                        [bos.dosutil]      +
PREVIEW only? (install operation will NOT occur)  no          +
COMMIT software updates?                      no          +
SAVE replaced files?                          yes         +

```

```

                                SAVE replaced files?

Press Enter or Cancel to return to the application.
Field cannot be edited.
Use tab key to sequence through valid selections or return
to application and use PF4 or Esc+4 to generate a list.

yes

```

```

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

```

Figure 9. Saving previous version when updating fileset

3.2.2.3 How to reject applied software

If you find out that a fileset was not compatible with some of your applications, or if the fileset introduced some other problems, you want to be able to remove the fileset. If you have applied the fileset, it is a simple procedure of executing the following command:

```
# installp -r bos.sysmgt.trace 4.3.3.11
```

When rejecting an applied fileset, you need to give the level of the fileset as a parameter to the `installp` command. When using SMIT, you can do this under the software maintenance menus as shown in Figure 10.

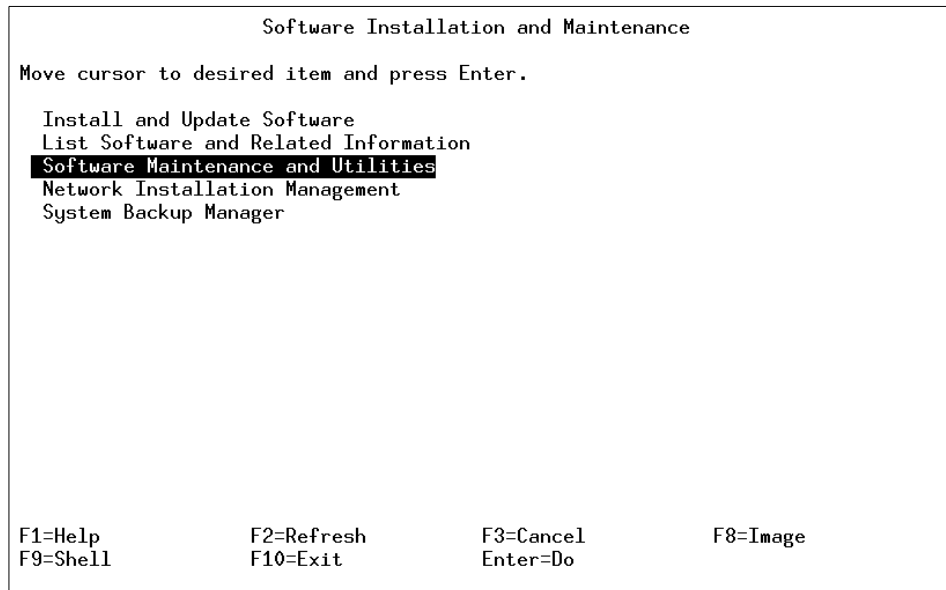


Figure 10. Software maintenance and utilities

Under this submenu you can among other things, choose either to commit an applied fileset or reject an applied fileset as shown in Figure 11 on page 52.

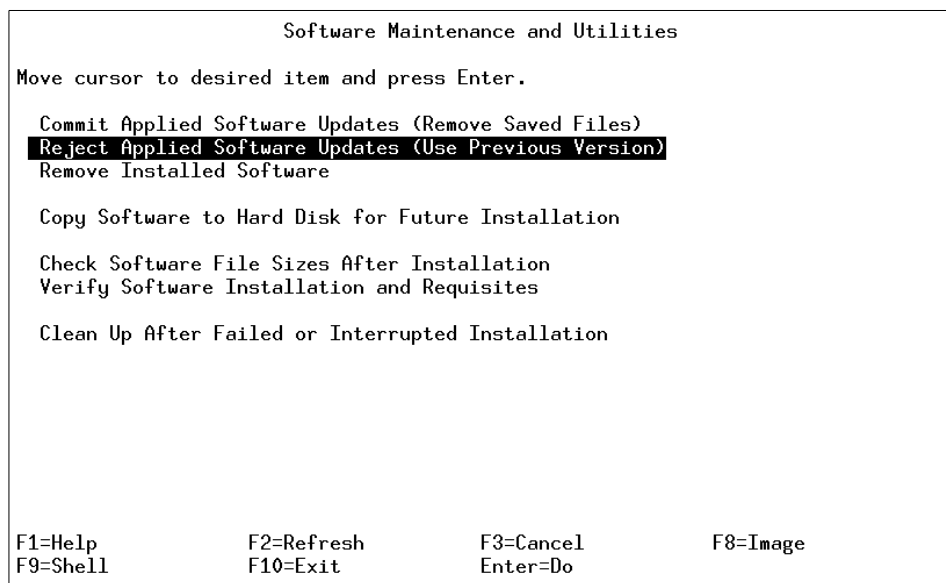


Figure 11. SMIT menu for rejecting an applied fileset

3.2.2.4 Broken or inconsistent software

Filesets in the broken state have encountered a problem while installing an update to the fileset. To correct the problem, the update should be reinstalled, making sure that these options in the menu are set as indicated as shown in Table 7.

Table 7. Choice of options when reinstalling software

Option	Value
Commit software updates	yes
Save replaced files	no
Automatically install requisite software	yes

Filesets or fixes in the inconsistent state have / (root) and /usr parts that are out of synchronization, usually because installation was interrupted or failed. To recover, try to reinstall the software. Alternately, remove the fileset or reject the update.

3.2.2.5 Install same or older version

If you end up with a fileset in the committed state that you do not want to use, the only way to remove it is to do a reinstallation of the base level of the fileset. This can be done through SMIT under all of the installation menus as shown in Figure 12

```

Install and Update from ALL Available Software

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                [Entry Fields]
* INPUT device / directory for software      /dev/cd0
* SOFTWARE to install                        [bos.dosutil]      +
PREVIEW only? (install operation will NOT occur) no          +
COMMIT software updates?                    yes              +
SAVE replaced files?                         no                +
AUTOMATICALLY install requisite software?    yes              +
EXTEND file systems if space needed?         yes              +
OVERWRITE same or newer versions?           Do                +
VERIFY install and check file sizes?        no                +
DETAILED output?                            no                +
Process multiple volumes?                   yes              +

F1=Help          F2=Refresh      F3=Cancel      F4=List
Esc+5=Reset      Esc+6=Command  Esc+7=Edit     Esc+8=Image
Esc+9=Shell      Esc+0=Exit     Enter=Do

```

Figure 12. SMIT option for overwrite of fileset at same or newer version

This can also be done by use of the -F flag in combination with the normal -a for apply or -ac for commit. For example:

```
# installp -acFd /dev/cd0 bos.dosutil
```

3.2.2.6 How to clean up after a failed or interrupted installation

If the installation, for some reason, has been interrupted, you can have status reports on the fileset indicating a problem. For example, the following output was generated after sending a SIGKILL signal to an installation process:

```

# lslpp -h bos.dosutil
Fileset          Level      Action      Status      Date      Time
-----
Path: /usr/lib/objrepos
bos.dosutil
          4.3.3.0  APPLY      PENDING     06/15/00  14:16:49

# lslpp -l bos.dosutil
Fileset          Level      State      Description
-----
Path: /usr/lib/objrepos
bos.dosutil
          4.3.3.0  APPLYING   DOS Utilities

```

When you see this kind of output you should use the `lppchk` command to check what exactly is the consistency problem with the fileset. For example:


```
# lppchk -v
lppchk: The following filesets need to be installed or corrected to bring
the system to a consistent state:
```

```
bos.dosutil 4.3.3.0 (APPLYING)
```

The `lppchk` command verifies that files for an installable software product (fileset) match the software vital product data (SWVDP) database information for file sizes, checksum values, or symbolic links. As shown, the `-v` flag is used to verify that the `/` (root), `/usr`, and `/usr/share` parts of the system are valid with each other. In other words, this flag verifies that all software products installed on the `/` (root) file system are also installed on the `/usr` file system.

When you run into this kind of problem, you need to clean up after the installation. This is done in the Clean Up After Failed or Interrupted Installation submenu as shown in Figure 11 on page 52, or by issuing the `installp` command with the `-C` flag. This will automatically search for filesets in other states than applied or committed and remove them. For example:

```
# installp -C
```

3.3 Uninstall software

To remove a software product, use the `installp` command as in the following example:

```
# installp -u bos.dosutil 4.3.3.0
```

Or you can use the `smitty remove`, a preferred method, as shown in Figure 13 on page 56.

```

Remove Installed Software

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

* SOFTWARE name          [Entry Fields]
[ bos.dosutil ]          +
PREVIEW only? (remove operation will NOT occur)  yes      +
REMOVE dependent software?                          no      +
EXTEND file systems if space needed?                no      +
DETAILED output?                                    no      +

F1=Help           F2=Refresh       F3=Cancel       F4=List
Esc+5=Reset       Esc+6=Command    Esc+7=Edit      Esc+8=Image
Esc+9=Shell       Esc+0=Exit       Enter=Do

```

Figure 13. Removing software through SMIT

3.4 Summary

As a general summary of this chapter, there is but one single advise:

Understand your task

Find out what you are to install, choose the right installation option, and finally, if you have to repair a failed installation, choose the right flag to reject, uninstall, or clean up.

3.5 Command summary

The following section provides a list of the key commands discussed in this chapter. For a complete reference of the following commands, consult the AIX product documentation.

3.5.1 installp

As seen below, the `installp` command is a very useful and powerful tool. More on the `installp` command can be found in *Commands Reference, Volume 3*, SC23-4117, and in the *Installation Guide*, SC23-4112.

To install with apply only or with apply and commit:

```
installp [ -a | -ac [ -N ] ] [ -eLogFile ] [ -V Number ] [ -dDevice ] [ -b ] [ -S ] [ -B ] [ -D ] [ -I ] [ -p ] [ -Q ] [ -q ] [ -v ] [ -X ] [ -F | -g ] [ -O { [ r ] [ s ] [ u ] } ] [ -tSaveDirectory ] [ -w ] [ -zBlockSize ] { FilesetName [ Level ]... | -f ListFile | all }
```

To commit applied updates:

```
installp -c [ -eLogFile ] [ -VNumber ] [ -b ] [ -g ] [ -p ] [ -v ] [ -X ] [ -O { [ r ] [ s ] [ u ] } ] [ -w ] { FilesetName [ Level ]... | -f ListFile | all }
```

To reject applied updates:

```
installp -r [ -eLogFile ] [ -VNumber ] [ -b ] [ -g ] [ -p ] [ -v ] [ -X ] [ -O { [ r ] [ s ] [ u ] } ] [ -w ] { FilesetName [ Level ]... | -f ListFile }
```

To uninstall (remove) installed software:

```
installp -u [ -eLogFile ] [ -VNumber ] [ -b ] [ -g ] [ -p ] [ -v ] [ -X ] [ -O { [ r ] [ s ] [ u ] } ] [ -w ] { FilesetName [ Level ]... | -f ListFile }
```

To clean up a failed installation:

```
installp -C [ -b ] [ -eLogFile ]
```

To list all installable software on media:

```
installp { -l | -L } [ -eLogFile ] [ -d Device ] [ -B ] [ -I ] [ -q ] [ -zBlockSize ] [ -O { [ s ] [ u ] } ]
```

To list all customer-reported problems fixed with software or display all supplemental information:

```
installp { -A|-i } [ -eLogFile ] [ -dDevice ] [ -B ] [ -I ] [ -q ] [ -z BlockSize ] [ -O { [ s ] [ u ] } ] { FilesetName [ Level ]... | -f ListFile | all }
```

To list installed updates that are applied but not committed:

```
installp -s [ -eLogFile ] [ -O { [ r ] [ s ] [ u ] } ] [ -w ] { FilesetName [ Level ]... | -fListFile | all }
```

Table 8 gives a general summary of some useful `installp` flags.

Table 8. General `installp` summary

Flag	Description
-ac	Commit
-g	Includes requisites
-N	Overrides saving of existing files
-q	Quiet mode
-w	Does not place a wildcard at end of fileset name
-X	Attempts to expand file system size if needed
-d	Input device
-l	List of installable filesets
-c	Commit an applied fileset
-C	Clean up after an failed installation
-u	Uninstall
-r	Reject an applied fileset
-p	Preview of installation
-e	Define an installation log
-F	Forced overwrite of same or newer version

3.5.2 `instfix`

The `instfix` command is used to install fixes and to check for installed fixes. More on the `instfix` command can be found in *Commands Reference, Volume 3, SC23-4117* and in the *Installation Guide, SC23-4112*.

The syntax of `instfix` is as follows:

```
instfix [ -T ] [ -s String ] [ -S ] [ -k Keyword | -f File ] [ -p ] [ -d  
Device ] [ -i [ -c ] [ -q ] [ -t Type ] [ -v ] [ -F ] ] [ -a ]
```

Table 9 gives a general summary of some useful `instfix` flags.

Table 9. General `instfix` summary

Flag	Description
-T	Displays the entire list of fixes present on the media.
-i	Shows if the fix is installed, should be used with -k or -f
-k	Keyword, the APAR number is a keyword
-f	Specifies the input file containing keywords or fixes
-p	Displays filesets associated with keywords

3.6 Quiz

The following assessment questions will help verify your understanding of the topics discussed in this chapter.

1. Before installation occurs, which of the following should be used to view the contents of the media-defined bundle shipped as a part of AIX V4?
 - A. The `inutoc` command
 - B. The `installp` command
 - C. The SMIT's List Software on the Installation Media menu
 - D. View contents of files located in `/usr/sys/inst.data/sys_bundles`
2. A system administrator needs to install the Personal Productivity Bundle, without the DOS utilities fileset (`bos.dosutil`). Which of the following procedures is the best way for a system administrator to successfully perform the installation?
 - A. Install the bundle and then remove the DOS utilities fileset
 - B. Use the `chgcass` command with the `-d` option for `bos.dosutil`
 - C. Use the ODM edit (`odme`) utility to remove the product definition from the system's ODM database
 - D. Remove the `bos.dosutil` name from `/usr/sys/inst.images/sys_bundles` for the Personal Productivity Bundle

3. Which of the following procedures is most appropriate to remove a committed optional program product from an AIX V4 system?
 - A. Use the Remove Software Products menu in SMIT
 - B. Use the `odmedit` command to change the status of the product to “uninstalled”
 - C. Use the `reject` option for `installp` to remove each unwanted program product installed on a system
 - D. There is no systematic way to remove optional program products

3.6.1 Answers

The following are the preferred answers to the questions provided in this section.

1. C
2. A
3. A

3.7 Exercises

In this exercise, the system has been installed using AIX Version 4.3.3 maintenance level 2. Start with choosing a fileset well suited for this exercise (not system critical and with some fix levels available, for example, `bos.sysmgt.trace`). Verify that the previous version of your chosen fileset is in committed state before doing this exercise. Do not test this in a production system:

1. Download an updated fileset, for example, `bos.sysmgt.trace 4.3.3.11`, from the Web. This can be done from:

<http://www.ibm.com/servers/aix/download/>

Install the fileset in applied state. Verify the state of the fileset. Reject the fileset.

2. Install the fileset in applied state once more, during the installation, and send SIGKILL to the `installp` PID. Check for installation problems. Clean up after the failed installation.

Chapter 4. System boot

The following topics are discussed in this chapter:

- A general boot process
- Differences between MCA and PCI systems
- Boot phase 1
- Boot phase 2
- Boot phase 3
- Common boot problem scenarios and how to fix them

Boot problems are among the most common problems. When looking at the subject of installation and system recovery, it is important that you have good knowledge on the boot process. This chapter begins with a general overview of the boot process, then expands on the details and discusses the process with their LED codes in further detail. A summary of the LED codes can be found in 4.6.2, “LED codes” on page 80.

4.1 General overview of the boot process

Both hardware and software problems can cause the system to halt in the boot process. The boot process is also dependent on what hardware platform is used. In the initial startup phase, there are some important differences between MCA and PCI systems, and these differences will determine the way to handle a hardware related boot problem. These differences will be covered in Section 4.2, “BIST - POST” on page 64.

A general representation of the boot process is shown in Figure 14 on page 62.

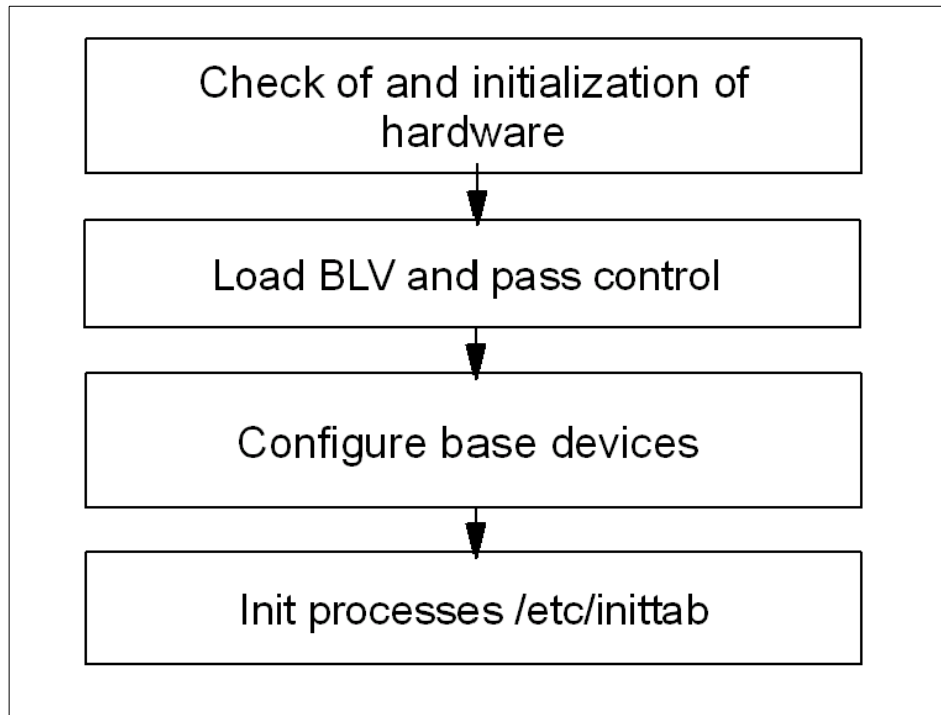


Figure 14. General boot order

The initial hardware check is to verify that the primary hardware is OK. This phase is divided into two separate phases on an MCA system, first a built-in self test (BIST), and the second, a power-on self test (POST). On PCI systems, it is handled by a single POST. After this, the system attempts to load the boot logical volume (BLV) into a RAM file system (RAMFS) and passes control to the BLV. Since there is no LVM device driver loaded into memory, the system has to find the correct BLV location without using LVM. The correct address information (offset and length) is written in the first physical disk sector (512 byte block) on the boot disk. This sector is called boot record.

Content of the BLV

Soft ROS (PCI architecture models only)

- Soft ROS performs certain system initialization on the PCI architecture models that is not provided by their ROS, but required by AIX.

AIX kernel

- The kernel is always loaded from the BLV. There is a copy of the kernel in /unix (soft link to /usr/lib/boot/unix_mp or unix_up). This version is used to build the hd4 file system where the kernel image is read during system boot.

rc.boot

- This is the configuration script that will be called three times by the init process during boot.

Reduced ODM

- Device support is provided only to devices marked as base devices.

Boot commands

- For example, `cfgmgr`, `bootinfo`.

Because the rootvg is not available at this point, all the information needed for boot is included in the BLV used for creation of the RAMFS in the memory. After this, the init process is loaded and starts to configure the base devices. This is called boot phase 1 (init executes the rc.boot script with an argument of 1).

The next step, called phase 2, aims at activating rootvg, and this is probably the phase where the most common boot problems occur, for example, a file system or the jfslog is corrupt. Next, the control is passed to the rootvg `init` command and the RAMFS is released.

Finally, the init process, now loaded from disk (not the BLV init), executes the rc.boot script with an argument of 3 to configure the remaining devices. This final stage is done from /etc/inittab.

4.2 BIST - POST

As mentioned before, there are differences between the classic RS/6000 system with MCA architecture and the PCI systems that are delivered today. The MCA system will be discussed first.

4.2.1 MCA systems

At a system startup of an MCA system, the first thing that happens is a BIST. These tests reside in EPROM chips, and the hardware tested by BIST are mainly components on the motherboard. LED codes shown during this phase of the startup will be in the range of 100 - 195, depending on the status of the hardware. After this, the POST will be initialized.

The task of the POST is to find a successful hardware path to a BLV. All hardware that is required to load a boot image is tested. The LED codes at this stage are in the range of 200 - 2E7, and both hardware and software problems can cause a halt in the startup process at this stage.

On an MCA system, the load of the BLV starts with checking the bootlist. The bootlist is defined by the key position. When the key is in normal position applications will be started as well as network services. This is done when the init process reads /etc/inittab and executes the configuration scripts referenced in the file. A normal boot is represented by the runlevel 2. The /etc/inittab file is discussed in further detail in Sections 4.1, "General overview of the boot process" on page 61 and 4.5.1, "/etc/inittab" on page 78. To manipulate the boot list for normal mode, use the following command:

```
# bootlist -m normal hdisk0 hdisk1 rmt0 cd0
```

This will cause the system to first search hdisk0 for a usable BLV. If there is no BLV at hdisk0, then hdisk1 will be searched, and so on.

The service boot list is used when booting the system for maintenance tasks. No applications or network services will be started. To check what the service bootlist looks like, use the -o option which was introduced with AIX Version 4.2.1 as follows:

```
# bootlist -m service -o
fd0
cd0
rmt0
hdisk2
ent0
```

Another feature introduced with AIX Version 4.2 is the use of generic device names. Instead of pointing out the specified disk, with hdisk0 or hdisk1, you can use the generic definition of SCSI disks. For example:

```
# bootlist -m service cd rmt scdisk
```

This will cause the system to probe any CD, then probe any tape drive, and finally, probe any SCSI disk for a BLV. The actual probing of the disk is a check of sector 0 for a boot record, which, in turn, will point out the boot image.

Changes to the boot list can also be done through the diag menus. At the Function Selection menu, select **Task Selections** as shown in Figure 15.

```
FUNCTION SELECTION801002

Move cursor to selection, then press Enter.

Diagnostic Routines
  This selection will test the machine hardware. Wrap plugs and
  other advanced functions will not be used.
Advanced Diagnostics Routines
  This selection will test the machine hardware. Wrap plugs and
  other advanced functions will be used.
Task Selection(Diagnostics, Advanced Diagnostics, Service Aids, etc.)
  This selection will list the tasks supported by these procedures.
  Once a task is selected, a resource menu may be presented showing
  all resources supported by the task.
Resource Selection
  This selection will list the resources in the system that are supported
  by these procedures. Once a resource is selected, a task menu will
  be presented showing all tasks that can be run on the resource(s).

F1=Help           F10=Exit          F3=Previous Menu
```

Figure 15. Function selection menu in diag

In the list of tasks, choose **Display or Change Bootlist** as shown in Figure 16 on page 66.

```
TASKS SELECTION LIST 801004

From the list below, select a task by moving the cursor to
the task and pressing 'Enter'.
To list the resources for the task highlighted, press 'List'.

[MORE...18]
  Display Firmware Device Node Information
  Display Hardware Error Report
  Display Hardware Vital Product Data
  Display Microcode Level
  Display Previous Diagnostic Results
  Display Resource Attributes
  Display Service Hints
  Display Software Product Data
  Display System Environmental Sensors
  Display Test Patterns
  Display or Change Bootlist
  Download Microcode
[MORE...12]

F1=Help           F4=List           F10=Exit          Enter
F3=Previous Menu
```

Figure 16. Task selection menu in diag

Finally, you have to choose whether to change the **Normal mode bootlist** or the **Service mode bootlist** as shown in Figure 17.

```
DISPLAY/ALTER BOOTLIST 802590

Select an option, then press Enter.

  Normal mode bootlist
  This selection allows displaying, altering, or erasing
  the normal mode bootlist.
  Service mode bootlist
  This selection allows displaying, altering, or erasing
  the service mode bootlist.

F3=Cancel           F10=Exit
```

Figure 17. Display/alter bootlist menu in diag

At this point, a lot of things can cause a boot problem. The boot list could point to a device that does not have a BLV, or the devices pointed to are not accessible because of hardware errors.

The following sections cover some problems that can cause a halt. All problems at this stage of the startup process have an error code defined, which is shown in the LED display on the front panel.

4.2.1.1 LED 200

The LED code 200 is connected to the secure key position. When the key is in the secure position, the boot will stop until the key is turned either to the normal position or the service position. The boot will then continue.

4.2.1.2 LED 299

An LED code of 299 shows that the BLV will be loaded. If this LED code is passed, then the load has been successful. If, after passing 299, you get a stable 201, then you have to re-create the BLV as discussed in Section 4.2.1.4, “How to re-create the BLV” on page 67.

4.2.1.3 MCA LED codes

Table 10 provides a list of the most common LED codes on MCA systems. More of these can be found in the *Message Guide and References* which is part of the AIX Version 4 Base Documentation.

Table 10. Common MCA LED codes

LED	Description
100 - 195	Hardware problem during BIST
200	Key mode switch in secure position
201	1. If LED 299 passed re-create BLV 2. If LED 299 has not passed, POST encountered a hardware error
221, 721, 221 - 229, 223 - 229, 225 - 229, 233 - 235	The bootlist in NVRAM is incorrect (boot from media and change the bootlist), or the bootlist device has no bootimage (boot from media and recreate the BLV), or the bootlist device is unavailable (check for hardware errors).

4.2.1.4 How to re-create the BLV

When the LED code indicates that the BLV cannot be loaded, you should start by checking for hardware problems, for example, cable connections. The next step is to start the system in maintenance mode from an external media, for

example, an AIX installation CD. Use the **Access this Volume Group** action and start a shell menu for re-creation of the BLV (this menu is also used if the boot problem was due to an incorrect bootlist). Execute the following command if you want to re-create the BLV on hdisk0:

```
# bosboot -ad /dev/hdisk0
```

Another scenario where you might want to create a BLV with the `bosboot` command is with a mirrored rootvg. Just mirroring this volume group does not make the disks containing the secondary copy bootable, since the boot record is not a logical volume (AIX mirroring works only on logical volumes). You still have to define the disks in the bootlist and execute the `bosboot` command on the secondary copy. The `bosboot` command creates both the BLV and the boot record.

Accessing rootvg

The following is a short summary on how to access the maintenance menus. For more detailed information, see *Installation Guide, Chapter 10 - Accessing a system that will not boot*, SC23-4112.

1. Boot the system from media
2. At the installation menu, choose **Start Maintenance for System Recovery**.
3. On the next menu, choose **Access a Root Volume Group**.
4. A list of accessible disks are shown, choose the rootvg disk.
5. Finally, choose the **Access this Volume Group and start a shell** when you want to re-create the BLV. Change the bootlist or forgotten root password.

Choose the **Access this Volume Group and start a shell before mounting file systems** if file systems or the jfslog in rootvg are corrupt.

4.2.2 PCI systems

When booting PCI systems, there are important differences from the MCA systems. It has already been mentioned that there is an absence of BIST. Another difference is the absence of the key switch. Modern PCI systems use a logical keymode switch, which is handled by the use of function key. Also, the diag function is missing on some older PCI systems. The following section discusses how to change the bootlist and discusses the support of the normal and service boot options on PCI systems.

4.2.2.1 Changing the bootlist on PCI systems

All PCI systems have System Management Services (SMS) menus. On most systems, these menus can be accessed by pressing **F1** or **1** when the console is initiated (the use of **F1** or **1** depends on the use of graphical display or ASCII terminal). At this time, a double beep is heard. Depending on the PCI model, there are three or four choices in the SMS main menu. One of these is named boot. Under this menu, you can define the bootlist. The SMS main menu from a 43P-140 is shown in Figure 18. Newer PCI systems also have an additional selection called multiboot.



Figure 18. SMS main menu

Changing the boot order can also be done with the `bootlist` command.

4.2.2.2 Normal boot and Service boot on PCI systems

Some PCI systems do not support service mode, for example, the 7248-43P. The only way to boot in another mode, such as maintenance mode, is to change the normal bootlist. This can be done with the `bootlist -m normal` command if the system is accessible. If the system is not accessible, this can be done by booting from media and changing the bootlist through the SMS menus.

All PCI systems have a default bootlist. On modern PCI systems, this default bootlist can be accessed by using the **F5** function key. On older PCI systems, this cannot be done. Instead, a single bootlist is provided that can be reset to the default values by removing the battery for about 30 seconds. This is because the bootlist is stored in NVRAM, and the NVRAM is only non-volatile as long as the battery is maintaining the memory.

Newer PCI architecture machines, for example, the 43P-150, supports a service bootlist. The simplest way to find out if a particular system supports the service boot option is to execute:

```
# bootlist -m service -o
0514-220 bootlist: Invalid mode (service) for this model
```

The error message above indicates that the system does not support the service boot option.

All new PCI systems support the following key allocation standard:

- F1 or 1 on ASCII terminal: Starts System Management Services
- F5 or 5 on ASCII terminal: Boot diag, use default boot list of fd, cd, scdisk, network adapter
- F6 or 6 on ASCII terminal: Boot diag, use of custom service boot list

4.2.2.3 POST LED codes on PCI systems

On old PCI systems, such as the 7020-40P or the 7248-43P, the LED display is missing; so, there will be no LED codes to help solve boot problems. Fortunately, this has been changed on modern PCI systems, but the error codes generated during this phase of the system startup differs from model to model. The only way to figure out the exact meaning of an error code is to refer to the *Service Guide* delivered with the system. IBM provides a Web page where *Service Guides* for most PCI systems are available in HTML and PDF format. The URL is:

http://www.rs6000.ibm.com/resource/hardware_docs/

4.3 Boot phase 1

So far, the system has tested the hardware, found a BLV, created the RAMFS, and started the init process from BLV. The rootvg has not yet been activated. From now on, the boot sequence is the same on both MCA systems and PCI systems.

The workflow for boot phase 1 is shown in Figure 19.

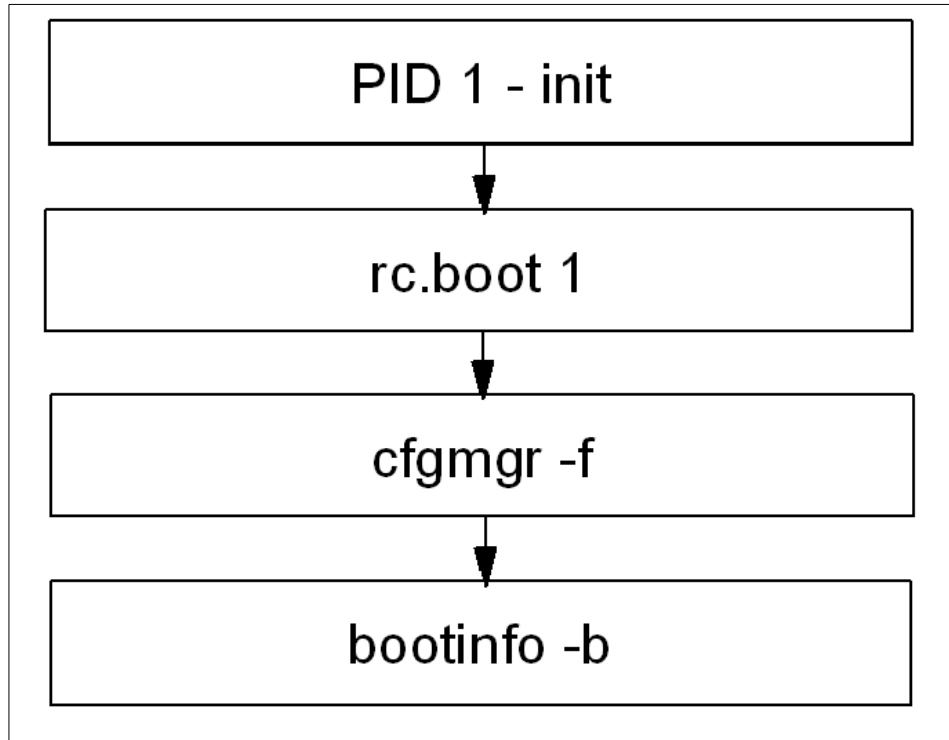


Figure 19. Boot phase 1

During this phase, the following steps are taken.

- The init process started from RAMFS executes the boot script rc.boot 1. At this stage, the `restbase` command is called to copy the reduced ODM from the BLV into the RAMFS. If this operation fails, you will see a LED code of 548.
- After this, `cfgmgr -f` reads the Config_Rules class from the reduced ODM. In this class, devices with the attribute `phase=1` will be considered base devices. Base devices are all devices that are necessary to access rootvg. The process invoked with rc.boot 1 attempts to configure devices so that rootvg can be activated in the next rc.boot phase.
- At the end of boot phase 1, the `bootinfo -b` command is called to determine the last boot device. At this stage, the LED shows 511.

4.4 Boot phase 2

In boot phase 2 the rc.boot script is passed the parameter 2. The first part of this phase is shown in Figure 20.

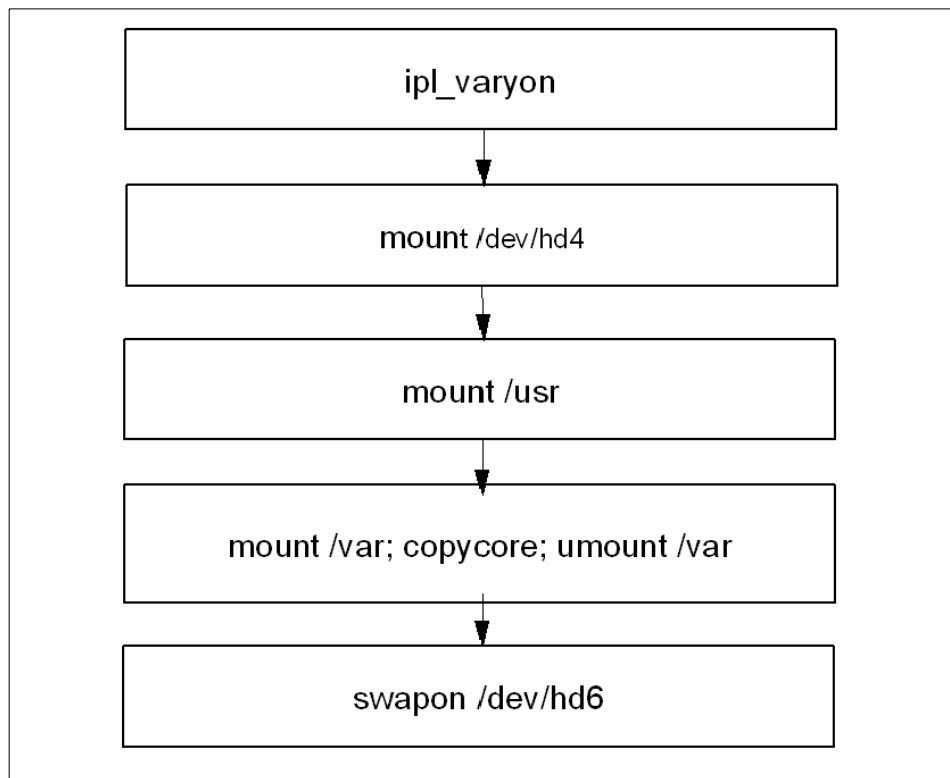


Figure 20. Boot phase 2, part one

During this phase, the following steps are taken.

- Rootvg will be varied on with the special `ipl_varyon` utility. If this command is not successful, one of the following LED codes will appear - 552, 554, 556.
- After the successful execution of `ipl_varyon`, the root file system (`/dev/hd4`) will be mounted on a temporary mount point (`/mnt`) in RAMFS. If this fails, 555 or 557 will appear in the LED display.
- Next, the `/usr` and `/var` file system is mounted. If this fails, the LED 518 appears. The mounting of `/var` at this point enables the system to copy an

eventual dump from default dump devices, /dev/hd6, to default copy directory, /var/adm/ras. This is done with the `copycore` command.

- After this, rootvg's primary paging space, /dev/hd6, will be activated.

The second part of this phase is shown in Figure 21.

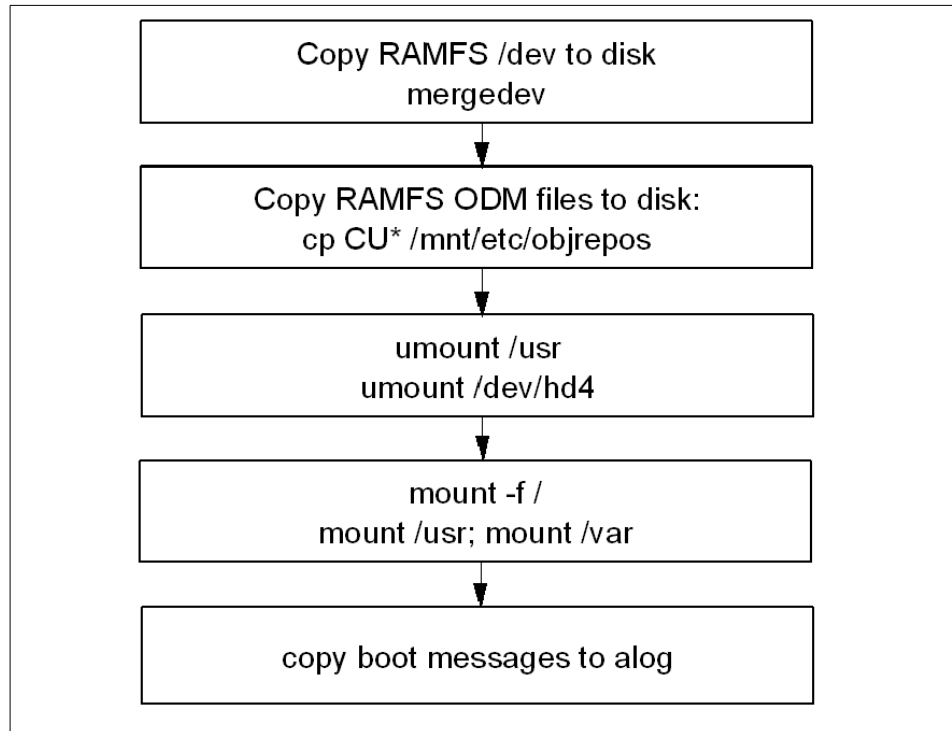


Figure 21. Boot phase 2, part two

- Next, the copy of rootvg's RAMFS ODM, and /dev directories will occur (`mergedev`). This is possible because of the temporary mount point, /mnt, is used for the mounted root file system.
- Next, the /usr and /var from the RAMFS is unmounted.
- Finally, the root file system from rootvg (disk) is mounted over the root file system from the RAMFS. The mount points for the rootvg file systems become available. Now, the /var and /usr file systems from the rootvg can be mounted again on their ordinary mount points.
- There is no console available at this stage; so all boot messages will be copied to the error log.

As mentioned, there are a lot of different problem possibilities in this phase of the boot. The following section discusses how to correct some of them.

4.4.1 LED 551, 555, or 557

There can be several reasons for a system to halt with LED codes - 551,555, or 557. For example:

- A damaged file system
- A damaged Journaled File System (JFS) log device
- A failing disk in the machine that is a member of the rootvg

To diagnose and fix these problems, you will need to boot from a bootable media, access the maintenance menus, choose **Access a Volume Group and start a shell before mounting file systems**, and then do one or all of the following actions.

To ensure file system integrity, run the `fsck` command to fix any file systems that may be corrupted:

```
# fsck -y /dev/hd1
# fsck -y /dev/hd2
# fsck -y /dev/hd3
# fsck -y /dev/hd4
# fsck -y /dev/hd9var
```

To correct the function of the log device, run `logform` on `/dev/hd8` to re-create the logdevice:

```
# /usr/sbin/logform /dev/hd8
```

Or, if the BLV is corrupted, re-create the BLV and update the bootlist:

```
# bosboot -a -d /dev/hdisk0
# bootlist -m normal hdisk0
```

4.4.2 LED 552, 554, 556

An LED code of 552, 554, or 556 during a standard disk based boot indicates a failure occurred during the varyon of the rootvg volume group. This can be the cause of:

- A damaged file system
- A damaged Journaled File System log device
- A damaged IPL-device record or a damaged IPL-device magic number (the magic number indicates the device type)

- A damaged copy of the Object Data Manager (ODM) database on the boot logical volume
- A hard disk in the inactive state in the root volume group
- A damaged superblock

To diagnose and fix the problem, you will need to boot from the installation media and navigate the menus to access the volume group and start a shell before mounting the file systems.

If fsck indicates that block 8 could not be read when used, as shown in Section 4.4.1, “LED 551, 555, or 557” on page 74, the file system is probably unrecoverable. The easiest way to fix an unrecoverable file system is to re-create it. This involves deleting it from the system and restoring it from a backup. Note that /dev/hd4 (root file system) cannot be re-created. If /dev/hd4 is unrecoverable, you must reinstall AIX.

A corrupted ODM in the BLV is also a possible cause for these LED codes. To create a correct one, run the following commands that remove the system's configuration and save it to a backup directory:

```
# /usr/sbin/mount /dev/hd4 /mnt
# /usr/sbin/mount /dev/hd2 /usr
# /usr/bin/mkdir /mnt/etc/objrepos/bak
# /usr/bin/cp /mnt/etc/objrepos/Cu* /mnt/etc/objrepos/bak
# /usr/bin/cp /etc/objrepos/Cu* /mnt/etc/objrepos
# /usr/sbin/umount all
# exit
```

After this, you must copy this new version of the ODM in the RAMFS to the BLV. This is done with the `savebase` command. Before that, make sure you place it on the disk used for normal boot by executing:

```
# lslv -m hd5
```

Save the clean ODM database to the boot logical volume. For example:

```
# savebase -d /dev/hdisk0
```

Finally, re-create the BLV and reboot the system. For example:

```
# bosboot -ad /dev/hdisk0
# shutdown -Fr
```

Another possible reason for these error codes is a corrupted superblock. If you boot in maintenance mode and get error messages, such as not an AIX

file system, or not a recognized file system type, it is probably due to a corrupted superblock in the file system.

Each file system has two super blocks, one in logical block 1 and a copy in logical block 31. To copy the superblock from block 31 to block 1 for the root file system, issue the following command:

```
# dd count=1 bs=4k skip=31 seek=1 if=/dev/hd4 of=/dev/hd4
```

4.4.3 LED 518

The 518 LED code has an unclear definition in the *Messages Guide and Reference*, which says:

Display Value 518

Remote mount of the / (root) and /usr file systems during network boot did not complete successfully.

This is not the entire problem. If the system runs into problems while mounting the /usr from disk (locally, not network mount) you will get the same error. Fix this problem the same way as any other rootvg file system corruption is fixed.

4.4.4 The alog command

Up until this stage, the system has not yet configured the console; so, there is no stdout defined for the boot processes. At this stage, the alog command comes to good use.

The alog command can maintain and manage logs. All boot information is sent through the alog. To look at the boot messages, use the following command:

```
# alog -ot boot
***** no stderr *****
-----
Time: 12          LEDS: 0x538
invoking top level program -- "/usr/lib/methods/definnet > /dev/null
2>&1;opt=~ /u
sr/sbin/lsattr -E -l inet0 -a bootup_option -F value`
      if [ $opt = "no" ];then nf=/etc/rc.net
      else nf=/etc/rc.bsdnet
      fi;$nf -2;x=$?;test $x -ne 0&&echo $nf failed. Check for invalid
command
s >&2;exit $x"
Time: 21          LEDS: 0x539
return code = 0
***** no stdout *****
```

At this point, the `bootup_option` is checked to determine if a BSD-style configuration of TCP/IP services is to be used, or if the default of ODM supported configuration should be used. During this stage, the LED codes 538 and 539 are shown as shown in the preceding example.

4.5 Boot phase 3

So far, the following boot tasks has been accomplished:

- Hardware configuration performed during BIST and / or POST
- The load of BLV
- Phase 1 where base devices are configured to prepare the system for activating the rootvg
- Phase 2 where rootvg is activated

Finally, phase 3, initiated by the `init` process loaded from rootvg, is shown in Figure 22.

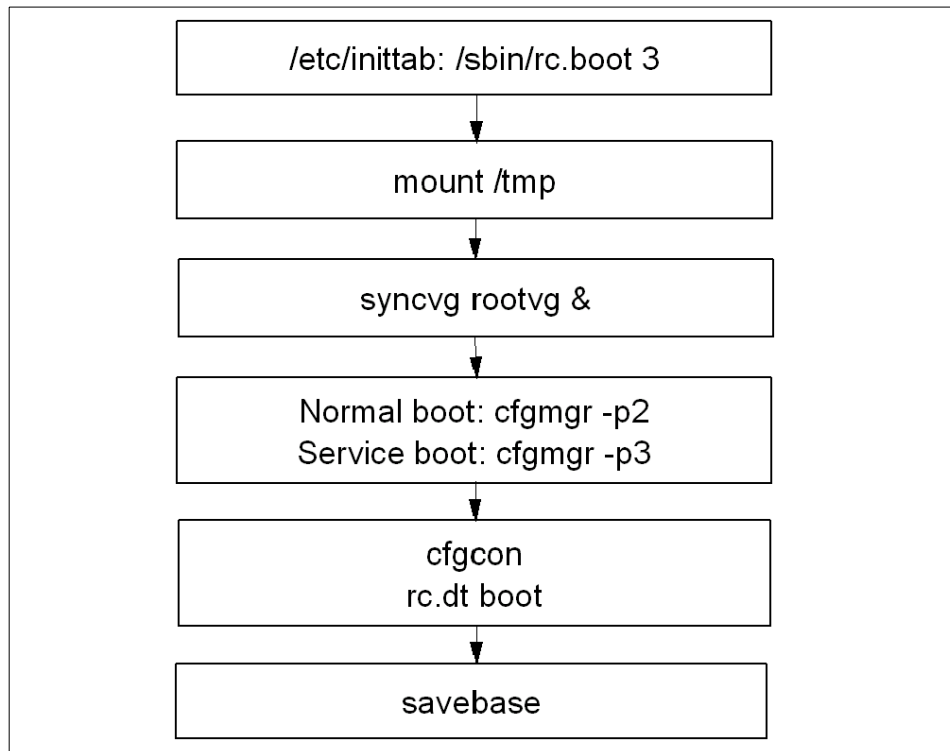


Figure 22. Boot phase 3

- Phase 3 is started in `/etc/inittab`.
- First it will mount `/tmp`.
- After this, the `rootvg` will be synchronized. This can take some time. That is why the `syncvg rootvg` is executed as a background process. At this stage, the LED code 553 is shown.
- At this stage, the `cfgmgr -p2` for normal boot and the `cfgmgr -p3` for service mode also is executed. `cfgmgr` reads the `Config_rules` file from ODM and checks for devices with `phase=2` or `phase=3`.
- Next, the console will be configured. LED codes shown when configuring the console is shown in “`cfgcon LED codes`” on page 78.
- And finally, the synchronization of the ODM in the BLV with the ODM from the `/` (root) file system is done by the `savebase` command.

When `cfgcons` is called, different LED codes are shown depending on which device is configured.

cfgcon LED codes

1. `c31`: Console not yet configured. Provides instructions to select console.
2. `c32`: Console is a `lft` terminal.
3. `c33`: Console is a `tty`.
4. `c34`: Console is a file on the disk.

4.5.1 /etc/inittab

The `/etc/inittab` file supplies configuration scripts to the `init` process. In Figure 23 on page 79, the highlighted line is the `rc.boot` with parameter 3 executed.


```

(C) COPYRIGHT International Business Machines Corp. 1989, 1993
: All Rights Reserved
: Licensed Materials - Property of IBM
:
: US Government Users Restricted Rights - Use, duplication or
: disclosure restricted by GSA ADP Schedule Contract with IBM Corp.
:
: Note - initdefault and sysinit should be the first and second entry.
:
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
rc:2:wait:/etc/rc 2>&1 | alog -tboot > /dev/console # Multi-User checks
fbcheck:2:wait:/usr/sbin/fbcheck 2>&1 | alog -tboot > /dev/console # run /etc/fi
rstboot
srcmstr:2:respawn:/usr/sbin/srcmstr # System Resource Controller
rctcpip:2:wait:/etc/rc.tcpip > /dev/console 2>&1 # Start TCP/IP daemons
rcnfs:2:wait:/etc/rc.nfs > /dev/console 2>&1 # Start NFS Daemons
cron:2:respawn:/usr/sbin/cron
piobe:2:wait:/usr/lib/lpd/pio/etc/pioinit >/dev/null 2>&1 # pb cleanup
qdaemon:2:wait:/usr/bin/startsrc -sqdaemon
writesrv:2:wait:/usr/bin/startsrc -swritesrv

```

Figure 23. Example of rc.boot 3 in /etc/inittab

The /etc/inittab file is composed of entries that are position dependent and have the following format:

```
Identifier:RunLevel:Action:Command
```

The first line in /etc/inittab (initdefault) defines what runlevel is to be considered as a default runlevel. In this example, the runlevel is 2, which means a normal multi-user boot. If this line is missing, you are prompted at boot to define the runlevel. You can also use the `telinit` command to direct a particular run level.

The rc.boot line is to be executed on all run levels (this equals runlevel 0123456789). The action defined, sysinit, has to finish before continuing with the next line in /etc/inittab. From rc.boot 3, among a lot of other things, the rootvg is synchronized, the mirrord is started, and the /tmp directory mounted. A detailed description of /etc/inittab is provided in *IBM Certification Study Guide AIX V4.3 System Support*, SG24-5129.

4.5.2 LED 553

An LED code of 553 is caused when the /etc/inittab cannot be read. To recover from an LED 553, check /dev/hd3 and /dev/hd4 for space problems and erase files if necessary. Check the /etc/inittab file for corruption and fix it if necessary. Typical examples of syntax errors found in /etc/inittab that are

seen at the support centers are incorrectly defined entries in the file. When editing /etc/inittab, the inittab commands should be issued. For example:

- mkitab
- chitab

It is helpful to remember that /etc/inittab is very sensitive to even the smallest syntax error. A misplaced dot can halt the system boot.

4.5.3 LED c31

LED c31 is not really an error code, but the system is waiting for input from you on the keyboard. This is usually encountered when booting from CD-ROM or mksysb tape. This is normally the dialog to select the system console.

4.6 Summary

The next sections provide short summaries of the boot phases and some common LED codes.

4.6.1 Boot phases

BIST and POST are used to test hardware and to find a successful hardware path to a BLV.

Boot phase 1 (init rc.boot 1) is used to configure base devices.

Boot phase 2 (init rc.boot 2) is used to activate the rootvg.

Boot phase 3 (init /sbin/rc.boot 3) is used to configure the rest of devices.

4.6.2 LED codes

LED codes shown during POST on a MCA system are listed in Table 11.

Table 11. MCA POST LED

LED	Reason / Action
100 - 195	Hardware problem during BIST
200	Key mode switch in secure position
201	1. If LED 299 passed re-create the BLV 2. If LED 299 has not passed, POST encountered a hardware error

LED	Reason / Action
221 721 221 - 229 223 - 229 225 - 229 233 - 235	The bootlist in NVRAM is incorrect (boot from media and change the bootlist), or the bootlist device has no bootimage (boot from media and recreate the BLV), or the bootlist device is unavailable (check for hardware errors).

LED codes shown during boot phase 2 are shown in Table 12.

Table 12. Boot phase 2 LED codes

LED	Reason / Action
551 555 557	1. Corrupted file system (fsck -y <device>) 2. Corrupted jfslog (/usr/sbin/logform /dev/hd8) 3. Corrupted BLV - (bosboot -ad <device>)
552 554 556	The ipl_varyon failed. Except for the reason mentioned above (551, 555, or 557): 1. Corrupted ODM (backup ODM, recreate with savebase) 2. Superblock dirty (Copy in superblock from block 31)
518	/usr cannot be mounted 1. If /usr should be mounted over the network (check for network problem) 2. If /usr is to be mounted locally (fix the file system)

LED codes shown during boot phase 3 are shown in Table 13.

Table 13. Boot phase 3 LED codes

LED	Reason / Action
553	Syntax error in /etc/inittab
c31	Define the console

4.7 Quiz

The following assessment questions will help verify your understanding of the topics discussed in this chapter.

1. In order to log important events during a system boot process and view boot information, which of the following AIX V4 commands must be performed?
 - A. `alog`
 - B. `errpt`
 - C. `logger`
 - D. `bootlist`
2. `rootvg` has just been mirrored. In order to make `hdisk1` bootable, which of the following procedures should be performed?
 - A. Update `bootlist` and reboot.
 - B. Add `hdisk1` to `bootlist` and reboot.
 - C. Add `hdisk1` to `bosboot` and reboot.
 - D. Run `bosboot` and update the `bootlist`.

4.7.1 Answers

The following are the preferred answers to the questions provided in this section.

1. A
2. D

4.8 Exercises

The following exercises provide sample topics for self study. They will help ensure comprehension of this chapter.

Do not perform these exercises on an existing file system or on a production system:

1. Create a file system for this exercise and copy in some files to the file system. Then, destroy the first super block. This can be done by copying 4 KB from `/dev/zero` to block one on your logical volume, for example:

```
dd count=1 bs=4k seek=1 if=/dev/zero of=/dev/thomasclv
```

Try to mount the file system and run `fsck` on the file system to determine the problem. Finally, fix the problem as described in this chapter.

2. While still on your test system, with verified `mksysb` at hand, make a backup of `/etc/inittab`. Remove the first line (first uncommented line, that is the `sysinit` stanza) and try to reboot. You are, at reboot, prompted for what?

After the boot has finished, edit the `/etc/inittab` and change a dot to a comma or a colon to semicolon on a line with `action=wait`. What happens? What is the LED code displayed? What do you have to do to fix this?

Chapter 5. Disks and file systems

In AIX, the logical volume manager (LVM) provides a hierarchy of structures to manage fixed disk storage. Each individual fixed-disk drive is called a physical volume (PV) and has a logical name, such as `hdisk0`, and a corresponding device special file name, such as `/dev/hdisk0`. A RAID is named `/dev/hdiskX`, but is a special case of a collection of disks. Every physical volume in use belongs to a volume group (VG). All of the physical volumes in a volume group are divided into physical partitions (PPs) of the same size.

Within each volume group, one or more logical volumes (LVs) are defined. Logical volumes are groups of information located on physical volumes. Data on logical volumes appears to be contiguous to the user but can be discontinuous on the physical volume. This allows file systems, paging space, and other logical volumes to be resized or relocated, span multiple physical volumes, and have their contents mirrored for greater flexibility and availability in the storage of data.

Each logical volume consists of one or more logical partitions (LPs). Each logical partition corresponds to at least one physical partition. If mirroring is specified for the logical volume, additional physical partitions are allocated to store the additional copies of each logical partition. Although the logical partitions are numbered consecutively, the underlying physical partitions are not necessarily consecutive or contiguous.

Logical volumes can serve a number of system purposes, such as paging, but each logical volume that holds ordinary system or user data or programs contains a single journaled file system (JFS). Each JFS consists of a pool of page-size (4 KB) blocks. When data is to be written to a file, one or more additional blocks are allocated to that file. These blocks may or may not be contiguous with one another or with other blocks previously allocated to the file.

After installation, a system has one volume group (the `rootvg` volume group) consisting of a base set of logical volumes required to start the system and any others you specify to the installation script. Any other physical volumes you have connected to the system can be added to a volume group (using the `extendvg` command). You can add the physical volume either to the `rootvg` volume group or to another volume group (defined by using the `mkvg` command). Logical volumes can be tailored using commands or the SMIT interface.

5.1 Volume groups

If the physical hardware is the foundation for a system, then the volume groups are the cornerstones. Volume group management is one of the most important considerations in managing your system. It is from here that the administrator or support professional creates the future path of the system. Not planning how to manage or create volume groups in the beginning could lead to complications in the future.

5.1.1 Creating a volume group

Creating a volume group is the first step in setting up a system. The command used to create a volume group is `mkvg`. However, it is easier to create a volume group using SMIT.

Some considerations when creating a new volume group are as follows:

- The physical volume is checked to verify that it is not already in another volume group. If the system believes the physical volume belongs to a volume group that is varied on, it exits. But, if the system detects a description area from a volume group that is not varied on, it prompts you for confirmation in continuing with the command. The previous contents of the physical volume are lost; so, you must be cautious when using the override function.
- Before you attempt to add a new volume group, check the root file system (with the `df` command) to ensure that 1 to 2 MB of free space exists. If you run the `mkvg` command on a full rootvg file system, the `mkvg` command fails when it tries to vary on the newly created volume group. If this occurs, add or free 2 MB of space in the `/etc` directory for file updates.
- To use the `mkvg` command, you must either have root user authority or be a member of the system group.
- For disks greater than 4 GB, make sure that the Physical Partition Size (-s) is set to a large enough value so that 1016 physical partitions per PV limit is not violated. With the default value, 4 MB, along with the default maximum number of physical partitions (1016), a disk up to 4 GB can only be accommodated. Or, with AIX Version 4.3.2, use a large enough factor value (-t) such that factor x 1016 is greater than the number of partitions that would need to be created with given partition size and disk size. For example, a partition size of at least 16 MB would be needed to create a volume group with a 10 GB disk. Or, with a factor size of 2, a smaller partition size of 8 MB can be used. However, this limits the total number of disks that can be added to the volume group. If a factor value is used, a maximum of 32/factor disks can be included in the volume group.

- Whenever a volume group is created, the operating system automatically does a vary on. However, if you create a volume group with the `-c` flag (for use in HACMP clusters), the system will not auto vary on the volume group at the end of the Concurrent Capable volume group creation. Instead, the `mkvg` command notifies you to manually `varyonvg` the volume group in either non-concurrent or concurrent mode. Note that, to vary on the volume group with concurrent more, you have to configure HACMP.

The following examples show how these steps are performed.

Check for existing volume groups using the `lsvg` command:

```
# lsvg
rootvg
volg01
volg02
```

Check for available physical volumes using the `lspv` command

```
# lspv
hdisk0          000bc6fdc3dc07a7    rootvg
hdisk1          000bc6fdbff75ee2    volg01
hdisk2          000bc6fdbff92812    volg02
hdisk3          000bc6fdbff972f4    None
```

The PV `hdisk3` is available for a new user VG. The volume group, `volg03`, will be created on the physical volume `hdisk3`.

The `chdev -l hdisk3 -a pv=yes` command can be used to make a disk available from a no longer needed volume group.

Check the attributes of the disk as follows:

```
# lsattr -E -l hdisk3
pvid          000bc6fdbff972f40000000000000000 Physical volume identifier False
queue_depth  3                               Queue DEPTH                False
size_in_mb    9100                               Size in Megabytes          False
```

Notice the size of `hdisk3` in megabytes. It is has a capacity of 9100 MB.

SMIT can also be used (Figure 24 on page 88) as follows:

```
# smitty vg
```

```

                                Volume Groups

Move cursor to desired item and press Enter.

  List All Volume Groups
  Add a Volume Group
  Set Characteristics of a Volume Group
  List Contents of a Volume Group
  Remove a Volume Group
  Activate a Volume Group
  Deactivate a Volume Group
  Import a Volume Group
  Export a Volume Group
  Mirror a Volume Group
  Unmirror a Volume Group
  Synchronize LVM Mirrors
  Back Up a Volume Group
  Remake a Volume Group
  List Files in a Volume Group Backup
  Restore Files in a Volume Group Backup

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

```

Figure 24. The Volume Groups screen

Select the **Add a Volume Group** option as shown in Figure 25.

```

                                Add a Volume Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                [Entry Fields]
VOLUME GROUP name                [volg03]
Physical partition SIZE in megabytes 16 +
* PHYSICAL VOLUME names          [hdisk3] +
Activate volume group AUTOMATICALLY yes +
  at system restart?
Volume Group MAJOR NUMBER         []  +#
Create VG Concurrent Capable?     no  +
Auto-varyon in Concurrent Mode?   no  +

F1=Help          F2=Refresh      F3=Cancel      F4=List
F5=Reset         F6=Command     F7=Edit        F8=Image
F9=Shell         F10=Exit       Enter=Do

```

Figure 25. The Add a Volume Group selection screen

Enter the volume group name (`volg03`) and hdisk number (`hdisk3`). Select the physical partition size, in this case 16 (Figure 26), because you do not want to exceed the default maximum of 1016 PPs per disk. The disk is bigger than 4 GB, and the limitation of PPs is not allowed to be violated, $16 \times 1016 = 16256$, which is larger than the disk size but using a PP size of 8 will be $8 \times 1016 = 8128$, which will not utilize the full disk capacity.

```

                                Add a Volume Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                [Entry Fields]
VOLUME GROUP name                [volg03]
Physical partition SIZE in megabytes  [16]      +
* PHYSICAL VOLUME names           [hdisk3]      +
Activate volume group AUTOMATICALLY  yes        +
  at system restart?
Volume Group MAJOR NUMBER           []          +
                                          +
                                          +
                                ARE YOU SURE?
Continuing may delete information you may want
to keep. This is your last chance to stop
before continuing.
  Press Enter to continue.
  Press Cancel to return to the application.
F1  █ F1=Help                F2=Refresh                F3=Cancel
F5  F8=Image                 F10=Exit                  Enter=Do
F9

```

Figure 26. The Add a Volume Group warning screen

The system prompts for confirmation on the creation of the volume disk. Press **Enter** to continue, and a screen similar to Figure 27 on page 90 will appear.

```

                                COMMAND STATUS

Command: OK          stdout: yes          stderr: no

Before command completion, additional instructions may appear below.

volg03
█

F1=Help          F2=Refresh          F3=Cancel          Esc+6=Command
Esc+8=Image      Esc+9=Shell         Esc+0=Exit         /=Find
n=Find Next

```

Figure 27. The Add a Volume Group Command status screen

The command status screen indicates successful completion of the volume group creation. Press **F10=Exit** to exit to the system prompt to check the volume group with the commands shown in the following examples.

Note

The volume group could also have been created using the following command:

```
# mkvg -f -y volg03 -s16 hdisk3
```

Check the physical volume and notice that `hdisk3` has been assigned to the volume group `volg03`.

```
# lspv
hdisk0          000bc6fdc3dc07a7    rootvg
hdisk1          000bc6fdbff75ee2    volg01
hdisk2          000bc6fdbff92812    volg02
hdisk3          000bc6fdbff972f4    volg03
```

5.1.2 Migrating data to another disk in the same volume group

When migrating data from one physical volume to another in the same volume group, use the `migratepv` command. There are a few considerations before doing this:

- The `migratepv` command cannot migrate a striped logical volume. To do this, use the `cplv` and `rmlv` commands.
- The new physical volume must be part of the same volume group.
- Ensure that all file systems on the logical volume are unmounted.
- Only the root user has authority to use the `migratepv` command.

The following commands show examples of migrating data to other disks in the same volume group.

Check which physical volumes are in the system and to which volume groups they are assigned by using the `lspv` command:

```
# lspv
hdisk0          000bc6fdc3dc07a7   rootvg
hdisk1          000bc6fdbff75ee2   volg01
hdisk2          000bc6fdbff92812   volg01
hdisk3          000bc6fdbff972f4   volg02
```

Check the `hdisk1` and `hdisk2` that belong to `volg01` volume group:

```
# lspv hdisk1
PHYSICAL VOLUME:   hdisk1                VOLUME GROUP:   volg01
PV IDENTIFIER:    000bc6fdbff75ee2     VG IDENTIFIER
000bc6fdc07cc316
PV STATE:         active
STALE PARTITIONS: 0                      ALLOCATABLE:    yes
PP SIZE:          16 megabyte(s)      LOGICAL VOLUMES: 2
TOTAL PPs:        542 (8672 megabytes)  VG DESCRIPTORS: 2
FREE PPs:        482 (7712 megabytes)
USED PPs:        60 (960 megabytes)
FREE DISTRIBUTION: 109..48..108..108..109
USED DISTRIBUTION: 00..60..00..00..00

# lspv hdisk2
PHYSICAL VOLUME:   hdisk2                VOLUME GROUP:   volg01
PV IDENTIFIER:    000bc6fdbff92812     VG IDENTIFIER
000bc6fdc07cc316
PV STATE:         active
STALE PARTITIONS: 0                      ALLOCATABLE:    yes
PP SIZE:          16 megabyte(s)      LOGICAL VOLUMES: 1
```

```

TOTAL PPs:          542 (8672 megabytes)      VG DESCRIPTORS:   1
FREE PPs:        541 (8656 megabytes)
USED PPs:        1 (16 megabytes)
FREE DISTRIBUTION:  109..107..108..108..109
USED DISTRIBUTION:  00..01..00..00..00

```

The information on `hdisk1` in `volg01` will be moved to `hdisk2` in the same `volg01` volume group. Use the `migratepv` command as follows:

```
# migratepv hdisk1 hdisk2
```

After migrating the physical volume, check the physical volumes:

```

# lspv hdisk1
PHYSICAL VOLUME:   hdisk1                VOLUME GROUP:     volg01
PV IDENTIFIER:     000bc6fdbff75ee2                VG IDENTIFIER
000bc6fdc07cc316
PV STATE:          active
STALE PARTITIONS:  0                    ALLOCATABLE:      yes
PP SIZE:           16 megabyte(s)          LOGICAL VOLUMES:  0
TOTAL PPs:         542 (8672 megabytes)    VG DESCRIPTORS:   2
FREE PPs:        542 (8672 megabytes)
USED PPs:        0 (0 megabytes)
FREE DISTRIBUTION:  109..108..108..108..109
USED DISTRIBUTION:  00..00..00..00..00

# lspv hdisk2
PHYSICAL VOLUME:   hdisk2                VOLUME GROUP:     volg01
PV IDENTIFIER:     000bc6fdbff92812                VG IDENTIFIER
000bc6fdc07cc316
PV STATE:          active
STALE PARTITIONS:  0                    ALLOCATABLE:      yes
PP SIZE:           16 megabyte(s)          LOGICAL VOLUMES:  3
TOTAL PPs:         542 (8672 megabytes)    VG DESCRIPTORS:   1
FREE PPs:        481 (7696 megabytes)
USED PPs:        61 (976 megabytes)
FREE DISTRIBUTION:  109..47..108..108..109
USED DISTRIBUTION:  00..61..00..00..00

```

The migration has successfully completed. The `hdisk1` can now be removed from the volume group. The highlighted portions of the preceding examples show the PPs as they are migrated to different disks.

5.1.3 Importing a volume group from another system

When a disk or set of disks containing data that must be moved to another system, it is important to take the right steps. Generally once all the users of

the data have been identified and any applications using the disks have been stopped, and the file systems unmounted, the follow steps should be taken:

- Run the `varyoffvg` command to make the volume group offline.
- Run the `exportvg` command to remove the volume group from the system.
- Run the `rmdev -l hdiskn -d` command to delete the physical volume definition (this command does not remove any data from the physical fixed disk storage).

If a new disk is added into an existing environment, and this disk has data on it that needs to be accessed, the new disk will need to be imported. However, this is not the only requirement. The new disk needs to be configured to the system first using the `cfgmgr` command. The `cfgmgr` command configures devices and optionally installs device software into the system.

Note

Before importing the volume group, you should examine there are no same logical volume and/or file system names between the existing volume groups and the newly importing volume group. Otherwise, the AIX LVM changes the logical volume and file system names to uniquely assigned name to import this volume group successfully.

Once the disk has been set up in the new environment, the data needs to be imported using the `importvg` command. The `importvg` command imports a new volume group definition from a set of physical volumes.

Once the volume group has been imported, the `varyonvg` command may need to be run depending on the AIX version (AIX Version 4.3 or later automatically does the `varyonvg` option). The `varyonvg` command activates the volume group specified by the `VolumeGroup` parameter and all associated logical volumes.

Before mounting the file system, it will need to be checked using the `fsck` command. This may or may not give errors, but it should be run to ensure file system integrity. The `fsck` command checks file system consistency and interactively repairs the file system.

The following is an example of this scenario.

A disk has been added to the environment, and the user wants to have the data on that disk available for use. These are the steps to follow:

```
# lspv
hdisk0          000bc6fdc3dc07a7  rootvg
```

```

hdisk1      000bc6fdbff75ee2  volg01
hdisk2      000bc6fdbff92812  volg01
hdisk3      000bc6fdbff972f4  volg02

```

Run the configuration manager and detect the new disk:

```

# cfmgr
# lspv
hdisk0      000bc6fdc3dc07a7  rootvg
hdisk1      000bc6fdbff75ee2  volg01
hdisk2      000bc6fdbff92812  volg01
hdisk3      000bc6fdbff972f4  volg02
hdisk4      000bc6ddc0c0973a  None

```

Notice that `hdisk4` is not assigned to a volume group:

```

# lspv hdisk4
0516-320 : Physical volume 000bc6ddc0c0973a is not assigned to
          a volume group.

```

Import the `hdisk` into the volume group `volg03`:

```

# importvg -y volg03 hdisk4
0516-530 sync1vodm: Logical volume name loglv00 changed to loglv02.
volg03

```

The volume group on `hdisk4` has been imported into the volume group `volg03`, and it has also renamed the `jfslog`. Vary the volume group on:

```

# varyonvg volg03

```

List the volume group to check what the logical volume is:

```

# lsvg -l volg03
volg03:
LV NAME      TYPE      LPs  PPs  PVs  LV STATE      MOUNT POINT
loglv02      jfslog    1    1    1    closed/syncd  N/A
lv02         jfs       1    1    1    closed/syncd  /test

```

Run the `fsck` to check the file system on the logical volume `lv02`:

```

# fsck /test
** Checking /dev/lv02 (/test)
** Phase 0 - Check Log
log redo processing for /dev/lv02
** Phase 1 - Check Blocks and Sizes
** Phase 2 - Check Pathnames
** Phase 3 - Check Connectivity
** Phase 4 - Check Reference Counts

```



```

** Phase 5 - Check Inode Map
** Phase 6 - Check Block Map
559 files 8944 blocks 23824 free

```

Mount the file system `/test` (providing there is no `/test` file system already defined):

```
# mount /test
```

Check that the file system is mounted:

```

# mount
node      mounted      mounted over  vfs      date      options
-----
...
      /dev/hd3      /tmp          jfs      Jun 11 16:41 rw,log=/dev/hd8
      /dev/hd1      /home         jfs      Jun 11 16:42 rw,log=/dev/hd8
      /dev/lvol01   /filsys01     jfs      Jun 15 13:44 rw,log=/dev/loglv00
      /dev/lvol02   /filsys02     jfs      Jun 15 13:44 rw,log=/dev/loglv00
      /dev/lvol03   /filsys03     jfs      Jun 15 14:18 rw,log=/dev/loglv01
      /dev/lv02     /test         jfs      Jun 15 18:03 rw,log=/dev/loglv02

```

The system is now available for the user. If the volume group, `volg03`, is to be integrated into the volume group, `volg02`, use the `migratepv` command as described in 5.1.2, “Migrating data to another disk in the same volume group” on page 91.

5.1.4 Replacing a disk with another

If a disk in a volume group must be replaced with another disk, the `replacepv` command can be used. The `replacepv` command replaces allocated physical partitions and the data they contain from the `SourcePhysicalVolume` to `DestinationPhysicalVolume`. The specified source physical volume cannot be the same as `DestinationPhysicalVolume`.

The allocation of the new physical partitions follows the policies defined for the logical volumes that contain the physical partitions being replaced.

Note

The `DestinationPhysicalVolume` size must be at least the size of the `SourcePhysicalVolume`.

The `replacepv` command cannot replace a `SourcePhysicalVolume` with stale logical volume unless this logical volume has a non-stale mirror.

An example of this is shown as follows:

Check the system to see if any disks are available as follows:

```
# lspv
hdisk0      000bc6fdc3dc07a7   rootvg
hdisk1      000bc6fdbff75ee2   uservg
hdisk2      000bc6fdbff92812   None
hdisk3      000bc6fdbff972f4   None
hdisk4      000bc6fd672864b9   None
```

Replace `hdisk1` with `hdisk2` as follows:

```
# replacepv hdisk1 hdisk2
0516-1232 replacepv:
NOTE: If this program is terminated before the completion due to
a system crash or ctrl-C, and you want to continue afterwards
execute the following command
replacepv -R /tmp/replacepv26606
```

Check the system as follows:

```
# lspv
hdisk0      000bc6fdc3dc07a7   rootvg
hdisk1      000bc6fdbff75ee2   None
hdisk2      000bc6fdbff92812   uservg
hdisk3      000bc6fdbff972f4   None
hdisk4      000bc6fd672864b9   None
```

During the `replacepv` operation, `hdisk1` was removed from the volume group and replaced with `hdisk2`.

5.1.5 Reducing a volume group

If a disk needs to be removed from a system due to volume group reduction or due to incorrect removal, `reducevg` command needs to be used. The `reducevg` command removes physical volumes from a volume group.

Note

If there are allocated physical partitions of logical volumes on this physical volumes, you can not remove the physical volume from the volume group. First, you have to move the allocated physical partitions of logical volumes on this physical volumes to another physical volumes.

The following commands provide an example of this task.

In this example, `hdisk2` has been removed.

Display a list of physical volumes in a system using the `lspv` command. Below is the listing before `hdisk2` was removed:

```
# lspv
hdisk0          000bc6fdc3dc07a7    rootvg
hdisk1          000bc6fdbff75ee2    volg01
hdisk2          000bc6fdbff92812    volg01
hdisk3          000bc6fdbff972f4    volg02
hdisk4          000bc6ddc0c0973a    volg03
```

After a system reboot, the new configuration shows that `hdisk2` is missing:

```
# lspv
hdisk0          000bc6fdc3dc07a7    rootvg
hdisk1          000bc6fdbff75ee2    volg01
hdisk3          000bc6fdbff972f4    volg02
hdisk4          000bc6ddc0c0973a    volg03
```

Running the `lsdev` command shows that the disk has a status of `Defined`:

```
# lsdev -Ccdisk
hdisk0 Available 30-58-00-8,0 16 Bit SCSI Disk Drive
hdisk1 Available 30-58-00-9,0 16 Bit SCSI Disk Drive
hdisk2 Defined 10-60-00-8,0 16 Bit SCSI Disk Drive
hdisk3 Available 10-60-00-9,0 16 Bit SCSI Disk Drive
hdisk4 Available 30-58-00-10,0 16 Bit SCSI Disk Drive
```

Checking the volume group `volg01`, it shows that the **TOTAL PPs** should be **17344 MB**:

```
# lsvg volg01
VOLUME GROUP:   volg01                VG IDENTIFIER:  000bc6fdc07cc316
VG STATE:       active                 PP SIZE:        16 megabyte(s)
VG PERMISSION:  read/write             TOTAL PPs:      1084 (17344
megabytes)
MAX LVs:        256                   FREE PPs:       1023 (16368
megabytes)
LVs:            3                      USED PPs:       61 (976 megabytes)
OPEN LVs:       0                      QUORUM:         2
TOTAL PVs:      2                      VG DESCRIPTORS: 3
STALE PVs:      0                      STALE PPs:      0
ACTIVE PVs:     1                      AUTO ON:        yes
MAX PPs per PV: 1016                   MAX PVs:        32
```

Running the `lsattr` command on the only disk assigned to `volg01` shows a size of 9100 MB. The volume group is reduced using the `reducevg` command:

```
# lsattr -E -l hdisk1
pvid          000bc6fdbff75ee20000000000000000 Physical volume identifier
False
queue_depth 3                               Queue DEPTH                False
size_in_mb  9100                           Size in Megabytes          False
```

Remove the physical volume `hdisk2` from the volume group `volg02` using the `reducevg` command:

```
# reducevg volg01 hdisk2
```

Check the volume group to ensure that it has been set correctly:

```
# lsvg volg01
VOLUME GROUP:   volg01                VG IDENTIFIER:  000bc6fdc07cc316
VG STATE:       active                 PP SIZE:        16 megabyte(s)
VG PERMISSION:  read/write             TOTAL PPs:      542 (8672 megabytes)
MAX LVs:        256                    FREE PPs:       481 (7696 megabytes)
LVs:           3                       USED PPs:       61 (976 megabytes)
OPEN LVs:       0                      QUORUM:         2
TOTAL PVs:     1                       VG DESCRIPTORS: 2
STALE PVs:     0                       STALE PPs:      0
ACTIVE PVs:    1                       AUTO ON:        yes
MAX PPs per PV: 1016                   MAX PVs:        32
```

5.1.6 Reorganizing a volume group

To reorganize a volume group, the `reorgvg` command is used. The `reorgvg` command reorganizes the placement of allocated physical partitions within the volume group according to the inter- and intra-physical partition allocation policy of each logical volume. Use the LogicalVolume parameter to reorganize specific logical volumes. Highest priority is given to the first logical volume name in the logical volume parameter list, and lowest priority is given to the last logical volume in the parameter list. The volume group must be varied on and must have free partitions before you can use the `reorgvg` command.

The following are a few considerations for using the `reorgvg` command:

- The `reorgvg` command does not reorganize the placement of allocated physical partitions for any striped logical volumes.
- At least one free physical partition must exist on the specified volume group for the `reorgvg` command to run successfully.

- To use this command, you must either have root user authority or be a member of the system group.
- If you enter the `reorgvg` command with the volume group name and no other arguments, it will only reorganize the first logical volume in the volume group. The first logical volume is the one listed by the `lsvg -l VolumeName` command.

The following commands provide an example of this task.

List the system to check what volume groups are available:

```
# lsvg
rootvg
volg01
volg02
```

Select the volume group to be reorganized, in this case, `volg02`, and then list the logical volumes in the `volg02` volume group:

```
# lsvg -l volg02
volg02:
LV NAME          TYPE      LPs   PPs   PVs  LV STATE   MOUNT POINT
lv0103           jfs       40    40    1    open/syncd /filsys03
loglv01          jfslog    1     1     1    open/syncd  N/A
```

Run the `reorgvg` command on the `volg02` volume group:

```
# reorgvg volg02
0516-962 reorgvg: Logical volume lv0103 migrated.
0516-962 reorgvg: Logical volume loglv01 migrated.
```

If the logical volume, `lv0103`, was to be reorganized, the command would have been as follows:

```
# reorgvg volg02 lv0103
```

5.2 Logical volumes

The logical volume is created within a volume group. Although there may be more than one logical volume per volume group, there can be only one file system per logical volume. The file system is super-imposed on the logical volume. The size of a logical volume can, for example, be increased without the file system size having to be increased. However, if you increase the file system size, the logical volume size may need to be increased. This is done automatically until the maximum number of logical partitions setting is exceeded.

5.2.1 Creating a logical volume and setting the attributes

As just described, a logical volume is created in a volume group. The volume group is limited up to 256 logical volumes per volume group by default. When you use the `-B` flag of the `mkvg` command during creation of the volume group, you create a BigVG capable volume group. The maximum will be 512 per volume group. In this section, a logical volume, `logvol01`, will be created on the volume group `volg01`. Although you can use the `mklv` command to create a logical volume, using a SMIT dialog is much easier.

The following commands provide an example of this task.

Check the system to see what logical volumes are assigned to the system:

```
# lsvg -o | lsvg -i -l
volg01:
LV NAME          TYPE      LPs   PPs   PVs  LV STATE    MOUNT POINT
rootvg:
LV NAME          TYPE      LPs   PPs   PVs  LV STATE    MOUNT POINT
hd5              boot      1     1     1    closed/syncd N/A
hd6              paging    64    64    1    open/syncd   N/A
hd8              jfslog    1     1     1    open/syncd   N/A
hd4              jfs       3     3     1    open/syncd   /
hd2              jfs       32    32    1    open/syncd   /usr
hd9var           jfs       1     1     1    open/syncd   /var
hd3              jfs       2     2     1    open/syncd   /tmp
hd1              jfs       3     3     1    open/syncd   /home
lv00             jfs       4     4     1    open/syncd   /usr/welcome_arcade
lv01             jfs       2     2     1    open/syncd   /usr/welcome
```

Check the volume group, `volg01`, for availability and size:

```
# lsvg volg01
VOLUME GROUP:   volg01                VG IDENTIFIER:   000bc6fdca261bbf
VG STATE:       active                 PP SIZE:         16 megabyte(s)
VG PERMISSION:  read/write             TOTAL PPs:       1084 (17344
megabytes)
MAX LVs:        256                FREE PPs:        1084 (17344
megabytes)
LVs:            0                USED PPs:         0 (0 megabytes)
OPEN LVs:       0                QUORUM:           2
TOTAL PVs:      2                VG DESCRIPTORS:  3
STALE PVs:      0                STALE PPs:        0
ACTIVE PVs:     2                AUTO ON:          yes
MAX PPs per PV: 1016             MAX PVs:          32
```

Run `smitty lv` to enter SMIT Logical Volumes menu as shown in Figure 28 on page 101.

```
# smitty lv
```

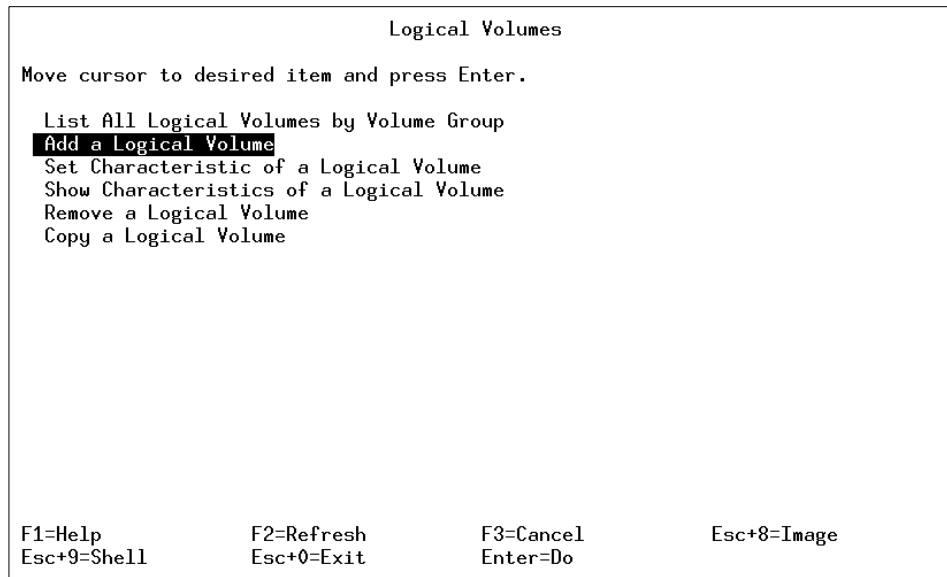


Figure 28. The SMIT Logical Volumes screen.

Select the **Add a Logical Volume Option** and press **Enter** as shown in Figure 29.

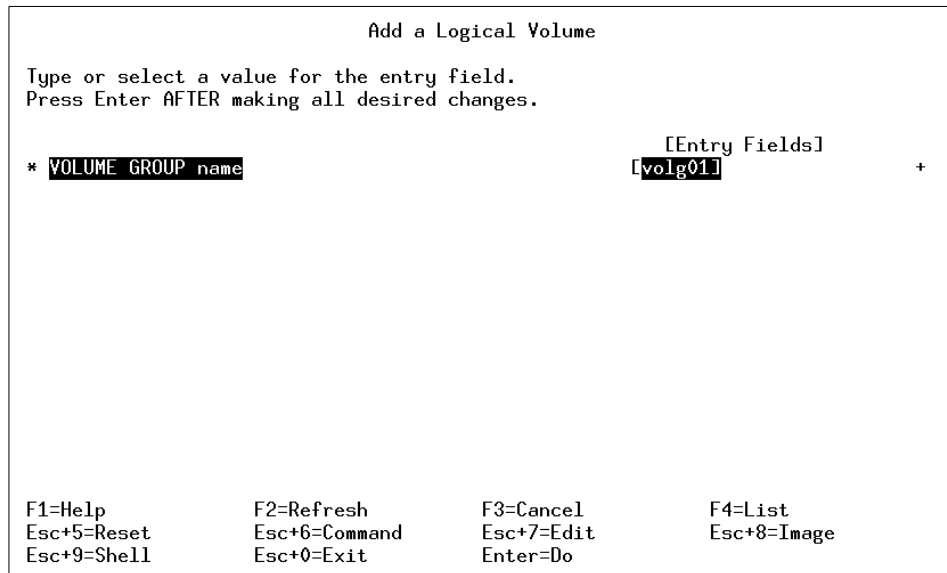


Figure 29. The Add a Logical Volume screen

Type in the volume group name or use the **F4=List** option to select the volume group name. In Figure 30, the Add a logical volume menu can be seen.


```

                                Add a Logical Volume

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

[TOP]                                [Entry Fields]
Logical volume NAME                    [logvol01]
* VOLUME GROUP name                    volg01
* Number of LOGICAL PARTITIONS          [2] #
PHYSICAL VOLUME names                  [hdisk1 hdisk2] +
Logical volume TYPE                    []
POSITION on physical volume            center +
RANGE of physical volumes              minimum +
MAXIMUM NUMBER of PHYSICAL VOLUMES    [2] #
to use for allocation
Number of COPIES of each logical      1 +
partition
Mirror Write Consistency?              yes +
Allocate each logical partition copy   yes +
[MORE...11]

F1=Help          F2=Refresh          F3=Cancel          F4=List
Esc+5=Reset      Esc+6=Command      Esc+7=Edit        Esc+8=Image
Esc+9=Shell      Esc+0=Exit        Enter=Do

```

Figure 30. The Add a Logical Volume menu 1 of 2

The name of the logical volume has been entered as well as the physical volumes it will utilize for the logical volume. You do not have to specify the physical volume names, except to make the LVM choose the physical partition allocation policy other than the default.

As shown in this case, the logical volume has been set up to use the center position for the allocation of the logical volume on the physical volume. The default for this setting is center.

The intra-disk allocation policy choices are based on the five regions of a disk where physical partitions can be located. The five regions are: Outer edge, inner edge, outer middle, inner middle, and center. The edge partitions have the slowest average seek times, which generally result in longer response times for any application that uses them. The center partitions have the fastest average seek times, which generally result in the best response time for any application that uses them. There are, however, fewer partitions on a physical volume at the center than at the other regions (unless when mirrored with mirror write consistency check).

Figure 31 on page 104 illustrates the regions that can be used for allocating physical partitions in a physical volume.

LVM Intra Disk Positions

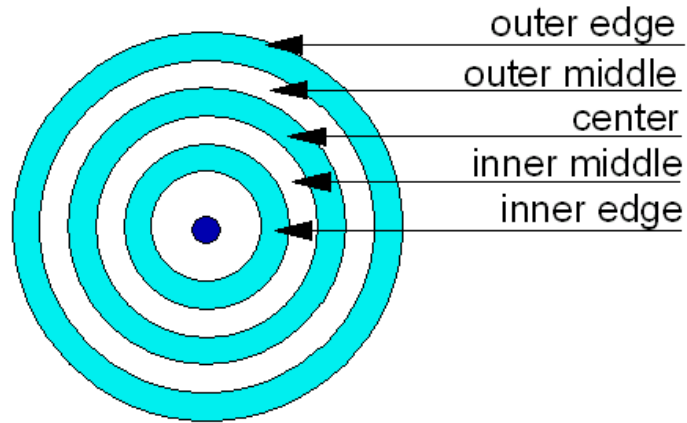


Figure 31. Five regions of a disk

Note

To ensure a JFS is allocated on the center region, you have to create a logical volume on the center region first, then create the JFS on it, or, if the space is available, to change the attributes and reorg.

Figure 32 on page 105 is the second half of the screen as described in Figure 30 on page 103, and the significant portion here is Stripe Size, which is not being set up for this example and the significant portion here is Stripe size, which is not being set up for this example. Since this attribute is only used in the striped logical volumes.

```

                                Add a Logical Volume

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

[MORE...11]                                [Entry Fields]
Mirror Write Consistency?                   yes                +
Allocate each logical partition copy        yes                +
  on a SEPARATE physical volume?
RELOCATE the logical volume during          yes                +
  reorganization?
Logical volume LABEL                        []
MAXIMUM NUMBER of LOGICAL PARTITIONS       [512]              #
Enable BAD BLOCK relocation?               yes                +
SCHEDULING POLICY for reading/writing      parallel           +
  logical partition copies
Enable WRITE VERIFY?                       no                 +
File containing ALLOCATION MAP              []
Stripe Size?                               [Not Striped]     +
[BOTTOM]

F1=Help      F2=Refresh      F3=Cancel      F4=List
Esc+5=Reset  Esc+6=Command  Esc+7=Edit    Esc+8=Image
Esc+9=Shell  Esc+0=Exit    Enter=Do

```

Figure 32. The Add a Logical Volume menu 2 of 2

After the command is run a screen similar to Figure 33 is shown.

```

                                COMMAND STATUS

Command: OK          stdout: yes          stderr: no

Before command completion, additional instructions may appear below.

logvol01
█

F1=Help      F2=Refresh      F3=Cancel      Esc+6=Command
Esc+8=Image  Esc+9=Shell    Esc+0=Exit    /=Find
n=Find Next

```

Figure 33. The Command Status Screen for the logical volume

The logical volume has been created. Press **F10=Exit** to exit to the command prompt and check the logical volume. The following example shows the results of this action:

```
# lslv logvol01
LOGICAL VOLUME:      logvol01          VOLUME GROUP:      volg01
LV IDENTIFIER:      000bc6fdca261bbf.1  PERMISSION:        read/write
VG STATE:           active/complete  LV STATE:          closed/syncd
TYPE:               jfs                WRITE VERIFY:      off
MAX LPs:            512                PP SIZE:           16 megabyte(s)
COPIES:             1                  SCHED POLICY:     parallel
LPs:                2                  PPs:              2
STALE PPs:          0                  BB POLICY:         relocatable
INTER-POLICY:       minimum             RELOCATABLE:      yes
INTRA-POLICY:       center              UPPER BOUND:      2
MOUNT POINT:        N/A                LABEL:            None
MIRROR WRITE CONSISTENCY: on
EACH LP COPY ON A SEPARATE PV?: yes
```

The logical volume is now created and ready for the creation of file systems.

The INTER-POLICY setting controls the behavior of allocation between physical volumes in a VG. You can use this attribute to command the LVM to precisely adhere to the physical partition allocation policy for the logical volume.

5.2.2 Different LVs associated with a JFS

In every volume group that has logical volumes created, there are various logical volumes that are associated with the system as shown in the following example:

```
# lsvg -o | lsvg -i -l
volg01:
LV NAME          TYPE      LPs  PPs  PVs  LV STATE    MOUNT POINT
logvol01         jfs      2    2    1    closed/syncd  N/A
rootvg:
LV NAME          TYPE      LPs  PPs  PVs  LV STATE    MOUNT POINT
hd5              boot     2    2    1    closed/syncd  N/A
hd6              paging   40   40   1    open/syncd    N/A
hd8              jfslog   1    1    1    open/syncd    N/A
hd4              jfs      2    2    1    open/syncd    /
hd2              jfs     118  118  1    open/syncd    /usr
hd9var           jfs      1    1    1    open/syncd    /var
hd3              jfs      3    3    1    open/syncd    /tmp
hd1              jfs     11   11   1    open/syncd    /home
```

The following logical volumes are all journaled file systems belonging to the rootvg volume group `hd4`, `hd2`, `hd9var`, `hd3`, and `hd1`.

The logical volume, `hd8`, is the JFS log. The function of the JFS log is record modifications in the JFS file system.

The logical volume, `hd5`, is the boot logical volume. Re-create it and rewrite boot image if it is accidentally corrupted or missing.

The `hd6` is the paging space for the rootvg volume group by default. Paging space, sometimes called swap space, is a regular logical volume of the type paging. It is fixed disk storage that allows a system to operate with virtual memory larger than the installed physical memory.

The `logvol01` logical volume is the user defined logical volume belonging to the user defined volume group, `volg01`.

5.2.3 Moving a logical volume from one physical volume to another

There may be instances where the volume group needs to be migrated from one disk to another. This must not be confused with migrating a physical volume in the same volume group as described in 5.1.2, “Migrating data to another disk in the same volume group” on page 91. This method is used for moving the specified logical volumes on the physical volume, not the every physical partition on the physical volume.

5.2.3.1 Using the `migratepv` command

When migrating a logical volume from one physical volume to another using the `migratepv` command, there are a few considerations before doing this:

- The `migratepv` command cannot migrate a striped logical volume. To do this, use the `cplv` and `imlv` commands.
- The new physical volume must be part of the same volume group.
- Ensure that all file systems on the logical volume are unmounted.
- Only the root user has authority to use the `migratepv` command.

The following commands provide an example of this task.

In the following example, the logical volume, `lv01`, on the volume group, `volg1`, situated on `hdisk1` will be migrated to `hdisk2`:

```
# lslv lv01
LOGICAL VOLUME:    lv01                VOLUME GROUP:    volg1
LV IDENTIFIER:    000bc6fdbff8e05a.1    PERMISSION:      read/write
```

```

VG STATE:          active/complete      LV STATE:         opened/syncd
TYPE:             jfs                  WRITE VERIFY:    off
MAX LPs:         512                   PP SIZE:        16 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:    /fs1                   LABEL:         /fs1
MIRROR WRITE CONSISTENCY: on
EACH LP COPY ON A SEPARATE PV ?: yes

```

```
# lspv hdisk1
```

```

PHYSICAL VOLUME:  hdisk1                VOLUME GROUP:   volg1
PV IDENTIFIER:    000bc6fdbff75ee2      VG IDENTIFIER
000bc6fdbff8e05a
PV STATE:        active
STALE PARTITIONS: 0                     ALLOCATABLE:    yes
PP SIZE:         16 megabyte(s)         LOGICAL VOLUMES: 2
TOTAL PPs:      542 (8672 megabytes)    VG DESCRIPTORS: 2
FREE PPs:       531 (8496 megabytes)
USED PPs:       11 (176 megabytes)
FREE DISTRIBUTION: 109..97..108..108..109
USED DISTRIBUTION: 00..11..00..00..00

```

```
# lspv hdisk2
```

```

PHYSICAL VOLUME:  hdisk2                VOLUME GROUP:   volg1
PV IDENTIFIER:    000bc6fdbff92812      VG IDENTIFIER
000bc6fdbff8e05a
PV STATE:        active
STALE PARTITIONS: 0                     ALLOCATABLE:    yes
PP SIZE:         16 megabyte(s)         LOGICAL VOLUMES: 0
TOTAL PPs:      542 (8672 megabytes)    VG DESCRIPTORS: 1
FREE PPs:       542 (8672 megabytes)
USED PPs:       0 (0 megabytes)
FREE DISTRIBUTION: 109..108..108..108..109
USED DISTRIBUTION: 00..00..00..00..00

```

Migrate the logical volume from one disk to another:

```
# migratepv -l lv011 hdisk1 hdisk2
```

Check that the logical volume has migrated:

```
# lslv lv011
```

```

LOGICAL VOLUME:   lv011                  VOLUME GROUP:   volg1
LV IDENTIFIER:    000bc6fdbff8e05a.1    PERMISSION:     read/write

```

```

VG STATE:          active/complete      LV STATE:          opened/syncd
TYPE:              jfs                  WRITE VERIFY:     off
MAX LPs:           512                  PP SIZE:          16 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:       /fs1                 LABEL:           /fs1
MIRROR WRITE CONSISTENCY: on
EACH LP COPY ON A SEPARATE PV ?: yes

```

```
# lspv hdisk1
```

```

PHYSICAL VOLUME:  hdisk1                VOLUME GROUP:    volg1
PV IDENTIFIER:    000bc6fdbff75ee2      VG IDENTIFIER
000bc6fdbff8e05a
PV STATE:         active
STALE PARTITIONS: 0                    ALLOCATABLE:     yes
PP SIZE:          16 megabyte(s)        LOGICAL VOLUMES: 1
TOTAL PPs:        542 (8672 megabytes)  VG DESCRIPTORS: 2
FREE PPs:         541 (8656 megabytes)
USED PPs:         1 (16 megabytes)
FREE DISTRIBUTION: 109..107..108..108..109
USED DISTRIBUTION: 00..01..00..00..00

```

```
# lspv hdisk2
```

```

PHYSICAL VOLUME:  hdisk2                VOLUME GROUP:    volg1
PV IDENTIFIER:    000bc6fdbff92812      VG IDENTIFIER
000bc6fdbff8e05a
PV STATE:         active
STALE PARTITIONS: 0                    ALLOCATABLE:     yes
PP SIZE:          16 megabyte(s)        LOGICAL VOLUMES: 1
TOTAL PPs:        542 (8672 megabytes)  VG DESCRIPTORS: 1
FREE PPs:         532 (8512 megabytes)
USED PPs:         10 (160 megabytes)
FREE DISTRIBUTION: 109..98..108..108..109
USED DISTRIBUTION: 00..10..00..00..00

```

The logical volume has now been migrated from hdisk1 to hdisk2.

Note

The following step is used only if you are migrating the BLV in a rootvg volume group:

```
migratepv -l hd5 SourceDiskNumber DestinationDiskNumber
```

Next, you will get a message warning you to perform the `bosboot` command on the destination disk. You must also perform a `mkboot -c` command to clear the boot record on the source. Do the following:

```
bosboot -a -d /dev/DestinationDiskNumber
```

then:

```
bootlist -m normal DestinationDiskNumber
```

then:

```
mkboot -c -d /dev/SourceDiskNumber
```

5.2.3.2 Using the `cplv` and `rmlv` commands

The `cplv` command is used to copy a logical volume to either a new or existing logical volume. The `cplv` command is used to copy a logical volume to either a new or existing logical volume in the same volume group. You can use the `cplv` command to copy a non-striped or striped logical volume.

Considerations when using the `cplv` command are:

- The `cplv` command will fail if a new logical volume is created and the volume group is varied on in concurrent mode.
- If you are copying a striped logical volume, and the destination logical volume does not exist, an identical copy, including the striped block size and striping width of the source logical volume, is created, and then the data is copied.
- If you are copying a striped logical volume and you have created the destination logical volume with the `mklv` command using a different stripe block size and striping width, or the destination is not a striped logical volume, the new characteristics are maintained, and the data is copied from the source logical volume.
- To use the `cplv` command, you must either have root user authority or be a member of the system group.

The `rmlv` command is used to remove a logical volume from a volume group.

Considerations when using the `rmlv` command are:

- This command removes information about the specified logical volumes.
- To use the `rmLV` command, you must either have root user authority or be a member of the system group.

5.3 Journalized file systems

A file system is a general representation of a storage space on UNIX. Although there are several file system implementation on AIX (JFS, NFS, AFS, and so on), only the journaled file system (JFS) is a native local file system implementation on AIX (the newest release of AIX, AIX 5L also supports an enhanced native local file system, called JFS2). A JFS is created on top of a logical volume. There are some considerations when you are creating a JFS:

- If performance is a key consideration, then the logical volume must be created in the center of a disk (unless you are using mirrored disks with MWCC, then the outer edge is best). A file system cannot reside in the center of the physical volume if the physical partitions are placed on the middle or edges of the physical volume.
- When increasing the size of the file system it will automatically increase the size of the logical volume if required. However, increasing the size of a logical volume will not automatically increase the size of the file system.

There is a lot of information about file systems. The following discussion starts at an intermediate technical level. If you do not already know how to create or mount a file system, or what some of the related control files are, such as `/etc/filesystems`, you may wish to review this in the AIX product documentation.

5.3.1 Metadata

Data and metadata must not be confused. Data is the actual user data within a file system. Metadata is the structural data associated with the file system, such as the organization of directories, inode tables, and links. Metadata is not data supplied by a user; it is information about the structure of user data.

5.3.2 Mounting and unmounting a file system

To mount a newly created JFS, the `mount` command is used. To unmount a file system, the `umount` or `unmount` commands are used. Either of these commands can be used, as they are identical in function.

5.3.2.1 Unmounting a file system

To unmount the file system, use the `umount` or `umount` commands. If however, a file system cannot be unmounted, use the `fuser` command to determine who has a file open on the device. You cannot use the `umount` command on a device in use. A device is in use if any file is open for any reason or if a user's current directory is on that device.

In the following example, the file system, `test01`, needs to be unmounted:

```
# umount /test01
umount: 0506-349 Cannot unmount /dev/lv02: The requested resource is busy.
```

The file system cannot be unmounted, as it is busy. Check which resource is locking the device:

```
# fuser -u /dev/lv02
/dev/lv02: 13984c (user01)
```

The resource has been identified as `user01`. The user can either log out of the system, or, if needed, the running resource can be terminated using the `kill -1` or `fuser -k` commands.

5.3.2.2 Mounting a file system over an existing file system

If a file system is mounted over a directory (called a *mount point*) held in another file system, beneath the mount point hierarchy in the mounted over file system, is hidden by the newly mounted file system. The originally mounted file system's data will be unavailable for use.

An example of where you would overmount is in a development environment where you are working with different levels of the same code and do not wish to change your make files. In the next example, there are two logical volumes, `lv0101` and `lv0102`. The file system on `lv0101` is mounted on `/filesystem01`, and the file system on `lv0102` is not yet mounted:

```
# mount
node          mounted          mounted over    vfs    date          options
-----
/dev/hd4      /
/dev/hd2      /usr
/dev/hd9var   /var
/dev/hd3      /tmp
/dev/hd1      /home
/dev/hd1      /home
/dev/lv00     /usr/welcome_arcade jfs    Jun 11 16:42 rw,log=/dev/hd8
rw,log=/dev/hd8
```

```

        /dev/lv01      /usr/welcome      jfs    Jun 11 16:42
rw,log=/dev/hd8
        /dev/lvol01   /filsys01         jfs    Jun 14 13:31
rw,log=/dev/loglv00

```

If a listing of the mounted file system `filsys01` is done, the directory containing data `fs1dir` is displayed:

```

# ls -l filsys01
total 16
drwxr-sr-x  20 root      sys      2560 Jun 14 13:32 fs1dir
drwxrwx---   2 root      system    512 Jun 14 13:28 lost+found

```

If the file system on logical volume `lv0102` is now mounted over the same mount point as that of `lv0101`:

```
# mount /dev/lvol02 /filsys01
```

and then checked it can be noted that both file systems are still shown as being mounted:

```

# mount
node          mounted          mounted over     vfs      date           options
-----
        /dev/hd4      /                jfs       Jun 11 16:41  rw,log=/dev/hd8
        /dev/hd2      /usr             jfs       Jun 11 16:41  rw,log=/dev/hd8
        /dev/hd9var   /var             jfs       Jun 11 16:41  rw,log=/dev/hd8
        /dev/hd3      /tmp             jfs       Jun 11 16:41  rw,log=/dev/hd8
        /dev/hd1      /home            jfs       Jun 11 16:42  rw,log=/dev/hd8
        /dev/lv00     /usr/welcome_arcade jfs       Jun 11 16:42
rw,log=/dev/hd8
        /dev/lv01     /usr/welcome     jfs       Jun 11 16:42
rw,log=/dev/hd8
        /dev/lvol01   /filsys01       jfs       Jun 14 13:31
rw,log=/dev/loglv00
        /dev/lvol02   /filsys01       jfs       Jun 14 13:44
rw,log=/dev/loglv01

```

If a listing of the mounted file system, `filsys01`, is done, the directory containing data `fs2dir` is displayed:

```

# ls -l /filsys01
total 32
drwxr-sr-x   5 root      sys      9728 Jun 14 13:37 fs2dir
drwxrwx---   2 root      system    512 Jun 14 13:28 lost+found

```

The way to fix this is to unmount the logical volume, `lv0102`, and then mount it on a new mount point:

```
# umount /dev/lv0102
```

Once unmounted, the data on `lv0101` will be available again, as it was not overwritten:

```
# mount
```

node	mounted	mounted over	vfs	date	options
/dev/hd4	/		jfs	Jun 11 16:41	rw,log=/dev/hd8
/dev/hd2	/usr		jfs	Jun 11 16:41	rw,log=/dev/hd8
/dev/hd9var	/var		jfs	Jun 11 16:41	rw,log=/dev/hd8
/dev/hd3	/tmp		jfs	Jun 11 16:41	rw,log=/dev/hd8
/dev/hd1	/home		jfs	Jun 11 16:42	rw,log=/dev/hd8
/dev/lv00	/usr/welcome_arcade		jfs	Jun 11 16:42	
rw,log=/dev/hd8	/dev/lv01	/usr/welcome	jfs	Jun 11 16:42	
rw,log=/dev/hd8	/dev/lv0101	/filsys01	jfs	Jun 14 13:31	
rw,log=/dev/loglv00					

```
# ls -l /filsys01
```

permissions	links	owner	group	size	date	file
drwxr-sr-x	20	root	sys	2560	Jun 14 13:32	fs1dir
drwxrwx---	2	root	system	512	Jun 14 13:28	lost+found

5.3.3 Reducing the size of a file system

There may be occasion to shrink a file system, although this may not be common. Before shrinking a file system, the following needs to be checked:

- For a file system in `rootvg`, the file `image.data` must exist. If this file does not exist, then it needs to be restored using the `mksysb` command because the existing `image.data` is out of date.
- For a file system that may exist on a user volume group the file `/tmp/vgdata/vgname/vgname.data` must exist. If this file does not exist, then the `mkvgdata VGName` command must be run, which will create this file.

Below is an example of the information for the `/usr` file system from the `image.data` file showing volume group, logical volume, and file system information:

```
##Command used for vg_data; /usr/sbin/lsvg
```

```
vg_data:
```

```

        VGNAME= rootvg
        PPSIZE= 16
...
##Command used for lv_data; /usr/sbin/lslv
...
lv_data:
    VOLUME_GROUP= rootvg
    LV_SOURCE_DISK_LIST= hdisk0
...
    LOGICAL_VOLUME= hd2
...
    MAX_LPS= 32512
...
    LPS= 430
...
    MOUNT_POINT= /usr
...
    PP_SIZE= 16
...
    PP= 430
...
    LV_MIN_LPS= 54
...
##Commands used for fs_data; /usr/bin/df and /usr/sbin/lsjfs
...
fs_data:
    FS_NAME= /usr
    FS_SIZE= 14090240
    FS_MIN_SIZE= 1748712
    FS_LV= /dev/hd2
    FS_FS= 4096
    FS_NBPI= 4096
    FS_COMPRESS= no
    FS_BF= false
...

```

The following is an example of /tmp/vgdata/vgname/vgname.data:

```

##Command used for vg_data; /usr/sbin/lsvg

vg_data:
    VGNAME= volg01
    PPSIZE= 16
    VARYON= yes
    VG_SOURCE_DISK_LIST= hdisk1
...
lv_data:

```

```

VOLUME_GROUP= volg01
LV_SOURCE_DISK_LIST= hdisk1
LV_IDENTIFIER= 000fa17d2d4bda99.3
LOGICAL_VOLUME= lv00
VG_STAT= active/complete
TYPE= jfs
MAX_LPS= 512
COPIES= 1
LPs= 40
STALE_PPs= 0
INTER_POLICY= minimum
INTRA_POLICY= middle
MOUNT_POINT= /u
MIRROR_WRITE_CONSISTENCY= on
...
PP_SIZE= 16
SCHED_POLICY= parallel
PP= 40
...
LV_MIN_LPS= 37
...
##Commands used for fs_data; /usr/bin/df and /usr/sbin/lsjfs

fs_data:
    FS_NAME= /u
    FS_SIZE= 1310720
    FS_MIN_SIZE= 1188384
    FS_LV= /dev/lv00
    FS_FS= 4096
    FS_NBPI= 4096
...

```

For example:

On the above system the following is the current disk usage as per the `df` command:

```

# df -k

```

Filesystem	1024-blocks	Free	%Used	Iused	%Iused	Mounted on
/dev/hd4	16384	8656	48%	1281	16%	/
/dev/hd2	7045120	6170764	13%	31736	2%	/usr
/dev/hd9var	16384	14416	13%	399	10%	/var
/dev/hd3	16384	15792	4%	28	1%	/tmp
/dev/hd1	16384	15764	4%	41	2%	/home
/dev/lv00	655360	61168	91%	4528	3%	/u

On investigation into the reason for the high utilization of the /u file system, the following is found:

```
# ls -l /u
total 804520
drwxrwxrwx  2 root      system      512 Jul 05 17:59 lost+found
-rwxrwxrwx  1 user01   sys        411904000 Jul 05 18:28 tempfile1
drwxrwsrwx  7 root      sys         512 Jul 05 18:17 userdir1
```

The file, /u/tempfile1, is no longer needed and can be removed, and then the file system will be shrunk.

Remove the file using the `rm` command and then check the new disk usage as per the `df` command:

```
# df -k
Filesystem      1024-blocks      Free %Used    Iused %Iused Mounted on
/dev/hd4         16384           6288   62%     1283   16% /
/dev/hd2        7045120        6170764  13%     31736   2% /usr
/dev/hd9var      16384          14412   13%         400  10% /var
/dev/hd3         16384          15800   4%         28    1% /tmp
/dev/hd1         16384          15764   4%         41    2% /home
/dev/lv00        655360         463820  30%     4527   3% /u
```

Run the `mkvgdata` command to create a new `/tmp/vgdata/vgname/vgname.data` file. In this case, the file name is `/tmp/vgdata/volg01/volg01.data`. For the root volume group, the `mkszfile` command needs to be run:

```
# mkvgdata volg01
```

If the `/tmp/vgdata/volg01/volg01.data` is checked, the following can be seen:

```
lv_data:
    VOLUME_GROUP= volg01
    LV_SOURCE_DISK_LIST= hdisk1
    LV_IDENTIFIER= 000fa17d2d4bda99.3
    ...
    LABEL= /u
    MAPFILE=
    LV_MIN_LPS= 12
    ...
fs_data:
    FS_NAME= /u
    FS_SIZE= 1310720
    FS_MIN_SIZE= 383080
    ...
```

Notice that `LV_MIN_LPS=` has reduced from 37 to 12 and that `FS_MIN_SIZE=` has reduced from 1188384 to 383080. These numbers must be large enough to hold the current data otherwise the process will fail.

Calculate any requirement for a new `PP_SIZE`. Typically a smaller disk will be more efficiently used with a smaller `PP_SIZE`. Disks under 300 MB use a 2 MB `PP_SIZE` by default, all others use a 4 MB size by default. You have to conform to the general rule for making a volume group on a physical volume, `1016 x PP_SIZE` greater than the real capacity of the physical volume.

Save the volume group using the `savevg` command. During a `savevg`, the `/tmp/vgdata/vgname/vgname.data` file can be created using the `-i` flag, which has the same effect as running the `mkvgdata` command:

```
# savevg -f/dev/rmt0 -v volg01
...
The total size is 161611492 bytes.
Backup finished on Thu Jul 6 10:00:25 CDT 2000; there are 218300 blocks on
1 volumes.
```

```
0512-038 savevg: Backup Completed Successfully
```

Note

The `savevg` command uses the `backup` command to save the contents data of the journaled file systems held in the target volume group. It never saves the contents of the raw device type logical volume (logical volumes not used for journaled file system).

Check the volume groups and the disks associated with the volume groups:

```
# lsvg
rootvg
volg01
# lspv
hdisk0          000fa17debb9c93a    rootvg
hdisk1          000fa17dc9bf376f    volg01
```

Unmount the file system:

```
# umount /u
```

To restore the contents of the backup tape of the volume group `volg01` taken by `savevg` command, you have to remove the physical volume and volume group, since the `restvg` command does not allow restoring to the existing volume group and the physical volumes. The `-f` option flag of the `reducevg`

command deletes the physical volume forcibly, if there are any logical volumes the exist on the physical volume:

```
# reducevg -d -f volg01 hdisk1
rmlv: Logical volume logvol01 is removed.
rmlv: Logical volume loglv00 is removed.
rmlv: Logical volume lv00 is removed.
ldeletepv: Volume Group deleted since it contains no physical volumes.
```

Now, the system needs to be restored using the `restvg` command with the `-s` flag. The `-s` flag (meaning shrink) specifies that the logical volumes be created at the minimum size possible to accommodate the file systems. This size is specified by the value of the `LV_MIN_LPS` field of the `lv_data` stanza of the `vgname.data` file where the `vgname` is `/tmp/vgdata/volg01/volg01.data`:

```
# restvg -s -q -f/dev/rmt0
```

```
Will create the Volume Group:   volg01
Target Disks:   hdisk1
Allocation Policy:
    Shrink Filesystems:   yes
    Preserve Physical Partitions for each Logical Volume:   no
```

```
volg01
...
x          10970 ./u/...
The total size is 161611492 bytes.
The number of restored files is 4516.
```

After the restore, the file system may need to be mounted by using the `mount` command.

The file system can now be checked for disk usage:

```
# df -k
```

Filesystem	1024-blocks	Free	%Used	Iused	%Iused	Mounted on
/dev/hd4	16384	6080	63%	1283	16%	/
/dev/hd2	7045120	6170764	13%	31736	2%	/usr
/dev/hd9var	16384	14408	13%	400	10%	/var
/dev/hd3	16384	15796	4%	29	1%	/tmp
/dev/hd1	16384	15764	4%	41	2%	/home
/dev/lv00	196608	23452	89%	4527	10%	/u

Note the file system has been shrunk from a size of 655360 to 196608. The file system can now grow as required.

The system can also be restored using the `smitty restvg` command as shown in Figure 34 on page 120. Note the SHRINK the file systems? option is set to yes.

```

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?         [ yes ]           +
  PHYSICAL VOLUME names          [ ]               +
  (Leave blank to use the PHYSICAL VOLUMES listed
   in the vgroupname.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)

F1=Help      F2=Refresh      F3=Cancel      F4=List
F5=Reset     F6=Command     F7=Edit       F8=Image
F9=Shell     F10=Exit       Enter=Do

```

Figure 34. The SMIT `restvg` screen

When shrinking a root volume group file system the process is similar with a few exceptions:

- Use the `mksysb` backup to back up the `rootvg` volume group.
- User volume groups will have to be exported using the `exportvg` command.
- The system would have to be restored as described in *AIX Version 4.3 Installation Guide, Chapter 5; Installing BOS from a System Backup*. A panel will be available to allow you to shrink the file systems.
- Once the system has been restored, the user volume groups will have to be imported by using the `importvg` command.

Note

If needed, a full description of reducing a root volume group can be found in *AIX Version 4.3 System Management Guide: Operating System and Devices, Reducing the File System Size in the rootvg Volume Group*.

5.3.4 Removing a file system

To remove a file system from the system, the `rmfs` command is used as follows:

To remove the file system, `filsys02`, which resides on the logical volume, `lv0102`, the following steps are followed:

```
# mount
node      mounted      mounted over  vfs      date      options
-----
/dev/hd4  /              /              jfs      Jun 11 16:41 rw,log=/dev/hd8
/dev/hd2  /usr          /usr          jfs      Jun 11 16:41 rw,log=/dev/hd8
/dev/hd9var /var        /var        jfs      Jun 11 16:41 rw,log=/dev/hd8
/dev/hd3  /tmp        /tmp        jfs      Jun 11 16:41 rw,log=/dev/hd8
/dev/hd1  /home       /home       jfs      Jun 11 16:42 rw,log=/dev/hd8
/dev/lv00 /usr/welcome_arcade /usr/welcome_arcade jfs      Jun 11 16:42 rw,log=/dev/hd8
/dev/lv01 /usr/welcome /usr/welcome jfs      Jun 11 16:42 rw,log=/dev/hd8
/dev/lvol01 /filsys01   /filsys01   jfs      Jun 14 13:31 rw,log=/dev/loglv00
/dev/lvol02 /filsys02   /filsys02   jfs      Jun 14 17:17 rw,log=/dev/loglv01
```

Unmount the file system that will be removed:

```
# umount /filsys02
```

Remove the file system (the `-r` flag of the `rmfs` command specifies that the mount point is also removed):

```
# rmfs -r /filsys02
```

```
rmlv: Logical volume lv0102 is removed.
```

```
# lslv -L lv0102
```

```
0516-306 lslv: Unable to find lv0102 in the Device
Configuration Database.
```

As can be seen when the file system is removed, the underlying logical volume will also be removed, and it also removes the corresponding entry in the `/etc/filesystems` file.

5.3.5 Creating a new JFS log

If a journal file system is used, then a `jfslog` is necessary. The `jfslog` is a logical volume used for maintaining the file system integrity of file systems which associated with this `jfslog`. To create, mount, and use journal file systems, you have to have at least one `jfslog` per volume group. More than one journal file system residing in a volume group can share same `jfslog`. To format the `jfslog` on the existing logical volume explicitly, you can use the `logform` command. This step is also done automatically when creating a new journal file system.

To configure the jfslog on the system, you can use the following method. The jfslogs shown in the examples as a jfslog logical volume type.

The logical volume, loglv00, is the JFS log for the volume group volg01:

```
# lsvg -o | lsvg -i -l
testvg1:
LV NAME          TYPE      LPs  PPs  PVs  LV STATE  MOUNT POINT
loglv01          jfslog    1    1    1    open/syncd  N/A
lv02             jfs       10   10   1    open/syncd  /test01
volg01:
LV NAME          TYPE      LPs  PPs  PVs  LV STATE  MOUNT POINT
logvol01         jfs       10   10   1    open/syncd  /userfs01
loglv00          jfslog    1    1    1    open/syncd  N/A
rootvg:
...
lv01             jfs       2    2    1    open/syncd  /usr/welcome
```

If while mounting a file system, the following or similar error should occur:

```
# mount /userfs01
mount: 0506-323 Cannot get information about log device /dev/loglv00.
```

remove the corrupt logical volume loglv00 from the system:

```
# rmlv loglv00
Warning, all data contained on logical volume loglv00 will be destroyed.
rmlv: Do you wish to continue? y(es) n(o)? y
rmlv: Logical volume loglv00 is removed.
```

Use the mklv command to create a jfslog file system loglv00 for the volume group volg01:

```
# mklv -t jfslog -y loglv00 volg01 1
loglv00
```

Run the logform command to initialize the logical volume, loglv00, for use as a JFS log:

```
# logform /dev/loglv00
logform: destroy /dev/loglv00 (y)?y
```

Check the integrity of the file system using the fsck command. Fix the superblock error if needed:

```
# fsck /userfs01

** Checking /dev/rlogvol01 (/userf)
** Phase 0 - Check Log
log redo processing for /dev/rlogvol01
```

```

** Phase 1 - Check Blocks and Sizes
** Phase 2 - Check Pathnames
** Phase 3 - Check Connectivity
** Phase 4 - Check Reference Counts
** Phase 5 - Check Inode Map
** Phase 6 - Check Block Map
Superblock is marked dirty; FIX? y
1809 files 159704 blocks 167976 free
***** Filesystem was modified *****

```

Mount the file system and check that it is mounted:

```

# mount /userfs01
# mount
node          mounted      mounted over  vfs      date      options
-----
/dev/hd4      /             /             jfs      Jun 19 14:50 rw,log=/dev/hd8
/dev/hd2      /usr          /usr          jfs      Jun 19 14:50 rw,log=/dev/hd8
/dev/hd9var   /var          /var          jfs      Jun 19 14:50 rw,log=/dev/hd8
/dev/hd3      /tmp          /tmp          jfs      Jun 19 14:50 rw,log=/dev/hd8
/dev/hd1      /home         /home         jfs      Jun 19 14:51 rw,log=/dev/hd8
/dev/lv00     /usr/welcome_arcade jfs      Jun 19 14:51 rw,log=/dev/hd8
/dev/lv01     /usr/welcome  jfs      Jun 19 14:51 rw,log=/dev/hd8
/dev/lv02     /test01       jfs      Jun 19 14:51 rw,log=/dev/loglv01
/dev/logvol01 /userfs01     jfs      Jun 19 16:00 rw,log=/dev/loglv00

```

5.4 Managing a paging space

A paging space is fixed disk storage working as a backing store to hold not currently accessed data in virtual memory. If some processes or kernel require this data, then they are read from the corresponding paging space disk blocks into memory (called a paged in). On AIX, a paging space is a logical volume with LV TYPE set to paging. The default paging space hd6 is created upon initial installation of AIX in the rootvg volume group, and activated automatically every booting up the system.

This section describes the following topics.

- How to create a new paging space
- How to expand a existing paging space
- How to remove a paging space
- How to shrink a existing paging space size

5.4.1 How to create a new paging space

On AIX, creating a new paging space is easy task, since a newly creating paging space is activated at the moment of the creation, if you want to do so. But before creating it actually, you have to examine the following points.

- How much paging space is needed for your system?

It depends on the virtual memory usage of your application. Some applications require three or four times of physical memory to work smoothly.

- Is there enough free disk space to create new paging space on your system?

If your rootvg volume group has only 100 MB or less free space, it is not recommended adding a new paging space in the rootvg. These space are usually required for system maintenance task (for example, applying PTFs).

- Is there any possibility to affect user application performance?

Creating a new paging space on physical volume consumes certain disk I/O bandwidth on your system, if the paging space is used heavily. If your application is I/O intensive and sensitive, it is not recommended creating a new paging space on the same physical volume that holds your application data. In this case, you might consider additional disk I/O path to create a new paging space by adding new adapter and disks.

To add a new paging space, you can use the following method. This task is also achieved by using `mkps` command.

Use the `smit lvm` command, then select **Paging Space** followed by **Add Another Paging Space**. When you are prompted, select the volume group you would like to add a paging space to, from the list. The results of these actions are shown in Figure 35.

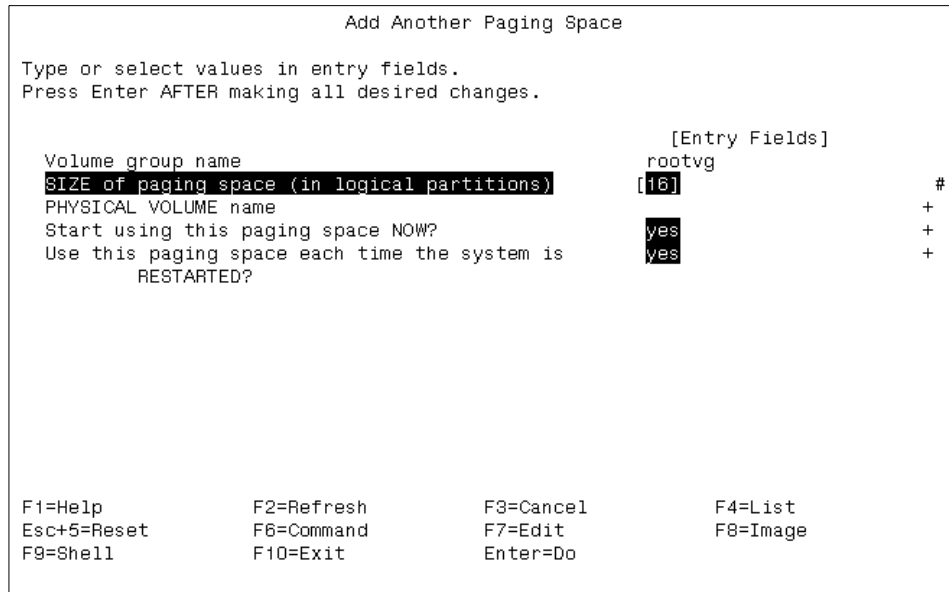


Figure 35. The SMIT Add Another Paging Space dialog

Then press **Enter** to generate the paging space.

There is no field to specify the logical volume name of this newly creating paging space. By default, AIX will assign sequentially the name paging00, paging01, to pagingnn for paging space. The following points are for your consideration.

- The size of the paging space is specified as a multiplication of the PP_SIZE of the volume group. In this example, it is 16 MB.
- If you want to use this paging space now, alter the Start using this paging space NOW? field to yes, as shown.
- If you want to activate this paging space across boot, alter the Use the paging space each time the system is RESTARTED? to yes, as shown.

To confirm the result of this task, please type the `lspv -a` command like this:

```

# lspv -a
Page Space Physical Volume Volume Group Size %Used Active Auto Type
hd6         hdisk0          rootvg      1024MB 0    yes  yes  lv
paging00    hdisk0          rootvg      256MB 0    yes  yes  lv

```

5.4.2 How to expand an existing paging space

To expand an existing paging space, you can use the following method. This task is also achieved by using `chps` command. It remains activated after expansion.

Use the `smit lvm` command and select **Paging Space** then **Change / Show Characteristics of a Paging Space**. You will be prompted to select the paging space from the list. The results of these actions are shown in Figure 36.

```
Change / Show Characteristics of a Paging Space

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                     [Entry Fields]
Paging space name                    hd6
Volume group name                    rootvg
Physical volume name                 hdisk0
NUMBER of additional logical partitions [16] #
Or NUMBER of logical partitions to remove [] #
Use this paging space each time the system is
RESTARTED?                          yes      +

F1=Help      F2=Refresh      F3=Cancel      F4=List
Esc+5=Reset  F6=Command      F7=Edit       F8=Image
F9=Shell     F10=Exit        Enter=Do
```

Figure 36. The SMIT Change / Show Characteristics of a Paging Space dialog

Press **Enter** to execute the dialog.

Note that the size is specified as a difference. So, if you have an existing paging space with 16 PPs (assume it corresponds 256 MB), then you should specify 32 PPs (it is equal to 512 MB), since you want to have the 512 MB size paging space. The result is 768 MB (256 MB + 512 MB).

To confirm the result of this task, type the `lspvs -a` command as shown in the following example.

```
# lspvs -a
Page Space Physical Volume Volume Group Size %Used Active Auto Type
hd6        hdisk0          rootvg      1024MB 0    yes  yes  lv
paging00   hdisk0          rootvg      512MB  0    yes  yes  lv
```

5.4.3 How to remove an existing paging space

Before removing the existing paging space, all the references to this paging space should be removed. This requires the paging space to be deactivated first, and a subsequent reboot of the system.

To deactivate an existing paging space, you can use the following method. This task is also achieved by using `chpvs` command.

Using the same SMIT dialog as shown in Figure 36, modify the Use this paging space each time the system is RESTARTED? field to no. Press **Enter** to run the dialog and reboot your system.

```
# shutdown -Fr now
```

To confirm the result of this task, type the `lspvs -a` command as shown in the following example.

```
# lspvs -a
Page Space Physical Volume Volume Group Size %Used Active Auto Type
hd6        hdisk0          rootvg      1024MB 0    yes  yes  lv
paging00   hdisk0          rootvg      512MB  0    no   no   lv
```

Remove this paging space using SMIT or by using `rmpvs` command. This step is not shown in this example, but was completed successfully.

To confirm the result of this task, enter the `lspvs -a` command as shown in the following example.

```
# lspvs -a
Page Space Physical Volume Volume Group Size %Used Active Auto Type
hd6        hdisk0          rootvg      1024MB 0    yes  yes  lv
```

5.4.4 How to shrink an existing paging space size

Basically, there is no way shrinking an existing paging space size directly with AIX Version 4.3. You have to remove it, then re-create it with a smaller size which requires a system reboot. AIX 5L has enhancements that allow you to avoid the system reboot.

If you want to shrink the default paging space (/dev/hd6) size, then the following procedures should be followed.

1. Create a new paging space (typically, /dev/paging00) that has enough size to continue the system operating.
2. Change the default paging space /dev/hd6 to deactivate after the system reboot.
3. Modify the /sbin/rc.boot file, since activating (swapon) the default paging space is hard-coded in this startup procedure script. It must activate the newly created paging space from the previous step. You should create a backup of this script first.
4. Change the default paging space using the `sysdumpdev` command.
5. Re-create the BLV to reflect the above modification.
6. Reboot the system.
7. Remove the default paging space /dev/hd6.
8. Re-create the default paging space /dev/hd6 with your specified size. You cannot use the `mkpfs` command in here, since it always assigns the name `pagingnn`.
9. Change the additional paging space you created in the previous step to deactivate after the system reboot (assume it is /dev/paging00).
10. Restore the original /sbin/rc.boot.
11. Change the default paging space using the `sysdumpdev` command.
12. Re-create the BLV to reflect the above modification.
13. Reboot the system.
14. Remove the additional paging space (assume it is /dev/paging00).

These previous steps are shown in the following example.

```
# mkpfs -a -n -s 64 rootvg
paging00
# lspfs -a
Page Space Physical Volume Volume Group Size %Used Active Auto Type
hd6        hdisk0          rootvg      2048MB 0    yes  yes  lv
paging00   hdisk0          rootvg      1024MB 1    yes  yes  lv
# chps -a n hd6
# cp /sbin/rc.boot /sbin/rc.boot.orig
# vi /sbin/rc.boot
```

Change the paging space entry in the /sbin/rc.boot file from *swapon /dev/hd6* to *swapon /dev/paging00*.

```

# sysdumpdev -P -p /dev/paging00
primary /dev/paging00
secondary /dev/sysdumpnull
copy directory /var/adm/ras
forced copy flag TRUE
always allow dump FALSE
dump compression OFF
# bosboot -d /dev/hdisk0 -a
bosboot: Boot image is 6748 512 byte blocks.
# shutdown -Fr now
# lspvs -a
Page Space Physical Volume Volume Group Size %Used Active Auto Type
hd6          hdisk0          rootvg          2048MB 0      no    no    lv
paging00     hdisk0          rootvg          1024MB 1      yes   yes   lv
# rmvs hd6
rmlv: Logical volume hd6 is removed.
# mklv -b n -t paging -y hd6 rootvg 64
# swapon /dev/hd6
# chps -a n paging00
# cp -p /sbin/rc.boot.orig /sbin/rc.boot
# sysdumpdev -P -p /dev/hd6
primary /dev/hd6
secondary /dev/sysdumpnull
copy directory /var/adm/ras
forced copy flag TRUE
always allow dump FALSE
dump compression OFF
# bosboot -d /dev/hdisk0 -a
# shutdown -Fr now
# rmvs paging00
# lspvs -a
Page Space Physical Volume Volume Group Size %Used Active Auto Type
hd6          hdisk0          rootvg          1024MB 0      yes   yes   lv

```

5.5 Working with physical volumes

In AIX, fixed disk storage device is represented as a logical instance, called a physical volume. Usually it has a name `hdiskN`, where `N` is a sequence of numbers starting from zero. The physical volume is not used directly by any applications, even if your application does raw I/O. To use fixed disk storage in AIX, you must configure a volume group, which is composed of one or more physical volumes.

5.5.1 Removing a physical disk drive from a system

When removing the disk from the system, it is done at a volume group and physical volume level.

In the following system, there are two volume groups, `rootvg` and `volg01`. The `volg01` volume group has three disks assigned to it, and the disk, `hdisk3`, needs to be removed from the volume group. There is only one logical volume (`logvol01`) on the `volg01` volume group, and the file system is `/userfs01`. If there are logical volume residing on the disk to be removed, use the `migratepv` command as described in 5.2.3, “Moving a logical volume from one physical volume to another” on page 107:

```
# lsvg
rootvg
volg01

# lspv
hdisk0          000bc6fdc3dc07a7   rootvg
hdisk1          000bc6fdbff75ee2   volg01
hdisk2          000bc6fdbff92812   volg01
hdisk3          000bc6fdbff972f4   volg01

# lsvg -l volg01
volg01:
LV NAME          TYPE          LPs   PPs   PVs  LV STATE      MOUNT POINT
logvol01         jfs           10    10    1    open/syncd    /userfs01
loglv00          jfslog        1      1    1    open/syncd    N/A

# mount
node             mounted         mounted over    vfs      date          options
-----
/dev/hd4         /               jfs            Jun 19 18:08 rw,log=/dev/hd8
/dev/hd2         /usr            jfs            Jun 19 18:08 rw,log=/dev/hd8
/dev/hd9var      /var            jfs            Jun 19 18:08 rw,log=/dev/hd8
/dev/hd3         /tmp            jfs            Jun 19 18:08 rw,log=/dev/hd8
/dev/hd1         /home           jfs            Jun 19 18:09 rw,log=/dev/hd8
/dev/lv01        /usr/welcome    jfs            Jun 19 18:09
rw,log=/dev/hd8
/dev/logvol01    /userfs01       jfs            Jun 19 18:09
rw,log=/dev/loglv00
```

The first step in the process is to unmount the file system:

```
# umount /userfs01
```

Remove the physical volume from the volume group:

```
# reducevg -df volg01 hdisk3
```

Ensure the physical volume is no longer associated with a volume group:

```
# lspv
hdisk0          000bc6fdc3dc07a7    rootvg
hdisk1          000bc6fdbff75ee2    volg01
hdisk2          000bc6fdbff92812    volg01
hdisk3          000bc6fdbff972f4    None
```

Remove the disk from the system:

```
# rmdev -d -l hdisk3
hdisk3  deleted
```

Ensure that the disk has been removed:

```
# lsdev -Ccdisk
hdisk0 Available 30-58-00-8,0 16 Bit SCSI Disk Drive
hdisk1 Available 30-58-00-9,0 16 Bit SCSI Disk Drive
hdisk2 Available 10-60-00-8,0 16 Bit SCSI Disk Drive
```

Mount the file system to make the system available for use:

```
# mount /userfs01
# mount
node          mounted          mounted over    vfs      date          options
-----
/dev/hd4      /
/dev/hd2      /usr
/dev/hd9var   /var
/dev/hd3      /tmp
/dev/hd1      /home
/dev/logvol01 /userfs01          jfs      Jun 20 09:33 rw,log=/dev/loglv00
```

5.5.2 Recovering an incorrectly removed disk

If a disk needs to be recovered that was incorrectly removed from the system, and the system was rebooted, the `synclvodm` command will need to be run.

This is an advanced topic condensed to demonstrate the requirement to use several commands to recover from incorrectly removed disks. It is possible that customer situations will require several more steps than what is shown in this sample.

In the following example, a disk has been incorrectly removed from the system, and the logical volume control block needs to be rebuilt.

The disks in the system before the physical volume was removed were:

```
# lsdev -Cc disk
hdisk0 Available 30-58-00-8,0 16 Bit SCSI Disk Drive
hdisk1 Available 30-58-00-9,0 16 Bit SCSI Disk Drive
hdisk2 Available 10-60-00-8,0 16 Bit SCSI Disk Drive
hdisk3 Available 10-60-00-9,0 16 Bit SCSI Disk Drive
```

The allocation of the physical volumes before the disk was removed was:

```
# lspv
hdisk0          000bc6fdc3dc07a7    rootvg
hdisk1          000bc6fdbff75ee2    volg01
hdisk2          000bc6fdbff92812    volg01
hdisk3          000bc6fdbff972f4    volg01
```

The logical volumes on the volume group are:

```
# lsvg -l volg01
volg01:
LV NAME          TYPE      LPs  PPs  PVs  LV STATE   MOUNT POINT
logvol01         jfs       1000 1000  2    open/syncd /userfs01
loglv00          jfslog    1     1    1    open/syncd  N/A
```

The logical volume distribution on the physical volumes is:

```
# lslv -l logvol01
logvol01:/userfs01
PV          COPIES          IN BAND          DISTRIBUTION
hdisk1      542:000:000    19%              109:108:108:108:109
hdisk3      458:000:000    23%              109:108:108:108:025
```

After a reboot, the system disk configuration appears as follows:

```
# lspv
hdisk0          000bc6fdc3dc07a7    rootvg
hdisk1          000bc6fdbff75ee2    volg01
hdisk3          000bc6fdbff972f4    volg01
```

When trying to mount the file system on the logical volume, the error may appear as follows:

```
# mount /userfs01
mount: 0506-324 Cannot mount /dev/logvol01 on /userfs01: There is an input
or output error.
```

To get the logical volume synchronized correctly, the following needs to be done:

```
# syncldm -v volg01
syncldm: Physical volume data updated.
syncldm: Logical volume logvol01 updated.
syncldm: Warning, lv control block of loglv00 has been over written.
0516-622 syncldm: Warning, cannot write lv control block data.
syncldm: Logical volume loglv00 updated.
```

The system can now be repaired. If the file system data was spread across all the disks, including the failed disk, it may need to be restored from the last backup.

5.5.3 General tips on boot problems

If, for some inexplicable reason, the system will not boot and all the errors have been checked, ensure the following have been checked:

- Check that any changes made in the `/etc/inittab` file are not causing the boot problem.
- Check that any changes made in `/etc/environment` file is not causing the boot problem.
- Check that the root file system or one of the other file system in the rootvg volume group have sufficient space.
- Check that a log file is not full or corrupt, thus not allowing a system to boot.
- Check the `/etc/filesystems` file to ensure that the changes made are causing the system not to boot.
- Make sure any mirrored disks have a boot image and are contained in the `bootlist`. Use the `bosboot` and `bootlist` commands.

5.6 Command summary

The following section provides a list of the key commands discussed in this chapter. For a complete reference of the following commands, consult the AIX product documentation.

5.6.1 The `cfgmgr` command

The `cfgmgr` command configures devices and optionally installs device software into the system.

The `cfgmgr` command syntax is as follows:

```
cfgmgr [ -f | -s | -p Phase ] [ -i Device ] [ -l Name ] [ -v ]
```

The commonly used flags are provided in Table 14.

Table 14. Commonly used flags of the `cfgmgr` command

Flag	Description
-f	Specifies that the <code>cfgmgr</code> command executes the phase 1 configuration rules. This flag is not valid at run time (after system start).
-i <i>Device</i>	Specifies the location of the installation medium.
-l <i>Name</i>	Specifies the named device to configure along with its children.
-p <i>Phase</i>	Specifies that the <code>cfgmgr</code> command executes the specified phase.
-s	Specifies that the <code>cfgmgr</code> command executes the phase 2 configuration rules.
-v	Specifies verbose output. The <code>cfgmgr</code> command writes information about what it is doing to standard output.

5.6.2 The `bosboot` command

The `bosboot` command creates the boot image that interfaces with the machine boot ROS (Read-Only Storage) EPROM (Erasable Programmable Read-Only Memory).

The `bosboot` command syntax is as follows:

For general use:

```
bosboot -Action [ -d Device ] [ -Options ... ]
```

To create a device boot image:

```
bosboot -a [ -d Device ] [ -p Proto ] [ -k Kernel ] [ -U ] [ -I | -D ] [ -l LVdev ] [-L] [ -M { Norm | Serv | Both } ] [ -O Number ] [ -T Type ] [ -b FileName ] [ -q ]
```

To copy a device boot image:

```
bosboot -w FileName [ -d Device ] [ -q ]
```


To create a ros emulation boot image:

```
bosboot -r FileName [ -d Device ] [ -l LVdev ] [ -M { Norm | Serv | Both } ] [ -q ]
```

The commonly used flags are provided in Table 15.

Table 15. Commonly used flags of the bosboot command

Flag	Description
-a	Creates complete boot image and device.
-d <i>Device</i>	Specifies the boot device. This flag is optional for hard disk

5.6.3 The bootlist command

The `bootlist` command allows the user to display and alter the list of possible boot devices from which the system may be booted. When the system is booted, it will scan the devices in the list and attempt to boot from the first device it finds containing a boot image.

The `bootlist` command syntax is as follows:

```
bootlist [ { -m Mode } [ -r ] [ -o ] [ [ -i ] | [ [ -f File ] [ Device [ Attr=Value ... ] ... ] ] ] ]
```

The commonly used flags are provided in Table 16.

Table 16. Commonly used flags of the bootlist command

Flag	Description
<i>Device</i>	Provides the names of the specific or generic devices to include in the boot list.
-f <i>File</i>	Indicates that the device information is to be read from the specified file name.
-i	Indicates that the device list specified by the -m flag should be invalidated.
-m <i>Mode</i>	Specifies which boot list to display or alter. Possible values for the mode variable are normal, service, both, or prevboot.

Flag	Description
-o	Indicates that the specified boot list is to be displayed after any specified alteration is performed. The output is a list of device names. This flag applies only to AIX Version 4.2.1 or later.
-r	Indicates that the specified boot list is to be displayed after any specified alteration is performed. The output is hardware-platform dependent. It may be a hexadecimal dump of the boot list or a list of device names. (This is normally used for problem determination.)

5.6.4 The chps command

The `chps` command changes attributes of a specific paging space. The `PagingSpace` parameter specifies the name of the paging space to be changed.

The `chps` command syntax is as follows:

```
chps [ -s LogicalPartitions ] [ -a { y | n } ] PagingSpace
```

The commonly used flags are provided in Table 17.

Table 17. Commonly used flags of the `chps` command

Flag	Description
-a	Specifies to use a paging space at the next system restart.
y	Specifies that the paging space is active at subsequent system restarts.
n	Specifies that the paging space is inactive at subsequent system restarts.
-s <i>LogicalPartitions</i>	Specifies the number of logical partitions to add.

5.6.5 The `cplv` command

Copies the contents of a logical volume to a new logical volume.

The `cplv` command syntax is as follows:

To Copy to a New Logical Volume

```
cplv [ -v VolumeGroup ] [ -y NewLogicalVolume | -Y Prefix ]  
SourceLogicalVolume
```

To Copy to an Existing Logical Volume

```
cplv -e DestinationLogicalVolume [ -f ] SourceLogicalVolume
```

The commonly used flags are provided in Table 18.

Table 18. Commonly used flags of the `cplv` command

Flag	Description
<code>-e</code>	Specifies that the <code>DestinationLogicalVolume</code> exists and that a new logical volume should not be created. If the <code>DestinationLogicalVolume</code> is smaller than the <code>SourceLogicalVolume</code> , the extra logical partitions are not copied. When you use this flag, any data already in the <code>DestinationLogicalVolume</code> is destroyed. For this reason, user confirmation is required unless the <code>-f</code> flag is added. The Type characteristic of the <code>DestinationLogicalVolume</code> must be copy to prevent inadvertently overwriting data. To change the Type characteristic, use the <code>chlv</code> command.
<code>-f</code>	Copies to an existing logical volume without requesting user confirmation.
<code>-v VolumeGroup</code>	Specifies the volume group where the new logical volume resides. If this is not specified, the new logical volume resides in the same volume group as the <code>SourceLogicalVolume</code> .
<code>-y NewLogicalVolume</code>	Specifies the name to use, in place of a system-generated name, for the new logical volume. Logical volume names must be unique system wide names and can range from 1 to 15 characters.
<code>-Y Prefix</code>	Specifies a prefix to use in building a system-generated name for the new logical volume. The prefix must be less than or equal to 13 characters. A name cannot begin with a prefix already defined in the PdDv class in the Device Configuration Database for other devices or a name already used by another device.

5.6.6 The fsck command

The `fsck` command checks and interactively repairs inconsistent file systems. You should run this command before mounting any file system. You must be able to read the device file on which the file system resides. Normally, the file system is consistent, and the `fsck` command merely reports on the number of files, used blocks, and free blocks in the file system. If the file system is inconsistent, the `fsck` command displays information about the inconsistencies found and prompts you for permission to repair them when the `-y` flag is not used.

Note

If you run the `fsck` command on a mounted file system, it might report the following messages.

```
Bad Inode Map (NOT SALVAGED)
Bad Block Map (NOT SALVAGED)
```

This is a normal situation (you can not determine if this file system is corrupted or not from this evidence only), especially, on the frequently written file system such as `/var`. You can see the `fsck` command warning about this in the following.

```
Checking a mounted filesystem does not produce dependable results.
```

To determine this file system is corrupted or not, you have to unmount the file system, then run the `fsck` command on it.

The `fsck` command syntax is as follows:

```
fsck [ -n ] [ -p ] [ -y ] [ -dBlockNumber ] [ -f ] [ -ii-NodeNumber ] [ -o
Options ] [ -tFile ] [ -V VfsName ] [ FileSystem1 - FileSystem2 ... ]
```

The commonly used flags are provided in Table 19.

Table 19. Commonly used flags of the `fsck` command

Flag	Description
<code>-dBlockNumber</code>	Searches for references to a specified disk block. Whenever the <code>fsck</code> command encounters a file that contains a specified block, it displays the i-node number and all path names that refer to it.

Flag	Description
-f	<p>Performs a fast check. Under normal circumstances, the only file systems likely to be affected by halting the system without shutting down properly are those that are mounted when the system stops. The -f flag prompts the <code>fsck</code> command not to check file systems that were unmounted successfully. The <code>fsck</code> command determines this by inspecting the <code>s_fmod</code> flag in the file system superblock.</p> <p>This flag is set whenever a file system is mounted and cleared when it is unmounted successfully. If a file system is unmounted successfully, it is unlikely to have any problems. Because most file systems are unmounted successfully, not checking those file systems can reduce the checking time.</p>
-ii-NodeNumber	<p>Searches for references to a specified i-node. Whenever the <code>fsck</code> command encounters a directory reference to a specified i-node, it displays the full path name of the reference.</p>
-n	<p>Assumes a no response to all questions asked by the <code>fsck</code> command. It does not open the specified file system for writing.</p>
-o Options	<p>Passes comma-separated options to the <code>fsck</code> command. These options are assumed to be file system implementation-specific, except that the following are currently supported for all file systems:</p> <p><i>mountable</i></p> <p>Causes the <code>fsck</code> command to exit with success, returning a value of 0, if the file system in question is mountable (clean). If the file system is not mountable, the <code>fsck</code> command exits returning with a value of 8.</p> <p><i>mytype</i></p> <p>Causes the <code>fsck</code> command to exit with success (0) if the file system in question is of the same type as either specified in the <code>/etc/filesystems</code> file or by the <code>-v</code> flag on the command line. Otherwise, 8 is returned. For example, <code>fsck -o mytype -v jfs /</code> exits with a value of 0 if / (the root file system) is a journaled file system.</p>

Flag	Description
-p	Does not display messages about minor problems but fixes them automatically. This flag does not grant the wholesale license that the -y flag does and is useful for performing automatic checks when the system is started normally. You should use this flag as part of the system startup procedures, whenever the system is being run automatically. Also allows parallel checks by group. If the primary superblock is corrupt, the secondary superblock is verified and copied to the primary superblock.
-tFile	Specifies a File parameter as a scratch file on a file system other than the one being checked, if the fsck command cannot obtain enough memory to keep its tables. If you do not specify the -t flag and the fsck command needs a scratch file, it prompts you for the name of the scratch file. However, if you have specified the -p flag, the fsck command is unsuccessful. If the scratch file is not a special file, it is removed when the fsck command ends.
-V VfsName	Uses the description of the virtual file system specified by the VFSName variable for the file system instead of using the /etc/filesystems file to determine the description. If the -V VfsName flag is not specified on the command line, the /etc/filesystems file is checked and the vfs=Attribute of the matching stanza is assumed to be the correct file system type.
-y	Assumes a yes response to all questions asked by the fsck command. This flag lets the fsck command take any action it considers necessary. Use this flag only on severely damaged file systems.
-C	Specifies that all future dumps will be compressed before they are written to the dump device. The -C flag applies to only AIX Version 4.3.2 and later versions.
-c	Specifies that dumps will not be compressed. The -c flag applies to only AIX Version 4.3.2 and later versions.

5.6.7 The fuser command

The `fuser` command lists the process numbers of local processes that use the local or remote files specified by the File parameter. For block special devices, the command lists the processes that use any file on that device.

The `fuser` command syntax is as follows:

```
fuser [ -c ] [ -f ] [ -k ] [ -u ] File ...
```

Each process number is followed by a letter indicating how the process uses the file:

- c Uses the file as the current directory.
- p Uses the file as the parent of the current directory (only when in use by the system).
- r Uses the file as the root directory.

The commonly used flags are provided in Table 20.

Table 20. Commonly used flags of the *fuser* command

Flag	Description
-k	Sends the SIGKILL signal to each local process. Only the root user can kill a process of another user.
-u	Provides the login name for local processes in parentheses after the process number.
-c	Reports on any open files in the file system containing File.
-f	Reports on open instances of File only.

Note

The -c and -f flags apply to AIX Version 4.3 and later releases.

5.6.8 The *migratepv* command

The *migratepv* command moves allocated physical partitions from one physical volume to one or more other physical volumes.

The *migratepv* command syntax is as follows:

```
migratepv [ -i ] [ -l LogicalVolume ] SourcePhysicalVolume  
DestinationPhysicalVolume ...
```

The commonly used flags are provided in Table 21.

Table 21. Commonly used flags of the *migratepv* command

Flag	Description
-i	Reads the DestinationPhysicalVolume parameter from standard input.

Flag	Description
-l <i>LogicalVolume</i>	Moves only the physical partitions allocated to the specified logical volume and located on the specified source physical volume.

5.6.9 The mkboot command

The `mkboot` command creates the boot image, the boot record, and the service record. This command is NOT a user-level command and is NOT supported in AIX Version 4.2 or later.

The `mkboot` command syntax is as follows:

```
mkboot -d Device [ -b ] [ -D ] [ -c ] [ -h ] [ -i ] [ -I ] [ -l LVDev ] { -k
Kernel | -e Expander } [-L] [ -s ] [ -r ] [ -p Offset ] [ -w ] -f FileSystem
```

The commonly used flags are provided in Table 22.

Table 22. Commonly used flags of the `mkboot` command

Flag	Description
-c	Zeros out the boot record on the device. This flag is optional.
-d <i>Device</i>	Specifies the device required for the IPL record. This flag is required.

5.6.10 The mklv command

The `mklv` command creates a new logical volume within a volume group.

The `mklv` command syntax is as follows:

```
mklv [ -a Position ] [ -b BadBlocks ] [ -c Copies ] [ -d Schedule ] [ -e
Range ] [ -i ] [ -L Label ] [ -m MapFile ] [ -r Relocate ] [ -s Strict ] [
-t Type ] [ -u UpperBound ] [ -v Verify ] [ -w MirrorWriteConsistency ] [ -x
Maximum ] [ -y NewLV | -Y Prefix ] [ -S StripeSize ] VG Number [ PV ]
```


The commonly used flags are provided in Table 23.

Table 23. Commonly used flags of the `mkiv` command

Flag	Description
-a <i>Position</i>	<p>Sets the intra-physical volume allocation policy (the position of the logical partitions on the physical volume). The Position variable can be one of the following:</p> <p><i>m</i> Allocates logical partitions in the outer middle section of each physical volume. This is the default position.</p> <p><i>c</i> Allocates logical partitions in the center section of each physical volume.</p> <p><i>e</i> Allocates logical partitions in the outer edge section of each physical volume.</p> <p><i>ie</i> Allocates logical partitions in the inner edge section of each physical volume.</p> <p><i>im</i> Allocates logical partitions in the inner middle section of each physical volume.</p>
-b <i>BadBlocks</i>	<p>Sets the bad-block relocation policy. The Relocation variable can be one of the following:</p> <p><i>y</i> Causes bad-block relocation to occur. This is the default.</p> <p><i>n</i> Prevents bad-block relocation from occurring.</p>
-c <i>Copies</i>	<p>Sets the number of physical partitions allocated for each logical partition. The Copies variable can be set to a value from 1 to 3; the default is 1.</p>
-d <i>Schedule</i>	<p>Sets the scheduling policy when more than one logical partition is written. The Schedule variable can be one of the following:</p> <p><i>p</i> Establishes a parallel scheduling policy. This is the default for scheduling policy.</p> <p><i>s</i> Establishes a sequential scheduling policy.</p>

Flag	Description
-e <i>Range</i>	<p>Sets the inter-physical volume allocation policy (the number of physical volumes to extend across using the volumes that provide the best allocation). The Range value is limited by the UpperBound variable, (set with the -u flag) and can be one of the following:</p> <p><i>x</i> Allocates across the maximum number of physical volumes.</p> <p><i>m</i> Allocates logical partitions across the minimum number of physical volumes. This is the default range.</p>
-i	<p>Reads the <i>PhysicalVolume</i> parameter from standard input. Use the -i flag only when <i>PhysicalVolume</i> is entered through standard input.</p>
-L	<p>Sets the logical volume label. The default label is None. The maximum size of the label file is 127 characters.</p> <p>Note: If the logical volume is going to be used as a journaled file system (JFS), then the JFS will use this field to store the mount point of the file system on that logical volume for future reference.</p>
-m <i>MapFile</i>	<p>Specifies the exact physical partitions to allocate. Partitions are used in the order given in the MapFile parameter.</p> <p>Used partitions in the MapFile parameter are not legal since the new logical volume cannot occupy the same physical space as a previously allocated logical volume. All physical partitions belonging to a copy are allocated before allocating for the next copy of the logical volume. The MapFile parameter format is:</p> <p><i>PVname:PPnum1[-PPnum2]</i>. In this example, <i>PVname</i> is a physical volume name (for example, <i>hdisk0</i>) as specified by the system. It is one record per physical partition or a range of consecutive physical partitions. <i>PPnum</i> is the physical partition number.</p> <p><i>PVname</i> Name of the physical volume as specified by the system.</p> <p><i>PPnum</i> Physical partition number.</p>

Flag	Description
<code>-r Relocate</code>	<p>Sets the reorganization relocation flag. For striped logical volumes, the Relocate parameter must be set to <code>n</code> (the default for striped logical volumes). The Relocate parameter can be one of the following:</p> <p><code>y</code> Allows the logical volume to be relocated during reorganization. This is the default for relocation</p> <p><code>n</code> Prevents the logical volume from being relocated during reorganization.</p>
<code>-s Strict</code>	<p>Determines the strict allocation policy. Copies of a logical partition can be allocated to share or not to share the same physical volume. The Strict parameter is represented by one of the following:</p> <p><code>y</code> Sets a strict allocation policy; so, copies for a logical partition cannot share the same physical volume. This is the default for allocation policy.</p> <p><code>n</code> Does not set a strict allocation policy; so, copies for a logical partition can share the same physical volume.</p>
<code>-S StripeSize</code>	<p>Specifies the number of bytes per striped. Must be a power of two, between 4 KB and 128 KB, for example 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, or 128 KB.</p>
<code>-t Type</code>	<p>Sets the logical volume type. The standard types are <code>jfs</code> (file systems), <code>jfslog</code> (journal file system logs), and <code>paging</code> (paging spaces), but a user can define other logical volume types with this flag. You cannot create a striped logical volume of type <code>boot</code>. The default is <code>jfs</code>. If a log is manually created for a file system, the user must run the <code>logform</code> command to clean out the new <code>jfslog</code> before the log can be used. For example, to format the logical volume <code>logdev</code>, enter:</p> <pre>logform /dev/logdev</pre> <p>where <code>/dev/logdev</code> is the absolute path to the logical volume.</p>
<code>-u UpperBound</code>	<p>Sets the maximum number of physical volumes for new allocation. The value must be between one and the total number of physical volumes. The default is the total number of physical volumes in the volume group. When used to create a striped logical volume, using the <code>-S</code> flag, the <code>-u</code> flag sets the number of physical volumes being striped across.</p>

Flag	Description
<code>-v Verify</code>	<p>Sets the write-verify state for the logical volume. Causes (y) all writes to the logical volume to either be verified with a follow-up read or prevents (n) the verification of all writes to the logical volume. The Verify parameter is represented by one of the following:</p> <p><i>n</i> Prevents the verification of all write operations to the logical volume. This is the default for the <code>-v</code> flag.</p> <p><i>y</i> Causes the verification of all write operations to the logical volume.</p>
<code>-w MirrorWriteConsistency</code>	<p><i>y</i> Turns on mirror write consistency, which insures data consistency among mirrored copies of a logical volume during normal I/O processing.</p> <p><i>n</i> No mirror write consistency (see the <code>-f</code> flag of the <code>syncvg</code> command).</p>
<code>-x Maximum</code>	<p>Sets the maximum number of logical partitions that can be allocated to the logical volume. The default value is 512. The number represented by the Number parameter must be equal to or less than the number represented by the Maximum variable. The maximum number of logical partitions per logical volume is 32,512.</p>
<code>-Y NewLogicalVolume</code>	<p>Specifies the logical volume name to use instead of using a system-generated name. Logical volume names must be unique system wide name and can range from 1 to 15 characters. If the volume group is varied on in concurrent mode, the new name should be unique across all the concurrent nodes the volume group is varied on. The name cannot begin with a prefix already defined in the PdDv class in the Device Configuration Database for other devices.</p>
<code>-Y Prefix</code>	<p>Specifies the Prefix to use instead of the prefix in a system-generated name for the new logical volume. The prefix must be less than or equal to 13 characters. The name cannot begin with a prefix already defined in the PdDv class in the Device Configuration Database for other devices, nor be a name already used by another device.</p>

Note

The `-c`, `-d`, `-e`, `-m`, `-s`, and `-w` flags are not valid when creating a striped logical volume using the `-S` flag.

5.6.11 The mkps command

The `mkps` command adds additional paging space to the system.

The `mkps` command syntax is as follows:

To add a logical volume for additional paging space

```
mkps [ -a ] [ -n ] [ -t lv ] -s LogicalPartitions VolumeGroup [ PhysicalVolume ]
```

To add additional paging space on an nfs server

```
mkps [ -a ] [ -n ] -t nfs ServerHostName ServerFileName
```

The commonly used flags are provided in Table 24.

Table 24. Commonly used flags of the `mkps` command

Flag	Description
-a	Specifies that the paging space is configured at subsequent restarts.
-n	Activates the paging space immediately.
-s <i>LogicalPartitions</i>	Specifies the size of the paging space and the logical volume to be made in logical partitions
-t	Specifies the type of paging space to be created. One of the following variables is required: lv Specifies that a paging space of type logical volume should be created on the system. nfs Specifies that a paging space of type NFS should be created on the system.

5.6.12 The replacepv command

The `replacepv` command replaces a physical volume in a volume group with another physical volume.

The `replacepv` command syntax is as follows:

```
replacepv [ -f ] {SourcePhysicalVolume | SourcePhysicalVolumeID }  
DestinationPhysicalVolume  
replacepv [ -R ] dir_name [ DestinationPhysicalVolume ]
```

The commonly used flags are provided in Table 25.

Table 25. Commonly used flags of the `replacepv` command

Flag	Description
-f	Forces to replace a SourcePhysicalVolume with the specified DestinationPhysicalVolume unless the DestinationPhysicalVolume is part of another volume group in the Device Configuration Database or a volume group that is active.
-R dir_name	Recovers <code>replacepv</code> if it is interrupted by <ctrl-c>, a system crash, or a loss of quorum. When using the -R flag, you must specify the directory name given during the initial run of <code>replacepv</code> . This flag also allows you to change the DestinationPhysicalVolume.

5.6.13 The `restvg` command

The `restvg` command restores the user volume group and all its containers and files as specified in the `/tmp/vgdata/vgname/vgname.data` file (where `vgname` is the name of the volume group) contained within the backup image created by the `savevg` command.

The `restvg` command restores a user volume group. The `bosinstall` routine reinstalls the root volume group (`rootvg`). If the `restvg` command encounters a `rootvg` volume group in the backup image, the `restvg` command exits with an error.

If a `yes` value has been specified in the `EXACT_FIT` field of the `logical_volume_policy` stanza of the `/tmp/vgdata/vgname/vgname.data` file, the `restvg` command uses the map files to preserve the placement of the physical partitions for each logical volume. The target disks must be of the same size or larger than the source disks specified in the `source_disk_data` stanzas of the `vgname.data` file.

The `restvg` command syntax is as follows:

```
restvg [ -b Blocks ] [ -f Device ] [ -q ] [ -s ] [-n ] [-p PPsize ] [ DiskName ]
```

The commonly used flags are provided in Table 26.

Table 26. Commonly used flags of the `restvg` command

Flag	Description
-b <i>Blocks</i>	Specifies the number of 512-byte blocks to read in a single input operation. If this parameter is not specified the default of 100 is used by the <code>restore</code> command. Larger values result in larger physical transfers to tape devices.
-f <i>Device</i>	Specifies the device name of the backup media. The default is <code>/dev/rmt0</code> .
-q	Specifies that the usual prompt not be displayed before the restoration of the volume group image. If this flag is not specified, the prompt displays the volume group name and the target disk-device names.
-s	Specifies that the logical volumes be created at the minimum size possible to accommodate the file systems. This size is specified by the value of <code>LV_MIN_LPS</code> field of the <code>lv_data</code> stanza of the <code>vgname.data</code> file (where <code>vgname</code> is the name of the volume group). The <code>-s</code> flag overrides the values of the <code>SHRINK</code> and <code>EXACT_FIT</code> fields in the <code>logical_volume_policy</code> stanza of the <code>vgname.data</code> file. The <code>-s</code> flag causes the same effect as values of <code>SHRINK=yes</code> and <code>EXACT_FIT=no</code> would cause.
-n	Specifies that the existing MAP files are ignored. The <code>-n</code> flag overrides the value of the <code>EXACT_FIT</code> field in the <code>logical_volume_policy</code> stanza of the <code>vgname.data</code> file.
-p <i>PPsize</i>	Specifies the number of megabytes in each physical partition. If not specified, <code>restvg</code> uses the best value for the <code>PPsize</code> , dependent upon the largest disk being restored to. If this is not the same as the size specified in the <code>vgname.data</code> file, the number of partitions in each logical volume will be appropriately altered with respect to the new <code>PPsize</code> . If a <code>PPsize</code> is specified that is smaller than appropriate for the disk sizes, the larger <code>PPsize</code> will be used. If a <code>PPsize</code> is specified that is larger than appropriate for the disk sizes, the specified larger <code>PPsize</code> will be used.

Flag	Description
<i>DiskName</i>	Specifies the names of disk devices to be used instead of the disk devices listed in the <code>vname.data</code> file. Target disk devices must be defined as empty physical volumes; that is, they must contain a physical volume identifier and must not belong to a volume group. If the target disk devices are new, they must be added to the system using the <code>mkdev</code> command. If the target disk devices belong to a volume group, they must be removed from the volume group using the <code>reducevg</code> command.

5.6.14 The `sysdumpdev` command

The `sysdumpdev` command changes the primary or secondary dump device designation in a system that is running.

The `sysdumpdev` command syntax is as follows:

```
sysdumpdev -P { -p Device | -s Device } [ -q ]
```

```
sysdumpdev [ -p Device | -s Device ] [ -q ]
```

```
sysdumpdev [ -d Directory | -D Directory | -e | [ -k | -K ] | -l | -L | -p  
Device | -q | -r Host:Path | -s Device | -z ]
```

The commonly used flags are provided in Table 27.

Table 27. Commonly used flags of the `sysdumpdev` command

Flag	Description
<code>-d Directory</code>	Specifies the Directory the dump is copied to at system boot. If the copy fails at boot time, the <code>-d</code> flag ignores the system dump.
<code>-D Directory</code>	Specifies the Directory the dump is copied to at system boot. If the copy fails at boot time, using the <code>-D</code> flag allows you to copy the dump to an external media. Note: When using the <code>-d Directory</code> or <code>-D Directory</code> flags, the following error conditions are detected: Directory does not exist. Directory is not in the local journaled file system. Directory is not in the rootvg volume group.
<code>-e</code>	Estimates the size of the dump (in bytes) for the current running system.

Flag	Description
-k	Requires the key mode switch to be in the service position before a dump can be forced with the reset button or the dump key sequences. This is the default setting.
-K	The reset button or the dump key sequences will force a dump with the key in the normal position or on a machine without a key mode switch. Note: On a machine without a key mode switch, a dump can not be forced with the reset button nor the key switch without this value set.
-l	Lists the current value of the primary and secondary dump devices, copy directory, and forcecopy attribute.
-L	Displays statistical information about the most recent system dump. This includes date and time of last dump, number of bytes written, and completion status.
-P	Makes permanent the dump device specified by -p or -s flags. The -P flag can only be used with the -p or -s flags.
-p <i>Device</i>	Temporarily changes the primary dump device to the specified device. The device can be a logical volume or a tape device. For a network dump, the device can be a host name and a path name.
-q	Suppresses all messages to standard output. If this flag is used with the -l, -r, -z or -L flag, the -q command will be ignored.
-r <i>Host:Path</i>	Frees space used by the remote dump file on server Host. The location of the dump file is specified by the Path.
-s <i>Device</i>	Temporarily changes the secondary dump device to the specified device. The device can be a logical volume or a tape device. For a network dump, the device can be a host name and a path name.
-z	Determines if a new system dump is present. If one is present, a string containing the size of the dump in bytes and the name of the dump device will be written to standard output. If a new system dump does not exist, nothing is returned. After the sysdumpdev -z command is run on an existing system dump, the dump will no longer be considered recent.

5.7 Quiz

The following assessment questions will help verify your understanding of the topics discussed in this chapter.

1. There are two disks, hdisk0 and hdisk1, in the same volume group. In order to move one of the logical volumes, hd9var, from hdisk0 to hdisk1, which of the following commands should be used?
 - A. `cp hd9var hdisk1`
 - B. `chlv hd9var hdisk0 hdisk1`
 - C. `chpv hd9var hdisk0 hdisk1`
 - D. `migratepv -l hd9var hdisk0 hdisk1`
2. Which of the following statements best describes AIX journaled file systems?
 - A. Data access time is improved by JFS logging.
 - B. A JFS log records file system metadata.
 - C. JFS logging is optional for file systems.
 - D. JFS logging provides database transaction logging.
3. Two disks, hdisk0 and hdisk1, are both included in the root volume group. The following information shows the current contents of hdisk1:

```
# lspv -l disk1
hdisk1:
```

LV NAME	LPs	PPs	DISTRIBUTION	MOUNT POINT
hd1	1	1	01..00..00..00..00	N/A
hd3	8	8	00..00..00..08..00	/tmp

Which of the following commands should be used to move all data from hdisk1 to hdisk0?

- A. `migratepv hdisk1 hdisk0`
- B. `cp1v` for each logical volume
- C. `migratepv -l hd3 hdisk1 hdisk0`
- D. `mk1vcopy` for each logical volume contained on hdisk1

4. A user has accidentally removed the boot logical volume from the system. In order to re-create the boot's logical volume, which of the following procedures should be performed?
 - A. Create the LV hd5 on rootvg on the edge, then run bosboot.
 - B. Create a logical volume called hd5 within the rootvg, and reboot the system.
 - C. Create a file system mounted on /blv and copy /unix file into the /blv directory.
 - D. Reconfigure a logical volume called hd5 on hdisk0, with the same size as the root file system.

5. A system administrator has a system where the file systems are much larger than they need to be. In order to allow the file systems to be created with the smallest size when the backup is restored, which of the following procedures should occur before or after performing the mksysb system backup?
 - A. Before performing the mksysb backup, edit the image.data file and set EXACT_FIT=yes.
 - B. Before performing the mksysb backup, edit the bosinst.data file and set INSTALL_METHOD=reduce.
 - C. Before performing the mksysb backup, edit the bosinst.data file and set EXISTING_SYSTEM_OVERWRITE=yes.
 - D. After booting from the mksysb, choose the menu option to shrink file systems.

6. A volume group, appvg, on hdisk4 contains all of the application data. The disk that contains this volume group must be moved to another system. Which of the following groups of commands, in the order specified, will remove the disk and volume group definitions from the current system?
 - A. exportvg appvg / varyoffvg appvg / rmdev -l hdisk4
 - B. reducevg appvg / varyoffvg appvg / exportvg appvg
 - C. reducevg appvg / exportvg appvg / varyoffvg appvg
 - D. varyoffvg appvg / exportvg appvg / rmdev -l hdisk4 -d

7. A system administrator must perform disaster recovery onto a smaller system. The original rootvg drive was 4.5GB and is being replaced with a 1.0 GB drive. Which of the following procedures should be performed before performing the backup to make sure that the mksysb restores on the 1.0 GB disk?
 - A. Create the LV hd5 on rootvg on the edge, then run bosboot.
 - B. Create a logical volume called hd5 within the rootvg, and reboot the system.
 - C. Create a file system mounted on /blv and copy /unix file into the /blv directory.
 - D. Reconfigure a logical volume called hd5 on hdisk0, with the same size as the root file system.

- A. Edit the image.data file and set FS_COMPRESS=yes for each file system.
 - B. Edit the image.data file and set UPPER_BOUND=4 for each logical volume.
 - C. Edit the image.data file and change the PP_SIZE for each logical volume to 4 MB.
 - D. Edit the image.data file and divide the logical partition number for each logical volume by 2.
8. The disk, hdisk4, contains the volume group, appvg. The disk is physically attached to the system. Now the disk and volume group must be configured so they are available to the system. Which of the following group of commands, in the order given, should be run to successfully complete the configuration?
- A. mkdev / mkgv / varyonvg
 - B. cfgmgr / importvg / varyonvg (on pre-AIX 4.3 systems)
 - C. cfgmgr / varyonvg / importvg
 - D. extendvg / importvg / varyonvg
9. In the process of recovering a multi-disk volume group, a disk was removed from the system without running the standard process. Which of the following procedures should be performed to complete the recovery?
- A. Run the `synclvodm` command
 - B. The references to the old disk should be removed from the `/etc/vg` file
 - C. Run the `reorgvg` command to reorganize the volume group ignoring the removed disk
 - D. No action is necessary if the removed disk contained only paging space

5.7.1 Answers

The following are the preferred answers to the questions provided in this section.

1. D
2. B
3. A
4. A
5. D
6. D
7. C
8. B
9. A

5.8 Exercises

The following exercises provide sample topics for self study. They will help ensure comprehension of this chapter.

1. On a test system, migrate a logical volume from one disk to another.
2. On a test system, create a boot image.
3. On a test system, reduce a volume group.
4. Create a new JFS log on a new hdisk.
5. Import an old disk from another system into the current system.

Chapter 6. System backup and recovery

The following topics are discussed in this chapter:

- Backup procedures
- Restore procedures
- Troubleshooting backup and restore procedures

At most sites, information stored on computers is worth more than the computers themselves. Protecting this information is one of the system administrator's most important tasks.

6.1 Backup

This section will cover backup and restore procedures of your data. When do you need backups? When your worst fear happens, and you lost all your data, backups will help you to survive. Keep it in your mind and take frequent backups.

6.1.1 Backup of the rootvg volume group

In AIX, the files and directories are divided into two categories, for system and user. For the system, most AIX components (BOS, LPPs, miscellaneous configuration files, and so on) are held in the rootvg volume group. This category is not changed frequently except for the /var file system contents (usually holds the system and application logs). For the user data, it could be held in the either the rootvg volume group or user defined volume groups. This category is changed frequently, since the user applications frequently change the data each day or each hour.

Due to the differences of the characteristics of these two categories, It is strongly recommended that you place user category data in the volume group other than the rootvg volume group. It will provide you easy backup operation policy, creating the backup of the rootvg volume group when some software maintenance are made, and take frequent backup of the other volume groups to protect user category data.

To backup the contents of the rootvg volume group, you can use the `mksysb` command, commonly used for creating a bootable tape.

Features of `mksysb` backup are:

- Backup of the rootvg group only.

- Back up only mounted file systems.
- The image backup is performed using the `backup` command.
- Provides facilities for non-interactive install.
- Saves system paging space definitions.
- Saves logical volumes polices.

AIX Version 3 uses the `tar` command during a `mksysb` for `rootvg`.

6.1.2 The data layout of a mksysb tape

The `mksysb` tape has special layout designed for easy BOS installation and recovery. The layout of `mksysb` tape is shown in the Figure 37 on page 158.

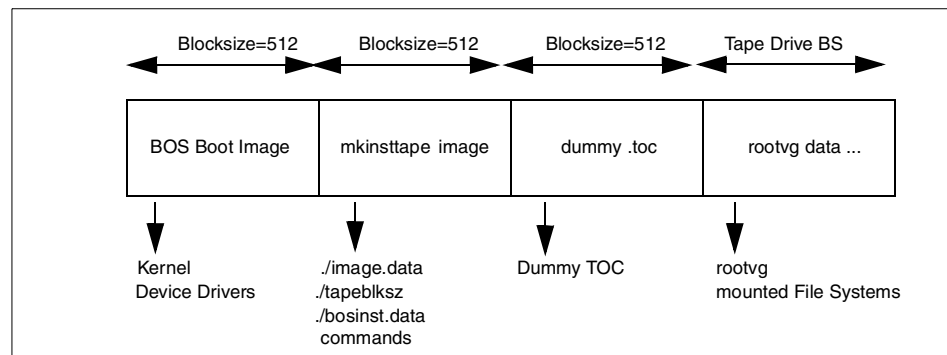


Figure 37. Contents of `mksysb` image

The BOS boot image contains a copy of the system's kernel and device drivers needed to boot from `mksysb` tape. It is created by `bosboot` command.

There are two important files in `mkinstimage` (the second image of the `mksysb` tape): `/image.data` and `/bosinst.data`. The `image.data` file contains information describing the image installed during the BOS installation process. This information includes the sizes, names, maps, and mount points of logical volumes and file systems in the `rootvg`. The `mkszfile` command generates the `image.data` file. The `image.data` file is arranged in stanza format. Each stanza contains one or more fields. The most important fields for you are:

SHRINK When set to YES, causes the system to create the smallest file systems required to contain all the data in the file system.

BOSINST_FILE	Provides the full path name of a file or command to execute after BOS install completes.
EXACT_FIT	When set to YES, causes the system to place logical volumes on the disk according to the physical partition maps that were generated with -m flag of the <code>mksysb</code> command.

You can customize this file before using the `mksysb` command.

The `./bosinst.data` file allows you to specify the requirements at the target system and how the user interact with the target system. This file contains the customized BOS install procedures and dictates how the BOS install program will behave. You can customize this file before using the `mksysb` command or use a procedure to customize this after the image backup is done.

Take note that the `mksysb` command uses the `backup` command to save the contents of JFS data held in the rootvg volume group. It does not save raw data.

6.1.3 Back up non-rootvg volume group

If you need to make a backup of the non-rootvg volume group, use the `savevg` command. It works the same as the `mksysb` command expect that it does not create a bootable tape. The first three images on the tape are dummy replacements for the images normally found on a bootable tape (refer to Figure 37 on page 158). The `savevg` command uses the data file `/tmp/vgdata/uservg/uservg.data`, created by the `mkvgdata` command. This file contains information about a user volume group, and it is similar to `image.data` file. After making changes in `uservg.data`, you can remake the user volume group using the `restvg` command.

To back up the `uservg` volume group to the tape drive, enter the following:

```
# savevg -if /dev/rmt0 uservg
```

To back up the `uservg` volume group to the tape drive excluding the files listed in the `/etc/exclude.uservg` file, enter the following:

```
# savevg -ief /dev/rmt0 uservg
```

6.1.4 Back up file systems

The `backup` command is the preferred command for making backups of an AIX system. There are two backup techniques available:

1. Backup by file name:

- a. To back up all the files and subdirectories in the /home directory using full path names, use:

```
# find /home -print | backup -if /dev/rmt0
```

- b. To back up all the files and subdirectories in current directory using relative path names, use:

```
# cd /home  
# find . -print | backup -if /dev/rmt0
```

2. Back up of the file system by inode has the advantage of making incremental backups.

To backup file system /home at the 0 level, enter the following:

```
# backup -0 -uf /dev/rmt0 /home
```

To generate a system backup on the tape and to create /image.data, use command:

```
# mksysb -i /dev/rmt0
```

To generate a system backup and exclude the /home directory, use:

```
# echo /home > /etc/exclude.rootvg  
# mksysb -e /dev/rmt0
```

Note

Before running the `mksysb` command, ensure that enough space is available in the /tmp file to store a boot image. It typically needs 8 to 12 MB of free space in /tmp. Use `-X` flag with `mksysb` to dynamically increase the /tmp file system.

6.2 Recovery

This section discusses the recovery procedures of volume groups and file systems.

6.2.1 Recovery of rootvg

You can use the `mksysb` tape in two situations, as described in the following:

1. Reinstalling or clone system:
 - a. Check if your system will boot from tape:

```
# bootinfo -e
```

If a 1 is returned, a boot from tape is supported. If a 0 is returned, a boot from tape is not supported

- b. Put the mksysb tape in tape drive
- c. Check booting order for service mode:

```
# bootlist -m service -o
```

If it is necessary, change it to `rmt0`:

```
# bootlist -m service rmt0
```

- d. Reboot system

2. Extracting data from mksysb tape (see 6.2.4, “Extracting data from mksysb tape” on page 161).

6.2.2 Restore a non-rootvg volume group

To restore a backup of the user volume group use the `restvg` command from a savevg image. This utility can be used to shrink the size of file systems within the uservg volume group. All you have to do is to modify the `/tmp/vgdata/uservg/uservg.data` file.

To restore the volume group uservg image from the tape onto the disks specified in the `/tmp/vgdata/uservg/uservg.data` file, enter the following:

```
# restvg -f /dev/rmt0
```

6.2.3 Restore a file system

The `restore` command is used to restore data backed up with the `backup` command.

`restore -Tvf /dev/rmt0` will show the table of contents for the tape and list the files on it.

`restore -xvf /dev/rmt0 /home/ostach` restores individual files from backup made by `backup -i` command.

`restore -rvf /dev/rmt0` restores an entire file system archive.

6.2.4 Extracting data from mksysb tape

If you need to verify the mksysb tape or extract some data from it follow procedures:

1. Issue the `restore` command:
 - a. Rewind tape using the command:

```
# tctl -f /dev/rmt0 rewind
```

- b. Move the tape forward to the third tape marker (beginning of fourth image):

```
# tctl -f /dev/rmt0.1 fsf 3
```

- c. Restore date:

```
# restore -xqvf /dev/rmt0.1 /tmp/my_file
```

2. SMIT fast path:

```
# smitty lsmksysb
```

6.2.5 A customized mksysb restore

The /image.data file is usually automatically generated upon creation of the mksysb tape, using the -i flag of the mksysb command.

This file is used during a restore, to enable customized actions.

You can tailor these actions through the following procedure.

1. Create a file named signature consisting of one word: data
2. Back up the edited bosinst.data file and the new signature file to diskette:

```
# ls ./bosinst.data signature | backup -qiv /dev/fd0
```

3. Put the diskette in the diskette drive of the target machine you are installing.
4. Boot the target machine from the install tape and install AIX. The BOS installation program will use the diskette file rather than the default bosinst.data file shipped with the installation media.

You can customize the /image.data file using a text editor. Commonly modified fields are described in the following.

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: Migrate, preserve, or overwrite. The default value is initially blank. The installation program assigns a value, depending on which version of AIX was previously installed.
PROMPT	Specifies whether the installation program uses menus from which you make choices.

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.
HDISKNAME	Specifies the path name of the target disk.

If you would like to exclude some files or directories from the backup put these filenames into the `/etc/exclude.rootvg` file and use `-e` flag with the `mksysb` command.

6.3 Other UNIX backup commands

If you familiar with other UNIX backup commands, you can use them in AIX as well.

1. `tar` is a traditional UNIX archive command. It can generate a tar file as well as tapes or diskettes, `tar` backups files, directories, and subdirectories. It does not support AIX ACLs.

To create `tar` backup of home directory, enter:

```
# tar -cvf /dev/rmt0 /home/ostach
```

To create a tar backup of a relative path name, enter:

```
# tar -cvf /dev/rmt0 file1 file2
```

To list contents of tar archive file, enter:

```
# tar -tvf /tmp/mybackup.tar
```

To restore from backup tar:

```
# tar -xvf /dev/rmt0
```

2. The `cpio` command reads or writes from `stdin` and `stdout`. It is a common UNIX command; so, it is very useful for moving information between systems. To back up data in the current directory to the `/tmp/file.cpio` file using `cpio`, enter:

```
# find . -print | cpio -ov >/tmp/file.cpio
```

To restore data from `cpio` archive file, `/tmp/file.cpio` use:

```
# cpio -idv < /tmp/file.cpio
```

6.4 Sysback

IBM Operational Support Services for RS/6000 system backup and recovery - Sysback provides easy backup and recovery of either individual files or your

entire system. Sysback is available on a limited basis from IBM and as a services offering. It provides the following functions.

- Replicates your AIX operating system
- Improves performance and capacity of your backups
- Utilizes the AIX interface, System Management Interface Tool (SMIT)
- Provides backup and recovery from local and remote devices

With the IBM Operational Support Services for RS/6000 system backup and recovery software, Sysback, you get a flexible backup method that handles the recovery and replication of your Advanced Interactive Executive (AIX) systems. Sysback is a single product for backing up and restoring user data, applications, and your operating system.

Sysback performs backup, listing, verification, and restoration from various backup types including:

- A full system backup (including multiple volume groups)
- Select volume groups
- Select file systems
- Select files or directories
- Raw logical volumes

6.4.1 Sysback installation

You can install Sysback using your current hardware configurations or you can change the configuration. Some of the installation features include the abilities to:

- Install locally from a tape drive or remotely from a tape drive or files
- Boot over the network which removes your local media from the process
- Preserve previous volume groups and logical volume placements
- Create logical volumes types
- Change logical volume and file system sizes and placement
- Create, import, or exclude individual volume groups

6.4.2 Virtual devices

Sysback increases your backup performance and volume by allowing each user to group multiple tape drives into a single virtual device. Each user can select from the following backup types:

- Sequential performs an automatic backup on the next device, when a prior tape reaches the end of its volume
- Parallel strips data across multiple devices in parallel, thus completing backups in as little as one-third the time
- Multi-copy creates multiple, identical backups in the same time it takes to create a single backup without the AIX Sysback software

6.4.3 Other features

Using the AIX user-friendly interface, System Management Interface Tool (SMIT), Sysback also provides:

- Sequential auto-loader support
- Software data compression
- User and host security features
- Selective file restoration
- Re-creation of volume groups, logical volumes, and file systems from backup media
- Incremental backups
- Multiple tape volume support
- An on-screen progress indicator
- Exclusion of files or directories
- The ability to append multiple backups to the same tape

6.4.4 Optional features

The Sysback Offline Mirror Backup feature allows you to perform backups on offline mirrors of data. The backup can include a single file system or logical volume to a complete system. When complete, the offline copies are returned to their original file system or logical volume. The files are also compared, and only the changed files are updated from the active copies.

6.5 Troubleshooting

This section will cover problems that can occur during backup procedures.

6.5.1 Remote backup

It is possible to create `tar` backup images on remote tape drives. To make server3 files backed up on a server1 tape drive, perform the following steps.

```
# hostname
server3
# cd /test
# tar cBf - . | rsh server1 "dd ibs=512 obs=512 of=/dev/rmt0"
5080+0 records in.
5080+0 records out.
```

The `-B` flag for `tar` tells it to create 512-byte blocks, which is necessary on pipes. The `-f -` combination makes `tar` send output to `stdout`. The `rsh` takes `stdin` and writes it to `/dev/rmt0` using 512-byte blocks.

Note

Remember to set up the `/etc/hosts.equiv` and `$HOME/.rhosts` files to create relationships between systems to work with `rsh`.

6.5.2 Block size determination

The block size problem is usually encountered while moving a tape from one system to another.

The following are a two methods to find out the block size:

- Method 1

Use the `dd` command to read a single block from the device and find out what block size is used for the archive:

```
dd if=/dev/rmt0 bs=128k count=1 | wc -c
```

This will return to you the size in bytes of the block being read. Assuming that your backup was made with the same physical block size, you can change your device to use this block size.

- Method 2

Use the `tcopy` command as follows to find out the block size:

```
# tcopy /dev/rmt0
tcopy : Tape File: 1; Records: 1 to 7179 ; size:512
tcopy : Tape File: 1; End of file after :7179 records; 3675648 bytes
tcopy : Tape File: 2; Records: 1 to 2900 ; size:512
tcopy : Tape File: 2; End of file after 2900 records, 76890 bytes
...
```

This will give you a list of all the files found on the media with their byte count and the block size (shown in bold) used.

6.5.3 Tape block size determination scenario

The following procedure describes problems with the tape block size. First, the `/etc/hosts` file is backed up to the tape using `tar` command with a fixed tape block size 512 bytes. After this, the block size is changed to 2048, and tape is attempted to be read (note the error shown in bold).

```
# chdev -l rmt0 -a block_size=512
rmt0 changed
# lsattr -El rmt0 -a block_size
block_size 512 BLOCK size (0=variable length) True
# tar cvf /dev/rmt0 /etc/hosts
a /etc/hosts 4 blocks.
# chdev -l rmt0 -a block_size=2048
rmt0 changed
# tar tvf /dev/rmt0
tar: 0511-193 An error occurred while reading from the media.
There is an input or output error.
```

To determine tape block size use, the procedure described in 6.5.2, “Block size determination” on page 166 or use of `block_size=0`.

```
# chdev -l rmt0 -a block_size=512
rmt0 changed
# tar tvf /dev/rmt0
-rw-rw-r--  0 0      1817 Jun 09 16:24:17 2000 /etc/hosts
# chdev -l rmt0 -a block_size=0
rmt0 changed
# tar tvf /dev/rmt0
tar: The block size is 1 bytes.
-rw-rw-r--  0 0      1817 Jun 09 16:24:17 2000 /etc/hosts
```

6.6 Command summary

The following section provides a list of the key commands discussed in this chapter. For a complete reference of the following commands, consult the AIX product documentation.

6.6.1 The `mksysb` command

The `mksysb` command creates an installable image of the root volume group either in a file or onto a bootable tape. The command has the following syntax:

```
mksysb [ -e ] [ -p ] [ -X ] [ -i | -m ] Device | File
```

The commonly used flags are provided in Table 28.

Table 28. Commonly used flags of the `mksysb` command

Flag	Description
-e	Excludes files listed in the <code>/etc/exclude.rootvg</code> file from being backed up.
-i	Calls the <code>mkszfile</code> command, which generates the <code>/image.data</code> file.
-m	Generates map files.
-p	Disables software packing of the files as they are backed up.
-X	Specifies to automatically expand the <code>/tmp</code> file system if necessary.

6.6.2 The `savevg` command

The `savevg` command finds and backs up all files belonging to a specified volume group. The command has the following syntax:

```
savevg [ -e ] [ -f Device ] [ -i | -m ] [ -p ] [ -v ] [ -X ] VGName
```

The commonly used flags are provided in Table 29.

Table 29. Commonly used flags of the `savevg` command

Flag	Description
-e	Excludes files specified in the <code>/etc/exclude.vgname</code> file from being backed up by this command.
-f Device	Specifies the device or file name on which the image is to be stored. The default is the <code>/dev/rmt0</code> device.
-i	Creates the data file by calling the <code>mkvgdata</code> command.
-m	Creates the data file with map files.
-p	Disables software packing of the files as they are backed up.
-X	Specifies to automatically expand the <code>/tmp</code> file system if necessary.

6.6.3 The `restvg` command

The `restvg` command restores the user volume group and all its containers and files. The command has the following syntax:

```
restvg [ -f Device ] [ -s ] [-n ] DiskName ... ]
```

The commonly used flags are provided in Table 30.

Table 30. Commonly used flags of the `restvg` command

Flag	Description
<code>-n</code>	Specifies that the existing MAP files are ignored.
<code>-f Device</code>	Specifies the device or file name on which the image is to be stored. The default is the <code>/dev/rmt0</code> device.
<code>-s</code>	Specifies that the logical volumes be created at the minimum size possible to accommodate the file systems

6.6.4 The backup command

The `backup` command backs up files and file systems. The command has the following syntax:

```
backup -i [ -p [ -e RegularExpression ] ] [ -f Device ] [ -l Number ] [ -o ] [ -q ] [ -v ]
```

The commonly used flags are provided in Table 31.

Table 31. Commonly used flags of the `backup` command

Flag	Description
<code>-f Device</code>	Specifies the output device.
<code>-i</code>	Specifies that files be read from standard input and archived by file name.
<code>-m</code>	Creates the data file with map files.
<code>-q</code>	Indicates that the removable medium is ready to use.
<code>-v</code>	Causes the <code>backup</code> command to display additional information about the backup.

6.6.5 The restore command

The `restore` command extracts files from archives created with the `backup` command. The command has the following syntax:

```
restore -x -T [ v q ] [ -f Device ] [ File ... ]
```

The commonly used flags are provided in Table 32.

Table 32. Commonly used flags of the restore command

Flag	Description
-f <i>Device</i>	Specifies the device or file name on which the image is to be stored. The default is the /dev/rmt0 device.
-T	Displays information about the backup archive.
-q	Indicates that the removable medium is ready to use.
-v	Causes the backup command to display additional information about the backup.
-x	Restores individually named files specified by the File parameter.

6.6.6 The tar command

The `tar` command manipulates archives by writing files to, or retrieving files from, an archive storage medium. The command has the following syntax:

```
tar { -c | -t | -x } [ -B ] [ -v ] [ -f Archive] [ File | Directory ...
```

The commonly used flags are provided in Table 33.

Table 33. Commonly used flags of the tar command

Flag	Description
-c	Creates a new archive and writes the files specified by one or more File parameters to the beginning of the archive.
-t	Lists the files in the order in which they appear in the archive.
-B	Forces input and output blocking to 20 blocks per record.
-f <i>Archive</i>	Uses the <i>Archive</i> variable as the archive to be read or written.
-v	Lists the name of each file as it is processed.
-x	Restores individually named files specified by the File parameter.

6.7 Quiz

The following assessment questions will help verify your understanding of the topics discussed in this chapter.

1. Which of the following is an example of a backup by relative path name?
 - A. `tar -cvf /dev/rfd0 /file1`
 - B. `tar -cvf /dev/rfd0 file1 file2`
 - C. `tar -cvf /dev/rfd0 /home/file1`
 - D. `tar -cvf /dev/rfd0 /home/file1/file2`
2. Which of the following commands should be used to view the contents of a tape in `/dev/rmt0` that was created using the backup command?
 - A. `restore -T`
 - B. `restore -Tf/dev/rmt0`
 - C. `restore -xf/dev/rmt0`
 - D. `backup -tvf/dev/rmt0`

6.7.1 Answers

The following are the preferred answers to the questions provided in this section.

1. B
2. B

6.8 Exercises

The following exercises provide sample topics for self study. They will help ensure comprehension of this chapter.

1. Create a bootable tape by using the `mksysb` command.
2. Restore files from the second image of `mksysb` tape by using the `tctl` and `restore` commands.
3. On a test system that does not affect any user, save a user volume group.
4. Try to restore a user volume group by shrinking the file systems.
5. Make a file system backup, by using the `backup` command.

Chapter 7. Network Installation Management

Network Installation Management (NIM) is used to manage remote sites on a network. The types of machines you can manage are *stand-alone*, *diskless*, and *dataless*. A *stand-alone* machine is one that can boot (start up) by itself. *Diskless* and *dataless* systems cannot boot by themselves; they must use remote resources to boot. *Diskless* systems have no disk drive. *Dataless* systems have a local disk drive but they cannot boot from it.

Using NIM, you can install a group of machines with a common configuration or customize an installation for the specific needs of a given machine. The number of machines you can install simultaneously depends on the throughput of your network, the disk access throughput of the installation servers, and the platform type of your servers.

The NIM environment comprises client and server machines. A server provides resources (for example, files and programs required for installation) to another machine. A machine that is dependent on a server to provide resources is known as a client. In this guide and reference, any machine that receives NIM resources is a client, although the same machine can also be a server in the overall network environment.

For more information on NIM, refer to *NIM from A to Z in AIX 4.3*, SG24-5524.

7.1 Debugging NIM boot images

If a client machine is unable to network boot from its boot server, there may be a problem in one or more of the following stages of the network boot:

- Establishing network communication between the client and server
- Obtaining the boot image from the server
- Running the boot image on the client

7.1.1 Establishing network communication

The following steps may be used to establish network communication:

1. Before initiating the network boot on the client, perform a ping test from the client bootp menus.
2. If the ping test fails, verify that the client, server, and gateway addresses are specified correctly.
3. If the addresses are correct, try to ping the server from a different machine in the client's subnet.

4. If the server can be pinged from another machine, the network adapter on the boot client may be faulty.
5. If the server cannot be pinged from another machine in the client's subnet, there may be routing problems between the client and the server, or else network communications on the server may be faulty. Perform network debugging procedures to determine the source of the problem.

7.1.2 Obtaining the boot image from the server

The following steps may be used to obtain a boot image from the server.

1. If the ping test is successful, perform a network boot of the client. When a network boot is initiated on a client, a bootp request packet is sent from the client to the server.

The server then replies with a packet to the client. The client machine displays the number of packets sent and received for the bootp request. If a packet is sent from the client, but none is received, another packet will be sent.

2. If bootp packets continue to be sent but not received, the boot server may not be responding to the request.
3. From the bootp server, view the `/etc/bootptab` file on the server. It should contain an entry for the client machine with the following information:

```
<hostname of client>  
bf=<boot file>  
ip=<client ip address>  
ht=<network type>  
sa=<boot server address>  
sm=<client subnet mask>  
ha=<network adapter hardware address> (required only if bootp requests  
are sent by broadcasting)
```

If an entry does not exist, either the NIM command used to set up the current operation failed, or the machine was reset before the boot operation could occur.

Re-run the NIM `bos_inst`, `diag`, or `maint_boot` operation to prepare the server for the client boot request.

If the entry exists in `/etc/bootptab`, verify that the specified data is correct. If a field contains incorrect data, the information that was used to define the machine or network in the NIM database was probably wrong. Correct this problem by resetting the client machine, correcting the incorrect data in the client or network definition, retrying the NIM operation, and rebooting the client.

4. If the `/etc/bootptab` file is correct, verify that the `inetd` daemon is running. If it is not running, start it and retry the network boot from the client. If the `inetd` daemon is running, it should automatically start the `bootpd` daemon when the bootp request is received at the server.
5. If the `bootpd` daemon is not started, verify that the `bootpd` entry in the `/etc/inetd.conf` file is not commented out. If it is commented out, uncomment it and restart `inetd` with the `refresh -s inetd` command. Retry the network boot from the client.
6. If a bootp reply is still not received at the client, manually start the `bootpd` daemon in debug mode:
 - Comment out the `bootpd` entry from the `/etc/bootptab` file on the server.
 - Stop all running `bootpd` processes.
 - Restart `inetd` using the `refresh -s inetd` command.
 - Start `bootpd` from the command line using the `/usr/sbin/bootpd -s -d -d -d` command.
7. Retry to network boot from the client. If no output is displayed from the running `bootpd` command, the client bootp request is not reaching the server. Verify that the addresses specified in the bootp menus are correct. If they are correct, perform network debugging procedures to determine why the packet is not reaching the server.
8. If the server receives the client bootp request, then running the `bootpd` command displays output matching the client data in the `/etc/bootptab` file. Verify that the specified addresses are correct. This information is sent back to the client in the bootp reply.
9. If the client is still not receiving the bootp reply, perform network debugging procedures to determine why the reply packet is not reaching the client.
10. After the client receives the bootp reply, it will use `tftp` to transfer the boot image from the server.
11. The number of `tftp` packets transferred to the client will be displayed at the client machine.
12. The boot image has been successfully retrieved at the client machine when the LED shows 299 on rs6k-platform machines or when the bottom third of the screen turns gray on other platforms.
13. If the `tftp` transfer of the boot image does not complete successfully, the client may be trying to get the wrong boot image. Verify that the client definition in the NIM database shows the correct platform and kernel type.

If the data is incorrect, correct it, reset the client machine, re-run the NIM operation, and reboot the client over the network.

14. Verify that the /tftpboot directory on the boot server contains a link with the client name to the correct boot image. If the link does not exist, reset the client machine, re-run the NIM operation, and reboot the client over the network.

15. If the link with the client name is pointing to the correct boot image and the tftp transfer of the boot image does not complete successfully, the boot image may be corrupted.

Re-create the boot image by performing a NIM check operation with the force flag on the SPOT. If the client is not an rs6k-platform machine, also make sure the client has the latest version of the firmware installed.

7.1.3 Running the boot image on the client

After the client machine has successfully received the boot image from the server, the most common errors encountered are hangs with the LED showing 608, 611, or 613. Some machines may not have LED displays. Debugging such problems on these machines will require using debug-enabled boot images.

7.1.3.1 Error 608

Attempting to retrieve the client.info file with tftp. Note that a flashing 608 indicates multiple attempt(s) to retrieve the client_info file are occurring.

7.1.3.2 Error 611

The /etc/exports file either does not have the correct permissions for the client to mount /usr or does not have any entry for /usr.

7.1.3.3 Error 613

The system is unable to set up the routing tables.

7.2 Error 611 - network error

If you get an error 611 during boot, the problem is that the /etc/exports file either does not have the correct permissions for the client to mount /usr or does not have any entry for /usr.

To rectify this problem type the following command:

```
exportfs
```

Using the `exportfs` command, verify that each entry is filled in correctly.

If you receive the following error message when adding the network boot client:

```
Configuring network boot for client thumper.aix.dfw.ibm.com
/usr/ro,root=thumper.aix.dfw.ibm.com
Starting NFS and BOOTP services..
exports: /usr: sub-directory (/usr/lpp) already exported
/usr not found in etc/exports
```

the client has been configured, but you must correct the problem with the export before booting the client.

Execute the `exportfs` command.

If you continue to have problems trying to export a `/usr` parent directory, check the `/etc/exports` file, and look for an existing `/usr` subdirectory that is not a file system. If you have a `/usr` subdirectory that is not a file system you will not be allowed to export `/usr` until you remove it from the `/etc/exports` file.

An example would be:

```
/usr/sys/inst.images -rw
/usr/lpp -root=mars,access=mars
```

In the above example the `/usr/sys/inst.images` is its own file system, but `/usr/lpp` is still part of the `/usr` file system.

Execute the following command to remove `/usr/lpp` from the `/etc/exports` file.

```
/usr/sbin/rmmfsexp -d /usr/lpp -B
```

Re-add the network boot client by running the `smitty sysback` command. Verify by executing the `exportfs` command.

7.3 The `nim` command

The `nim` command performs an operation on a NIM object. The type of operation performed is dependent on the type of object specified by the *ObjectName* parameter. Possible operations include initializing environments and managing resources. You can use the `lsnim` command to display the list of supported operations.

The `nim` command syntax is as follows.

```
nim {-o Operation} [ -F ] [ -t Type ] [ -a Attribute=Value . . . ]
{ObjectName}
```

Table 34 provides a list of the flags and their descriptions, the most important functions are the flag sub functions.

Table 34. Commonly used flags of the nim command

Flag	Flag Description
-a <i>Attribute = Value . . .</i>	Assigns the specified value to the specified attribute. Use the <code>lsnim -q Operation -t Type</code> command to get a list of valid attributes for a specific operation.
-F	Overrides some safety checks, performs a force.

Flag	Flag Description
<i>-o Operation</i>	<p>Specifies an operation to perform on a NIM object. The possible operations are:</p> <p>allocate Allocates a resource for use.</p> <p>bos_inst Performs a BOS installation.</p> <p>change Changes an object's attributes.</p> <p>check Checks the status of a NIM object.</p> <p>cust Performs software customization.</p> <p>deallocate Deallocates a resource.</p> <p>define Defines an object.</p> <p>diag Allows a machine to boot a diag image.</p> <p>dkls_init Initializes a diskless machine's env.</p> <p>dtls_init Initializes a dataless machine's env.</p> <p>fix_query Lists the fix info. for a given APAR or keyword.</p> <p>lppchk Verifies installed filesets on NIM machines and SPOTs.</p> <p>lslpp Lists licensed program information about an object.</p> <p>maint Performs software maintenance.</p> <p>remove Removes an object.</p> <p>reset Resets an object's NIM state.</p> <p>sync_roots Synchronizes root directories for diskless and dataless clients for a specific SPOT.</p> <p>unconfig Unconfigures the NIM master fileset.</p> <p>maint_boot Lets machine boot in maintenance mode.</p> <p>showlog Displays a client's install, boot or custom log, or a SPOT's install log from the NIM master.</p> <p>showres Displays the contents of a resource.</p> <p>alt_disk_install Performs an alternate disk installation.</p>

Flag	Flag Description
-t <i>Type</i>	<p>Specifies the type of the NIM object for define operations. The possible types are:</p> <p>resource types:</p> <p>bosinst_data Config file used during base system installation.</p> <p>dump Parent directory for client dump files.</p> <p>fix_bundle Fix (keyword) input file for the cust or fix_query operation.</p> <p>home Parent directory for client /home directories.</p> <p>image_data Config file used during base system installation.</p> <p>installp_bundle Installp bundle file.</p> <p>lpp_source Source device for optional product images.</p> <p>mksysb AIX mksysb image.</p> <p>paging Parent directory for client paging files.</p> <p>root Parent directory for client / directories.</p> <p>script Executable file that is run on a client.</p> <p>shared_home /home directory shared by clients.</p> <p>spot Shared Product Object Tree - equivalent to /usr file system.</p> <p>tmp Parent directory for client /tmp directory.</p> <p>exclude_files Files excluded from a mksysb image.</p> <p>resolv_conf Name-server configuration file.</p> <p>machine types:</p> <p>diskless All file systems and resources remote.</p> <p>dataless Local paging, dump; remote /, /usr; others remote or local.</p> <p>standalone Local file systems and resources.</p> <p>master Machine that controls the NIM environment.</p> <p>network types:</p> <p>tok Token-Ring network.</p> <p>ent Ethernet network.</p> <p>fddi FDDI network.</p> <p>generic Other TCP/IP networks.</p> <p>group types:</p> <p>mac_group Group of machines.</p> <p>res_group Group of resources.</p>

The following are examples of using the `nim` command:

To define a resource that is a directory containing installable images that is located on server `altoid` and has a path name of `/usr/sys/inst.images`, and name that resource `images`, enter:

```
# nim -o define -t lpp_source -a server=altoid \  
-a location=/usr/sys/inst.images images
```

To remove a resource named `dump_files`, enter:

```
# nim -o remove dump_files
```

Machines on the `BLDG905` network use the `gateway905` gateway to reach the `OZ` network. Machines on the `OZ` network use the `gatewayOZ` gateway to reach the `BLDG905` network. To add a route between two networks named `BLDG905` and `OZ`, enter:

```
# nim -o change -a routing1="OZ gateway905 gatewayOZ" BLDG905
```

To have NIM check on the usability of a SPOT named `myspot`, enter:

```
# nim -o check myspot
```

To have NIM check on the usability of a SPOT named `myspot` and force results from busy clients, add the `-F` flag. This is not normally needed with `check`, however use it to get the best results.

```
# nim -F -o check myspot
```

To allocate resources to a diskless workstation with the name of `syzygy` and SPOT attribute value of `spot1`, enter:

```
# nim -o allocate -a spot=spot1 syzygy
```

To deallocate an `lpp_source` named `images` from the standalone machine `client1`, enter:

```
# nim -o deallocate -a lpp_source=images client1
```

To install the machine `bluefish`, using the resources `spot1`, `images1`, `bosinst_data1`, and `rconf1`, first allocate the resources by entering:

```
# nim -o allocate -a spot=spot1 -a lpp_source=images1 \  
-a bosinst_data=bosinst_data1 -a resolv_conf=rconf1 bluefish
```

Then, perform the BOS installation by entering:

```
# nim -o bos_inst bluefish
```

To install a software product into a spot, spot1, such that the image for the installable option, adt, resides in the lpp_source, images, enter:

```
# nim -o cust -a lpp_source=images -a filesets=adt spot1
```

To uninstall the software products bos.INed and adt from a spot, spot1, enter:

```
# nim -o maint -a installp_flags="-u" -a filesets="bos.INed adt" spot1
```

To initialize the environment for a diskless workstation with the name of syzygy, using the resources spot1, root1, dump1, and paging1, first allocate the resources by entering:

```
# nim -o allocate -a spot=spot1 -a root=root1 -a dump=dump1 \  
-a paging=paging1 syzygy
```

Then initialize the resources for the client machine by entering:

```
# nim -o dkls_init syzygy
```

To initialize the environment for a dataless workstation with the name of syzygy, using the resources spot1, root1, and dump1, first allocate the resources by entering:

```
# nim -o allocate -a spot=spot1 -a root=root1 -a dump=dump1 syzygy
```

Then initialize the resources for the client machine by entering:

```
# nim -o dtls_init syzygy
```

To list information about fixes installed on client Standalone1 for 20 APAR numbers, create the file /tmp/apar.list with one APAR number per line, as shown:

```
IX123435  
IX54321  
IX99999  
...
```

then enter:

```
# nim -o define -t fix_bundle -alocation=/tmp/apar.list \  
-aserver=master fix_bun  
# nim -o allocate -a fix_bundle=fix_bun Standalone1  
# nim -o fix_query Standalone1
```

To allocate all resources applicable to standalone machines from the NIM resource group res_grp1, to the machine mac1, enter:

```
# nim -o allocate -a group=res_grp1 mac1
```


To install the machine bluefish while allocating the resources spot1, images1, bosinst_data1, and rconf1 automatically when the bos_inst operation starts, enter:

```
# nim -o bos_inst -a spot=spot1 -a lpp_source=images1 \  
-a bosinst_data=bosinst_data1 -a resolv_conf=rconf1 bluefish
```

To define default routes for the networks net1 and net2 that use default gateways gw1 and gw2 respectively, enter the following two commands:

```
# nim -o change -a routing1="default gw1" net1  
# nim -o change -a routing1="default gw2" net2
```

To install the machine catfish with the contents of the installp_bundle bundle1, while allocating this resource and the lpp_source images1 when the customer operation runs, enter:

```
# nim -o cust -a installp_bundle=bundle1 -a lpp_source=images1 catfish
```

To define a machine group named Disklsmacs1 with members that are NIM diskless machines named diskls1, diskls2, and diskls3, enter:

```
# nim -o define -t mac_group -a add_member=diskls1 \  
-a add_member=diskls2 -a add_member=diskls3 Disklsmacs1
```

To initialize the group of diskless machines defined by the machine group dtgrp1, while allocating the required and optional resources defined by the resource group dk_resgrp1, when the dkls_init operation runs, enter:

```
# nim -o dkls_init -a group=dtgrp1 dk_resgrp1
```

To exclude the member named dataless1 from operations on the machine group DatalsMac1, and then initialize the remaining members while allocating the dataless resources defined by the resource group named DatalsRes1, enter the following two commands:

```
# nim -o select -a exclude=datals2 DatalsMac1  
# nim -o dtls_init -a group=DatalsMac1 DatalsRes1
```

To verify the file checksums for all packages beginning with the name bos on NIM targets in the group of standalone machines macgrp1, and displaying detailed error information and updating the software database to match the actual file checksum when inconsistencies are found, enter:

```
# nim -o lppchk -a lppchk_flags='-c -m3 -u' -a filesets='bos*' macgrp1
```

Since the lppchk operation runs in the background on group members by default, to view the output from the lppchk operation enter:

```
# nim -o showlog -a log_type=lppchk macgrp1
```

From the master, to uninstall the software products bos.INed and adt from a standalone machine, stand1, such that installp_bundle, bundle2, contains the names of the installable options, enter:

```
# nim -o maint -a installp_flags="-u" -a installp_bundle=bundle2 stand1
```

To enable the NIM standalone client, stand1, to boot in maintenance mode, enter:

```
# nim -o maint_boot stand1
```

To view the boot logs of the machines defined by the group Disklsmacs1, enter:

```
# nim -o showlog -a log_type=boot Disklsmacs1
```

To list all problems fixed by software on the lpp_source lpp_source1, use:

```
# nim -o showres -a instfix_flags="T" lpp_source1
```

To clone a rootvg on client austin to hdisk2, but only run phase1 and phase2 (leaving the /alt_inst file systems mounted), enter:

```
# nim -o alt_disk_install -a source=rootvg -a disk='hdisk2'\
-a phase=12 austin
```

7.4 The showmount command

The `showmount` command displays a list of all clients that have remotely mounted a file system from a specified machine in the `Host` parameter. This information is maintained by the `mountd` daemon on the `Host` parameter. This information is saved in the `/etc/rmtab` file in case the server abnormally terminates. The default value for the `Host` parameter is the value returned by the `hostname` command.

The `showmount` command syntax:

```
showmount [ -a ] [ -d ] [ -e ] [ Host ]
```

The Flags for the `showmount` command are described in Table 35.

Table 35. Commonly used flags of the `showmount` command

Flag	Description
-a	Prints all remote mounts in the format <i>HostName:Directory</i> , in which <i>HostName</i> is the name of the client and <i>Directory</i> is a directory pathname that has been remotely mounted.

Flag	Description
-d	Lists only directories that have been remotely mounted by clients.
-e	Prints the list of exported directories.

To check which file systems are allowed to be exported type:

```
# lsfs
Name          Nodename  Mount Pt          VFS  Size  Options  Auto
Accounting
/dev/hd4      --        /                 jfs  24576 --       yes
no
/dev/hd1      --        /home             jfs  360448 --       yes
no
/dev/hd2      --        /usr              jfs  663552 --       yes
no
/dev/hd9var   --        /var              jfs  401408 --       yes
no
/dev/hd3      --        /tmp              jfs  65536  --       yes
no
/dev/lv00     --        /export/lpp_source jfs  884736 rw       yes
no
/dev/lv01     --        /export/spot      jfs  442368 rw       yes
no
```

Run the `showmount` command to display a list of all clients that have remotely mounted a file system.

```
# showmount
raven.itsc.austin.ibm.com
```

Run `showmount -a` to see which directories have been remotely mounted with the host details.

```
# showmount -a
raven.itsc.austin.ibm.com:/export/spot/aix432spot/usr
```

The `showmount -d` command is similar to the `showmount -a` command except it does not show the host details.

```
# showmount -d
/export/spot/aix432spot/usr
```

The `showmount -e` command displays a list of exported directories:

```
# showmount -e
export list for aix4xdev:
/richfs          raven.itsc.austin.ibm.com
/export/redbooks (everyone)
```

The `showmount -e raven` command displays a list of exported directories on the remote host.

```
# showmount -e raven
export list for raven:
/elaine (everyone)
```

7.5 Producing debug output for NIM BOS installations

Due to problems in the network or in the NIM configuration, clients may fail to boot properly or install. When this happens, it may be necessary to produce debug information in order to determine the cause of the problem. If a client machine fails to configure properly from the network boot image, debug output from the boot image can be obtained by building the debug-enabled image and attaching a tty to the client system. This will display the commands and output that are run as the client is configured before further processing is done by AIX.

If the system has been booted from the network boot image, but failures are still occurring during a BOS installation, it may be necessary to collect debug information from the BOS install program. The commands and output from the BOS install program will automatically be displayed on the tty if the boot image was built debug-enabled. If the boot image was not built for debugging, output can be obtained by either setting a value in a `bosinst.data` file or by entering special codes at the installation menus.

When problems arise during a NIM BOS installation, you will most likely see system “hangs”. Viewing the debug output can be extremely useful, because you will be able to see the commands that failed. The problem may be a misconfiguration of the network adapter or an inability to perform an operation from the client to the server. By examining the debug output, you can see what failed and make corrections to avoid the error in the future.

You will see the `showled` command running in the debug output. This command displays status values on the LEDs on the front of the machine. Frequently, known problems and solutions are referenced by the LED value that is displayed when a problem occurs. Some machines do not have LEDs for displaying such information. Therefore, when debugging problems on such machines, special attention should be given to observing the values that the `showled` commands are displaying.

Obtaining debug information from a network installation can save you time in determining the root cause of a problem. Usually, the problem will be an incorrect definition in the NIM environment that can be found without the debug information. However, with the debug information, you can significantly reduce the scope of the investigation.

7.5.1 Producing debug output from a network boot image

1. Create debug versions of the network boot images using the check operation from the Web-based System Manager or SMIT interfaces or by using the following command:

```
nim -Fo check -a debug=yes SPOTName
```

where SPOTName is the name of your SPOT.

2. Get the address for entering the debugger:

From Web-based System Manager

- a. From the NIM Resources container, double-click the SPOT resource to open the properties notebook. 2.
- b. Click the Boot Image Information tab in the properties notebook to obtain the address.

Alternatively, you can use the following command to get the address:

```
lsnim -a enter_dbg SPOTName
```

where SPOTName is the name of your SPOT. The displayed output will be similar to the following:

```
spot1:  
enter_dbg = "chrp.mp 0x001840d4"  
enter_dbg = "chrp.up 0x00160b7c"  
enter_dbg = "rs6k.mp 0x001840d4"  
enter_dbg = "rs6k.up 0x00160b7c"  
enter_dbg = "rspc.mp 0x001840d4"  
enter_dbg = "rspc.up 0x00160b7c"
```

Write down the enter_dbg address for the client you are going to boot. For example, if your client is an rs6k-uniprocessor machine, you would write down the address 160b7c.

3. Attach a tty device to your client system (port 1).
4. Set up and perform the NIM operation that will require the client to boot over the network. Boot the client over the network.
5. After the client gets the boot image from the SPOT server, the debug screen will appear on the tty. At the > prompt, enter:

```
st Enter_dbg_Value 2
```

where Enter_dbg_Value is the number you wrote down in step 2 as your machine type's enter_dbg value. Specifying a 2 at the address of the enter_dbg value prints the output to your tty.

6. Type g for go and press Enter to start the boot process.

7. Use Ctrl-s to temporarily stop the process as you watch the output on the tty. Use Ctrl-q to resume the process.
8. To rebuild your boot images in non-debug mode, use the following command:

```
nim - Fo check SPOTName
```

where SPOTName is the name of your SPOT.

If the boot image is left in debug mode, every time a client is booted from these boot images, the machine will stop and wait for a command at the debugger ">" prompt. If you attempt to use these debug-enabled boot images and there is not a tty attached to the client, the machine will appear to be hanging for no reason.

7.5.2 Producing debug output from the BOS install program

There are two ways to obtain debug output from the BOS install program. Method A involves entering a special value at one of the installation menus. Method B uses a bosinst_data resource to tell the installation program to display debug output.

Method A: To Produce Debug Output When Not Using a bosinst_data Resource

1. To enable debugging for the BOS install program, start by performing all the processing you would normally do to install a client.
2. Since you are not using a bosinst_data resource, you will be prompted to supply information about the installation to the BOS install program.
3. Select your console.
4. Select your language.
5. The Welcome to Base Operating System Installation and Maintenance menu is displayed. Instead of selecting one of the options, enter 911 at the prompt and press Enter.
6. Continue the normal procedure for selecting options and specifying data until the installation begins. Debug output will be sent to the client's display as the installation proceeds.

Method B: To Produce Debug Output When Using a bosinst_data Resource

1. To enable debugging for the BOS install program, set the value BOSINST_DEBUG = yes in the control_flow stanza of the bosinst.data file that you are using for your bosinst_data resource.

A minimum bosinst.data file for debugging purposes would contain the following lines:

```
control_flow: BOSINST_DEBUG = yes
```

2. In addition to the processing you would normally do to install a client, include the modified bosinst_data resource as a resource for the operation. After the client boots over the network, it will use the bosinst_data resource to obtain settings for the installation. If the only data specified in your bosinst.data file is BOSINST_DEBUG = yes, you will be prompted for the remaining required information before the installation will continue. Debug output will be sent to the client's display as the installation continues.

7.6 Quiz

The following assessment questions will help verify your understanding of the topics discussed in this chapter.

1. Company ABC recently ordered 30 new model F50 systems, which they are custom installing with AIX Version 4.3.1 as branch office servers. The system administrator decided to use NIM to install the new servers with the base operating system and all of the applications the systems will need. The install type is spot, using a non /usr spot named 431spot. The installation of the first system is hanging at 611 LED, but all the file systems appear to be properly exported from the NIM server. Which of the following commands will build debug boot images?
 - A. `nim -o check -a debug=yes 431spot`
 - B. `nimclient -o check -a debug=yes 431spot`
 - C. `nim -o debug 431spot`
 - D. `lsnim -a debug=yes 431spot`
2. Company ABC is migrating all of the plant servers from AIX Version 4.2.1 to AIX Version 4.3.1 using NIM. The 240 server in the customer services department is hanging during the install, and the LED is at 611, indicating a failure mounting a network file system from the NIM server. What can the system administrator do to determine which file system the NIM client is unable to mount.
 - A. Unmount the NFS file systems exported from the server to the client.
 - B. Put the tftp daemon on the server in debug mode.
 - C. Restart the install using NIM debug boot images.
 - D. Restart the NFS services on the NIM server.

7.6.1 Answers

The following are the preferred answers to the questions provided in this section.

1. A
2. C

7.7 Exercises

The following exercises provide sample topics for self study. They will help ensure comprehension of this chapter.

1. How do you debug a NIM install? Which command would you use?
2. Debug NIM error code 611.
3. Determine if the NIM spot and lpp_source are exported. What command would you use?

Appendix A. Using the additional material

This redbook is also available as Web material. See the section below for instructions on using or downloading the material.

A.1 Locating the additional material on the Internet

The CD-ROM, diskette, or Web material associated with this redbook is also available in softcopy on the Internet from the IBM Redbooks Web server. Point your Web browser to:

<ftp://www.redbooks.ibm.com/redbooks/SG246183>

Alternatively, you can go to the IBM Redbooks Web site at:

ibm.com/redbooks

Select the **Additional materials** and open the directory that corresponds with the redbook form number.

A.2 Using the Web material

The additional Web material that accompanies this redbook includes the following:

<i>File name</i>	<i>Description</i>
SG246183.zip	Zipped HTML source

A.2.1 System requirements for downloading the Web material

The following system configuration is recommended for downloading the additional Web material.

Hard disk space:	40 MB
Operating System:	Windows or AIX with Netscape browser
Processor:	Pentium 386 or PowerPC 604e
Memory:	128 MB

A.2.2 How to use the Web material

Create a subdirectory (folder) on your workstation and copy the contents of the Web material into this folder. Point your browser at the index.html file to launch the application. The Web content has been optimized for the Netscape browser.

Appendix B. Special notices

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Appendix C. Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

C.1 IBM Redbooks

For information on ordering these publications see “How to get IBM Redbooks” on page 201.

- *IBM Certification Study Guide AIX V4.3 System Administration*, SG24-5129
- *IBM Certification Study Guide AIX V4.3 System Support*, SG24-5139
- *IBM Certification Study Guide AIX Performance and System Tuning*, SG24-6184 (December 2000)
- *IBM Certification Study Guide AIX Problem Determination Tools and Techniques*, SG24-6185 (December 2000)
- *IBM Certification Study Guide AIX Communications*, SG24-6186 (December 2000)
- *IBM Certification Study Guide AIX HACMP*, SG24-5131
- *IBM Certification Study Guide RS/6000 SP*, SG24-5348
- *NIM: From A to Z in AIX 4.3*, SG24-5524
- *RS/6000 Performance Tools in Focus*, SG24-4989
- *Problem Solving and Troubleshooting in AIX Version 4.3*, SG24-5496
- *AIX Logical Volume Manager, from A to Z: Introduction and Concepts*, SG24-5432
- *AIX Version 4.3 Differences Guide*, SG24-2014

C.2 IBM Redbooks collections

Redbooks are also available on the following CD-ROMs. Click the CD-ROMs button at ibm.com/redbooks for information about all the CD-ROMs offered, updates and formats.

CD-ROM Title	Collection Kit Number
IBM System/390 Redbooks Collection	SK2T-2177
IBM Networking Redbooks Collection	SK2T-6022

CD-ROM Title	Collection Kit Number
IBM Transaction Processing and Data Management Redbooks Collection	SK2T-8038
IBM Lotus Redbooks Collection	SK2T-8039
Tivoli Redbooks Collection	SK2T-8044
IBM AS/400 Redbooks Collection	SK2T-2849
IBM Netfinity Hardware and Software Redbooks Collection	SK2T-8046
IBM RS/6000 Redbooks Collection (PDF Format)	SK2T-8043
IBM Application Development Redbooks Collection	SK2T-8037
IBM Enterprise Storage and Systems Management Solutions	SK3T-3694

C.3 Other resources

These publications are also relevant as further information sources:

- *PCI Adapter Placement Reference*, SA38-0538
- *SSA Adapters: User's Guide and Maintenance Information*, SA33-3272
- *System Management Concepts: Operating System*, SC23-4311
- You can access all of the AIX documentation through the Internet at the following URL: www.ibm.com/servers/aix/library

The following types of documentation are located on the documentation CD that ships with the AIX operating system:

- User guides
- System management guides
- Application programmer guides
- All commands reference volumes
- Files reference
- Technical reference volumes used by application programmers

C.4 Referenced Web sites

These Web sites are also relevant as further information sources:

- <http://www.rs6000.ibm.com>
- ibm.com/redbooks
- <http://www.ibm.com/servers/aix/download>
- <http://www.opengroup.org/onlinepubs/9629799/toc.htm>
- <http://www.ibm.com/services/learning/aix/#order>

- <http://www.ibm.com/certify>
- http://www.rs6000.ibm.com/resource/hardware_docs/
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Abbreviations and acronyms

ABI	Application Binary Interface	CD-ROM	Compact Disk-Read Only Memory
AC	Alternating Current	CE	Customer Engineer
ADSM	ADSTAR Distributed Storage Manager	CEC	Central Electronics Complex
ADSTAR	Advanced Storage and Retrieval	CHRP	Common Hardware Reference Platform
AIX	Advanced Interactive Executive	CLIO/S	Client Input/Output Sockets
ANSI	American National Standards Institute	CMOS	Complimentary Metal Oxide Semiconductor
APAR	Authorized Program Analysis Report	COLD	Computer Output to Laser Disk
ASCI	Accelerated Strategic Computing Initiative	CPU	Central Processing Unit
ASCII	American National Standards Code for Information Interchange	CRC	Cyclic Redundancy Check
ATM	Asynchronous Transfer Mode	CSR	Customer Service Representative
BFF	Backup File Format	CSS	Communication Subsystems Support
BOS	Base Operating System	CSU	Customer Set-Up
BI	Business Intelligence	CSU	Channel Service Unit
BIST	Built-In Self-Test	CWS	Control Workstation
BLAS	Basic Linear Algebra Subprograms	DAS	Dual Attach Station
BOS	Base Operating System	DASD	Direct Access Storage Device (Disk)
CAE	Computer-Aided Engineering	DAT	Digital Audio Tape
CAD	Computer-Aided Design	DC	Direct Current
CAM	Computer-Aided Manufacturing	DDC	Display Data Channel
CATIA	Computer-Graphics Aided CDC Compact Disk	DDS	Digital Data Storage
		DE	Dual-Ended
		DFS	Distributed File System
		DIMM	Dual In-Line Memory Module
		DIP	Direct Insertion Probe

DIVA	Digital Inquiry Voice Answer	FDDI	Fiber Distributed Data Interface
DLT	Digital Linear Tape	FDX	Full Duplex
DMA	Direct Memory Access	FRU	Field Replaceable Unit
DOS	Disk Operating System	FTP	File Transfer Protocol
DRAM	Dynamic Random Access Memory	F/W	Fast and Wide
DSU	Data Service Unit	GPFS	General Parallel File System
DW	Data Warehouse	GUI	Graphical User Interface
EC	Engineering Change	HACMP	High Availability Cluster Multi Processing
ECC	Error Checking and Correction	HACWS	High Availability Control Workstation
EEPROM	Electrically Erasable Programmable Read Only Memory	HDX	Half Duplex
EIA	Electronics Industry Association	HIPPI	High Performance Parallel Interface
EISA	Extended Industry Standard Architecture	HiPS	High Performance Switch
ELA	Error Log Analysis	HiPS LC-8	Low-Cost Eight-Port High Performance Switch
EMIF	ESCON Multiple Image Facility	HP	Hewlett-Packard
EPOW	Environmental and Power Warning	HPF	High Performance FORTRAN
ESCON	Enterprise Systems Connection (Architecture, IBM System/390)	HPSSDL	High Performance Supercomputer Systems Development Laboratory
ESSL	Engineering and Scientific Subroutine Library	HP-UX	Hewlett-Packard UNIX
ETML	Extract, Transformation, Movement and Loading	HTTP	Hypertext Transfer Protocol
F/C	Feature Code	Hz	Hertz
FC-AL	Fibre Channel-Arbitrated Loop	IA	Intel Architecture
FCP	Fibre Channel Protocol	ID	Identification
		IDE	Integrated Device Electronics
		IDS	Intelligent Decision Server

IEEE	Institute of Electrical and Electronics Engineers	LPP	Licensed Program Product
I²C	Inter Integrated-Circuit Communications	LVM	Logical Volume Manager
I/O	Input/Output	MAP	Maintenance Analysis Procedure
IP	Internetwork Protocol (OSI)	MAU	Multiple Access Unit
IPL	Initial Program Load	Mbps	Megabits Per Second
IrDA	Infrared Data Association (which sets standards for infrared support including protocols for data interchange)	MBps	Megabytes Per Second
IRQ	Interrupt Request	MCA	Micro Channel Architecture
ISA	Industry Standard Architecture	MCAD	Mechanical Computer-Aided Design
ISB	Intermediate Switch Board	MES	Miscellaneous Equipment Specification
ISDN	Integrated-Services Digital Network	MIP	Mixed-Integer Programming
ISV	Independent Software Vendor	MLR1	Multi-Channel Linear Recording 1
ITSO	International Technical Support Organization	MMF	Multi-Mode Fibre
JBOD	Just a Bunch of Disks	MP	Multiprocessor
JFS	Journalled File System	MP	Multi-Purpose
JTAG	Joint Test Action Group	MPC-3	Multimedia PC-3
L1	Level 1	MPI	Message Passing Interface
L2	Level 2	MPP	Massively Parallel Processing
LAN	Local Area Network	MPS	Mathematical Programming System
LANE	Local Area Network Emulation	MTU	Maximum Transmission Unit
LAPI	Low-Level Application Programming Interface	MVS	Multiple Virtual Storage (IBM System 370 and 390)
LED	Light Emitting Diode	MX	Mezzanine Bus
LFT	Low Function Terminal	NCP	Network Control Point
LP	Linear Programming	NFS	Network File System

NIM	Network Installation Manager	POST	Power-On Self-test
NT-1	Network Terminator-1	POWER	Performance Optimization with Enhanced RISC (Architecture)
NTP	Network Time Protocol		
NUMA	Non-Uniform Memory Access	PPP	Point-to-Point Protocol
NVRAM	Non-Volatile Random Access Memory	PREP	PowerPC Reference Platform
OCS	Online Customer Support	PSSP	Parallel System Support Program
ODM	Object Data Manager	PTF	Program Temporary Fix
OLAP	Online Analytical Processing	PTPE	Performance Toolbox Parallel Extensions
OS/390	Operating System/390	PTX	Performance Toolbox
OSL	Optimization Subroutine Library	PV	Physical Volume
OSLp	Parallel Optimization Subroutine Library	PVC	Permanent Virtual Circuit
P2SC	Power2 Super Chip	QMF	Query Management Facility
PAP	Privileged Access Password	QP	Quadratic Programming
PBLAS	Parallel Basic Linear Algebra Subprograms	RAM	Random Access Memory
PCI	Peripheral Component Interconnect	RAN	Remote Asynchronous Node
PDU	Power Distribution Unit	RAS	Reliability, Availability, and Serviceability
PE	Parallel Environment	RAID	Redundant Array of Independent Disks
PEDB	Parallel Environment Debugging	RDBMS	Relational Database Management System
PID	Program Identification	RIPL	Remote Initial Program Load
PIOFS	Parallel Input Output File System	ROLTP	Relative Online Transaction Processing
POE	Parallel Operating Environment	RPA	RS/6000 Platform Architecture
POP	Power-On Password	RVSD	Recoverable Virtual Shared Disk
POSIX	Portable Operating Interface for Computing Environments		

RTC	Real-Time Clock	SPOT	Shared Product Object Tree
SAN	Storage Area Network	SPS	SP Switch
SAS	Single Attach Station	SPS-8	Eight-Port SP Switch
SAR	Solutions Assurance Review	SRC	System Resource Controller
ScaLAPACK	Scalable Linear Algebra Package	SSC	System Support Controller
SCO	Santa Cruz Operations	SSA	Serial Storage Architecture
SCSI	Small Computer System Interface	STP	Shielded Twisted Pair
SDR	System Data Repository	SUP	Software Update Protocol
SDRAM	Synchronous Dynamic Random Access Memory	SVC	Switch Virtual Circuit
SDLC	Synchronous Data Link Control	Tcl	Tool Command Language
SE	Single-Ended	TCP/IP	Transmission Control Protocol/Internet Protocol
SEPBU	Scalable Electrical Power Base Unit	TCQ	Tagged Command Queuing
SGI	Silicon Graphics Incorporated	TPC	Transaction Processing Council
SLIP	Serial Line Internet Protocol	UDB EEE	Universal Database and Enterprise Extended Edition
SLR1	Single-Channel Linear Recording 1	UP	Uniprocessor
SMIT	System Management Interface Tool	USB	Universal Serial Bus
SMS	System Management Services	UTP	Unshielded Twisted Pair
SMP	Symmetric Multiprocessing	UUCP	UNIX-to-UNIX Communication Protocol
SOI	Silicon-on-Insulator	VESA	Video Electronics Standards Association
SP	Scalable POWERParallel	VG	Volume Group
SP	Service Processor	VM	Virtual Machine (IBM System 370 and 390)
SPEC	Standard Performance Evaluation Corp.		

VMM	Virtual Memory Manager
VPD	Vital Product Data
VSD	Virtual Shared Disk
VSM	Visual Systems Management
VSS	Versatile Storage Server
VT	Visualization Tool
WAN	Wide Area Network
WTE	Web Traffic Express
XTF	Extended Distance Feature

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