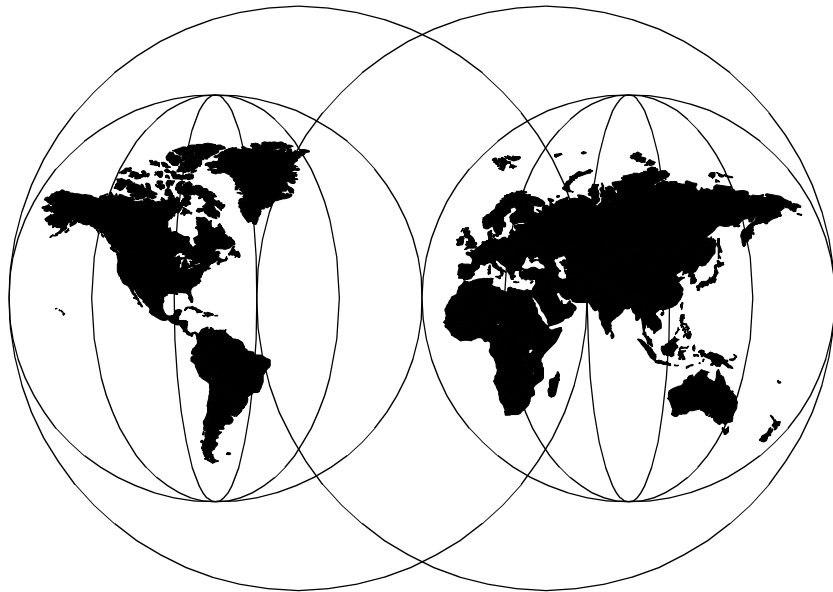




AIX Version 4.3 Migration Guide

Kevin Murrell, Michael Abel, Jan Robinson, Carsten Schmidt, Gene Thomas



International Technical Support Organization

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

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AIX Version 4.3 Migration Guide

October 1998

Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix E, "Special Notices" on page 191.

First Edition (October 1998)

This edition applies to Version 4, Release Number 3 of the AIX Operating System, Program Number 5765-C34.

Comments may be addressed to:
IBM Corporation, International Technical Support Organization
Dept. JN9B Building 045 Internal Zip 2834
11400 Burnet Road
Austin, Texas 78758-3493

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Preface

This redbook is intended to provide insight to AIX system administrators on the steps that are required when planning, preparing and actually migrating a system to the latest available level of AIX (currently AIX Version 4.3.2) from earlier versions of AIX.

Before discussing the actual migration steps, we first explain why we recommend that you upgrade your system and point out the enhancements and new functions that have been delivered with each new major release of AIX. In the chapters that follow, we then explain how to plan, prepare and perform the migration, focusing on providing hints, tips and sources of additional information, rather than a keystroke-by-keystroke description.

This book is essentially a follow-on to an earlier three-volume set that described what was, at the time, the non-trivial task of upgrading to AIX Version 4.1 from AIX Version 3.2.5.

Since those books were first published, the tools and facilities provided for AIX migration have improved tremendously. Also, the pervasiveness of the World Wide Web has resulted in much of the information presented in those books being available online and updated much more frequently. Wherever possible, we refer you to these online sources rather than provide you with snapshots of dynamic information. These factors have allowed us to condense three volumes into one. You will find, however, that a Web browser and Internet access is an essential part of this book.

How This Redbook is Organized

Chapter 1 focuses on the key issues of migration. We try to explain why you should consider migrating as soon as possible to AIX Version 4.3.

Chapter 2 summarizes the differences between AIX Version 3.2.5 and AIX Version 4.1 by listing the major new features and functions that were introduced with AIX Version 4.1.

Chapter 3 lists the enhancements and new functions that were added to AIX in Version 4.2.

Chapter 4 summarizes the differences between AIX Version 4.2 and AIX Version 4.3 by listing all the new features and functions that were introduced with AIX Version 4.3.

Chapter 5 covers the factors you need to consider when planning a migration. To help in determining the feasibility of such a migration, the topics covered here include:

- Documenting the existing environment (hardware and software)
- Mapping the existing environment to the target environment
- Reviewing the hardware, software and licensing issues
- Determining if the migration is achievable

Chapter 6 supports you in preparing for the actual migration. Typical steps during this phase include:

- Ordering of new software
- Ordering of new hardware
- Porting existing in-house applications
- Compiling a list of migration steps
- Scheduling system downtime

Chapter 7 then guides you through the actual process of migration itself.

Chapter 8 explains the post-migration tasks that are necessary to ensure that your system is ready to be taken into a production environment.

Chapter 9 covers miscellaneous topics that round off the process of migration. For example, we provide you with some ideas for cleaning up and optimizing your system before, during and after the migration. We also cover the set up of NIM and the online documentation of AIX Version 4.3.

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.

Kevin Murrell is an International Technical Support Specialist at the International Technical Support Organization, Austin Center. He is responsible for the support of AIX, IBM's implementation of UNIX and the RISC System/6000 platform. He has supported UNIX platforms for major manufacturers since 1984 and teaches classes worldwide on all areas of AIX. Before joining the ITSO two years ago, Kevin worked in the AIX System Support Centre, England as Group Leader for the Communications, Development and Graphics Support Group.

Michael Abel is the owner of the Stuttgart, Germany-based consulting and training company, res nova Unternehmensberatung GmbH. As a senior consultant, he supports and educates AIX customers throughout Europe. Michael has worked with AIX since the early days of the IBM RISC System/6000 family of products. He is the author of *AIX Version 3, Das Handbuch für Anwender und Systemverwalter* and numerous articles covering AIX-related topics in both English and German.

Jan Robinson is a Senior System Engineer based in Johannesburg, South Africa. Prior to joining IBM in 1996, Jan supported both hardware and software on a variety of UNIX platforms since 1986. He is currently responsible for the provision of specialized AIX support in the RS/6000 and SP2 environment.

Carsten Schmidt is a SP Systems Engineer with Lufthansa Systems Group, Germany. He holds a degree in Physics from the University of Dortmund, Germany. His areas of expertise include the design and planning of complex SP based solutions mainly in the SAP R/3 environment.

Gene Thomas is an AIX Development Analyst at the SWS Toronto laboratory. He has over 25 years of experience in the computer industry. For the last five years he focused on AIX. Gene supports the DB2 development community on the AIX platform, supporting base AIX, SP, HACMP, and other environments.

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Jim Beesley, Julie Craft, Nancy Springen, Gerald McBrearty, Jim Fair
IBM Austin

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Phil Langerholc
Indotronix International Corp.

Daniel Packman
University Corporation for Atmospheric Research

Comments Welcome

Your comments are important to us!

We want our redbooks to be as helpful as possible. Please send us your comments about this or other redbooks in one of the following ways:

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For IBM Intranet users <http://w3.itso.ibm.com>
- Send us a note at the following address:
redbook@us.ibm.com

Chapter 1. Why Migrate to AIX Version 4.3?

This section of the book is intended to answer the first question you should ask when we try to convince you to migrate to AIX Version 4.3.

"This sounds like a lot of work and expense. Why should I, what's in it for me?"

To be perfectly honest, the answer is:

"If your environment is stable and you do not intend to make any changes or additions whatsoever in the future, you could stay with your current version of AIX."

Keep in mind, though, that in the case of AIX Version 3.2.5, Support Services ended on December 31, 1997. This means that there is no longer any support for the operating system. Also, AIX Version 3.2.5 will not run on any of the new PCI bus RS/6000 systems. At first glance, this may not seem to be much of a problem; after all, you're happy with your system the way it is. Consider, however, the circumstances if your system were to be destroyed through fire, flood or other disaster? Without adequate disaster recovery procedures in place, you could be faced with the task of locating an identical or similar system on the secondhand market with the accompanying risk of getting an unreliable system. You would not be able to replace it with an identical new system from IBM since these models are no longer manufactured. An alternative is that you could replace it with one of the newer models and start from scratch with a new system. However, a further complication is that it is not possible to migrate to the newer platforms using only a mksysb of your Version 3.2.5 system; so even if good backups were available, recovering your system would not be trivial. If a disaster did occur, no matter which approach you were to choose, it is likely that you would be unable to access your applications or data for a considerable period of time. Only *you* can assess the impact that this would have on your business operations.

On the other hand, if you regard your system as a critical component of your business and need the peace-of-mind of knowing that your environment is fully supported and protected, then you really need to consider migrating to AIX Version 4.3 as soon as is practical. As you can see from Figure 1 on page 2, AIX Version 4.3 is the only release with *Standard Services* now and beyond the year 2000.

AIX Support Roadmap

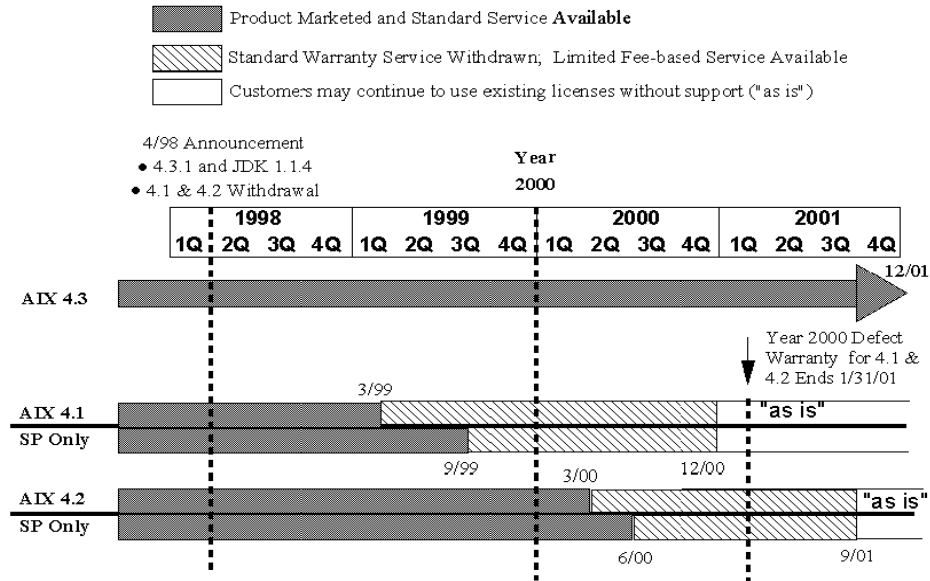


Figure 1. AIX Support Services Roadmap

When you upgrade, in addition to the extended support, you will also be able to take advantage of the many enhancements that have been introduced with each new version of AIX as shown below. More information on these enhancements is available in the following chapters.

- Enhancements delivered in AIX Version 4.1. For more details, see Chapter 2, "Enhancements Delivered with AIX Version 4.1" on page 5.
 - Support for New PowerPC and SMP Systems
 - Pthreads Implemented in the Kernel
 - New Asynchronous Terminal Subsystem for Streams-based Applications
 - Selectable Journaled File System Fragment Sizes
 - On-the-fly Software Data Compression/Decompression
 - Maximum File System Size Increased to 64 GB
 - Data Striping Across Multiple Disks
 - Conformance to Industry Standards

- Enhanced System Management Functions
 - Custom Installation Utility
 - Simpler and Faster Installation of BOS
 - TCP/IP Enhancements
 - Centrally Administered Remote System Installation (NIM)
 - Graphical Visual Systems-Management Tool (VSM)
 - Customizable Install with Installation Assistant
 - Ability to Remove Unwanted Software
 - New Graphical User Interface (CDE)
 - PC Client to UNIX Interoperability
 - New AIX Packaging
 - More Flexible Terms and Conditions
2. Enhancements Delivered in AIX Version 4.2. For more details, see Chapter 3, “Enhancements Delivered with AIX Version 4.2” on page 15.
- UNIX 95 Branding
 - Introduction of Admin Roles
 - Support for File Sizes Greater than 2 GB
 - Mirroring of root Volume Group
 - Support for Executables Larger than 256 MB
 - Introduction of NFS Version 3
 - Support for NFS over TCP
 - Multithreaded NFS Server Implementation
 - Improved NFS File Locking
 - NFS Performance Improvements
 - Addition of WebNFS Extension to NFS Protocol
 - Ability to Eliminate TCP/UDP Checksum Calculation
 - Network Time Protocol Support
 - POP 3 and IMAP 4 Mail Protocols Support
 - TCP/IP Path MTU Discovery Support
 - TCP/IP Group Routing Support
 - TCP/IP Multicast Support
 - Upgrade to PPP Implementation
 - Sendmail Updated to UCB Version 8.7
 - Network Install Manager (NIM) Enhancements
 - Web Browser Diagnostic Interface
3. Enhancements Delivered in AIX Version 4.3. For more details, see Chapter 4, “Enhancements Delivered with AIX Version 4.3” on page 25.
- Support for New 64-bit Hardware and Software
 - Concurrent Execution of 32-bit and 64-bit Applications
 - Open Group UNIX98 Conformance
 - X11R6 and Motif 2.1

- OpenGL and graPHIGS Now Included in Base
- IP Version 6 Support
- Sendmail Upgraded to UCB Version 8.8.8
- New IP Security Protocols
- Cache File System (CacheFS) Introduced
- Enhanced Automatic Mounting of File Systems with AutoFS
- Updates to DHCP
- Improved Telnet Server Performance
- Alternate Disk Installation Utility
- Concurrent Mode LVM Enhancements
- Raw LV On-Line Mirror Backups
- Support for 512 MB and 1024 MB Partition Sizes
- Faster JFS File Access with Direct I/O
- Improved JFS File Locking Mechanism
- Additional Performance Tools Provided with Base
- Unicode (UCS-2) Implemented
- Web-based System Manager
- HTML-based Online Documentation
- Lightweight Directory Access Protocol (LDAP) Support
- Java Development Kit Upgraded
- Scalability and System Limits Extended;
- Improved Trace Utility
- Fast fork() Function
- Login Performance Improvements
- Year 2000 Ready

Chapter 2. Enhancements Delivered with AIX Version 4.1

This chapter provides more details on the enhancements that were delivered with AIX Version 4.1

2.1 Support for New PowerPC and SMP Systems

The kernel in AIX Version 4.1 included new modules that provided support for the new PowerPC 603, 604 and 604E chips. Support for the Power Personal Systems line of products and the RS/6000 Symmetric Multiprocessing (SMP) systems was also included.

2.2 Pthreads Implemented in the Kernel

Threads were implemented within the kernel, allowing a one-to-one relationship between user threads and kernel threads. The thread library was based on POSIX 1003.4A (Draft 7).

2.3 Asynchronous Terminal Subsystem for Streams-Based Applications

AIX Version 4.1 used a new asynchronous terminal subsystem based on UNIX System V.4-compatible streams. This made it easier to port streams-based applications to AIX. Support for the AIX Version 3.2.5 asynchronous terminal functionality was still available from an application perspective.

2.4 Selectable Journaled File System Fragment Sizes

Prior to AIX Version 4.1, disk space was allocated in blocks of 4 KB. This allocation provided optimal performance, but wasted space in environments with a large number of small files, or files with final blocks containing only a few bytes. In AIX V4.1, the system administrator was able to select fragment sizes between 512 bytes and 4 KB blocks, allowing more efficient disk-space utilization in these situations.

Also, AIX Version 4.1 provided a defragmentation utility that could reorganize file systems on the fly. This utility could be activated from either the command line or a SMIT menu and provided considerable performance improvements for fragmented file systems.

2.5 On-the-Fly Software Data Compression/Decompression

New in AIX Version 4.1 was an on-the-fly software data compression and decompression option that achieved up to 50 percent reduction in disk space requirements. It was based on a fast Lempel-Ziv algorithm written at IBM that is similar to compression techniques available on personal computers. Even with software compression enabled, performance was very respectable.

2.6 Maximum File System Size Increased to 64 GB

AIX Version 4.1 introduced support for file systems up to 64 GB in size. This reduced the need to artificially distribute files where very large file systems were in use. This affected many database and scientific application users and reduced the amount of system administration involved in setting up the associated file systems. Note that the size of an individual file was not affected; this limit remained at 2 GB per file in AIX Version 4.1.

2.7 Data Striping Across Multiple Disks

This function allowed data to be striped across multiple disks. The data could be accessed by AIX from all the disks simultaneously, providing improved data access rates over non-striped data. This had major performance advantages for database applications.

2.8 Industry Standards-Compliance

AIX Version 4.1 was designed to conform to open standards for compatibility with other UNIX systems. The significant standards-compliant features of AIX Version 4.1 were as follows:

- It met the POSIX 1003.1 systems interface standard.
- It met the POSIX 1003.2 shells and commands standard.
- Thread support was based on Draft 7 of the POSIX 1003.4A threads specification. The AIX Version 4.1-based Distributed Computing Environment (DCE) support was provided by a mapping layer that converted from Draft 4 interfaces to Draft 7 interfaces.
- XPG4 from X/Open is a superset of the POSIX 1003.1 and 1003.2 standards. It provides more commonality in commands and interfaces and better internationalization support than XPG3. AIX Version 4.1 was branded as conforming to the following XPG4 profiles:
 - XPG4 Base Profile

- XPG4 Internationalized Systems Calls and Libraries
 - XPG4 Commands and Utilities
 - XPG4 C Language
 - XPG4 Transport Service (XTI)
 - XPG4 Terminal Interface
 - XPG4 Magnetic Media
 - XPG4 Network File System (NFS)
- AIX Version 4.1 was branded as conforming with the X/Open UNIX 93 profile, which was intended to provide a common UNIX interface specification.
 - IBM announced its intent to comply with the full Single UNIX Specification and to achieve UNIX 95 branding in a future release of AIX Version 4.

2.9 Enhanced System-Management Functions

System management has always been a major strength of AIX. The system-management facilities and customization capabilities of AIX Version 4.1 were greatly expanded to support a more diverse set of users with the introduction of the Power Personal systems.

System management and usability enhancements included:

- Repackaging of AIX for customizable installation
- Faster operating system installation
- Network Installation Manager (NIM)
- Visual Systems Manager (VSM)
- Installation Assistant (graphical and ASCII versions)
- Systems Management facilities provided by enhanced kernel functions
- Software Removal or Deinstallation
- Common Desktop Environment (CDE)

These enhancements, along with many others, were provided in direct response to customer requirements and feedback.

2.10 Custom Installation Utility

One of the larger efforts in the development of AIX Version 4.1 was to completely restructure the packaging of the operating-system components to support custom installation and improve modularity. The objective was to automatically install the minimum operating environment for the system being

installed and then provide the facilities for the administrator to customize the system by installing additional operating system components as required.

In AIX Version 3.2.5, all the RISC System/6000 device support was installed on every system, even if the hardware was not present or even supported on that particular system. As the number of systems supported by AIX expanded and diversified, this procedure greatly increased software installation time and disk space usage. To alleviate this problem, the AIX Version 4.1 install procedure was redesigned to automatically install a customized minimum operating system environment. The device configuration subsystem was modified to automatically install only the device packages required to support the installed hardware. If additional devices were added later, the appropriate device packages could be installed simply by making a single menu selection.

The custom install also determined if a minimum graphical environment or an ASCII-only based environment should be installed. It automatically installed the country-specific message packages, locales and helps for the primary language of the system to support the base operating system and all previously installed applications.

2.11 Simpler and Faster Installation of BOS

Installation of the base operating system was made much simpler and faster than it was in AIX Version 3.2. With fewer prompts and screens, it supported an optional no-prompt install using a data file on a diskette.

Installation of AIX Version 4.1 from tape took about half the time required to install the same set of products at AIX Version 3.2. Using a CD-ROM installation, the install times were improved even further.

AIX Version 4.1 supported four installation modes:

Overwrite	Completely reinstall the system.
Preservation	Re-create the /, /usr and /var file systems and leave everything else as it was.
Migration	Save all the user's files, configuration information and applications; then migrate the installed operating system components to the latest level.
mksysb Install	Restore the system from a previously created backup of the same system.

2.12 TCP/IP Enhancements

Enhanced TCP/IP features in AIX Version 4.1 included:

DHCP support

The Dynamic Host Configuration Protocol (introduced with AIX Version 4.1.4) allowed system administrators to assign network addresses to hosts automatically. This made network administration much easier, especially for systems that move around on a network, such as laptop PCs.

Secondary DNS resolver

The AIX Version 4.1.4 name resolvers provided support for more than two domains in the search directive in `/etc/resolv.conf`.

PPP support

Point-to-Point Protocol (PPP) was introduced with AIX Version 4.1.4 to provide TCP/IP over asynchronous lines in addition to SLIP.

sliplogin command

The `sliplogin` command simplified the support of SLIP over dial-up lines and allowed dial-up ports to support both normal dial-up users and SLIP connections.

IP multicast

IP multicasting support was added in AIX Version 4.1. It is used to broadcast to logical groups of network addresses, for example, in multimedia applications, such as live video over the Internet.

Packet drops

The `netstat` command was enhanced to include the number of packet drops in its output.

Promiscuous mode

Promiscuous mode support for the integrated Ethernet, Ethernet and FDDI adapters was included. This allowed the `iptrace` command to be used to look at all packets on a LAN, not just packets destined for adapters on that particular system.

OSPF routing

Open Shortest Path First routing was added (using gated, based on Cornell gated 3.0.2). This routing algorithm is an improvement over the vector-distance algorithms used previously.

Resolver API

New programming interfaces in the TCP/IP library allowed programmers to choose if they wanted BIND (named), NIS or /etc/hosts to resolve hostnames to IP addresses. Programmers could also add other name services.

2.13 Centrally Administered Remote System Installation (NIM)

A new Network Installation Manager (NIM) supported centrally administered, remote system installation of networked systems. This facility offered flexibility for centralized operating system and application installation through push installs to one or more network clients, pull requests from clients, and support of diskless and dataless clients from network servers.

NetView Distribution Manager (NetView DM) also offers remote application installation. However, NIM expanded this capability by also supporting remote operating system installation. These installation capabilities were ideal for customers who had a large number of AIX systems.

2.14 Graphical Visual Systems-Management Tool (VSM)

The Visual Systems Manager (VSM) was IBM's graphical, object-oriented, drag-and-drop systems-management tool. It provided a more intuitive interface and retained approximately 80 percent of the functionality of the SMIT interface. VSM was aimed at the new AIX user.

2.15 Customizable Install with Installation Assistant

In AIX Version 4.1, once the minimum operating environment had been installed on the system, a new feature called the Installation Assistant was started. This facility guided users through the customization process by taking them through either graphical or text-based menus to complete the installation and system setup. The graphical version utilized VSM to provide a drag-and-drop interface for tasks such as adding users, installing additional software and so on.

2.16 Ability to Remove Unwanted Software

At AIX Version 3.2.5, once a program product had been committed to the system, it was very difficult, and sometimes almost impossible, to remove it completely. AIX Version 4.1 allowed the removal of products that were no longer required, freeing up their resources.

2.17 New Graphical User Interface (CDE)

While AIX compared very favorably with other versions of UNIX in terms of ease of use, a number of further enhancements were made to AIX Version 4.1.

Common Desktop Environment (CDE) was bundled with AIX Version 4.1. For all users with graphics terminals, the CDE graphical user interface provided an intuitive, easy-to-use, drag-and-drop way to manage their environment. Jointly developed by IBM, Hewlett-Packard, Novell, and SunSoft, it was based on best-of-breed technologies in the industry. The CDE interface increased user productivity through ease-of-use.

2.18 PC Client to UNIX Interoperability

The AIX Connections package provided the capability to connect PC clients to UNIX data and applications running on the RISC System/6000. It supported clients running OS/2, Windows, Windows 95, Windows NT, UNIX, and Macintosh OS and provided file- and print-server functions compatible with:

- IBM's LAN Server Version 4
- Microsoft's LAN Manager
- NWserver
- MACserver

Support was provided for a wide range of protocols, including IPX/SPX, TCP/IP, NetBIOS, RFC 1001/1002, AppleTalk, and SPX2.

AIX Connections was packaged as either an option for existing AIX client or server licenses or as an integrated offering that included AIX Version 4.1 for Clients and the AIX Connections Version 4.1 option. It was priced according to the number of simultaneous logged-in connections to the server functions.

2.19 New AIX Packaging

AIX Version 4.1 was packaged differently from its predecessors. Packaging changes were made to ease the installation and maintenance of the AIX environment. The improved granularity allowed customers to install exactly what they needed to create their required environment, thereby allowing a smaller minimum installation size.

As part of the changes, new terminology was introduced for installable packages; these new terms are explained below.

Filesets

Filesets provide a specific function. For example, `bos.net.tcp.client` is a fileset in the `bos.net` package (Base Network Support and Applications) providing TCP/IP client support. A fileset is the smallest individually installable unit and consists of a collection of functionally related files.

Fileset Update

A fileset update either enhances or corrects a defect in a previously installed fileset.

Package

A package is a group of filesets with common function collected into a single installable image. The image is in Backup File Format (BFF).

Bundle

Bundles are collections of installable operating-system software components and Licensed Program Product (LPP) components that are grouped together and can be installed with one selection. AIX Version 4.1 supported both system-defined and user-defined bundles.

The system-defined bundles are defined as:

Client

A collection of software products for single-user systems running in a stand-alone or networked client environment.

Server

A collection of software products for multiuser systems running in a stand-alone or networked environment.

Personal Productivity

A collection of software products for graphical desktop systems running AIX and PC applications.

Application Development

A collection of software products for developing applications, for example, compilers/linkers, libraries and debuggers.

DCE Client

The software required to be a client in a Distributed Computing Environment (DCE) network.

Hardware Diagnostics

The group of filesets required to run concurrent hardware diagnostics.

Media-Defined Bundle

This was a new feature included in the AIX Version 4.1.4 maintenance level. It allowed bundles to be defined by the installation media and could be used by Independent Software Vendors (ISVs) to provide bundled installation of their own software.

Maintenance Level Bundle

A maintenance-level bundle is a collection of fixes and enhancements that update the operating system to the latest level. Software is selected for installation if it is in the bundle you choose and on the installation media.

Licensed Program Products

These are complete software products, including all packages and filesets needed to provide a specific function. For example, the Base Operating System (BOS) is a Licensed Program Product (LPP).

Product Offerings

Product Offerings are selected sets of packages which are sold together on physical media. Product Offerings should not be confused with bundles (see previous section).

Examples of Product Offerings were:

- AIX Version 4.1 for Clients: This product offering was packaged with functionality aimed at satisfying the users of client systems. It was designed for customers who did not need to provide network server support for LAN/WAN attached devices. These systems could be used as: client systems, personal productivity workstations, print servers, name servers, and gateways.
- AIX Connections Version 4.1: This was an integrated offering that included AIX Version 4.1 for Clients and the AIX Connections Version 4.1 option. For more information on the AIX Connections offering, see 2.18, “PC Client to UNIX Interoperability” on page 11.
- AIX Version 4.1 for Servers: This product offering was packaged and priced for full server-system functionality. These systems could be used as network file servers, data servers, print servers, iFOR/LS servers, compute servers, application servers, and so on. It was available in two versions:
 - AIX Version 4.1 Entry Server: The entry server was for small desktop or desktside systems. Customers could purchase a 1-2 user or unlimited license.
 - AIX Version 4.1 Advanced Server: The advanced server was for the larger desktside and rack systems. Customers purchased a base 1-2 user license with an incremental charge for the number of additional users. Incremental users could either be dedicated or network users.
- Hypertext: the complete InfoExplorer library product offering
- Diagnostics: full function diagnostic capability

Note that further modification of the packaging of AIX has taken place since AIX Version 4.1 was released. Separate client or server versions are no longer shipped because they have been combined into a single package.

2.20 More Flexible Terms and Conditions

From the introduction of AIX Version 4.1 Modification 4 (AIX V4.1.4) in October 1995, the AIX operating system was standardized on a single worldwide license called an International Program License Agreement (IPLA). This license was much simpler and more flexible than the license used for AIX Version 3.2.5. See 5.4.2.3, “IBM LPP Licensing Issues” on page 63, for more information about licensing issues.

Chapter 3. Enhancements Delivered with AIX Version 4.2

This chapter expands on the enhancements that were delivered with AIX V4.2.1. Please note that at the end of this year, December 31, 1998, AIX V4.1 will be withdrawn from marketing and the normal program services will cease on May 31, 1999 (or September 30, 1998 for Scalable POWERparallel Systems "SP"). If for some reason you need official support beyond these dates, there is a limited fee-based program service extension available beginning April 1, 1999 and ending no sooner than December 31, 2000. Year 2000 code defects for the most recent level of AIX V4.1 will be handled separately and will be fixed without charge until January 31, 2001.

3.1 UNIX 95 Branding

AIX V4.2 was designed to conform to X/Open's Single UNIX Specification (formerly known as Spec 1170) and IBM received X/Open UNIX 95 branding for this release. To conform to the specification, a number of minor changes to the operating system were necessary, particularly in the behavior of certain system calls. The changes were made in such a way that binary compatibility with earlier releases was not compromised.

3.2 Introduction of Admin Roles

A major native AIX security enhancement was added through the Administrative Roles feature. Administrative Roles allows systems administration tasks to be performed by non-root users who have been preauthorized to have access to specific administrative functions. For example, a non-root user can be preauthorized to initiate system backups or modify the attributes of log in IDs.

The amount of granularity and breadth of the assigned administration functions was completely controlled by the standard root administrator. This function was intended to allow trusted users more access to traditionally controlled, but non-critical, system administration features.

The roles were divided into the following default roles:

- ManageBasicUsers
- ManageAllUsers
- ManageBasicPasswds
- ManageAllPasswds

- ManageRolls
- ManageBackupRestore
- ManageBackup
- ManageShutdown

3.3 Support for File Sizes Greater Than 2 GB

In AIX Version 4.1 it was possible to build file systems which were larger than 2 GB (up to 64 GB). but you were still limited to files less than 2 GB. AIX Version 4.2 provided support for files greater than 2 GB so that users could store large quantities of data in a single file. Many, but not all, AIX commands supported the use of files larger than 2 GB. Additionally, some commands had large-file support with limitations. Depending upon the type of file system, files could reach a size approaching 64 GB.

3.4 Mirroring of Root Volume Group

Root volume group (rootvg) mirroring is the use of the LVM mirroring function, originally designed for mirroring user data, to keep an AIX system operational in the event of a disk failure to one or more of the drives that make up the rootvg. Additionally, this feature also provides multi-bootstrap (identical) images that may be used to boot an operational system in the event that one image becomes damaged.

3.5 Support for Executables Larger Than 256 MB

In contrast to AIX Version 4.1, initial program executables could be larger than 256 MB with AIX Version 4.2. A large executable is simply an executable program that is larger than a single segment (256 MB) in size. In AIX Version 4.1, the executable files were addresses in a single virtual memory segment. In order to be executable, the text, data and loader sections of the executable file had to reside in the first 256 MB of the file. If a program contained a large amount of text or initialized data, then AIX was unable to execute the program.

With AIX Version 4.2, however, it became possible to execute programs which were larger than 256 MB in size. However, due to the constraints of AIX's segmented address space, the following restrictions were placed on big executables:

The offset of the text section plus the size of the loader section must be less than 256 MB. Note that the alignment of the loader must be taken into account when making this calculation.

In the big executable design, the text and loader section of an executable were mapped into the TEXT segment of the process's address space. The DATA section of the executable was mapped starting at the BDATASEG(3) segment of the process's address space.

This design allowed the execution of programs with very large amounts of initialized data. The system loader performed all the necessary mappings to transform the big executable file into a usable process image.

3.6 Introduction of NFS Version 3

The Network File System (NFS) was updated in AIX Version 4.2.1 to include support for the latest NFS protocol update, NFS Version 3. AIX NFS continued to provide distributed file system access for AIX as in the past. The AIX Version 4.2.1 implementation continued to provide an NFS Version 2 client and server and was therefore backward compatible with the existing install base of NFS clients and servers.

The NFS Version 3 protocol brought many improvements for both NFS client and server. These were the most notable improvements:

- NFS Version 3 protocol allows the NFS client to request an asynchronous write and commit sequence for writing file data, allowing for faster file writes to the NFS server. In NFS Version 2, the NFS server had to write file data to disk before responding to the NFS client.
- NFS Version 3 relaxes the transfer size for READs and WRITEs. The AIX implementation (like most in the industry) offers a 32 KB READ and WRITE size for both client and server. NFS Version 2 limited the size of READ and WRITE requests to 8 KB.
- In NFS Version 2, reading a 128 KB file required the NFS client to send 16 individual remote procedure calls to the NFS server. With NFS Version 3, the same file can be read with four remote procedure calls.
- NFS Version 3 was developed with the ability to access files greater than 2 GB in size. The AIX NFS client and server have been implemented to take advantage of this ability to provide access to files greater than 2 GB.

3.7 Support for NFS Over TCP

The NFS client and server were also improved to allow them to utilize the TCP network transport for communication. Before AIX Version 4.2.1, NFS was limited to the UDP transport for remote procedure calls. In AIX Version 4.2.1, the default transport for NFS continued to be UDP, but for environments that could benefit from using TCP transport, selection of the TCP transport option could be made when the NFS client mounted the file system.

Typical examples of environments that may benefit from using NFS over TCP are:

- Networks with several intermediate gateways or routers
- Wide area networks
- Environments with heavily loaded NFS servers

In all cases, NFS over TCP should provide a well balanced network load.

3.8 Multithreaded NFS Server Implementation

The NFS client and server daemons were implemented in AIX Version 4.2.1 to use AIX's multithreading support. The NFS server daemon, `nfsd`, had previously been a *multiprocess* implementation in the past. With the multithreaded NFS server, load balancing the server became much easier. NFS server threads can be created and destroyed on demand as the incoming NFS client requests increase and decrease.

3.9 Improved NFS File Locking

In previous AIX releases, the NFS daemon that services network file locking requests was a separate, user-level process. In AIX Version 4.2.1, the NFS file locking requests were serviced in a similar fashion to normal NFS requests. The `rpc.lockd` daemon became a multithreaded kernel-level implementation, which allows for better throughput and response times.

3.10 NFS Performance Improvements

In certain circumstances, the AIX Version 4.2.1 NFS implementation would provide better NFS performance than previous releases. Improvement could be seen in environments where throughput was not limited because of CPU, network bandwidth, or disk bandwidth.

The NFS Version 3 implementation could provide better throughput for READ operations because of the availability of larger transfer sizes. Up to 20 percent more throughput can be obtained using a 32 KB READ size with NFS Version 3 when compared to the 8 KB READ size in NFS Version 2. Also, the use of the asynchronous write capability of NFS Version 3, along with the larger WRITE transfer sizes could also result in a throughput increase of two to three times the sequential write throughput available with NFS Version 2.

When limited to NFS Version 2 operations, the new server implementation could provide up to 10 percent improvement for overall throughput, or NFS operations per second, when compared with previous implementations of Version 2.

3.11 Addition of WebNFS Extension to NFS Protocol

The NFS Version 3 implementation in AIX Version 4.2.1 also introduced NFS server capability for WebNFS. WebNFS was defined by Sun Microsystems and is a simple extension to the NFS protocol. This extension is meant to provide easier access to the NFS server through Internet firewalls. The enhancements are also meant to provide easy access to WebNFS enabled clients. A WebNFS enhanced Web browser would be able to use an NFS URL to access data directly at the NFS server. An example of the NFS URL would be:

```
nfs://www.yourcompany.com/
```

WebNFS is meant to provide easy access to existing NFS server data and to take advantage of the scalability of NFS servers. It will work in tandem with existing Web-based protocols to provide data to Web clients.

3.12 Ability to Eliminate TCP/UDP Checksum Calculation

The process of computing and verifying TCP/UDP checksums can consume considerable CPU resource and, as a result, reduce the overall throughput of a network. However, there are cases where computing and verifying the checksum is not necessarily required, for example, when source and destination are nodes of an SP system or when the various elements of the network, such as switch fabric, memory subsystems and I/O bus, are trusted and it is possible to run without TCP or UDP checksum. Another area is in multimedia applications, where it would be impractical to request retransmission of corrupt packets.

In AIX Version 4.2, a modified `ifconfig` command provided two new options to allow a system administrator to decide if he wished to eliminate TCP/UDP checksum calculations:

- `tcp_nocksum`
- `-tcp_nocksum`

By default, TCP/UDP checksumming is enabled.

By disabling the computation and verification of TCP/UDP checksums over reliable networks and interfaces, the throughput on High Performance Switches and other reliable media can be increased, and it also decreases the amount of CPU needed to move segments within the local network.

The option to disable TCP/UDP checksum does not disable TCP, UDP, and IP *header* checksum calculations.

3.13 Network Time Protocol Support (NTP)

NTP Version 3 was implemented in AIX Version 4.2 as a series of tools to provide client/server network clock synchronization. This implementation conformed to (Network Time Protocol Version 3).

NTP provides for accurate network time by synchronizing a set of network clocks using distributed clients and servers. NTP can be used to synchronize systems in NCS cells and services that interact with NCS, or in services that require accurate time synchronizing such as DCE and NIM. NTP is built on the Internet Protocol (IP) and User Datagram Protocol (UDP), which provides a connectionless transport mechanism. It is specifically designed to maintain accuracy and robustness, even when used over typical Internet paths involving multiple gateways, highly dispersive delays and unreliable networks.

The system clock was and currently is the only supported reference clock in AIX Version 4.2.

3.14 POP3 and IMAP4 Mail Protocol Support

AIX Version 4.2.1 added server support for both the Post Office Protocol 3 (POP3) and Internet Message Access Protocol 4 (IMAP4) protocols.

The POP and IMAP protocols describe two methods of accessing electronic mail from a remote mail server. Both the POP and the IMAP servers are used

for e-mail access only. These servers rely on the Simple Mail Transfer Protocol (SMTP) for sending mail.

The AIX POP server conforms to RFC 1725, and the IMAP server conforms to RFC1730.

3.15 TCP/IP Path MTU Discovery Support

When two hosts are communicating across a path containing multiple networks, a transmitted packet will become fragmented if its size is greater than the smallest Maximum Transmission Unit (MTU) of any network in the path. Since packet fragmentation often results in reduced network performance, it is desirable to avoid fragmentation by transmitting packets with a size no greater than the smallest MTU in the network path. This size is called the path MTU (PMTU).

AIX Version 4.2.1 supported a PMTU discovery algorithm as described in RFC1191.

3.16 TCP/IP Group Routing Support

Group routing was an addition in AIX Version 4.2.1 that allowed network traffic to be segregated based on the group IDs of users. Each route had a list of allowed group IDs associated with it. When a search of the routing table was done on behalf of a user, a route could only be returned if the user's primary or auxiliary group IDs were allowed for that route.

A search of the routing table for the purpose of forwarding a packet used the list of group IDs associated with the incoming interface of the packet. This feature allowed administrators to restrict the use of routes to certain users and incoming interfaces.

3.17 TCP/IP Multicast Support

The addition of this support allowed an AIX Version 4.2.1 system to act as an IP Multicast router. AIX Version 4.2.1 would route multicasts over the following LANs: Ethernet, Token-ring and FDDI. Support for media-level multicast over ATM was not included.

"IP multicasting is the transmission of an IP datagram to a 'host group', a set of zero or more hosts identified by a single IP destination address."
Host Extensions for IP Multicasting, Steve Deering, Stanford University, August 1989.

Multicasting allows TCP/IP users to send or receive messages intended for a particular group without having to address each member explicitly. It is very useful for certain types of TCP/IP applications where a varying set of users require delivery of information. For example, it could be a financial group that sends out current stock quotes on a regular basis.

3.18 Upgrade to Point-to-Point Protocol Implementation

The implementation of PPP in AIX Version 4.2 was upgraded to provide authentication support, a feature not included in previous releases. Support was added for the following authentication protocols as described in RFC1334:

- Password Authentication Protocol (PAP)
- Challenge-Handshake Authentication Protocol (CHAP)

3.19 Sendmail Update to UCB Version 8.7

Sendmail in AIX Version 3.2.5 and AIX Version 4.1 was based on UCB Sendmail Version 5.64. AIX Version 4.2 Sendmail was updated to an implementation of UCB Sendmail Version 8.7 that included the service extensions to the Simple Mail Transfer Protocol (SMTP) as outlined in the following RFCs:

RFC165:

SMTP Service Extensions

RFC165:

SMTP Service Extension for 8-bit MIME transport

RFC165:

SMTP Service Extension for Message Size Declaration

3.20 Network Installation Manager (NIM) Enhancements

Two enhancements were made to the Network Installation Manager (NIM) in AIX Version 4.2.

- Groups of logically-related machines and resources became manageable.
- Although system backup images (mksysb) as a resource group were already supported by NIM in AIX Version 4.1, you were limited to the use of a previously created system backup. In AIX Version 4.2, it became possible to create a mksysb using NIM over the network such that it could

be restored on the machine from which the mksysb was taken or installed on another machine to clone the setup of the original system. When a mksysb resource was used to clone a system, any missing device software was automatically installed by NIM.

3.21 Web Browser Diagnostic Interface

This enhancement provided a Web browser interface to the `diag` command in AIX. It was the starting point for many future Web-based tools.

The Web Browser Diagnostic was invoked in AIX by issuing the command:

```
diag -w
```

The diagnostic panels were HTML pages, and the main page was located at:

```
file:/etc/lpp/diagnostics/data/diag.html
```

This version did not support remote diagnostics, and only one session of the diagnostics could be run at any one time. Some special diagnostic functions that required SMIT panels or use of the curses library (`libcur.a`) were also not supported in this version. All the diagnostics provided by the Web interface continued to be present in the traditional interface.

Chapter 4. Enhancements Delivered with AIX Version 4.3

The latest version of AIX, AIX Version 4.3, offers many enhancements over previous releases and is also the base for all future AIX enhancements through the year 2000. It offers application binary compatibility, with very few exceptions, across all AIX Version 4 releases and when combined with the new 64-bit hardware, introduces 64-bit computing to the RS/6000 platform for the first time. Its reliability and scalability, combined with 32/64-bit functionality, make it an ideal choice for today's heavy-duty commercial applications.

4.1 64-Bit Hardware and Software Support

When used in conjunction with the recently introduced 64-bit hardware platforms, AIX Version 4.3 users now have the ability to take advantage of the many benefits delivered by 64-bit computing. The new computing environment supports 64-bit exploitation through:

- A new 64-bit SMP Enterprise Server (the Model S70)
- A new 64-bit application environment
- A significantly expanded address space for program data, file buffers and shared memory objects

4.2 Concurrent Execution of 32-bit and 64-bit Applications

AIX Version 4.3 supports both 32-bit and 64-bit execution environments concurrently. You can run both 32-bit and 64-bit applications at the same time on 64-bit hardware platforms. This protects users' investment in their current 32-bit applications and allows them to take advantage of new 64-bit applications and middleware at their own pace. Environments running only 32-bit applications on 64-bit hardware will still benefit from the operating systems' exploitation of extended address space and increased real memory support.

Note that creation of 64-bit programs can be done on all hardware types; that is, you can write and compile your applications on either 64-bit or 32-bit hardware. However, 64-bit applications can only be executed on 64-bit hardware running AIX Version 4.3 (or later).

4.3 Open Group UNIX98 Conformance

AIX Version 4.3 is now aligned with the following standards:

- ISO/IEC 9945-1:1996 which incorporates ANSI/IEEE Std. POSIX 1003.1-1990, 1003.1b-1993, 1003.1c-1995 and 1003.1i-1995(1003.1b-1993 extension)
- ISO C Amendment 1: 1995 (Multibyte support)

Also, AIX Version 4.3.1 or later has been awarded UNIX 98 branding. The Open Group UNIX98 specification adds, in addition to the above:

- Extended threads functions over POSIX threads, based on industry input from Sun, Digital, HP and DCE
- Dynamic linking extensions to permit applications to share common code across many applications and ease maintenance of bug fixes and performance enhancements for applications.
- N-bit cleanup (64-bit and beyond) to remove any architectural dependencies in the UNIX specification. This is of particular relevance with IBM's move to 64-bit UNIX.
- Year 2000 alignment to minimize the impact of the millennium roll-over.
- IEEE POSIX 10003.1-1996 (1003.1c) threads support, including M:N threads.

More information about AIX standards compliance can be found at the following URL:

<http://www.rs6000.ibm.com/software/Standards/>

4.4 X11R6 and Motif 2.1

The sixth release of the X-window system has been ported to AIX Version 4.3 from software provided by the X Consortium. The X Consortium is an independent, non-profit corporation, the successor to the MIT X Consortium, which was part of the MIT Laboratory for Computer Science. The actual source for the AIX port was X11 Release 6.2, which is a proper subset of X11 R6.3 produced at the request of the OSF Common Desktop Environment (CDE) program. The libraries shipped with AIX are backward-compatible and client applications that access these libraries will work as on previous releases of AIX. IBM also ships X11R3, X11R4 and X11R5 compatibility options for maximum customer flexibility.

The Motif libraries shipping with AIX Version 4.3 contain the Motif 1.2 and Motif 2.1 shared objects; so the default installation of Motif provides versions for existing applications (Motif 1.2) and for development of 64-bit and threaded Motif applications (Motif 2.1). The default runtime environment is Motif 1.2; so existing applications will continue to load Motif 1.2. However, the default compile time library is Motif 2.1; so if you recompile an application on AIX Version 4.3, it will link to the Motif 2.1 libraries. Note that there is no binary compatibility path for Motif 1.2 to Motif 2.1 because the shr4.o shared object shipping in libXm.a is Motif 1.2, and not Motif 2.1.

4.5 OpenGL and graPHIGS Included at No Charge

Both OpenGL and graPHIGS are no longer shipped as a separate licensed programs, but are being shipped as part of the AIX base. In addition, improvements were made to OpenGL and graPHIGS for AIX Version 4.3, resulting in better performance for certain application scenarios and improved memory utilization by the graphics libraries. Significant performance gains were seen in some SDRC I-DEAS Master Series scenarios. Performance of graPHIGS surfaces, which includes CATIA shaded mode, improved by up to 10% on the GXT800P adapter and is, in some cases, even more.

Note:

The PEX API, previously included with PEX and PHIGS for AIX Version 4.2.1, has been removed and is not supported on AIX Version 4.3 or later.

Another enhancement supplied in AIX Version 4.3 is that OpenGL may now be used with 64-bit applications that request an indirect context. You can perform early application development of 64-bit OpenGL clients and remote display of 64-bit OpenGL clients on 32-bit graphics workstations. This 64-bit support is provided for OpenGL libraries and development tools. In AIX Version 4.3, 64-bit OpenGL supports indirect rendering contexts only. Indirect rendering specifies that OpenGL rendering for the context is performed through the X server.

OpenGL also supports Virtual Frame Buffering (VFB). VFB allows you to write Web-based 3D graphics applications for an RS/6000 server without the need for a 3D graphics adapter. Users can take advantage of multiple processors for near linear scalability because each client can render into their own frame buffer without interaction with the server.

4.6 IP Version 6 Support

AIX Version 4.3 includes support for IPv6, the next generation of the *Internet Engineering Task Force* (IETF) Internet Protocol. IPv4 and IPv6 can be used concurrently on AIX systems. Most of the AIX provided applications, such as name resolution, mail, r-commands (*rlogin*, *rsh*), *telnet*, *ftp* and *tftp*, have also been upgraded to support IPv6. Features available with IPv6 include dynamic autoconfiguration and dynamic routing.

4.7 Sendmail Upgrade to UCB Version 8.8.8

The Sendmail subsystem in AIX Version 4.3 has been updated to UCB Version 8.8.8 from the University of California at Berkeley. Version 8.8.8 contains many new features including security enhancements and facilities for combatting spam e-mail.

See the Sendmail home page at:

<http://www.sendmail.org/>

for extensive details about Sendmail.

4.8 New IP Security Protocols

AIX Version 4.3.0 implemented new security protocols for IP.

- Authentication Header (AH), for integrity and authentication
- Encapsulation Security Payload (ESP) for confidentiality

These protocols are supported both for IPv4 and IPv6, and any combination of installed authentication and encryption algorithms can be used for ESP with authentication.

AIX Version 4.3.1 improved IP security even further.

- Triple DES is now an additional choice for U.S. and Canadian customers.
- On PowerPC platforms, performance improvements have been made to the Commercial Data Masking Facility (CDMF), Hashed Message Authentication Code - Secure Hash Algorithm 1 (HMAC-SHA1), and Data Encryption Standard (DES) encryption routines. The performance improvements to the encryption and decryption algorithms have been achieved by taking advantage of features of the PowerPC architecture. This has resulted in an up to 300 percent performance improvement (up to four times the original throughput) on a 100 Mb Ethernet. For the slower

10 Mb Ethernet, the throughput is now at media speed but with a 50 percent lower CPU utilization. Similar performance gains are achieved on other media types, such as token-ring.

- Crypto extensions can be dynamically loaded and unloaded.
- The filter table now supports an unlimited number of rules.
- Logging of tunnel and filter events is significantly improved.
- Kerberos 5 support for secure remote TCP/IP commands: `rsh`, `rcp`, `rlogin`, `telnet`, `ftp`. With this capability, Kerberos 5 authentication is used between these commands and server daemons, avoiding the need for user passwords to pass in the clear on the network. Instead, Kerberos 5 credentials are used to authenticate users. User credentials can be forwarded to the server.

4.9 Cache File System (CacheFS) Introduced

The Cache File System (CacheFS) is a general purpose file system caching mechanism available in AIX Version 4.3 that improves NFS server performance and scalability by reducing server and network load. Designed as a layered file system, CacheFS provides the ability to cache one file system on another. In an NFS environment, CacheFS can increase the client per server ratio, reduce server and network loads, and improve performance for clients on slow links, for example, PPP.

4.10 Enhanced Automatic Mounting of File Systems with AutoFS

AIX Version 4.3 includes a port of the Sun ONC+ implementation of automatic mounting, known as AutoFS. This function replaces the current automount facility.

AutoFS consists of three components:

- The AutoFS file system kernel extension
- The Automount daemon
- The automount command

In order to take full advantage of the new AIX implementation of automatic mounting, please ensure that you have APAR IX76627 installed.

4.11 Updates to DHCP

A number of enhancements to Dynamic Host Configuration Protocol (DHCP) appeared in AIX Version 4.3. These included:

- Performance enhancements through data organization and threading
- Multiple database backend support through dynamic loading.
- Out of protocol modifications to databases using an administration interface.
- Logging-level readability and accuracy improvements
- Classless inter-domain routing (CIDR) addressing
- Support for virtual subnets

4.12 Improved Telnet Server Performance

Compared to previous AIX releases, significant improvements in Telnet server (telnetd) performance has been achieved through lower CPU utilization. This enables the same number of Telnet sessions to be handled more efficiently, or allows an increase in the number of active sessions.

4.13 Alternate Disk Installation Utility

Alternate Disk Installation is a new utility that allows a customer to install a completely new release or maintenance level of AIX on an alternate (unused) disk, without requiring the system to be taken down for an extended period of time. This is a significant usability enhancement for continuous (7 X 24) operations.

4.14 Concurrent Mode LVM Enhancements

Enhancements have been made to the Logical Volume Manager (LVM) to allow the commands `mklv`, `rmlv`, `splitlvcopy` and `chlv` (except name change) to function in concurrent mode. New options are also included for `syncvg (-H -P)` that allow a faster concurrent `syncvg` operation. These enhancements require that all machines in the cluster be at AIX Version 4.3 or later, and their use should not be attempted in mixed-release-level environments.

4.15 Raw LV Online Mirror Backups

The LVM now provides a snapshot capability for raw, mirrored logical volumes. One mirror of a mirrored logical volume can be used to archive the data on the raw logical volume without splitting the mirror copies from each other. Only the logical partitions that have changed during the system backup need to be resynchronized. For details, see the `chlvcopy` and the `readlvcopy` commands in the online documentation.

4.16 Support for 512 MB and 1024 MB Partition Sizes

Support for physical partition sizes of 512 MB and 1024 MB has been added. Also, support for more than 1016 physical partitions per physical volume is now included. This provides support for most existing volume groups that violate the 1016 physical partitions per physical volume limit. It should be noted, however, that these volume groups are not recognized by previous versions of AIX.

Table 1 shows the Logical Volume Manager (LVM) limits for each update level of AIX Version 4.3

Table 1. LVM Limits for Different Releases Levels of AIX Version 4

Logical Volume Manager (LVM) Parameter	Limits for AIX Version 4 Release		
	4.3.0	4.3.1	4.3.2
Maximum No. of Disks per Volume Group (VG)	32	32	128
Maximum No. of Logical Volumes per VG		256	512
Maximum No. of Physical Partitions per VG		32512	130048

Table 2 shows the relationship between the number of Physical Partitions (PPs) per disk and the maximum allowed number of disks in a Volume Group (VG).

Table 2. Relationship between PPs per Disk and Maximum Disks per VG

Physical Partitions (PPs) per Disk	Maximum Number of Disks per Volume Group	
	AIX Version 4.3.1	AIX Version 4.3.2
1016	32	128
2032	16	64
4064	8	32

Physical Partitions (PPs) per Disk	Maximum Number of Disks per Volume Group	
	AIX Version 4.3.1	AIX Version 4.3.2
8128	4	16
16256	2	8
32512		4
65024		2

It is important to note that all Physical Partitions in a particular Volume Group must be the same size.

4.17 Faster JFS File Access with Direct I/O

AIX Version 4.3 adds support for direct I/O. By bypassing the normal I/O buffers, this support allows higher bandwidth I/O for performance-critical applications.

4.18 Improved JFS File-Locking Mechanism

The JFS locking mechanism has been streamlined to allow read access up to four times faster in an application where two processes sequentially read different parts of the same file.

4.19 Additional Performance Tools Provided with Base

To assist users in getting the best out of their system and improve system serviceability, AIX Version 4.3 now provides tools formerly in the Performance Toolbox licensed program product at no additional charge:

These tools include: `bf`, `fdpr`, `filemon`, `fileplace`, `lockstat`, `netpmon`, `rmss`, `stem`, `svmon` and `tprof`.

4.20 Unicode (UCS-2) Implementation

Unicode, also known as UCS-2, is a standard based on a 16-bit code that can be used to encode all of the characters used by all the principle written languages in the world. A 32-bit version (UCS-4) has also been defined, but is rarely used and is of little commercial interest.

The development of UCS-2 on AIX is based on Unicode code set Version 2.0, which is widely accepted within the industry. The *Unicode 2.0 Standard* publication (ISBN 0-201-48345-9) is used as the primary reference.

4.21 Web-Based System Manager

AIX Version 4.3.0 introduced an initial technology version of Web-based System Manager for AIX, a tool that allows administrators to manage AIX systems either locally or over a network from virtually any client platform. This initial technology version became a full release of Web-based System Manager with AIX Version 4.3.1. With Web-based System Manager, you can manage AIX systems from anywhere in the Internet or intranet. It features an intuitive, object-oriented, easy-to-use GUI with TaskGuides that simplify unfamiliar or otherwise complex tasks.

4.22 HTML-Based Online Documentation

The online documentation for AIX has been converted from its previous hypertext version into HTML so that it can be accessed through a Web browser. The RS/6000 documentation libraries have also been converted to HTML format and are available on documentation CDs. The new version contains all the features of its predecessor, InfoExplorer, and retains a similar look and feel.

4.23 Lightweight Directory Access Protocol (LDAP) Support

The Lightweight Directory Access Protocol (LDAP) was introduced with AIX Version 4.3. LDAP provides very efficient client access to directory data on a server using standard Internet protocols. The implementation of LDAP in AIX provides the following features:

- High performance and scalability. The directory can support up to four million entries with sub-second response time for searches.
- Secure Sockets Layer (SSL) Version 3 support for both the directory server and client. SSL provides encryption of data and authentication using X.509v3 public-key certificates. The directory can be configured to run with or without SSL support.
- Support for LDAP referrals, allowing directory operations to be redirected to another LDAP directory server.

- Replication of the LDAP Directory, which allows additional copies of the directory to be available for directory read operations, increasing performance and reliability of access to the directory information.

For a more complete description of LDAP, please refer to the following URL:

<http://www-leland.stanford.edu/group/networking/directory/doc/ldap/ldap.html>

4.24 Java Development Kit Upgraded

Java Development Kit (JDK) Version 1.1.6 and IBM's Just-in-Time (JIT) Compiler Version 3.0 is supplied with AIX Version 4.3. These new versions have improved Java performance by up to 40 percent.

4.25 Extended Scalability and System Limits

A number of improvements have been made to the scalability of AIX with Version 4.3. In particular, certain system limits have been greatly expanded, as can be seen in the following table.

Table 3. Expanded AIX Version 4.3 System Limits

	New	Previous
Total open files per system	1000000	200000
Open files per process	32768	2000
Threads per process	32767 (M:N)	512
Maximum size for shared or mapped files per memory segment	2 GB	256 MB
Mbuf size limit	128 MB	64 MB
IPSEC filtering	Unlimited	Limited

4.26 Improved Trace Utility

Kernel trace buffers are no longer required to be in the kernel heap. It is now possible to allocate one or two trace buffers up to 268435184 bytes in size. This makes it much easier to capture critical events in situations where the buffer area can be overwritten very quickly by the volume of data being captured.

4.27 Fast fork() Function

An optional fast fork() interface called `f_fork()` has been provided in AIX Version 4.3. It is intended primarily for use by applications, such as Web servers, that require a “lightweight” fork behavior. The interface should be used for multithreaded applications that create new programs through `exec()` immediately after they call `f_fork()`.

4.28 Login Performance Improvements

User login performance in AIX Version 4.3 has been significantly improved for systems with a very large number of user accounts. This performance enhancement was achieved by indexing the `/etc/passwd` and `/etc/security/passwd` files using the username and userid as keys to create the index files (`/etc/passwd.nm.idx`, `/etc/passwd.id.idx`, `/etc/security/passwd.idx` and `/etc/security/lastlog.idx`). If these new files have been created (using the `mkpasswd` command), the password routines use the indexes in these files to read the correct offset within the ASCII files instead of having to sequentially search the files. On certain configurations the resulting performance improvement has been measured between 50 and 400%.

4.29 Year 2000 Ready

AIX is Year 2000 ready. When used in accordance with its associated documentation, it is capable of correctly processing, providing, and/or receiving date data within and between the twentieth and twenty-first centuries, provided all other products (for example, software, hardware, and firmware) used with the product properly exchange accurate date data with it.

IBM continues to work with its products to prepare for the year 2000, and as it does so, updates may be made available as needed for AIX 4.3 or other AIX products. For more information, read *AIX, UNIX Operating Systems and the Year 2000 Issue*, available at:

<http://www.software.ibm.com/year2000/papers/aixy2k.html>

This document, which is updated regularly, describes the Year 2000 issue as it affects UNIX-based operating systems, such as AIX, and gives complete listings of Year 2000 fixes available for all supported AIX versions and releases.

Of the programs shipped with AIX Version 4.3.0, the following program is not Year 2000 ready:

- JDK 1.1.2

Customers should plan to upgrade to JDK 1.1.4, which is Year 2000 ready and is available as part of AIX Version 4.3.1 or later (AIX Version 4.3 users can order APAR IX75968.)

Chapter 5. Planning For Your Migration

Migrating a working system from any version of one operating system to another is a complex procedure that should not be undertaken lightly. In most cases, the system being migrated is vital to the running of the company, and any downtime must be minimized. It is therefore important to carefully plan the migration to ensure that all possible risks are discovered before the event so that they may be eliminated or reduced. Always try to think of areas where your environment is unique and may be different from those used as examples in this book. In particular, pay attention to any third-party additions or extensions beyond the standard set of products. Invariably, the success of the migration will depend on your ability to identify and assess possible problems over and above those addressed in this document.

The migration planning process should not be viewed as an overhead or cost. Under no circumstances should you consider migrating your system without first developing and reviewing a formal plan. In addition to greatly assisting your migration, the planning process will result in up-to-date documentation and an improved understanding of your system. This can then be used as a starting point for establishing procedures such as change control, problem management and resolution, disaster recovery and capacity planning.

In order to perform a successful migration, a number of planning tasks need to be completed:

- Documenting your existing environment (hardware and software)
- Mapping the existing environment to the target environment
- Reviewing the hardware, software and licensing issues
- Determining if migration is achievable

You should read through each of the following sections in this chapter to assist you in planning your migration. The final result of your planning process should be a collection of schedules that accurately describe each of the steps in the migration; example schedules are shown below. The amount of detail in your own schedules will vary, depending upon the size, complexity and number of systems you intend to migrate.

5.1 Minimum System Requirements

Before considering a migration, you should be aware of the following minimum requirements for AIX Version 4.3.

Memory Requirements

AIX Version 4.3 requires a minimum of 32 MB of physical memory.

Initial Paging Space Requirements

AIX Version 4.3 requires the initial paging space (/dev/hd6) to be a minimum of 64 MB in size.

Disk Space Requirements

AIX Version 4.3 requires additional disk space for the same set of installed filesets due to the increased library sizes and additional function. Refer to the following tables for approximate disk space requirements.

Note: These measurements are given as a guide only and are based on the requirements for AIX Version 4.3.1. They are meant to help you understand that additional disk space may be required on your system when you install or migrate to AIX Version 4.3. For more accuracy, you can also use the tables of

individual fileset sizes provided in Appendix C, “AIX Version 4.3 CD-ROM Contents” on page 171.

Table 4. Disk Requirements (Graphical System with CDE)

	AIX 4.1.5 Allocated (Used)	AIX 4.2.1 Allocated (Used)	AIX 4.3.0 Allocated (Used)	AIX 4.3.1 Allocated (Used)
/	4 MB (2 MB)	16 MB (2.9 MB)	4 MB (2.1 MB)	4 MB (2.3 MB)
/usr	140 MB(134MB)	156 MB (143MB)	248 MB (208MB)	220 MB (217MB)
/var	4 MB (0.4 MB)	16 MB (0.9 MB)	4 MB (0.7 MB)	4 MB (0.7 MB)
/tmp	8 MB (0.3 MB)	16 MB (0.7MB)	12 MB (0.5MB)	12 MB (0.5 MB)

Table 5. Disk Requirements (Network Support, X11, CDE, and Client Bundle)

	AIX 4.1.5 Allocated (Used)	AIX 4.2.1 Allocated (Used)	AIX 4.3.0 Allocated (Used)	AIX 4.3.1 Allocated (Used)
/	4 MB (1.8 MB)	16 MB (3.2 MB)	4 MB (3.4 MB)	4 MB (3.4 MB)
/usr	172 MB(162 MB)	192 MB (170 MB)	248 MB (237 MB)	256 MB (217 MB)
/var	4 MB (0.5 MB)	16 MB (0.9 MB)	4 MB (0.7 MB)	4 MB (0.7 MB)
/tmp	8 MB (0.5 MB)	16 MB (0.7 MB)	12 MB (0.8 MB)	12 MB (0.8 MB)

Table 6. Disk Requirements (After Update from AIX Version 4.3.0)

	Product Media Allocated (Used)	Service Media Allocated (Used)
/	4 MB (1.8 MB)	16 MB (3.2 MB)
/usr	172 MB(162 MB)	192 MB (170 MB)
/var	4 MB (0.5 MB)	16 MB (0.9 MB)
/tmp	8 MB (0.5 MB)	16 MB (0.7 MB)

Note: The filesets that are automatically installed have changed since AIX Version 4.1. That is, bos.sysmgt.sysbr (the mkysyb fileset) and bos.net.nfs.client were not automatically installed in AIX Version 4.1, but are automatically installed in AIX 4.3. Some new filesets (such as Java and the Web-based System Manager) are also automatically installed in AIX Version 4.3.

5.2 Sample Migration Schedules

The following figures provide examples of typical schedules for planning a system migration to AIX Version 4.3. When drawing up schedules for a migration, at each stage ask yourself What if...? For example, What if that new piece of indispensable-hardware is damaged when it arrives, will it take another four weeks to obtain a replacement? How will that affect my schedule?

5.2.1 Sample Planning Schedule

The planning schedule is normally quite easy to prepare, and unless you already have aggressive deadlines, it can be worked on as and when your existing workload permits.

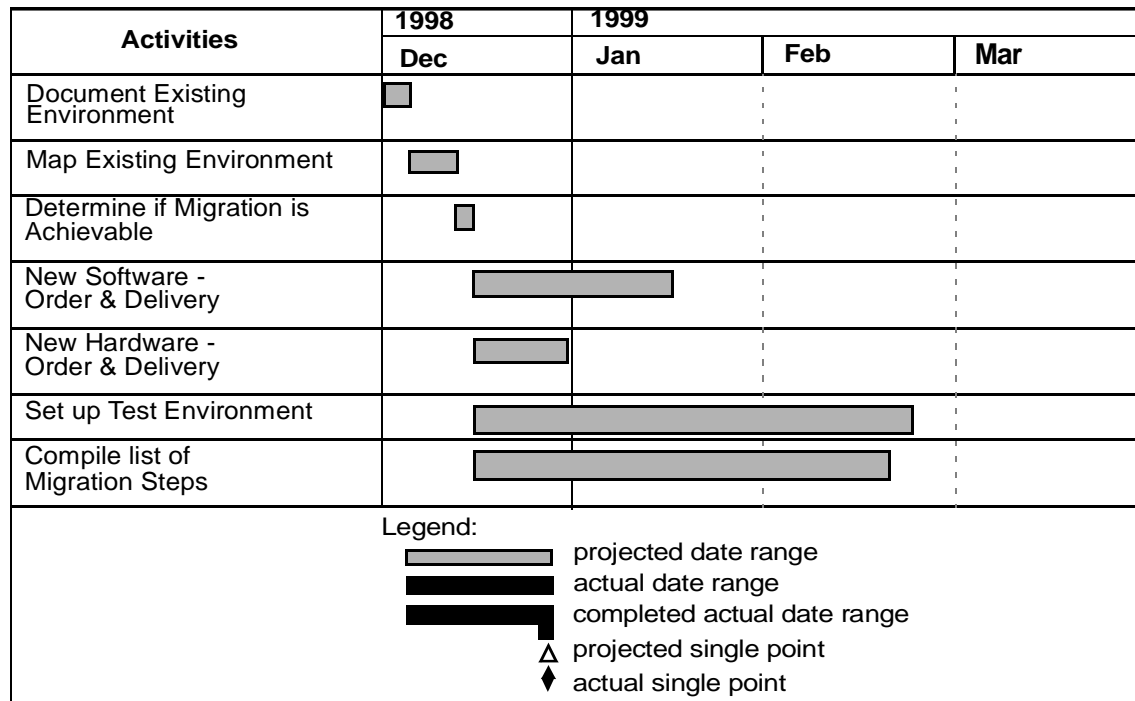


Figure 2. Example Planning Schedule - Planning Phase

5.2.2 Sample Test Environment Schedule

Any individual task that is large, complex or involves a number of interconnected tasks should be broken down and given its own schedule. In

this case, the tasks involved in setting up a test environment and using it to test the correct functioning of application software has been separated from the planning schedule. In some environments, testing and porting of in-house or third-party applications will justify its own schedule and may in fact be the most complex and time-consuming part of the migration.

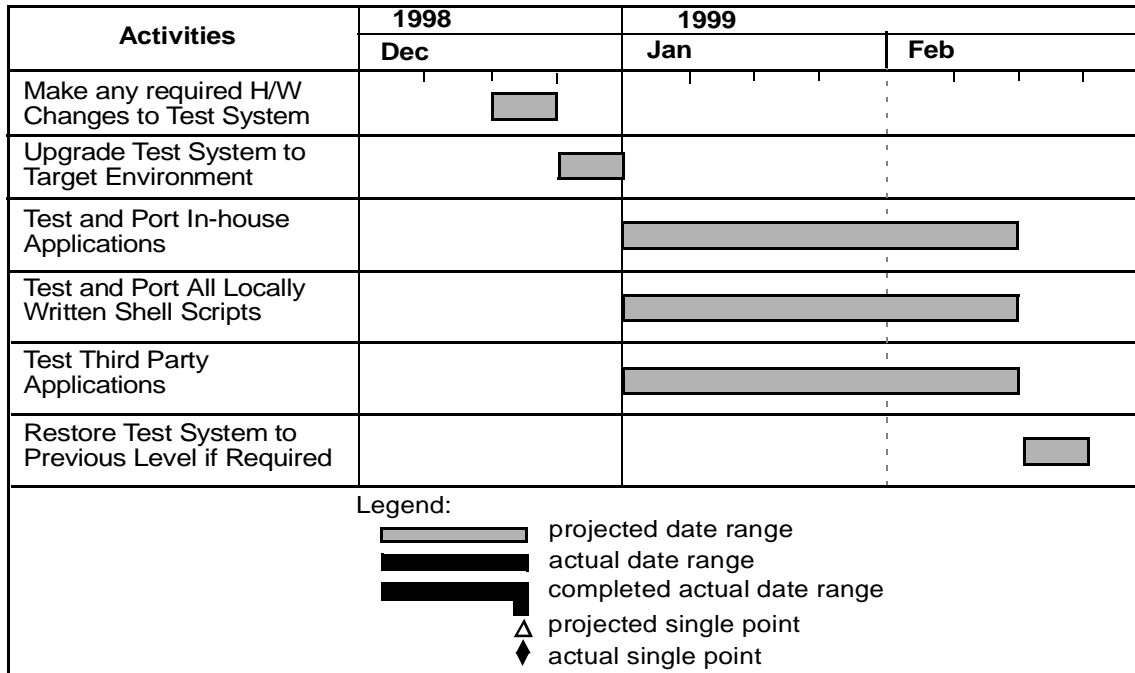


Figure 3. Example Planning Schedule - Setup Test Environment

5.2.3 Sample Migration Schedule

The schedule for the actual migration work itself is probably the easiest schedule to complete primarily because all the steps involved are relatively straightforward and short in duration. Although the total time involved may be short when compared with the other steps in your migration plan, this is the point at which you will be taking the system out of production and making significant changes to it. It is impossible to stress highly enough the importance of having full and verified backups before you begin to make those changes. If you do not have good backups and something goes wrong, it will be extremely difficult, if not impossible, to recover your system to its pre-changed state. For this reason, you should allow plenty of time to perform and verify the backups. If you are unsure how long this is likely to take, schedule a dummy run prior to the real thing.











Activities	1999	
	February	March
Schedule System Downtime		
Schedule System Backup		
Perform System Backup		
Test System Backup		
Upgrade Operating System		
Legend:  projected date range  actual date range  completed actual date range  projected single point  actual single point		

Figure 4. Example Planning Schedule - Migration Phase

5.2.4 Sample Post-Migration Schedule

The complexity and time required for the post-migration phase will depend to a great extent upon your applications and the system configuration. It will also be directly related to the availability of a test system and the amount of testing you are able to do before the migration. If your system is a server with extensive networking, you will probably need assistance during this stage. You should also remember to allow extra time for fixing minor network problems. These frequently occur after extended shutdowns and can often be quite time-consuming, particularly if travel between one site and another is required, or third-party vendors or network providers are involved. Once the migration is complete, you should back up the system again and verify the backups.

An important point to consider and include in your post-migration schedule is the point at which you must stop everything and restore your system to its original configuration if there are problems. You may wish to allow time to run the `snap` command and back up the system at this stage since it will probably be quicker to return to this state and resolve the problem rather than start the migration from scratch at a later date. You will also be able to provide the backup to support staff if their assistance is required. Remember to write down a complete description of the problem and any error messages that appeared.

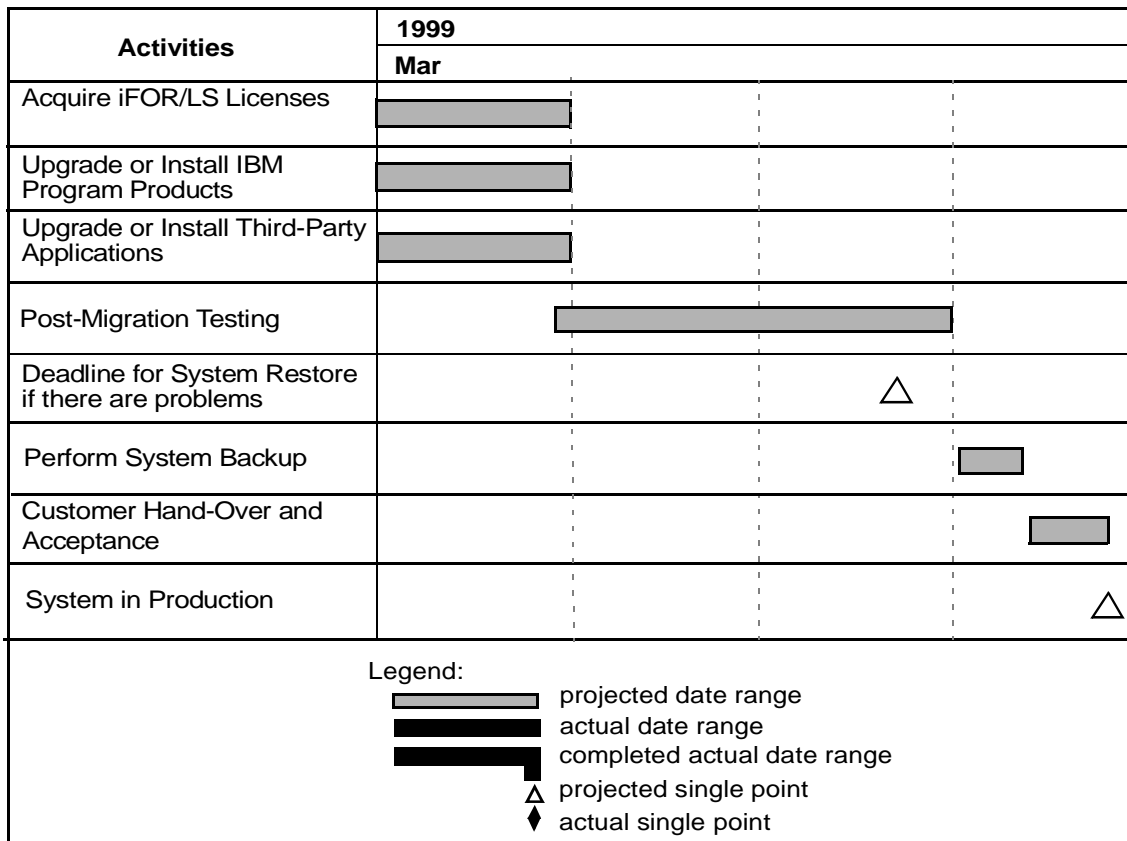


Figure 5. Example Planning Schedule - Post-Migration Phase

5.3 Documenting the Existing Environment

When planning your migration, the main objective is to guarantee the same or increased functionality at the target level of AIX that you currently have in your existing environment. With this in mind, you need to thoroughly examine your system and document exactly what is installed. It is imperative that you do not miss any components at this stage.

There are several ways to document your existing environment. One way is to use multiple AIX commands to display the information and then print or write down the data displayed. For each part of the system, you will need to use the appropriate command to extract the information and use it to complete an Existing Environment Table similar to the example provided in Appendix D., "Environment Tables" on page 185. An alternative is to use the

`snap` command. `snap` is a utility that was originally provided by IBM to assist users and support staff when trying to troubleshoot problems. It collects almost all system information and places it in the `/tmp/ibmsupt` (or user-specified) directory where it can be examined or copied to removable media for shipping to technical support. In this way, you can use a single command to capture almost all the system-related information that will be required. The only problem with using `snap` is that although it collects all the information you require, much of the information is collected through commands and options that some users may not be intimately familiar with. Consequently, the format and content of the information in the output files may not be immediately obvious to you. For this reason, we recommend that you run the `snap` utility and take a look at the output files. If you feel comfortable with the content, go ahead and use it. If not, then use the individual AIX commands that you are probably already familiar with. It is, however, a good idea to run the `snap` command immediately prior to actually performing the migration. In this way, you should have most of the information that would be required by support personnel if you were to experience a problem after your migration.

5.3.1 Using Standard AIX Commands

AIX provides a large collection of standard commands that provide you with information about the system configuration. For example, many commands beginning with the letters `ls` (for list) can be used to display configuration information. Normally, you must add options and parameters to the command to specify more accurately what information you would like to be displayed.

The following are typical configuration-list commands:

- `lsvg` The `lsvg` command displays information about a volume group.
- `lsuser` The `lsuser` command displays information about configured AIX users.
- `lslicense` The `lslicense` command shows the current AIX license information.
- `lsattr` The `lsattr` command lists the attributes of a particular device.

The output of the commands is displayed on standard output and may be further processed or redirected for saving and printing. If you will be using standard configuration commands to document your system and sufficient time is available, you may wish to combine the commands into a `snap`-like script that can be reused to document multiple systems.

5.3.2 Using The Snap Command

Whereas ls-type commands only display information specific to that particular command. The `snap` command collects a large amount of information from the system and stores the data in a default, or user-specified, directory.

To gather all system configuration information, log in as root (`snap` requires root authority) and enter the command:

```
# snap -a
```

Then wait for the command to complete.

`snap` will run for approximately 4 to 8 minutes, depending upon the performance of your system and the number of devices, users, disks, and so on that it must collect information about. The `snap` command starts by checking the space requirements and creating, by default, a directory called `/tmp/ibmsupt`. By specifying the `-d` option, you can redirect the output to another directory. Other options allow you to compress the data and write the output to diskette or tape for safekeeping. The output from `snap` occupies about 4 MB of free disk space on an average system, and the command uses approximately 8 MB of temporary space while running.

5.3.3 Documenting Your Hardware

You will need to document exactly what components are installed in each RS/6000 that is to be migrated. This information will then be used to determine if each component is actually supported at AIX Version 4.3. You will also need to consider devices that may be attached at a later date, for example, external tape drives. The device drivers for these products will need to be reloaded once the migration installation has taken place. When documenting your system, be sure to highlight any third-party components. Note that hardware upgrades are not taken into consideration in this section. We concentrate on the hardware components currently installed in or attached to our existing RS/6000 and their ability to function at AIX Version 4.3.

Some uniprocessor-to-multiprocessor hardware migration issues are discussed in "UP to SMP Migration and AIX Version 4.3" on page 149, but they are not discussed in this chapter.

5.3.3.1 RS/6000 Model Type

To find out what model of RS/6000 you have, look on the front panel and read the name located on the IBM badge. If for some reason you cannot find the information on the machine or you are gathering the information remotely

across a network, an alternative method is to use the information provided by the following command:

```
# uname -m
```

The output will be similar to that shown in Figure 6 on page 46. The ninth and tenth digits (counting from the left) relate to the CPU ID number. You can look up this number in the *Common Diagnostics and Service Guide*, SA23-2687, or in the *Service Request Number Cross-Reference Guide*, SA23-2629, to determine the associated model. A subset of the numbers are also specified in the man page for the `uname` command.

```
000005081800
```

Figure 6. Identifying Your CPU Type

In our example, the number 18 refers to a Model 7013-530H.

5.3.3.2 Installed Memory

Use the following command to find out what memory is installed:

```
# lsdev -CHc memory
```

On microchannel machines, the output will be similar to that in Figure 7.

```
name status    location description
mem0 Available 00-0B   16 MB Memory Card
mem1 Available 00-0D   16 MB Memory Card
mem2 Available 00-0F   16 MB Memory Card
mem3 Available 00-0H   16 MB Memory Card
```

Figure 7. Extracting Installed Memory Information

The location code in Figure 7 refers to the memory slot number for each installed memory card.

On PCI systems, the output of the `lsdev -CHc memory` does not display the memory slots, but provides you with a summary view of how the memory is installed.


```
# lsdev -CHc memory

          name      status   location description
          mem0      Available 00-00   Memory
          L2cache0  Available 00-00   L2 Cache

#
```

If you want to determine the amount of memory available on your system independent of the platform, use the command

```
# bootinfo -r
```

Comparable information is generated by `snap` and can be found in the file `/tmp/ibmsupt/general/general.snap`.

5.3.3.3 Hard Disk Drives

Use the following command to find out what hard disk drives are installed:

```
# lsdev -CHc disk
```

The output will be similar to that shown in Figure 8 below:

```
          name      status   location   description
          hdisk0    Available 00-08-00-1,0 1.0 GB SCSI Disk Drive
          hdisk1    Available 00-08-00-2,0 355 MB SCSI Disk Drive
```

Figure 8. Extracting Installed Hard Disk Drive Information

The location code in Figure 8 is in the format:

AB-CD-EF-GH

A detailed explanation of these location codes may be found in the manual, *Common Diagnostics and Service Guide*, SA23-2687.

In our example, both disks are SCSI, and as such, the following information is of interest:

- D - Microchannel slot number of the SCSI controller
- G - SCSI Address of the device

Both `hdisk0` and `hdisk1` are attached to an SCSI controller that is located in microchannel slot 8 and have an SCSI addresses of 1 and 2, respectively.

The output produced from issuing the `lsdev -CHc disk` command will contain information about both internal and externally attached disks. For example, if you have a 7135 RAIDiant Array or 7133 SSA attached, it will be important to identify its use. Any disks associated with a 7135 or 7133 will be shown as in the following examples.

```

name      status  location  description
hdisk5   Available 00-08-00-00 670 MB SCSI Disk Drive
hdisk4   Available 00-07-00-50 2.0 GB SCSI Disk Drive
hdisk6   Available 00-07-00-60 2.0 GB SCSI Disk Drive
hdisk3   Available 00-06-01-00 7135 Disk Array Device
hdisk7   Available 00-05-00-11 7135 Disk Array Device
hdisk0   Available 00-06-01-02 7135 Disk Array Device

```

Figure 9. 7135 RAIDiant Array Configuration

If you have SSA disk drives on your system, the `lsdev` commands will display the SSA drives that are installed.

```
# lsdev -CHc disk
```

```

name      status  location  description
hdisk2   Available 20-68-L   SSA Logical Disk Drive
hdisk3   Available 20-68-L   SSA Logical Disk Drive
hdisk4   Available 20-68-L   SSA Logical Disk Drive
hdisk5   Available 20-68-L   SSA Logical Disk Drive
hdisk6   Available 20-68-L   SSA Logical Disk Drive

```

Figure 10. 7133 SSA Logical Disk Configuration

```
# lsdev -CHS1 -cpdisk
```

```

name      status  location  description
pdisk0   Available 20-68-P   4GB SSA C Physical Disk Drive
pdisk1   Available 20-68-P   4GB SSA C Physical Disk Drive
pdisk2   Available 20-68-P   4GB SSA C Physical Disk Drive
pdisk3   Available 20-68-P   4GB SSA C Physical Disk Drive
pdisk4   Available 20-68-P   2GB SSA C Physical Disk Drive
pdisk5   Available 20-68-P   2GB SSA C Physical Disk Drive
pdisk6   Available 20-68-P   2GB SSA C Physical Disk Drive
pdisk7   Available 20-68-P   2GB SSA C Physical Disk Drive

```

Figure 11. 7133 SSA Physical Disk Configuration

5.3.3.4 Additional Logical Volume Manager (LVM) Information

It is important to not only document the physical structure of the disks but also to list information about volume groups, logical volumes and file systems. This can be done with the following commands. Please refer to your online documentation for the flags and parameters needed to provide you with any additional information necessary for your particular environment:

Example outputs are shown below.

- Volume Groups:

```
# lsvg
rootvg
nonrootvg
#
```

Figure 12. Extracting a List of Configured Volume Groups

- Volume Group Contents:

```
# lsvg -p rootvg nonrootvg
rootvg:
PV_NAME      PV STATE    TOTAL PPs   FREE PPs   FREE DISTRIBUTION
hdisk0       active      95          13         06..03..00..00..04
nonrootvg:
PV_NAME      PV STATE    TOTAL PPs   FREE PPs   FREE DISTRIBUTION
hdisk1       active      75          68         15..12..11..15..15
#
```

Figure 13. Extracting Volume Group Contents

- Logical Volumes:

```
# lsvg -o | lsvg -i -l

nonrootvg:
LV NAME          TYPE      LPs  PPs  PVs  LV STATE      MOUNT POINT
loglv00          jfslog   1    1    1    open/syncd    N/A
lv00             jfs      1    1    1    open/syncd    /data
rootvg:
LV NAME          TYPE      LPs  PPs  PVs  LV STATE      MOUNT POINT
hd6              paging   16   16   1    open/syncd    N/A
hd5              boot     2    2    1    closed/syncd  /blv
hd7              sysdump  2    2    1    open/syncd    /mnt
hd8              jfslog   1    1    1    open/syncd    N/A
hd4              jfs      1    1    1    open/syncd    /
hd2              jfs      50   50   1    open/syncd    /usr
hd1              jfs      1    1    1    open/syncd    /home
hd3              jfs      2    2    1    open/syncd    /tmp
hd9var           jfs      1    1    1    open/syncd    /var
#
```

Figure 14. Extracting Logical Volume Information

- File systems:

```
# lsfs

Name           Nodename  Mount Pt          VFS  Size    Options  Auto Acctg
/dev/hd4       --        /                 jfs  8192    --        yes no
/dev/hd1       --        /home             jfs  8192    --        yes no
/dev/hd2       --        /usr              jfs  409600  --        yes no
/dev/hd9var    --        /var              jfs  8192    --        yes no
/dev/hd3       --        /tmp              jfs  16384   --        yes no
/dev/hd7       --        /mnt              jfs  --      --        no no
/dev/hd5       --        /blv              jfs  --      --        no no
/usr/bin/blv.fs --        /usr/bin/blv.fs  --  --      --        no no
/dev/lv00      --        /data             jfs  8192    rw        yes no
#
```

Figure 15. Extracting a List of Configured File Systems

- File systems size:

```
# df

Filesystem      Total KB    free %used    iused %iused Mounted on
/dev/hd4        4096      476  88%      663   64% /
/dev/hd9var     4096     3372  17%       98    9% /var
/dev/hd2       204800   15540  92%    12917  25% /usr
/dev/hd3        8192     7816   4%       33    1% /tmp
/dev/hd1        4096     3932   4%       17    1% /home
/dev/lv00       4096     3936   3%       16    1% /data
#
```

Figure 16. Extracting File System Size Information

- Paging space:

```
# lspvs -a

Page Space  Physical Volume  Volume Group  Size  %Used  Active  Auto Type
hd6         hdisk0           rootvg        64MB   15    yes    yes  lv
#
```

Figure 17. Extracting Paging Space Information

- Dump device:

```
# sysdumpdev -l

primary      /dev/hd7
secondary    /dev/sysdumpnull
#
```

Figure 18. Extracting Dump Device Information

Using `snaps`, comparable information on disks and other elements of the Logical Volume Manager can be found in the files `/tmp/ibmsupt/filesys/filesys.snaps` and `/tmp/ibmsupt/lbm/lvm.snaps`.

5.3.3.5 Other SCSI Devices

You will also need to extract information about other (non-disk) SCSI devices, such as tape drives and library changers. The easiest way to extract this information is to use the following command:

```
# lsdev -CHs scsi
```

The output will be similar to that shown in Figure 19 below. The list will include attached SCSI disks, but these may be ignored as they have already been documented.

name	status	location	description
rmt0	Available	00-08-00-50	2.3 GB 8mm Tape Drive
hdisk0	Available	00-08-00-10	1.0 GB SCSI Disk Drive
hdisk1	Available	00-08-00-20	355 MB SCSI Disk Drive
cd0	Available	00-08-00-40	CD-ROM Drive

Figure 19. Extracting Other SCSI Device Information

`snap` lists the attributes of the SCSI devices in the file `/tmp/ibmsupt/general/general.snap`.

5.3.3.6 Microchannel Adapters

Use the following command to find out what microchannel adapters are installed:

```
# lsdev -CHc adapter -s mca
```

The output will be similar to that shown in Figure 20.

name	status	location	description
sio0	Available	00-00	Standard I/O Planar
scsi0	Available	00-08	SCSI I/O Controller
ent0	Available	00-03	Ethernet High-Performance LAN Adapter
tok0	Available	00-05	Token-Ring High-Performance Adapter
gda0	Available	00-07	Color Graphics Display Adapter

Figure 20. Extracting Installed Microchannel Adapter Information

The location code in Figure 20 is in the format:

AB-CD

where D refers to the microchannel slot number.

To get a list of PCI adapters, just replace the keyword “mca” with “pci” and repeat the command as shown above. `snap` documents attributes of adapters in the file `/tmp/ibmsupt/general/general.snap`.

5.3.4 Documenting The Installed Software

Documenting the software installed on your machine may not be as simple as it first sounds. In theory, each RS/6000 administrator should have hardcopy documentation telling him exactly what is installed. In real life, this is rarely the case. Be aware that unless third-party software uses and complies with

AIX's install guidelines, it will not be seen by AIX configuration commands and will have to be documented manually.

5.3.4.1 Base Operating System

The base operating-system level should be documented along with the number of licensed users. If your system is running AIX V3.2.4 or later, you can use the `oslevel` command. This command may take some time to complete depending upon what you have installed on your system. The following shows an example of the command output on an AIX V3.2.5 system:

```
# oslevel
Processing ... Please Wait
>3250
#
```

Figure 21. Checking the Operating System Level

If you are at AIX Version 3.2.4 or earlier, it can be very difficult to know the exact level you are running. If the `oslevel` command is not available on your system, the `lspp -l` command will give you a list of installed software and the latest level.

5.3.4.2 AIX License Information

To find the user license that is associated with the machine, refer to the licensing information associated with the RS/6000 in question. This information should be available; however, if it is not, we suggest that you contact your IBM License Administration Center. They will require the serial number of the machine along with a few other company details in order to check the license.

At this point, you may also wish to check the number of licensed users defined on the system. To do this, type in the following command:

```
# smit chlicense
```

The output will be similar to that shown in Figure 22 on page 54. The information of interest can be found between the square brackets.

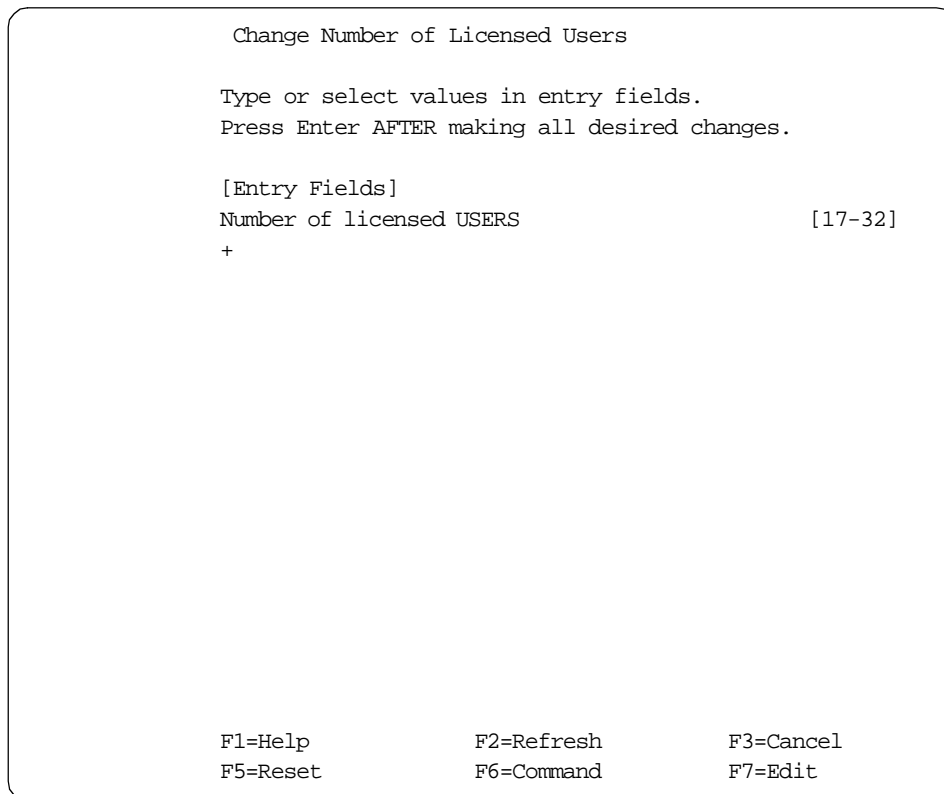


Figure 22. Establishing the Number of Licensed Users

Thus, in our example, the system is licensed for use by up to 32 concurrent users. You can also use the `lslicense` command to obtain equivalent information.

5.3.4.3 IBM Program Products

Every RS/6000 potentially has a different set of IBM program products installed. Products can be Optional Program Products (OPPs) that are included with the base operating system, but not necessarily installed, or Licensed Program Products (LPPs) that can be purchased separately.

For each program product installed, we need to obtain its product number, name and version. There are a number of methods available for gathering this information, and the easiest of these is to use the AIX command `lslpp`.

The `lslpp` command has many flags that allow the user to extract various details about the installed program products. We are not interested in many

of the fields and as such, will use a series of pipes and filters to extract the relevant information.

Use the following command to find out what program products you have installed:

```
# lslpp -ciq
```

If you translate the space characters in the output of the `lslpp -ciq` command to colons and redirect the output to a file, you can use the `cut` and `pr` commands to format the output more clearly.

```
# lslpp -ciq | tr ' ' ':' > /tmp/lslpp.op
# cat /tmp/lslpp.op | cut -f3 -d: > /tmp/lslpp.vers
# cat /tmp/lslpp.op | cut -f5 -d: > /tmp/lslpp.prod_num
# cat /tmp/lslpp.op | cut -f7 -d: > /tmp/lslpp.prod_names
# pr -t -m /tmp/lslpp.prod_num /tmp/lslpp.prod_names /tmp/lslpp.vers
```

The output will be similar to that shown in Figure 23 on page 55.

5696-623	perfmgr	01.01.00.00
5696-624	perfagent	01.01.00.00
5601-287	sna	01.02.00.00
5601-287	snamEn_US	01.02.00.00
5765-203	admserv	01.02.00.00
5765-203	adsm	01.02.00.10
5601-257	X11fnt	01.02.03.00
5601-257	X11mEn_US	01.02.03.00
5601-257	X11rte	01.02.03.00
5765-011	x3270	01.02.07.01
5765-030	bos	03.02.00.00
5765-030	bosadt	03.02.00.00
5765-030	bosext1	03.02.00.00
5765-030	bosext2	03.02.00.00
5765-030	bosnet	03.02.00.00
5765-030	bsl	03.02.00.00
5765-030	bsmEn_US	03.02.00.00

Figure 23. Establishing Which Program Products are Installed

The results obtained are presented in the following order:

<product number> <product name> <product version>

As you can see from the example, the product name is not very descriptive, and as such, you will need to use the product number and product version information to gain more details.

The product number will allow you to extract the full product name from the *IBM AIX Application Availability Guide*, available on the Internet at the following URL:

<http://www.rs6000.ibm.com/software/Apps/LPPmap.html>

The product version information in some cases may not directly relate to the actual version of the program product. For example, x3270 in our example has a product version shown as 01.02.07.01. This is not a valid version number because we know, from the *Availability Guide*, that the latest version of x3270 is 01.02.02.01. In cases such as these, it is necessary to investigate the product further. Occasionally, the product version is displayed when starting up the program product, or the information may be included in the associated README file in the /usr/lpp/<lpp name> directory, where <lpp name> refers to the program product name.

You will also notice that x3270 is not supported on AIX versions above V4.1. This means you should consider changing to program number 5765-398: 3270 *Host Connection Pgm(HCON) V2.1.4* for 3270 host connectivity.

snap documents the list of installed LPPs in the file /tmp/ibmsupt/general/general.snap.

5.3.4.4 Third-Party Software

There is no consistent method to extract information on the third-party applications that are installed. Depending on how the application was written or installed, it may or may not show up in an `ls1pp` listing and as such, you should not rely on this method. Generally, a third-party application will display its version and release information on start-up. If this is not the case, the application vendor should be contacted.

Note

Non-AIX device drivers will be deleted from the system during the migration and therefore must be reinstalled after migration.

5.3.4.5 In-House Developments

As with third-party applications, there are no commands available to extract information about what in-house developments reside on the system. This information must still be documented.

Any in-house developments, including customized shell scripts, may need to be tested, and if necessary modified, before migration can take place.

5.3.5 Documenting Other Configuration Details

In addition to the installed hardware and software, there are some elements of the basic system configuration that should be documented. Although all the configuration files that we tested in our numerous migration scenarios were migrated correctly, it is impossible to guarantee that every single installation, no matter how heavily customized, will be migrated correctly. For this reason, you should document anything that may have been modified from default settings. In fact, it is advisable to make backups of all your individual configuration files on separate media so that you can recover them if necessary without having to use your mksysb tape. A simple tar archive using relative pathnames is usually sufficient to be able to recover individual files if required. The areas that you should consider for documenting and saving are:

- All configuration files in /etc. For example, have you made changes to any of the /etc/rc* files? Possibly some `no` commands to tune your network?
- All configuration files in /usr. Have you made changes to your desktop default configuration files? Do you have any custom terminfo definitions?
- Any application-related configuration files that may reside in the root volume group. Be aware that some applications will install their own configuration files and startup scripts in the root volume group even though the data files may be totally separate.

5.3.5.1 Operating System Parameters

The most important parameters for the AIX operating system that are not available as a configuration file are the parameters for the sys0 device. To display and document them, use the following command:

```
# lsattr -E -l sys0
```

5.3.5.2 Device Parameters

As with the sys0 device, almost every other device has a set of unique attributes that should be documented. Use the `lsdev`, `lsattr` and `lscfg` commands to list all the devices and their attributes.

5.3.5.3 Users, Groups and Security

Most of the configuration concerning users, groups and security issues are kept in ASCII configuration files such as /etc/passwd and so on. The migration process preserves these files and conserves users, groups and their attributes as you had defined them to the system prior to the migration.

Nevertheless, we recommend that you document your user and group definitions before the migration. You may also find that, when it comes to users and groups, this is also the right time to clean up your system from definitions that are no longer needed.

Users

The most comprehensive way of documenting your user settings is the `lsuser` command. If you want to display, archive or print information about all users, use the following command.

```
# lsuser -f ALL
```

Of course, you can also access the same information by viewing the configuration files directly. For example, you will need to examine at least the following files for user information.

- `/etc/passwd`
- `/etc/security/passwd`
- `/etc/security/limits`
- `/etc/security/user`
- `/etc/security/login.cfg`

Groups

Similar to the `lsuser` command, you can use the `lsgroup` command to document your group definitions.

```
# lsgroup -f ALL
```

You can also examine the following files:

1. `/etc/group`
2. `/etc/security/group`

Security

Since the security information is mostly attached to users and groups, by documenting the user and group definitions, you should also have collected the necessary security data.

5.4 Mapping Between Environments

Once the system has been fully documented, the next step is to use the information you have collected to map your current AIX environment to the AIX Version 4.3 equivalent. Use the following sections to help you complete the Target Environment Tables. While mapping between environments, you

should also obtain an estimate of delivery lead-times from suppliers. This will enable you to estimate the overall duration of the project much more accurately.

5.4.1 Hardware Components

Many installations may have a mixture of both IBM and non-IBM hardware installed or connected to their system. If this is the case in your environment, you will have to contact each manufacturer or supplier, in turn, to confirm that each particular device is supported at AIX Version 4.3.

5.4.1.1 IBM Hardware Components

To confirm that your current hardware environment is supported at AIX Version 4.3 for each individual component, check Appendix A, “Unsupported Hardware on AIX Version 4.3” on page 167, to see if it is included in the list. If it is, contact your IBM representative or supplier to see if support for that particular component is planned.

Note:

The migration may have to be delayed until a device driver is available and the necessary testing has taken place.

If a hardware component is in the list of unsupported hardware and there are no plans to support it, the only alternative is to find a suitable replacement, unless you can change your environment to operate without that particular component. Your IBM representative may be able to provide you with further information about possible replacements.

5.4.1.2 Non-IBM Hardware Components

If you have any non-IBM hardware installed in your system, we recommend that you contact the hardware manufacturer to determine if the hardware has been tested and is supported at AIX Version 4.3. If it is, you may need to obtain updated device drivers unless there are generic device drivers supplied with AIX that may be used. Always request written confirmation from the supplier if you are in any doubt about support for a particular component.

5.4.2 IBM Licensed Program Products (LPPs)

In most cases, you will need to update some or all of your installed IBM Program Products to the latest release or version. This is probably the most difficult part of planning the migration, but it is also one of the most important.

IBM LPP tables are available at the following URL:

<http://www.rs6000.ibm.com/software/Apps/LPPmap.html>

You may also need to consult the IBM Announcement Letters at:

<http://www1.ibm.link.ibm.com>

The LPP maps and Announcement Letters should be used in conjunction with your list of installed LPPs to work out which LPPs you will need to update. A sample mapping is shown below as an example.

5.4.2.1 Sample Mapping AIX Version 3.2.5 To AIX Version 4.3

In our example scenario, we have the program products shown in Table 7 on page 60.

Table 7. Example Software Configuration at AIX Version 3.2.5

Product Number	Product Name	Version
5696-623	AIX Performance Toolbox/6000	V1.1
5696-624	AIX Performance Aide/6000	V1.1
5601-287	SNA Services/6000	V1.2
5665-203	ADSM/6000	V1.2.0
5601-257	AIX Windows 2D	V1.2.3
5756-030	AIX Operating System	V3.2.5
5765-011	AIX X-Windows 3270 Emulator/6000	V1.2.1
Included in BOS	AIX XL C Compiler/6000 (Base Op)	V1.3

From the online LPP tables and Announcement Letters, we can determine the latest available equivalents to our installed LPPs. Taking each program product in turn, we end up with the list shown in Table 8.

If your existing LPP is not detailed in the LPP tables, you should consult the Announcement Letters, which will provide information about when the product was withdrawn from marketing and the name and product number of its replacement. In some instances, you may find, particularly with AIX Version 3.2.5 program products, that a number of upgrades to the product have taken place since your particular version was available. If you find this to be the

case, you will have to look up each replacement product until you find the latest version.

Table 8. Equivalent Program Products at AIX Version 4.3

Product Number	Product Name and Version	Migration Action
5765-654	AIX Performance Toolbox for AIX V2.2 See note (1)	Upgrade Reqd.
5765-652	Communications Server V4.2	Chargeable upgrade
4073674	ADSM - ADSTAR V3.1	Chargeable Upgrade
5765-C34	AIX Operating System Version 4.3 See note (2)	Base Operating System
5765-398	3270 Host Connection Program	New Product
04L0675 (5807-AAR)	C for AIX (64bit)	Chargeable Upgrade
<p>Notes:</p> <ol style="list-style-type: none"> 1. AIX Performance Aide is included with Performance Toolbox with AIX Version 4.3 2. AIX Windows 2D is included in the AIX Version 4.3 base operating system, and as such, a replacement does not need to be ordered. OpenGL and graPHIGS are also included in AIX Version 4.3 base. 		

The Announcement Letters also provide details of upgrade costs and where applicable, any compatibility issues. For example, SNA Server/6000 Version 1.2 supported a combined read/write verb which is not supported in subsequent versions. If you have applications which make use of this feature, they will need to be modified.

During this mapping stage, you should also consider the possibility of using a completely new product as an alternative to simply upgrading your existing one. In the case of SNA Services, you have the option of either upgrading to Communications Server Version 4.2 or considering the IBM eNetwork Communications Server for AIX Version 5. Choosing a different product may provide you with additional features that you can use to improve your business processes or productivity.

5.4.2.2 Packaging Differences From AIX Version 3.2.5

A number of packaging changes have taken place between AIX Version 3.2.5 and AIX Version 4.3. This has resulted in some programs that were included as no-cost options in earlier versions of AIX becoming separately chargeable features in AIX Version 4.3. Similarly, some previously chargeable features are now included at no charge in AIX Version 4.3. You need to take these changes into account when mapping LPPs between one version of AIX and another.

Unbundled Features

The items shown in Table 9 on page 62 were included in AIX V3.2.5 at no charge and are now unbundled as separately chargeable features at AIX Version 4. They are listed with an explanation of the transition that was made for the feature:

Table 9. Unbundled Features in AIX Version 4

AIX V3.2.5 Features	AIX V4 Packaging
Data Encryption Support (DES)	Chargeable program for AIX Version 4
InfoExplorer and Hypertext Libraries	Not required with AIX Version 4.3, documentation is in HTML format See the section on InfoExplorer below
Basic X.25 Support	Chargeable program for AIX Version 4
XLC Compiler	Chargeable program for AIX Version 4
Debuggers	Use of dbx function in the C for AIX program is recommended

Newly Bundled Features

The items in Table 10 on page 62 were separately chargeable products or optional, chargeable features of the base operating system in AIX V3.2.5, but are now included at no charge in AIX V4.

Table 10. Newly Bundled Features in AIX Version 4

AIX V3.2.5 LPP/Feature	AIX V4 Packaging
XStation Manager	Included in Server packaging
AIXwindows 2D	Included with AIX Version 4 (installation is optional)
Fiber Distributed Data Interface (FDDI) support	Included with AIX Version 4

AIX V3.2.5 LPP/Feature	AIX V4 Packaging
Multi-Protocol Adapter (MPA) support	Included with AIX Version 4

InfoExplorer

The documentation in AIX Version 4.3 is now HTML-based and can be accessed through a Web browser. As such, InfoExplorer is no longer required. Some products which do not have HTML support may still require InfoExplorer, though. It is therefore available as a separate chargeable program for AIX Version 4.3.

In addition, the function shown in Table 11 on page 63 was offered as a separately chargeable, optional feature of the base operating system under AIX Version 3.2.5 and a separate product under AIX Version 4. In AIX Version 4.3, it has been withdrawn from marketing.

Table 11. AIX Version 4.3 Program Withdrawals

AIX V3.2.5 LPP/Feature	AIX V4 Packaging
InfoExplorer License Extension	Withdrawn from marketing. If a customer has previously purchased the InfoExplorer License Extensions, they are able to use it with AIX Version 4.3 assuming they use a migration install.

5.4.2.3 IBM LPP Licensing Issues

Once you have successfully mapped all of your AIX Version 3.2.5, 4.1 or 4.2 software to their logical AIX Version 4.3 equivalents, the next step is to clarify the licenses that you will need to obtain. Licensing information is usually included in the Announcement Letter for a particular product.

With the announcement of AIX Version 4.1.4 in October 1995, the licensing of the AIX Operating System was standardized worldwide on a single common license, known as an International Program License Agreement (IPLA). It is the long term goal for all of IBM's AIX Licensed Program Products to use this license. However, at present, the terms and conditions under which AIX program products are licensed can vary between products and between countries. In some cases, the license type used for a specific LPP was changed between AIX Version 3.2 and Version 4, usually as a result of the LPP adopting IPLA licensing.

Note:

The specific details of the Terms and Conditions under which AIX program products are licensed can vary depending upon the legal requirements in different countries. You should verify the appropriate conditions in your country with your local IBM representative or by referring to local product announcement letters.

Each purchased IBM Program Product requires a license. With some products, the license is enforced by the LUM or iFOR/LS license-management software through the use of a software key that is specific to the system for which the software is licensed. In these cases, the key must be requested from a Key Center after the software is installed. See Chapter 9, “License Management” on page 155, for more details of software licensing and associated management tools.

International Program License Agreement (IPLA)

The advantages of the IPLA license over the form of licensing used for AIX Version 3.2 include:

The IPLA license need not be physically signed by the customer.

In most countries, a customer licensing AIX and some LPPs would have to physically sign an individual license for each product or sign some form of document that grouped the products and allowed a single signature to cover multiple licenses. This is not required with an IPLA license.

The IPLA license is accepted by the customer in two ways:

- By electronic signature the first time the software is started
- Implicitly through the use of the software

The IPLA license is identical to that used for most IBM PC software and is now common throughout the world.

5.4.3 Third-Party Software Products

IBM is working closely with many of its software partners to aid in the migration and testing of their software products. Third-party products are becoming AIX Version 4.3-certified on a daily basis, and as such, it would be difficult to provide an up-to-date list of what is currently available. There are a number of concerns about third-party products that need to be addressed before a migration can take place:

1. Are the relevant third-party products available at AIX Version 4.3?

2. Do the third-party products depend upon IBM program products, and if so, are they available?
3. What will migration of an application involve? Is there need for a step in between because the application doesn't run on the current *and* final AIX Version?
4. How much down time should be allocated for the migration of the application? Is it, or must it, be considered as separate or additional down time?
5. Will there be a cost associated with the move between software levels?

The best source of information for each of these questions is the third-party application vendor themselves. IBM holds a limited amount of information about the major applications that have been ported to AIX, and your AIX Support Representative should be able to provide this information on request.

5.4.4 In-House Developments

Although in many cases binary compatibility is preserved between AIX Version 3.2 through Version 4.3, any in-house-written applications must still be tested and certified at the new level and ported, if necessary.

A few suggestions when moving to AIX Version 4.3:

- If your applications use kernel extensions, you may need to make modifications to port them to the new kernel environment. You must also make the kernel extension MP safe if you want to run it on an SMP system.
- Look at the contents of the bos.compat and X11.compat packages and determine if you are relying on commands, links, or libraries that are obsolete. If so, you should remove your dependency on them.
- For help or advice concerning porting your application, IBM has excellent staff available at AIX porting centers who are backed by the AIX development team.

5.4.5 Shell Scripts

With the somewhat erratic way in which UNIX was developed, similar commands evolved using slightly different flags or output conventions on different UNIX versions. As the operating system has matured, users and manufacturers have proposed standards for operating-system commands and libraries, such as POSIX 1003.2 and UNIX98 for example. Whenever

proposals have been accepted into the standards, IBM has, where necessary, modified the behavior of AIX to comply with these standards. Most of these changes were made when moving from AIX Version 3.2 to AIX Version 4.1, though more modifications continue as the standards are refined.

In some cases, the changes may affect the operation of some shell scripts or applications written in-house by systems administrators or users. The following list includes the modified commands that are most likely to cause a change in behavior. Consult the AIX Version 4.3 documentation available at:

http://www.rs6000.ibm.com/resource/aix_resource/Pubs/

for details of their new behavior and to determine if you are relying on options or features which may have changed.

Changed commands:

```
acctdusg, admin, axeb, awk, backbyname, bc, bsh, catman, chuser, cksum,
cmp, cp, cpio, csh, ctags, date, delta, df, diff, diskusg, du, ebxa,
echo, ed, expr, fold, fsdb, getconf, head, iconv, istat, join, ksh, ksh
built-in commands (echo fc jobs trap wait), lex, locale, localedef, lp,
lsfs, lsjfs, man, more, nice, nm, nohup, od, pack, paste, pax, renice,
sed, sort, strings, stty, tctl, tee, touch, uniq, wc, what and yacc
```

5.4.6 General Software Compatibility Issues

Most environments will contain software that you have obtained from various sources whether they be IBM, IBM Business Partners, third-party suppliers, in-house applications, or even freeware. All of these need to be documented, investigated and if necessary updated. We would like to remind you, however, that IBM places a very high priority upon maintaining binary compatibility with prior releases and that in most cases no changes will be needed to your applications.

In the rare situations where changes do need to be made, an AIX Version 4.3 porting guide and information on "The Developers Connection" CD, is available to assist customers and vendors developing adapters or extensions for AIX. Visit The Developers Connection at the following URL, for more information.

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

5.4.6.1 Binary Compatibility Between AIX Version 4 Releases

The following rules apply to binary compatibility of applications when moving between AIX Version 4 releases. When these rules are complied with, applications that are developed and compiled using either AIX Version 4.1 or 4.2 will execute properly on AIX Version 4.3. Should any customers or ISV

who has followed these rules encounter a problem running an AIX Version 4.1 or 4.2 application on AIX Version 4.3, their problem will be handled at the highest priority.

IBM has demonstrated remarkable success in delivering on this promise of binary compatibility. At the time of writing, only four confirmed binary compatibility problems had ever been reported when moving from AIX Version 4.1 to Version 4.2. During its first six months of use, only one binary compatibility problem has been reported moving to Version 4.3. All of these problems have been resolved to the customers' satisfaction.

AIX Version 4.3 Compatibility Rules and Restrictions

Applications written using earlier releases of AIX Version 4 (AIX Version 4.1 or AIX Version 4.2) for RS/6000 POWER, POWER2, and PowerPC-based models can be executed on AIX Version 4.3 without recompilation for the same and newer models in that processor family (POWER, POWER2, or PowerPC). The exceptions to this statement are applications using:

- Non-shared compiles of AIX shared libraries.
- Features explicitly described as non-portable by IBM in the AIX Version 4 reference manuals.
- Non-documented AIX internal features.
- X11R5 Server Extensions.
- Applications compiled using POWER2 or PowerPC-specific compiler options but executed on models other than POWER2 or PowerPC, respectively.
- Applications compiled on a given release level of AIX Version 4 may not operate properly on systems running an earlier release level of AIX Version 4.

Any program that must run in all environments, that is, POWER, POWER2, and PowerPC (601 and newer PowerPC processors), must be compiled using the common mode option of the compiler. Programs compiled to exploit POWER2 technology must be run on POWER2-based processors. Programs compiled to exploit PowerPC-based technology must be run on PowerPC-based processors. Existing binaries need not be recompiled to operate on the target processors.

64-bit applications produced using AIX Version 4.3 on any of the 32-bit processor models or the 64-bit processor models will execute without recompilation on the 64-bit processor models. 32-bit applications produced using AIX Version 4.3 on either 32- or 64-bit processor models will execute

without recompilation on both models. Applications created on a system using AIX Version 4.3 may not function reliably on a system using AIX Version 3.

Applications created on a system using AIX Version 4.3 may not function reliably on a system using earlier releases of AIX.

5.4.6.2 Compatibility Between AIX Version 3.2 and AIX Version 4.3

All AIX applications based on AIX Version 3.2 and for use with POWER, POWER/2, and POWERPC-based models will run compatibly on AIX Version 4.3 without recompilation for those same models. The only exceptions to this statement are applications using:

- Unsupported, user-created loadable kernel extensions
- Certain High Function Terminal control interfaces
- X11R3 input device interfaces
- CIO LAN device driver interface
- SCSI device configuration methods (IHVs)
- The nlist() interface
- SCSI device configuration methods (IHVs)
- DCE threads
- Applications compiled using POWER2 or PowerPC-specific compiler options, but executed on models other than POWER2 or PowerPC

Any program that must run in all environments, such as POWER, POWER2, and PowerPC (601 and newer PowerPC processors), must be compiled using the common mode option of the compiler. Programs compiled to exploit POWER2 technology must be run on POWER2-based processors. Programs compiled to exploit PowerPC-based technology must be run on PowerPC-based processors. Existing binaries need not be recompiled to operate on the target processors.

Applications must have been created using the AIX shared libraries for these statements to apply.

Client-Server Compatibility

A system using AIX Version 3.2 can operate as a server system for client machines using AIX Version 4.3 with the following exceptions:

- Network installation of AIX Version 4.3 clients
- Service SNA or X.25 to AIX Version 4.3 clients

- Service HCON to AIX Version 4.3 clients
- Service CGE extensions of PEX and PEX-PHIGS
- Use AIX Version 4.3 client installation formats

Font servers may be required on the AIX Version 4.3 clients to reliably handle X-windows between server and client.

A system using AIX Version 4.3 may operate as a server system for client machines using AIX Version 3.2 or greater as long as the necessary compatibility options are installed. All statements about binary compatibility apply in this case. AIX Version 4.3 applications may not execute reliably on AIX Version 3 systems using remote network mounts of the AIX Version 4.3 file system.

For further details about the differences between AIX Version 4.3 and earlier versions of AIX, see the *AIX Version 4.3 Differences Guide*, SG24-2014.

5.4.6.3 X11R5/X11R6.1 Compatibility Issues On AIX Version 4.3

X11 Libraries

The AIX 4.3.0 X server was upgraded to the X Consortium release 6 version of X (commonly known as X11R6.1). The libraries shipped by IBM with X11R6.1 are backward-compatible, and the client applications which access these libraries will work as on previous releases of AIX. As on earlier releases of AIX, IBM also ships X11R3, X11R4, and X11R5 compatibility installation options for maximum customer flexibility. In this way, client applications should experience no problems with compatibility.

The broad majority of applications using X fall into this category and will not likely see any difficulty.

X Server Extensions

The X server allows the addition of new functionality through its extension mechanism. For each extension, part of the extension is loaded into the X server before it can be executed.

X11R6.1 has modified how this mechanism works in the course of improvements to X, and it is this part of the extension that must be made compatible with X11R6.1 to execute properly. All X11R5 extensions supplied by IBM are compatible and will execute properly. In some circumstances, including but not limited to the following, a customer may have an extension that will not work with X11R6.1:

- A customer has a sample extension downloaded from the X Consortium FTP site.

- A customer develops his/her own extension.
- A customer uses a third-party extension.

In these cases, the extension will need to be made compatible with X11R6.1 before it will execute properly. Customer-developed extensions and sample X consortium extensions simply need to be recompiled with the X11R6.1 environment. For third-party extensions, the customer should contact the vendor for an X11R6.1-compatible update.

X-AsyncInput API

The XAsyncInput API is not supported in X11R6.1. Customers who have non-IBM applications that use X11R5 Extensions should review their compatibility with X11R6.1.

Non-IBM Display Adapters

Customers using non-IBM display adapters may also be using vendor-supplied software specific to those devices, which uses X11R6.1 server capabilities. If so, this software must be made compatible with X11R6.1 to operate properly. The customer should contact the particular vendor of the display adapter for this software.

5.4.7 Command Changes and Deletions

Migration from AIX Version 3 to AIX Version 4 removes a number of commands and makes changes to some others. Most of the removed commands are, in fact, still shipped within the `bos.compat.cmds` compatibility fileset, which is automatically installed during a Migration Install. Refer to 5.4.8, “Understanding Compatibility Filesets” on page 71. However, you should make every effort to remove any dependencies you may have on these compatibility filesets since there is no guarantee that they will be shipped with later versions of AIX.

A list of changed commands can be found in 5.4.5, “Shell Scripts” on page 65.

If you use one of these commands within your shell scripts, we recommend that you look at the description of the commands in the system documentation and modify your scripts to take the changes into account.

5.4.7.1 LFT Non-Supported Commands

Since the HFT (High Function Terminal) on AIX Version 3 has been replaced by the LFT (Low Function Terminal) on AIX Version 4, all commands specific to the HFT are no longer supported. This can have an impact on your existing shell scripts. The `open` command is a good example. Many users used to open

a new virtual terminal before starting an application. This is not supported in AIX Version 4.

The following commands are not supported by the LFT.

`chcolor`, `chcursor`, `chhwkbd`, `chkeymap`, `chnumvt`, `chsound`, `gm`, `lscolor`, `lsscreen`, `mkkbd`, `open`, `swkbd`.

Note also, that some commands are still supported on the LFT, but their behavior or their format have slightly changed.

- `chdisp`
The `chdisp` command has an improved format.
- `chfont`
The `chfont` command does not take effect until next IPL.
- `chkbd`
The `chkbd` command does not take effect until next IPL.
- `lsdisp`
The `lsdisp` command has an improved format.
- `lsfont`
The `lsfont` command has an improved format.
- `lskbd`
The `lskbd` command has an improved format.
- `mkfont`
The `mkfont` command does not take effect until next IPL.

All these changes can have an impact on your custom shell scripts.

5.4.7.2 Printer Name Changes

You should be aware that some printer names are different in AIX Version 4. For example, the 4019 printer is called 4019 in AIX V3.2.5 and `ibm4019` in AIX V4. This may cause a problem with shell scripts that calls the `mkvirprt` command.

5.4.8 Understanding Compatibility Filesets

In order to provide binary compatibility between AIX Version 3.2 and AIX Version 4, compatibility filesets are installed during the Migration Install. The compatibility filesets that are actually installed depends on the LPPs or Optional Program Products (OPPs) that were previously installed on your AIX Version 3.2.5 system. These filesets offer commands, library versions, symbolic links, and other functions that make AIX Version 4 look more like AIX Version 3.2.5 from the application point of view. For example, removed

commands are still shipped within AIX Version 4 within the `bos.compat.cmds` fileset.

You might need to use these filesets after the migration to run your shell scripts unchanged. If so, you should make plans to change your shell scripts in order to be more standards compliant. There is no guarantee that these filesets will be continue to be shipped with later versions of AIX.

Note

These compatibility filesets might not be provided in future AIX releases.

The compatibility filesets have their name characterized by the string *compat* in their name. The filesets are organized as follows:

- Base operating system commands
- Base operating system libraries
- Base operating system curses/termcap
- Base operating system network installation tools
- Base operating system directories/files symbolic links
- Messages
- X11R3 libraries
- X11R4 libraries
- X11 fonts
- Motif 1.0 libraries
- Motif 1.1.4 libraries

Below is a short description of the major compatibility filesets:

bos.compat.cmds

This fileset contains commands that are being removed from the AIX system. These commands are generally not standards compliant. For example, the `copy` and `li` commands are part of this fileset.

bos.compat.imk

This fileset provides input method keymaps and links which may be necessary for those applications that depend on the input method conventions used in AIX Version 3.1.

bos.compat.links

This fileset provides backwards compatibility for those links that were added

in the AIX Version 3.2 release for compatibility with AIX Version 3.1, but have been removed in the AIX Version 4.1 release. Note that these links might not be provided in future AIX releases.

bos.compat.lan

Provides COMIO interfaces for token-ring, Ethernet and FDDI devices that are compatible with the COMIO interface present in AIX Version 3.2.5. It supports usermode access only.

bos.compat.msg

This fileset provides symbolic links for backwards compatibility with message catalog packages that use the AIX Version 3.1 naming conventions for language-territory.

bos.compat.net

This fileset provides backwards compatibility for those links that were added in the AIX Version 3.2 bosnet.obj product.

bos.compat.NetInstl

This fileset provides the capability to serve AIX Version 3.2 installation images to AIX Version 3.2 clients from an AIX Version 4.1 server.

bos.compat.termcap

This fileset provides an older method of defining terminal definitions. Most people use terminfo. The library provides terminfo interface routines for curses applications. The same routines are provided by libcurses.a, as well.

bos.compat.termcap.data

This fileset provides the termcap tabset files for various terminals.

Note

In AIX Version 4.2, some of the compatibility filesets were removed as announced with AIX Version 4.1; so after migration to AIX Version 4.3, the following filesets will no longer be available.

- bos.compat.msg
- X11.compat.samples.util

There are also a number of compatibility filesets for X11R3, X11R4, Motif 1.0, Motif 1.1.4, and X11 fonts. If an application is not working on AIX Version 4, check the list of installed compatibility filesets.

The following example shows the content of a typical compatibility fileset. The `bos.compat.cmds` fileset is used in this example.

```
Fileset          File
-----
Path: /usr/lib/objrepos
bos.compat.cmds 4.3.1.0
/usr/lib/security/scan/xalclean.lst
/usr/lib/security/scan/virsig.lst
/usr/bin/mmsg
/usr/bin/del
/usr/bin/page -> /usr/bin/more
/usr/bin/copy -> /usr/bin/cp
/usr/bin/virscan
/usr/lib/security/scan
/usr/lib/security/scan/ghoclean.lst
/usr/bin/move -> /usr/bin/mv
/usr/bin/joinconf -> /usr/bin/confer
/usr/bin/confer
/usr/lib/security/scan/648clean.lst
/usr/lib/security/scan/darclean.lst
/usr/ucb/more -> /usr/bin/more
/usr/lib/security/scan/vacclean.lst
/usr/bin/di -> /usr/bin/li
/usr/bin/li
/usr/bin/delete -> /usr/bin/rm
/usr/ucb/sccs -> /usr/bin/sccs
#
```

Figure 24. Listing the Contents of Compatibility Filesets

5.4.9 AIX Packaging

AIX Version 4 provides new packaging that focuses on the two primary types of system usage, the client and the server. Unlike AIX Version 3.2, these packages are functionally different. AIX Version 4.3 for Clients is packaged as a single-user system and provides the functionality necessary for the client environment. AIX Version 4.3 for Servers is packaged as a multi-user system and provides increased functionality over and above that included in the client version.

Depending upon the level of functionality you require, you can select the appropriate package from the following list:

- AIX Version 4.3 for Entry Client
- AIX Version 4.3 for Workgroups
- AIX Version 4.3 Connections
- AIX Version 4.3 for Entry Servers (1-16 users)
- AIX Version 4.3 for Entry Servers (unlimited users)

- AIX Version 4.3 for Advanced Servers (1 to 2 user)

5.4.9.1 AIX Version 4.3 for Entry Clients

AIX Version 4.2 expanded the AIX family of operating system packages by introducing the AIX Version 4.2 Entry Client Package. This package provides the same reliability, scalability and industry-strength architecture that has come to be expected with AIX but with reduced functionality and at a lower cost. The package is designed to address the computing environment in which there is a requirement for a lower-function end-user client package, where the advanced features traditionally supplied with a UNIX-based operating system client is not needed.

The Entry Client Package includes:

- Uniprocessor support only
- A single user plus root login
- AIX Windows 2D development environment
- Common Desktop Environment
- DCE client support
- Support for many popular PCI, ISA, and PCMCIA adapters as provided in the larger AIX packages
- IDE disk and CD-ROM support
- SCSI disk, CD-ROM and tape support
- TCP/IP, NFS and NIS client support
- Available on CD-ROM only

The AIX Connections Option is not available with the AIX for Entry Client Package.

5.4.9.2 AIX Version 4.3 for Workgroups

With the introduction of the new AIX Version 4.2 for Entry Client, the previously announced AIX Version 4.1 for Clients package was renamed in AIX Version 4.2 to AIX Version 4.2 for Workgroups. This name change was made to better identify the package with its function as an advanced client with server capability. It addresses the computing environment in which there is a requirement for additional network support, such as file serving, program serving, time and name serving, beyond that provided by the Entry Client.

The AIX Version 4.3 for Workgroups package contains the same functionality and services contained in the AIX Version 4.2 for Entry Client Package plus:

- Symmetrical multiprocessor support
- One-to-two users plus root user
- Micro Channel device support.
- TCP/IP, NFS and NIS Server support
- Selected multiport device support

5.4.9.3 AIX Version 4.3 Connections Package

The AIX Connections package or LPP is licensed and priced according to the maximum number of AIX concurrent connections that will be used at any time. This form of licensing is used only for AIX Connections.

An AIX Concurrent Connection, or AIX Connect, is defined as any system that logs into the AIX Connections Version 4.3 function using the group or user ID and password of the AIX Connections Version 4.3 function. This includes specifying a user ID and password to log on to a server to access file and printer services. It does not include interactive login sessions such as Telnet and nwtty. These interactive sessions are counted as users (see Users below).

5.4.9.4 AIX Version 4.3 for Entry Servers

AIX Version 4.3 for Entry Servers comes in two forms: 1-16 users and unlimited users. The Low-End Server options are only applicable to low-end server systems (group D5). An upgrade path is available to move from 1-16 users to unlimited users.

5.4.9.5 AIX Version 4.3 for Advanced Servers

AIX Version 4.3 for Advanced Servers comes with a 1-2 user license as standard. This may be increased by purchasing additional designated or networked users. The High-End Server options are only applicable to our high-end server systems. AIX V4.3 for Advanced Servers uses the definition of a user as given in Users below, but further classifies the users as designated or network users.

There are a few details about both AIX Version 4.3 Client and Server licensing that need to be understood before a migration can take place. At AIX Version 3.2, the job of deciding what user license to buy for each machine was fairly simple to understand. First, calculate the maximum number of concurrent users; then select the appropriate user band and add up the tiers. At AIX Version 4.3, the concepts of “Designated” and “Networked” users have been introduced for the high-end server versions of the base operating system.

5.4.10 AIX User Licenses

An AIX Version 4.3 user is a terminal, remotely or locally attached, currently logged into AIX for entry of, and display or printing of, information. Terminals logged into programs executing under the control of AIX where the terminal does not create an AIX logon are not considered AIX users. In AIX Version 4.3, the following logins are counted as users:

- telnet
- login
- rlogin
- dtlogin
- nwtty
- nbtty

5.4.10.1 Designated Users

Designated users, similar to AIX V3.2 users, are restricted to a specific machine. Designated users need only be purchased up to an additional 78 (two are included with the base license) for the machine on which they are restricted. There is no additional charge for users beyond 80 (unlimited) on that machine.

5.4.10.2 Networked Users

Networked System Users can “float” around a network and can be used concurrently, limited only by the number of nodes at the location and the number of Networked System Users authorized on each particular node. Networked System Users can be purchased in any desired quantity. There is no unlimited option available. The exact quantity of users must be specified and paid for. Networked System Users are controlled by an iFOR/LS server on the network. iFOR/LS is included with AIX Version 4.3, but must be set up prior to activating the Networked System Users.

5.4.10.3 Designated or Networked Users?

It is generally advisable to select Networked users unless the following conditions apply:

- There is no network.
- More than 80 users require access to a single RS/6000.
- There are several discrete machines with users who each log on to only one application, some of which may be supporting more than 80 users.

Example

A customer has two RS/6000s on a network and 140 users. Consider three possible scenarios:

- All users need access to both systems concurrently.
Buy a 1-2 user High-End Server license for each machine, and buy 78 designated users for each machine. This provides unlimited usage on each machine (there is no charge after 80 users).
- All users access both systems but only one at a time.
Buy a 1-2 user High-End Server license for each machine. Buy 138 Networked User licenses so that users can float on the network and log onto either machine.
- 110 users use the first machine and 30 use the second.
Buy a 1-2 user High-End Server license for each machine. Buy 78 Designated users for the first machine and 28 for the second.

The most expensive scenario is the first example, and the least expensive is the third. In all cases, it is worth considering the addition of new users or machines that may affect what user licenses are purchased initially.

5.5 Migration Validation

Validating the planned migration at this stage is of utmost importance. You will need to take all of the information that has been collected and determine if you are in a position to go ahead with the migration.

5.5.1 Is the Migration Achievable?

By documenting the existing hardware and software environment and then mapping it over to the AIX Version 4.3 equivalent, you should now know if the migration is achievable. If any major problems were highlighted, they will have to be addressed in order to carry on with the migration. It may be that the migration is not possible at this point in time due to the availability of one or more of the vital components.

Hardware incompatibility problems will mean that you have to either:

- Wait for the hardware component to be certified as a valid AIX Version 4.3 component.
- Find an alternative hardware component that will provide the same functionality.
- Operate without the hardware component's functionality.

Software availability problems may mean a delay in scheduling your migration. Most major software packages that were available under AIX Version 3.2.5 are now also available under AIX Version 4.1 through Version 4.3 although you will probably find that they have also been upgraded to include superior functionality. In some cases, the software may not yet be ported or tested on AIX Version 4.3. This information should be gathered when planning your migration.

5.5.2 How Long Will the Migration Take?

When planning the migration, you will need to calculate the amount of time required to complete each step. At this stage, the timings will be based on rough estimates, and your plan should be updated as and when more information becomes available. The initial plan should, however, give you sufficient details to be able to plan human resources and calculate the estimated project duration.

5.5.2.1 Estimating Migration Times

Complex systems will have many variables to consider, and as such, migration times will vary considerably. The time taken by the AIX Migration Install process depends on the following factors:

- The installation method chosen
- The installation device (CD-ROM, tape drive type or network)
- The processor type and speed (POWER, POWER2, PowerPC)
- The amount of memory installed in the system
- The performance of the disks installed on the system
- The amount of software installed on the system

As an example, during our testing, migration of a Model 530 with the following LPPs installed took just under four hours.

```

X11fnt.coreX.fnt 01.02.03.00 AIXwindows Core X11 Fonts
X11fnt.ibm850.pc.fnt 01.02.03.00 AIXwindows Latin 1 (IBM-850) Fonts
X11fnt.iso88591.aix.fnt 01.02.03.00 AIXwindows Latin 1 (ISO8859-1)
Fonts
X11fnt.oldX.fnt 01.02.03.00 AIXwindows Miscellaneous X Fonts
X11mEn_US.msg 01.02.03.00 AIXWindows NL Message files
X11rte.ext.obj 01.02.03.00 AIXwindows Run Time Environment Extensions
X11rte.motif1.2.obj 01.02.03.00 AIXwindows Motif 1.2 Run Time Support
X11rte.obj 01.02.03.00 AIXwindows Run Time Environment
bos.obj 03.02.00.00 The Base Operating System
bosext1.csh.obj 03.02.00.00 C Shellbosext1.ecs.obj 03.02.00.00 Remote
Customer Services
bosext1.extcmds.obj 03.02.00.00 Extended Commands
bosext1.mh.obj 03.02.00.00 Mail Handler
bosext1.uucp.obj 03.02.00.00 Unix to Unix Copy Program
bosext1.vdidd.obj 03.02.00.00 CGI Device Drivers
bosext2.acct.obj 03.02.00.00 Accounting
bosext2.ate.obj 03.02.00.00 Asynchronous Terminal Emulator
bosext2.dlc8023.obj 03.02.00.00 IEEE Ethernet (802.3) Data Link Control
bosext2.dlcether.obj 03.02.00.00 Standard Ethernet Data Link Control
bosext2.dlcfddi.obj 03.02.00.00 FDDI Data Link Control
bosext2.dlcqllc.obj 03.02.00.00 X.25 QLLC Data Link Control
bosext2.dlcsdlc.obj 03.02.00.00 SDLC Data Link Control
bosext2.dlctoken.obj 03.02.00.00 Token-Ring Data Link Control
bosext2.dosutil.obj 03.02.00.00 DOS Utilities
bosext2.games.obj 03.02.00.00 Games
bosext2.x25app.obj 03.02.00.00 X.25 Applications, API, Sample Source
bosnet.ncs.obj 03.02.00.00 Network Computing System
bosnet.nfs.obj 03.02.00.00 Network File System/NIS/RPC Libs & Utils
bosnet.snmpd.obj 03.02.00.00 Simple Network Management Protocol Daemon
(Agent)
bosnet.tcpip.obj 03.02.00.00 TCP/IP Applications
bsl.en_US.aix.loc 03.02.00.00 AIX Locale - English ( United States )
bsl.en_US.pc.loc 03.02.00.00 PC Locale - English ( United States )
bsmEn_US.msg 03.02.00.00 Base System Messages - U.S. English

#

```

Figure 25. List of Installed AIX Version 3.2.5 LPPs

5.5.3 Is the Migration Cost within the Allocated Budget?

Upgrading to AIX Version 4.3 will provide you with many benefits in the long term due to its superiority over earlier versions and the support provided from

IBM. In the short term, however, it is important to consider all of the costs associated with the upgrade.

Depending upon your current version of AIX, there may be a charge involved with migrating the base operating system to AIX Version 4.3, but this is not the only expense that should be considered. Hardware replacement and software upgrades, if required, will need to be taken into account, as will system down time and the human resources needed to complete the exercise. As each migration exercise is different, a detailed cost model will need to be drawn up.

The cost model, in its simplest form, should at least include the following sections:

- Base operating system upgrade cost
- The cost of upgrading IBM program products
- The cost of new IBM program products
- The cost of upgrading third-party applications
- The cost of upgrading, replacing or rewriting in-house developments
- The cost of replacement hardware
- Human resource costs
- Cost of lost productivity due to system downtime

For the IBM components, your IBM salesman or Business Partner will be able to help you by using one of the IBM configurators, such as the PC-Configurator. For non-IBM components, you will need to contact the relevant supplier.

Note:

The PC-Configurator may not be able to provide the exact cost and should be used as a guide only.

The completed model should, hopefully, give you a better feel for the cost involved and will allow you to make an informed judgement.

Chapter 6. Preparing for Your Migration

This chapter covers the preparation phase of migrating to AIX Version 4.3. When preparing for the migration, there are a number of questions that you must consider.

1. If you need to order additional or replacement hardware, how long will it take?
2. How long will it take to obtain any software updates that are needed, including AIX if you do not already have it?
3. Do you have somewhere to keep everything safe until you are ready to begin?
4. Decide on your migration method; should it be a complete overwrite or a migration install?
5. Do you have a number of systems to migrate; should you use NIM?
6. If your applications need upgrading, is it just a patch to existing code or a completely new installation and reconfiguration?
7. If you need to completely reinstall and configure an updated application, has it changed so much that additional training will be needed?
8. Will you need to export data from any applications and then re-import the data after the applications have been updated?
9. How much effort will be required to port and test in-house applications?
10. Will you need to arrange on-site or on-call support from IBM or your application vendors in case of problems?
11. When can the actual migration be done such that it will cause least disruption to operations?
12. If, during the migration, things are not going to plan, at what point must you stop, restore your system to its original condition and replan the migration?

All of the above, and more, need to be considered very carefully before you can commit yourself to a timetable. The following sections should assist you in answering some of the above questions and help you in preparing a timetable for the migration. We also recommend that you check the comp.unix.aix newsgroup and archive for any additional material that may be relevant to your particular circumstances. The archive can be found at the following URL:

<http://www.thp.uni-duisburg.de/cuaix/cuaix.html>

6.1 Ordering Additional or Replacement Hardware and Software

During the planning stage, you should have already discovered if additional or replacement hardware and software will be needed. If this is the case, you

should also have obtained information about availability and delivery lead-times for these items since it is probably impossible for the migration to proceed without them. You should begin your preparation by noting the delivery lead-times on your timetable. When placing the actual orders, you should obtain firm commitments to these times by all suppliers. If any of the timescales seem unrealistic, do not be afraid to question them. If necessary, make adjustment or allowances in your timetable. Do not plan to begin the migration until all additional items have been received, checked and confirmed to be complete and undamaged.

6.2 Keep Things Safe!

Keep everything that you need for the migration in one, safely locked place. Do not leave things where they can be damaged or “misplaced”. This is especially important if you will be receiving new hardware or software at irregular intervals.

6.3 AIX Version 4.3 Installation Methods

Your choice of upgrade method will affect your preparation and timetable, since certain methods may mean having to spend considerable time in reconfiguring your installation. There are four methods that can be used to upgrade from an earlier version of AIX to Version 4.3. These methods are:

- New or Complete Overwrite Install
- Preservation Install
- Migration Install
- mkysyb Install

Note that, while preparing this document, we concentrated on the Migration Install method since this is the method we recommend and expect most customers to use. It is the default method when migrating from AIX Version 3.2 and later to AIX Version 4.3.

Note:

You can use any of the above methods to install a system from the network. Even though installing a system through a network is sometimes referred to in this document as a Network Install, it is not a separate installation method but an installation environment using Network Installation Management (NIM).

If you are running AIX Version 4.1.4 or later, you may also want to consider using a new utility called Alternate Disk Installation. This allows you to clone your existing root volume group to a spare disk or disks while the system is running. You can then update the cloned copy of your root volume group and switch to the updated copy at a later date. If updating the operating system on the cloned disks introduces problems, you can simply reboot with your original root volume group. See 8.5, “Alternate Disk Install Utility” on page 141, for more details.

6.3.1 New or Complete Overwrite Install

This method should be used to install AIX Version 4.3 on a new system or on a system on which you want to completely overwrite the existing version of AIX. It is also suitable for stand-alone systems with relatively simple configurations.

The main advantage of this method is that your resulting AIX Version 4.3 installation is perfectly clean, with all system configuration and customization files containing default information only.

On the other hand, the entire system will need to be reconfigured. The amount of work involved in doing this depends, of course, on the complexity of your installation. This must be taken into account before choosing such a method and when preparing your timetable.

For example, most or all of the following tasks will probably have to be performed depending on your specific environment.

- Set the system date and time for your time zone.
- Set a root user account password to restrict access to system resources.
- Confirm or change the install device you want to use for installing additional software. The device may be a CD-ROM, a tape drive or a local or remote directory.
- Check the system storage and paging space needed for installing and using additional software applications.
- Set your National Language Support (NLS) environment.
- Import user-defined volume groups. User-defined volume groups (non-root volume groups) are preserved during the installation. You will just need to import them and mount the associated file systems they contain.
- Create user accounts and passwords.
- Install third-party device drivers (for example, LAN printer server).

- Set your system network configuration (if applicable).
- Create local and remote terminals.
- Configure local and remote printers.
- Install and configure additional LPPs.
- Install and configure third-party software.

AIX Version 4 provides you with the Configuration Assistant to guide you through the above operations, either in a SMIT-based ASCII version or in a full graphical user interface. You should not underestimate the amount of time required to perform a total reconfiguration; this can be quite considerable in some circumstances. If you want to run the Configuration Assistant manually, simply execute the `install_assist` command.

6.3.2 Preservation Install

A Preservation Install is the default upgrade method for systems running AIX Version 3.1. This is in contrast to systems running AIX Version 3.2 and above, where the Migration Install is the default method. A Preservation Install can still be selected for these later systems, however.

This installation method should be used when the system to be migrated is running AIX Version 3.1 and you want to preserve the user data in the root volume group.

With the Preservation Install method, the contents of `/usr`, `/`, `/var`, and `/tmp` will be deleted. The Preservation Install will save the previous paging space and dump device, `/home` and other user-created file systems in root volume group.

User-defined volume groups, meaning non-root volume groups, will also be preserved and activated automatically after the upgrade. Before mounting the file systems belonging to these user-defined volume groups, you may need to re-create the file system's mount points if they were removed during the installation, for example, mount points you created directly under `/` or `/usr`.

Configuration files, with the exception of `/etc/filesystems`, `/etc/swapspaces` and `/etc/resolv.conf`, are also deleted. If you want any additional configuration files to be saved during the Preservation Install, you must edit the `/etc/preserve.list` file on your system and add the *full* path names of the configuration files you want to save. The system must also have sufficient disk space in the `/tmp` file system to store all the files listed in the `/etc/preserve.list` file; so it is advisable to check the free space in `/tmp` and clear out unwanted files.

6.3.3 Migration Install

This installation method is the default option for systems running AIX Version 3.2 and later. It is the easiest way to migrate your system to AIX Version 4.3 and is the method that we used throughout this book. The great advantage of the Migration Install is that allows you to upgrade your system to AIX Version 4.3, while still keeping customized configuration information and any installed, optional software. It means that, in the vast majority of cases, you should not need to perform any reconfiguration work after the migration has completed. This has obvious time-saving advantages.

If, for any reason, there are particular configuration files that cannot be migrated, they will be saved in a specific directory under /tmp/bos. This allows you to compare them with the new default files and transfer any changes to the new files after migration. System messages will inform you of the location of the saved files. Information will also be stored in a log file in the directories /var/adm/ras and /var/adm/sw.

The Migration Install preserves all file systems in the root volume group including /, /usr and /var. Non-root volume groups are also preserved.

Note that, if you are migrating from AIX Version 3.2 and the system has /dev/hd7 configured as the dump device, this dump device will be removed during the migration. This is because after the migration, the paging space (/dev/hd6) will be used as the dump device. This may help you in recovering extra disk space for the migration. If you have configured your own dump device as a specific logical volume other than /dev/hd7, it will be preserved.

Important Note:

Non-AIX device drivers will be deleted during the migration and must be reinstalled. All files in /usr/lib/drivers, /usr/lib/microcode, /usr/lib/methods, and /dev will be deleted. Non-AIX software products will remain on the system. Any product that was installed on the system to be migrated, and is able to run on an AIX Version 4.3 system, will not be affected.

The following filesets that are now obsolete, or have been superseded, will be removed during a migration from AIX Version 3.2. In addition, bosext2.dlc.* will be removed, except for those datalink controllers which were actually configured. Also xlfcmp.obj and xlfcmpm.*.msg will be removed if installed at a version lower than Version 3.

- aic.obj
- aic12.obj
- aicm.*.msg

- aic12m.*.msg
- bosadt.xde.obj
- bosex1.ecs.obj
- bosex1.vdidd.obj
- bosex2.lrn.info
- bsm.*.msg
- gPfonts.*
- OpenGL.*
- pcsim
- pcsim.obj
- pcsimm.*.msg
- softPEX.obj
- softgP.obj
- txtfmt.graf.obj
- txtfmtkj.*
- vdigft.obj
- vdiplot.obj
- xlccmp.obj
- X11_3d.*
- X11_3diEn_US.info

Note

If a new version of a software product is installed during the Migration Install, user configuration files from the previous version of this product will be preserved.

6.3.4 mksysb Install

A system can also be installed with AIX Version 4.3 by restoring a backup taken from another AIX Version 4.3 system. Since an AIX system backup is usually made with the `mksysb` command, this installation method is referred to, as a `mksysb` Install.

This method is typically used to upgrade (actually install) a system that has a very similar configuration to the system from which the backup was taken. When used for installing systems that have dissimilar configurations, there are some limitations. In all cases, information specific to each individual system, such as groups and users, hostname and so on, will need to be reconfigured. The `mksysb` install method is particularly suitable for cloning multiple identical systems from a previously migrated and tested system, especially when any individual customization is relatively simple or can be automated by use of a customization script and data file.

More information about AIX installation, and cloning in particular, can be found in the *AIX Version 4.3 Installation Guide*, available at the following URL:

http://www.rs6000.ibm.com/doc_link/en_US/a_doc_lib/aixins/aixinsgd/toc.htm

Cloning considerations are covered in Section 5 of the above guide.

6.3.5 Installing Over a Network

As we mentioned previously, all the installation types discussed above (New Install, Preservation Install, Migration Install and mksysb Install) can be also performed through a Local Area Network (LAN), by using Network Installation Manager (NIM). The only difference here is that a NIM server is used as an installation device instead of a CD-ROM or tape drive. A migration using NIM makes migration of multiple LAN-connected systems much easier and is well worth the initial effort involved in setting up a NIM environment.

In order to perform a migration using NIM, the NIM code must first be installed and configured on a server system running AIX Version 4.3 or equal to the version you are migrating to. The installation resources, a spot, and the systems to be migrated must then be defined as objects on the NIM server. Once these have been defined and the installation resources have been allocated to the system objects, the chosen installation method can be performed from the NIM server.

You can find more information on how to migrate multiple systems using NIM in the redbook titled *A Holistic Approach to AIX V4.1 Migration, Volume 2*, SG24-4653. Please refer also to 8.3, "Network Install Manager (NIM)" on page 132, which describes a minimum NIM setup for migration purposes.

6.4 Application Updates

If application updates are required, you will need to take into account whether the update is simply a series of minor patches to your existing code or a completely new installation. If it is a completely new installation, you should check with the supplier if your existing configuration data will be retained or if you will need to reconfigure the application from scratch. You should also establish if changes to the application require additional training or updated manuals. Another item you should consider is whether the application has changed significantly, particularly in the way that data is stored. You may need to export your data to tape and then import it again afterwards. The application vendor will probably provide tools and recommended procedures to achieve this. In all cases, you will need to make allowances in your migration timetable.

6.4.1 Porting In-House Applications

Actual porting of applications can be a complex process that is really beyond the scope of this book. We have therefore assumed that if your installation contains in-house applications, you will have sufficient expertise yourself, or can call upon that expertise, to assist you with porting issues. You should have already determined at the planning stage what porting will need to be done and the effort involved in achieving that. Having said that, AIX's binary compatibility guarantees mean that only in exceptional cases should you have a problem with in-house applications.

If you have determined that some porting effort will be required, if you keep in mind the restrictions explained in 5.4.6, "General Software Compatibility Issues" on page 66, there is no reason why you should not be able to do the work at your existing level of AIX. You should then be able to transfer your applications to AIX Version 4.3 with no problems.

Only you can judge the amount of time you will need to allow in your timetable for this work to be completed and tested.

6.4.2 Testing Custom Shell Scripts

Most installations will have custom shell scripts written in the C-Shell, Bourne Shell or Korn Shell that administrators or users have developed to assist them with their work. As we mentioned in 5.4.5, "Shell Scripts" on page 65, in order to meet compliance with evolving standards, some commands have changed and some have been removed. This will cause problems for custom shell scripts that make use of commands that have been removed, such as the `del` command or the `copy` command, for example. Also, some shell scripts may use commands whose options have changed slightly to comply with later standards. Although new command options should not affect the behavior of a shell script, options that are no longer supported or that have a different output may cause unexpected results.

Ideally, as with your in-house applications, these scripts should be tested on an AIX Version 4.3 test system prior to the migration. Where this is not possible, it may be necessary to check them manually for possible migration problems. 5.4.7, "Command Changes and Deletions" on page 70, lists the commands which have been changed or deleted and which may cause problems with custom shell scripts.

You should be able to find which of your shell scripts use these commands by using the `grep` command. You will then need to check each script in turn against the man page for the command to see if you are using features that are no longer supported.

6.5 Pre-Flight Checks

As part of your preparation, there are a number of minor, but nonetheless important items, that you should check.

6.5.1 Default User and Group Definitions

For the migration process to function correctly, system users and group definitions in the `/etc/group` and `/etc/passwd` files must be verified.

The following standard default entries should exist on an AIX Version 3 system in the `/etc/passwd` and `/etc/group` files before the migration to AIX Version 4.3. If an entry is missing or significantly different from the one shown below, you may encounter problems after the migration. Therefore, you should ensure that the default user and group definitions match the entries in the following list.

- `/etc/passwd` file

```
root::0:0:::/bin/ksh
daemon::1:1::/etc:
bin::2:2::/bin:
sys::3:3::/usr/sys:
adm::4:4::/var/adm:
uucp::5:5::/usr/lib/uucp:
guest::100:100::/home/guest:
nobody::4294967294:4294967294::/:
lpd::9:4294967294::/:
```

- `/etc/group` file

```
system::0:root
staff::1:
bin::2:root,bin
sys::3:root,bin,sys
adm::4:bin,adm
uucp::5:uucp
mail::6:
security::7:root
cron::8:root
printq::9:
audit::10:root
ecs::28:
nobody::4294967294:nobody,lpd
usr::100:guest
```

Also, there is a possibility that if an entry is missing or corrupted, that the migration itself might fail, or that other user definitions could become corrupted. We suggest that once you have verified the default entries, you use the following commands to check that your passwd and group files do not have any anomalies. So that you are able to control any corrections that may be needed, we also recommend that you do not use the `-y` option to specify automatic error correction.

The following command will verify the format of all user definitions in the user database.

```
# usrck -n ALL
```

The following command will verify the correctness of all group definitions.

```
# grpck -n ALL
```

6.5.2 Checking Scheduled Jobs

If the system you are migrating is a server, it will probably have jobs that have been scheduled to be executed at specific dates and times. The `cron` daemon that performs this task has an entry in the `/etc/inittab` file and is started and respawned automatically by `init` if it dies. `cron` checks the directories `/var/spool/cron/crontabs` and `/var/spool/cron/atjobs` and executes the jobs defined there.

Jobs submitted with the `at` command are temporarily stored in the `/var/spool/cron/atjobs` directory as files with names like `root.817794000.e` or `username.817794000.e`.

To check if you have jobs that have been scheduled with the `at` command, enter the following command:

```
# at -l
```

It should be noted that while testing `at` and `cron` jobs for an earlier AIX Version 4.1 migration redbook, the testers noticed a number of anomalies that occurred.

On some systems:

- Jobs that had been scheduled were actually executed during the migration.
- The contents of the `cron.deny` and `at.deny` files were lost.
- Crontab files for `root`, `sys` and `adm` were reset to defaults.

Although none of these problems were seen during our testing of the migration to AIX Version 4.3, we recommend that you:

- Reschedule jobs that are scheduled to take place during the migration time.
- Save the contents of `/var/spool/cron/atjobs` on a diskette.
- Remove the content of `/var/spool/cron/atjobs` to avoid jobs being executed during the migration.
- Check again with `at -l` that jobs are no longer scheduled.

We also recommend that you save on the same diskette the following files that you might have created or customized:

`/usr/adm/cron/at.allow`

`/usr/adm/cron/at.deny`

`/usr/adm/cron/cron.allow`

`/usr/adm/cron/cron.deny`

6.5.3 Access Control Lists (ACLs)

This facility, which was included in AIX Version 3.2.5, can provide much finer-grained access control to resources (files) than the standard permission bits. If you are using ACLs, you should be aware that files with specified ACL permissions that have been archived with traditional UNIX archive programs, such as `tar` or `cpio`, lose their extended permissions after they are reloaded. This applies to both AIX Version 3.2 and AIX Version 4. The only archive programs that preserve the settings of the ACL extended permissions in both versions of AIX are `backup` and `restore`.

In our migration tests, however, all ACLs were migrated successfully.

Attention:

Since AIX Version 3.2 system backup uses `tar`, your ACLs will not be saved by your system backup. You will need to use the `backup` utility or `aclget` and `aclput` utilities to separately save the files on your system that have ACLs associated with them.

6.5.4 Migration of Device Definitions

When migrating to AIX Version 4.3, you should be aware of the following:

- External devices that are in an available or defined state prior to the migration and not connected or powered off during the migration process, will be removed from the ODM database, and the associated device drivers may not be installed.

This is true for detectable devices, such as tape drives, CD-ROMs, disk units, and so on. For example, if you configured a CD-ROM drive on your system and the CD-ROM drive has been physically disconnected or powered off prior to the migration, its definition will be removed from the system.

You should therefore ensure that all external devices you want to keep through the migration are in the Available state, connected to the system and powered on.

If you need to check what devices are presently defined, enter the following command:

```
# lsdev -C
```

6.5.5 TCP/IP and Network Test Procedures

TCP/IP migration is an integral part of the Migration Install of AIX Version 4.3; so a successful TCP/IP migration relies on a successful AIX migration.

Before beginning a migration, you should be aware of the following limitations of the migration process:

1. Adapters may be renamed during the migration process. The migration process renames adapters in the order in which they are found in the physical adapter slots. Therefore, if you have added adapters to your system in non-ascending slot number order, you will find that they have been renamed after the migration. You can check if this will occur on your system by issuing the command `lsdev -CHc adapter -s <adapter type>` to list the number and location of the adapters. You must then compare the adapter names with the slot locations to ensure that they are both in ascending order. For example, if you have two ethernet adapters installed, named `ent0` and `ent1`, you should ensure that `ent0` is located in a lower slot number than `ent1`; otherwise it will be renamed.
2. Volume groups (and associated file systems) may not be automatically made available after a migration. This is important if your TCP/IP configuration files are in a file system on one of these volume groups.

In preparation for the migration, you will need to establish test procedures for TCP/IP and any other networking services you may have. These procedures should be sufficiently detailed to allow you to verify that the migration of these

services was successful and that communication between the migrated system and its peers is still possible. This will mean scheduling time and resources to do the testing. For example, you may need to schedule someone to be available at a remote site while you test remote printing or arrange assistance with testing mainframe connections. Once you have documented the testing procedures you will use, you should allow sufficient time for them in your migration timetable.

6.5.6 Checking Root Authentication Method

Before the migration, you should make sure that the root user has a primary authentication method of SYSTEM. This is important since you cannot be certain that any authentication method other than SYSTEM will work after the migration. To check the value, enter:

```
# lsuser -a auth1 root
root auth1=SYSTEM
```

If the value is different from SYSTEM, you can change it by entering:

```
# chuser auth1=SYSTEM root
```

Also make sure that the root user has a valid password and is not restricted in any way, for example, the rlogin, login or account-locked attributes.

6.6 Arranging for On-Site or On-Call Support

If your installation is particularly complex, or you will have lots of reconfiguration work to do, possibly because of a complete application update or a significant change of IBM LPP functionality, you may wish to notify your application vendor or support provider of your plans. You may also want to make arrangements for on-site or on-call support facilities. Being able to contact someone for assistance if you discover a problem may mean the difference between a successful migration or having to delay, recover and reschedule everything.

6.7 Recovery Plan

Probably the most important part of your preparation is forming a sensible recovery plan, so that if you encounter insurmountable problems you will be able to restore the system to its original condition and work can continue while you try and solve the problem at your leisure. A fundamental part of this recovery plan is having *full, tested, multiple backup copies* of all your system, user and application data. Clean your tape drive before making your backups, use

new tapes, run the tapes once through a backup sequence to make sure that they do not have media drop-outs that will cause tape errors. Finally, after you have made your backups, read them back so you are as certain as you can possibly be that they are perfect. If you are using Access Control Lists (ACLs), please refer to 6.5.3, "Access Control Lists (ACLs)" on page 93, for more information on how to preserve ACLs when backing-up and restoring files.

You should also decide at what point in the migration process, if all is not going to plan, you must stop the migration and revert to your old environment. It is no good continuing to struggle with a problem, hoping to fix it within the next half-hour or so and then finding that you do not have enough time to recover the system before the users arrive the next morning to begin work. Once you have made your plan, add checkpoints to your timetable, and do not deviate from them.

Chapter 7. Migrating Your System

This chapter covers the actual migration process itself. We recommend, and therefore assume, that you will be using the Migration Install method. This is the default migration method for all releases of AIX from AIX Version 3.2.

7.1 Backing Up Your AIX System

Even though the migration has been carefully planned, you must still protect your system against any problem that may occur during or after the migration. Backing up the entire system is an absolute necessity. We assume that the backup you are going to create is to be restored on the same system, with the same configuration. If it is to be restored on a different system or a system having a different configuration, the operation is called *cloning*. A brief explanation of cloning is given in 8.8, “Migrating to Different Hardware” on page 148. Before backing up your system, it is advisable to check the consistency of the file systems with either the `fsck` command or, if applicable, a utility supplied with your application. You may also want to unmount any file systems in non-root volume groups; then `varyoff` and export the volume groups.

7.1.1 Mksysb Limitations in AIX Version 3.2.5

These are some system backup limitations in AIX Version 3.2.5 when restoring a `mksysb` backup on a system having the same configuration.

- Restoring a `mksysb` backup removes the `/dev` directory completely and re-creates it from the ODM database. If you created files in the `/dev` directory without any configuration methods to re-create them and without proper entries in the ODM database, these files will not be restored on the target system. This will affect most OEM device drivers.
- Console attributes are not archived as part of a `mksysb` backup and therefore are not restored. For example, if you have the console login disabled prior to the system backup, it will be enabled after restoration.
- Restoration of a `mksysb` could result in two or more devices of the same type having their names swapped, and all of the customized attributes that go along with the names will also get swapped.

As mentioned above, during the restore procedure the complete devices database is re-created. All of the detectable devices, for example, tape drives, CD-ROM, 128-port adapters, and so on are defined and configured from scratch. The procedure then defines the non-detectable devices,

such as TTYs, printers, modems, and so on. It also updates the user-modified attributes of detectable devices.

This can be a problem if, for example, you had on your system a token-ring card installed in slot 5 and later added a token-ring card in slot 4.

When defining and configuring the detectable devices, the cards are configured in order starting with slot 1. Therefore, the card in slot 4 will be configured before the card in slot 5, and all the devices on card 4 will be configured before any devices on card 5. Thus, the cards will be named sequentially.

If the detectable devices are not named sequentially in your system, these devices will not be reconfigured properly. To check your adapter card device order, you can enter the following command:

```
# lsdev -C -s mca -F "location name" | sort
```

This problem could occur for adapter cards, tape drives, Remote Asynchronous Nodes (RANs), and so on. In many cases, the simplest solution to this problem is to swap any external cables or devices, such as RANs, to the adapters with the same names as the one they were originally attached to. Then update any system configuration documentation to reflect the new cabling.

The restore process also defines the non-detectable devices according to their parent device's name and type. If the parent is renamed as explained before, these non-detectable devices could be defined at the wrong locations. For example:

The source machine has two 16-port cards; card 1 is in slot 5, and card 2 has been added later and is located in slot 4. So, the cards are named as follows:

```
# lsdev -C -s mca -F "location name" | sort
00-04 sa3
00-05 sa2
#
```

Figure 26. Non-Sequential Device Configuration

Now when the backup is restored, the cards will be defined and named in the order of their slot number; so they will appear as:

```
# lsdev -C -s mca -F "location name" | sort
00-04 sa2
00-05 sa3
#
```

Figure 27. Sequential Device Configuration

Since child devices are associated by name, all the devices, TTYs and printers, for example, previously defined on card1 will now appear on card2 and vice versa.

- If there was not enough space in the /tmp directory when the mksysb backup was created, the restore process can fail. The reason is that at the very end of the restore procedure the `bosboot` command is called and can fail if the restored /tmp directory is full.

If this occurs, you will receive the following message:

```
"0301-152 bosboot: not enough file space to create:"
```

You will then be prompted to go to maintenance mode or continue. If you select maintenance mode and make room in /tmp by increasing the file system or by removing files, you can then run the `bosboot` command.

7.1.2 Backup Procedure

Only mounted file systems within the root volume group are archived with the `mksysb` command. Therefore, before backing up your system, determine which user file systems you want to keep mounted during the backup. Then, to backup your system, enter the following command:

```
# smitty mksysb
```

The SMIT backup screen will then be displayed.

```

Backup the System

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

[Entry Fields]

WARNING: Execution of the backup command will
result in the loss of all material
previously stored on the selected
output medium. This command backs
up only rootvg volume group.

FORCE increase of work space if needed          no          +

* Backup DEVICE or FILE                          [ ]

(example: /dev/rfd0)

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

```

Figure 28. SMIT System Backup Panel

The SMIT menu may vary slightly depending upon the level of AIX you are running, but specification of the backup device or file name is still the only mandatory entry that must be made.

After the `mksysb` has completed, backup the user-defined volume groups that contain user applications and data on a separate media with the following command:

```
# find <search_directory> -print | backup -ivf <archive_media>
```

where `<search_directory>` is the directory on which the user file system is mounted, for example `/data`, and `<archive_media>` is the backup device, for example `/dev/rmt0.1`

You may also use `tar`, `cpio` or any other utilities to back up non-root volume groups, but if you are using Access Control Lists (ACLs), `tar` and `cpio` will not preserve the ACL extended file permissions. The `backup` command is the only standard utility that preserves ACLs.

If raw devices (logical volumes) have been defined on the system, you can archive them with the `dd` command. At this stage, you should have already documented your system and kept track of the size of all logical volumes on your system by using the `lsvg` command.

To save a raw device, enter the following command:

```
# dd if=/dev/<rawdevice_name> of=/dev/rmtx
```

where `rmtx` is your tape drive name.

Note: If you are using a tape drive as an output device, you may want to change your tape drive block size to the default size of 512 bytes by using the following command:

```
# chdev -l rmtx -a block_size=512
```

Or if you want to use a different block size, for example 1024 bytes, you will have to specify a block size parameter to your `dd` command as follows.

```
# dd if=/dev/<rawdevice_name> of=/dev/rmtx bs=1024
```

Since raw devices are often used by special applications, like databases, you will usually find that a backup utility is provided with the application. If this is the case, you should use the that.

7.2 The AIX Migration Procedure

The following flowchart outlines the sequence of operations required when migrating from CD-ROM or tape. Selection of one of the installation methods, Complete Overwrite, Migration Install or Preservation Install, can be made from the Installation menu. This is reached by selecting Change/Show Installation Settings from the initial menu displayed after choosing the installation language.

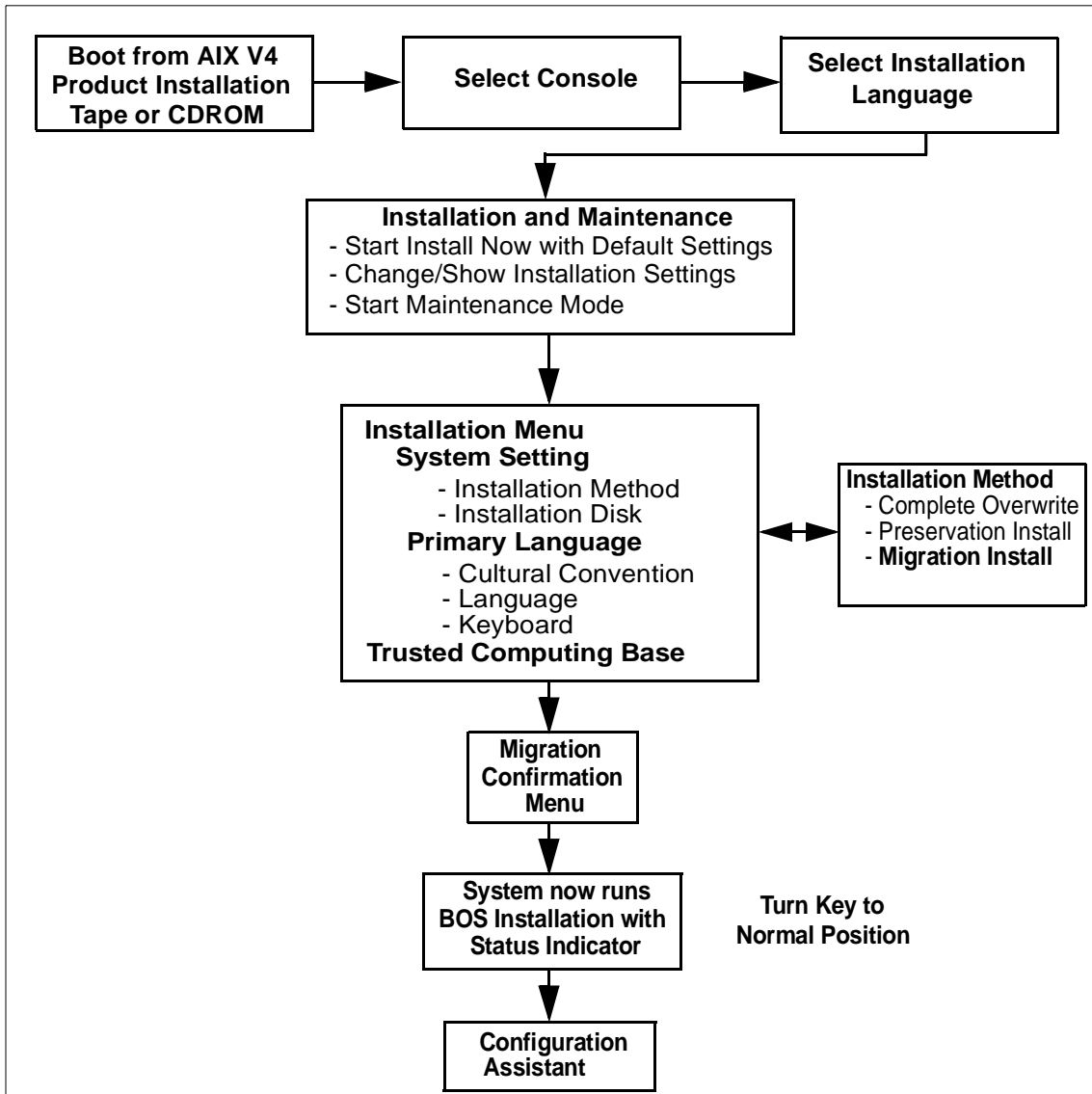


Figure 29. Migration Installation Flow

To begin the migration, proceed as follows:

1. Insert the AIX Version 4.3 installation media into the installation device.
2. Turn the system key to the service position.

Note:

If your model does not have a system key, refer to your hardware manual for the exact procedure to boot the system from tape or CD-ROM. In most cases, you are required to press a key during the boot process to access the System Management Services (SMS) menu. From there, you are able to select the boot device.

3. Reboot the system with the following command:

```
# shutdown -Fr
```

By doing this, the system will boot from the installation media. The installation media can be a CD-ROM or a tape.

When the system has booted from the installation media, a screen is displayed that prompts you to select the system console. This message is displayed on either the locally attached graphics, if available, or on an ASCII terminal connected to the native serial ports. If you are using an IBM 3151 terminal or similar, as the console, before starting the Migration Install procedure, set the communication options of your terminal as follows:

```
Line Speed (baud rate) = 9600
Word Length (bits per character) = 8
Parity = no (none)
Number of Stop Bits = 1
Interface = RS-232C (or RS-422A)
Line Control = IPRTS
```

Note: The IPRTS flag means ignore hardware handshaking.

Set the keyboard and display options on the ASCII terminal as follows:

```
Screen = normal
Row and Column = 24x80
Scroll = jump
Auto LF (line feed) = off
Line Wrap = on
Forcing Insert = line
Tab = field
Operating Mode = echo
Turnaround Character = CR
Enter = return
Return = new line
New Line = CR
Send = page
Insert Character = space
```

4. You must then select the language in which the installation instructions and messages are to be displayed. The language selected for the installation does not have to be the same as the language you intend to use as a primary language environment. This can be selected later.
5. The Welcome to the Base Operating System Installation and Maintenance menu is then displayed as shown below.

```
Welcome to Base Operating System
Installation and Maintenance

Type the number of your choice and press Enter.

1 Start installation Now with Default Settings
2 Change/Show Installation Settings and Install
3 Start Maintenance Mode for System Recovery

88 Help ?

Choice:
```

Figure 30. Base Operating System Installation and Maintenance Screen

6. It is at this point that you can confirm or change the installation and system settings that have been set for this installation, including the installation method, by selecting **option 2** and pressing **Enter**. The Installation and Settings screen will then be displayed. Since we are migrating from AIX Version 3.2.5 or later to AIX Version 4.3, the installation method should already be set to Migration, and the disk or disks containing the root volume group should already have been selected.

Note

It has been noticed on some systems running AIX Version 3.2.5 that the default installation method was not set correctly to Migration and was in fact set to Preservation. If you are running AIX Version 3.2.5, you should check that the correct method has been selected.

```

Installation and Settings

Either type 0 or 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 .....Migration
   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)

3. Install Trusted Computing Base .....No

>>> 0 Install with the settings listed above

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

```

Figure 31. Installation Settings Screen

7. You should also check that the correct disk or disks containing the root volume group you wish to migrate are selected. The Migration Install will propose that you install onto the disks belonging to the current root volume group. Since it is possible to have other root volume groups on your system, the selected disks should belong to the actual root volume group that you want to migrate. Check the result of the `lsvg -p rootvg` command you used earlier to document your system to verify this.
8. Select the primary language environment settings. This language setting will be used for messages, keyboard mapping, and the cultural conventions to be used after the migration.
9. If you are using Trusted Computing Base (TCB), you can set the Install Trusted Computing Base option to **Yes**. In this case, the AIX Version 3.2.5 TCB will not be preserved, but you will be able to use the AIX Version 4.3 TCB after the migration. If you set this option to **No**, you will not be able to use the AIX Version 4.3 TCB after the migration.
10. After you have confirmed that all the settings are correct, select option **0**, **Install with the settings listed above**. The Migration Menu Preparation in Progress screen will then be displayed.

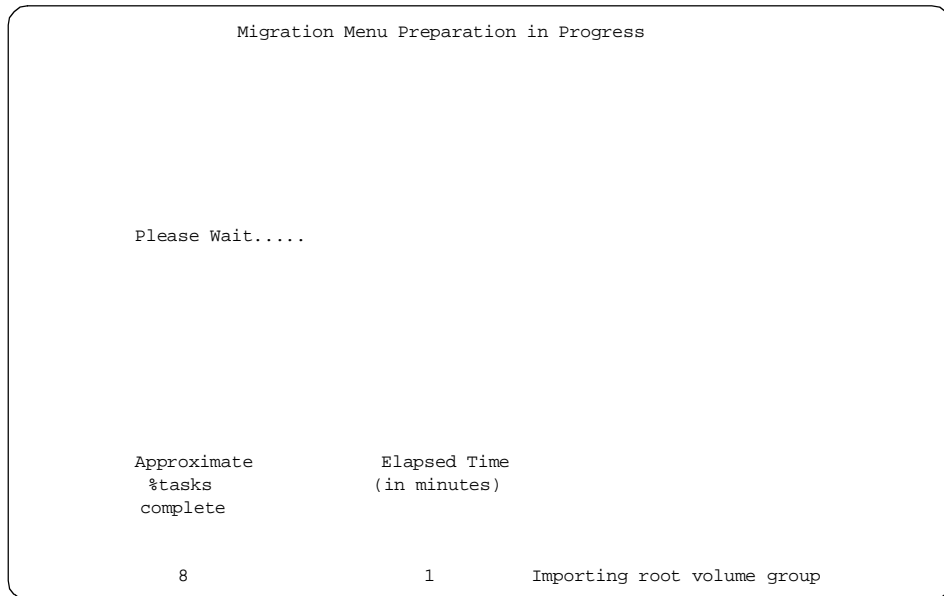


Figure 32. Migration Menu Preparation Screen

11. The migration process will then begin checking the installed components on the system and after a few minutes, the Migration Confirmation Menu will be displayed on the console.

```
Migration Confirmation

Either type 0 and press Enter to continue the installation, or type the
number of your choice and press Enter.

  1 List the saved Base System configuration files which will not be
    merged into the system. These files are saved in /tmp/bos.

  2 List the filesets which will be removed and not replaced.

  3 List directories which will have all current contents removed.

  4 Reboot without migrating.

>>> 0 Continue with migration.

    88 Help ?

-----
WARNING: Selected files, directories, and filesets (installable options)
from the Base System will be removed. Chose options 2 or 3 for more

Select option [0]:
```

Figure 33. Migration Confirmation Screen

At this stage, you are given the option to look at the base system configuration files that will not be merged during the migration and will be saved in /tmp/bos. You can also look at the filesets that will be removed and not replaced and any directories that will have all their current contents removed.

The list of files displayed by option 1 is written to /tmp/bos/cfgfiles.moved.

The list of filesets displayed by option 2 is stored in /tmp/bos/filesets.gone.

The list of directories displayed by option 3 is stored in /tmp/bos/directories.gone.

Note

Before you continue with the migration, it is highly recommended that you check the output of options 1, 2 and 3 for files, filesets or directories that have may been overlooked when the migration was being planned.

If for any reason you are not satisfied with the actions the system is going to take, you can elect to reboot the system without migrating and defer the migration to a later date.

Once you decide to proceed by selecting option **0, Continue with migration**, the following output will be displayed for a few minutes while

the system saves configuration files that cannot be migrated and removes any obsolete files or directories.

```
Saving system configuration files in /tmp/bos.....  
Removing obsolete filesets, directories, and files.....
```

Figure 34. Screen Output While Saving Configuration Files

12. After the previous step is complete, the migration process will begin to read from the installation media and update your system. While this is being done, the following screen will be displayed. The screen will be updated periodically to indicate the approximate percentage of tasks that have been completed and the elapsed time.

```
                Installing Base Operating System  
Turn the system key to the NORMAL position any time before the installation ends.  
  
                Please Wait.....  
  
                Approximate      Elapsed Time  
                %tasks          (in minutes)  
                complete  
  
                25                5                Restoring Base Operating System
```

Figure 35. Screen Output While Migration is in Progress

13. Turn the system key to the Normal position.

14. When the migration has completed, the system will reboot if you changed the system key from the Service position to the Normal position. The Installation Assistant menu will then be started.

7.3 Post-Migration Procedures and the Configuration Assistant

Since Migration to AIX 4.3 is, technically speaking, an actual installation of AIX, you will be provided with the Configuration Assistant application with either a GUI or ASCII interface, depending on your hardware.

The Configuration Assistant is a user-friendly, task-driven application that is intended to assist the administrator with the basic configuration of the system. If you used the Migration Install and therefore kept all or most of your systems configuration data, there should be no actual need to perform basic configuration.

If you are more familiar with SMIT, the command line or other ways to check out and reconfigure your system, you may leave the Configuration Assistant and log into the system to get access to the tools you would like to use.

7.3.1 Updating Other Software Products

If you have other program products installed which are shipped on the second or third AIX CD-ROMs, you will also need to update those products. If you have a graphical system, you can do this by selecting the option **Update Installed Software After a Migration Installation**, from the post-installation Configuration Assistant.

If you have an ASCII system, you will need to insert the particular CD-ROM and enter the following command:

```
# smit update_all
```

When migrating with NIM, this step may not be necessary, depending upon the contents of your lpp_source. By ensuring that your lpp_source includes all the updated software products required by the client system, you will save the extra time and effort needed to perform the update_all.

You will also need to install or update any other IBM or third-party software and applications that were identified as requiring updates. This includes any non-AIX device drivers that have been deleted during the migration. The method for installing these packages and whether or not they retain or re-use all your previous configuration information will vary depending upon the particular package.

7.3.2 Installing Licenses

Once all the software components have been updated or re-installed, any packages which are license controlled will also need to have their license

keys installed. For IBM and some other companies' software, the keys are installed through SMIT. Products that are not compatible with LUM, iFOR/LS or Net/LS will have their own methods for installing licenses. Chapter 9, "License Management" on page 155, provides an overview of license management and the LUM and iFOR/LS tools.

7.3.3 Post-Migration Testing

During the preparation phase, you should have compiled a list of tests and procedures that will need to be carried out to confirm the success of the migration. The tests should have been drawn-up after consultation with users and, at an absolute minimum, should verify that all networking and communication is working and that all aspects of the applications run successfully. You will probably need assistance with these tests, for example, to confirm that order-entry, weekly reports, payroll, and so on work correctly.

If at any stage during post-migration testing you discover a problem, you should be prepared to restore your system to its original condition, thereby allowing work to continue while you investigate and fix or circumvent the issue. The point at which you must begin to restore the system depends upon the amount of time you have left before work must begin and the length of time it will take to restore the system. This point should have been determined while planning the migration and should be prominent on your migration schedules. As mentioned earlier, before restoring the system to its original configuration, you may want to run the `snap` command and also take a full backup of the system. This will allow you to return to your existing state, when a solution to the problem has been found, without having to run through a full migration again. The `snap` output and system backup will also assist support staff if assistance is needed in resolving the problem.

7.3.4 Validating TCP/IP Migration

When considering the scope of this book, it was obvious that we could not hope to test every combination of networking or the multitude of applications that are available for AIX. One feature that is common to virtually every environment, though, is the use of TCP/IP. While preparing this book, correct migration of TCP/IP was therefore considered very carefully. The environments tested were originally running AIX Version 3.2.5, AIX Version 4.1.5 and AIX Version 4.2.1. In each case, before starting the migration, the test systems were customized. After the migrations completed, the systems were tested for correct functionality and also to ensure that all customization was still present. The areas that were tested included:

- Basic networking. For example, basic TCP/IP configuration settings, routing, default gateways, changes to `no` options and so on.

- Name resolution, including Domain Name System (DNS), secondary name servers for subdomains, and so on.
- Remote command execution, (`rlogin`, `rexec`, `rsh` and so on).
- File Transfer (FTP and TFTP).

Post migration testing established that each migration completed successfully, with no problems being recorded. All customization work performed prior to the migration was transferred correctly, to the extent that comments added to configuration files for our own documentation purposes were also still present.

Note

The default for the TCP/IP `ipforwarding` parameter changed to `NO` in AIX Version 4. This means you will have to reset it with the `no` command if your system was originally at AIX Version 3.2.5 and was acting as a gateway.

If you choose not to use Migration Install, you will need to do the following.

- Save all of your configuration files manually, or be sure that you can quickly and reliably recover these files from your system backup. As we mentioned earlier, it is a good idea to create an archive of all your configuration files in addition to your full system backup. If you use a standard utility like `tar` with relative pathnames, you can recover individual files more easily, and you reduce the possibility of damage to your `mksysb` backup. Note that the way your system is configured may mean that you will have to save more than just the basic configuration files. For instance, you may need to save X.25 configuration information if you are using TCP/IP over X.25 links.
- After the migration, you will need to reload all of your configuration files onto the system, into a temporary or work directory. You can then compare the default AIX Version 4.3 configuration files with your own customized files and update the defaults with any local changes that are required.
- You will also need to reconfigure any devices or other items whose configuration information has been lost. This includes loading any additional software and device drivers that are required.

7.3.4.1 TCP/IP Problems and IP Version 6

AIX Version 4.3 now includes support for IP Version 6, the next generation of Internet Protocol, in addition to IP version 4. Most AIX IP-related commands have also been enhanced to support both versions of IP. In most cases, the co-existence of IP Version 4 and Version 6 is totally transparent. However,

some older networking packages which are not IPv6-aware may have features that cause them to exhibit problems. This can often be resolved by simply changing the entry for that package in the `/etc/inetd.conf` file, from `tcp6` to `tcp`.

7.3.5 Migrating NFS and NIS from AIX Version 3.2

When migrating from AIX Version 3.2, the files `/etc/rc.nfs` and `/var/yp/Makefile` are not migrated. The migration process saves the old files in `/lpp/save.config/etc/rc.nfs` and `/lpp/save.config/var/yp/Makefile`. You must therefore reconfigure your Network Information Service (NIS) domain name before an NIS client will work.

For NIS servers, the NIS databases are unchanged, but you must reconfigure the NIS domain and restore any changes you may have made to `rc.nfs` and the `Makefile` because these files are replaced. User and group information is retained because the `passwd` and `group` files are not changed in a migration install.

For more information about managing TCP/IP in general, please consult the following publications:

- *AIX Version 4.3 System Management Guide: Communications and Networks*, SC23-4122
- *TCP/IP Network Administration*, Craig Hunt, O'Reilly and Associates Inc., Sebastopol, CA, ISBN 1-56592-322-7
- *DNS and Bind in a Nutshell*, P.Albitz and C.Liu, O'Reilly and Associates Inc. Sebastopol, CA, ISBN 1-56592-236-0
- *Managing NFS and NIS*, Hal Stern, O'Reilly and Associates Inc., Sebastopol, CA, ISBN 0-937175-75-7. Also available from IBM as publication number SR28-4969

7.3.6 Sendmail Update

The version of Sendmail that is supplied with AIX Version 4.3 has been updated to UCB Version 8.8.8. For further information, you can visit URL <http://www.sendmail.org>, which is the official Web site maintained by the Sendmail consortium.

7.3.6.1 Compatibility with AIX Version 3.2 and AIX Version 4.1

Sendmail Version 5.6.4, which was supported on AIX Version 3.2.5 and Version 4.1.5, is not compatible with Sendmail Version 8.8.8, which is supplied with AIX Version 4.3. Sendmail Version 8.8.8 will not work with the version 5.6.4 `/etc/sendmail.cf` configuration file, and there is no utility

available to migrate the old file. Consequently, the old /etc/sendmail.cf file is saved under the /usr/lpp/save.config directory and then overwritten during a migration. You must then reconfigure /etc/sendmail.cf manually.

If you have made complex changes to sendmail.cf and cannot immediately duplicate those changes in the new file, you can do the following to revert to your old Sendmail environment. Please be aware that Sendmail 5.6.4 is not supported on AIX Version 4.3; so this should be considered a purely temporary measure.

1. Log in as root.
2. Stop Sendmail with the following command:

```
# stopsrc -s sendmail
```
3. Save the existing Sendmail file:

```
# cp -p /usr/sbin/sendmail /usr/sbin/sendmail.888  
# cp -p /etc/sendmail.cf /etc/sendmail.cf.888
```
4. Copy back your old Sendmail files.

```
# cp /usr/lpp/save.config/usr/sbin/sendmail /usr/sbin/sendmail  
# cp /usr/lpp/save.config/etc/sendmail.cf /etc/sendmail.cf  
# cp /lpp/save.config/etc/sendmail.nl /etc/sendmail.nl
```
5. Restart Sendmail with the following command:

```
# startsrc -s sendmail -a "-bd -q30m"
```

7.3.6.2 Compatibility with AIX Version 4.2 and AIX Version 4.3

Sendmail Version 8.7.0, which is supplied with AIX Versions 4.2 and 4.3, is partially compatible with Sendmail Version 8.8.8 in that the Version 8.7.0 Sendmail.cf file can still be used with the new Sendmail binary. During a migration or update, the old Sendmail.cf file will be retained. However, you may wish to merge in the new options and rewrite rules that have been added in Version 8.8.8.

Chapter 8. Additional Information and Tasks

This chapter contains a few topics that, although they are not necessarily part of a successful migration to AIX Version 4.3, will assist you in the overall migration process or in optimizing and improving the subsequent performance of your system.

The subjects covered include:

1. Cleaning up and improving the layout of your system.
The tasks involved with planning, preparation, performing and post-processing a migration offer you the opportunity of cleaning up and optimizing your system.
2. Updating the system.
This section describes the update process from AIX Version 4.3.0 to AIX Version 4.3.1 and further.
3. NIM (Network Installation Management).
As mentioned in other parts of this redbook, NIM may be used to migrate a system to AIX Version 4.3. In this section, we describe how to set up a minimum NIM environment to do so.
4. Alternate disk installation utility.
5. Online documentation.
6. Web-based System Management.
7. Hardware migration.
Migration from earlier versions of AIX to the latest will sometimes also imply migration to new hardware. In this section, we explain how to transfer your existing environment to a new system.
8. UP to SMP migration.
Similarly, your migration may be part of a larger project to move from an older Uniprocessor system to an SMP system. In this section, we cover some of the things you will need to consider.

8.1 Cleaning Up and Improving the Layout of Your System

The task of migrating your system provides you with the perfect opportunity to assess your environment and identify areas where you may be able to improve performance, availability, or even make life a little easier for yourself when performing the usual administration chores. If the “non-production” time of your system has been severely limited, as most are, as the system has evolved, each addition has probably been made giving more priority to time

and convenience rather than efficiency. What may have been an excellent configuration and layout when you first entered production could have deteriorated over time, thereby reducing the throughput of your system. Changes in usage profile may also have altered the priority of certain applications. Your primary application of a few years ago could now be less important than later additions. By recognizing these changes and their progressive impact, you have the potential to improve and extend the useful life of the system and also improve user satisfaction at the same time. While planning your migration, we recommend that you prepare a system-usage profile and discuss this with users. Doing this will allow you to develop a clear understanding of the requirements and expectations of everyone and hopefully gain their agreement on resource priorities, if these are an issue.

Some areas to consider when cleaning up your system include:

- Disk Utilization Strategies
- Performance Strategies
- Availability Strategies
- Backup Strategies

8.1.1 Disk Utilization Strategies

The design of your volume groups and logical volume organization has a major impact upon the performance, availability and recovery capabilities of your system. The first thing to consider when evaluating your disk utilization strategy is volume group allocation.

8.1.1.1 Volume Groups

The most common hardware failure in a storage subsystem is disk failure, followed by failure of adapters and power supplies. When failures of this type occur, recovery is much easier if a well thought-out volume group design has been implemented.

Multiple Volume Groups:

Multiple volume groups are generally implemented for the following reasons:

- **Maintenance:**
Restricting the root volume group to storage of operating system information only is a good practice since operating system updates, additions and error recovery can be performed without danger to user data. Operating system backup and recovery is also much faster since user data and applications are not included in the backup. To separate user data from system related data means you will have to create and/or move the /u or /home file system onto a separate volume group.

- **Physical Partition Size:**

All physical volumes within a volume group must have the same physical partition size. In some cases, greater granularity may be required in allocation of physical partitions to logical volumes, and the only way to implement this is to place those logical volume with differing physical partition requirements into separate volume groups. An example of when this might be necessary would be in an environment where many small logical volumes need to be created for specialized file systems of a size that may entail much wasted space with 4 MB partitions (2 MB file systems, say). The greater flexibility afforded by the smaller partition is offset by increased performance overhead to the LVM.

- **Quorum Characteristics:**

If there is a requirement for implementing a file system in a non-quorum volume group, then a separate volume group that does not utilize quorum checking needs to be created.

- **Security:**

In order to allow important confidential data to be removed and stored in a secure place when required, a volume group consisting of physical volumes on removable disks can be created. At night, for example, the volume group can be exported and the disks with the sensitive data removed and stored in a secure place.

- **Multiple JFS Logs:**

In order to reduce bottlenecks in a volume group with many Journaled File Systems, multiple JFS logs can be implemented.

- **Switching Physical Volumes between Systems:**

In some cases, there may be a requirement to share a physical volume between systems for availability or shared access reasons, for example. If the physical volumes so utilized are maintained in a separate volume group, then this volume group can be exported and varied off line for re-use on another system without interrupting the normal operation of either system.

- **File System Size**

The size of any file system should be chosen to be large enough to accommodate the required files. Having said this, it is better to err on the small side as file systems can be easily expanded as the limit approaches. Reducing the size of a file system is a more complex procedure and therefore more work. Recovering free space that has been lost due to fragmentation can be accomplished using the `defragfs` command.

8.1.1.2 Physical Volumes

Another consideration is the number of physical volumes per volume group. This affects quorum-checking and mirroring. Quorum-checking is based upon the availability of a majority of Volume Group Descriptor Areas (VGDA) on the physical volumes that make up a volume group. In a volume group with only two volumes, one of those volumes will have two VGDA, and the other will have one. If the disk with two VGDA becomes unavailable for any reason, then the whole volume group will fail to varyon even if the other VGDA is perfectly good. With more than two disks, 51 percent or more of the VGDA must become unavailable for the varyon to fail and data to become inaccessible. This is particularly important in a two-disk mirrored system, where failure of the two VGDA disk will result in no access even though a good copy of the data is still available.

Enough physical disks must also be included to support the mirroring strategy required, both in terms of space for the mirrored copies and number of disks for the policies. If mirroring is to be done across the maximum number of physical volumes possible, for availability purposes, then it makes sense to have at least enough space to ensure that the copies are stored on separate physical volumes. A disk failure in this scenario will not impact access to the data.

8.1.1.3 Logical Volumes

The factors for deciding upon the number of logical volumes to create are basically performance and availability. As many logical volumes as there are different performance and availability requirements should be created. The design of the logical volumes themselves to satisfy these requirements is covered in Performance and Availability Strategies below. Within this, however, there is the consideration of disk space utilization. Depending upon the intended purpose of file systems that will be created within logical volumes, different fragment sizes may be required to optimally utilize the available disk space in the logical volumes. Choice of the correct fragment size can significantly improve disk space utilization. If there is a need for file systems containing many small files, then a logical volume for each file system with different requirements should be created.

8.1.1.4 File Systems

The primary considerations when creating file systems are as follows:

Fragment Size

Fragment size should be considered only if there will be many files in the file system less than 32 KB in size or compression if will be used. In the former case, the fragment size should be selected based upon the average size of

the files, in order to minimize wasted space. For example, file less than 512 bytes or that will grow in chunks less than 512 bytes would be more economically stored in a file system with a fragment size of 512.

Number of bytes per i-node (NBPI)

This parameter controls the number of i-nodes created in the file system. The main consideration here is the number of files that the file system will be expected to hold. If only a few large files will be stored, then increasing the NBPI to reduce the number of i-nodes created frees up disk resource that would otherwise have been used by the extra i-nodes. The NBPI and fragment size together directly affect the maximum possible size of a file system and this is therefore a further consideration.

Compression

If disk space is at a premium and performance is not the major issue, then file system compression should be considered. Using compression can enormously reduce the amount of storage space required by files at the cost of the overhead required for the compression. The algorithm is performed on a fragment basis, and its effectiveness is dependent upon the type of information contained in the file. Using larger fragment sizes will help to offset the performance overhead by reducing the number of allocation requests and physical I/O.

8.2 Performance and Availability Strategies

Having created volume groups and added the required number of physical volumes, the logical volumes and file systems need to be created. There are two basic considerations: performance and availability. Generally, designing for high performance will impact availability, and vice versa. The next two sections look at strategies from these perspectives.

8.2.1 Performance Strategies

The performance of a disk subsystem is a combination of factors that includes:

8.2.1.1 Adapters

This includes the physical performance capabilities of the particular adapter, as well as the organization of devices using the adapter. In order to maximize performance to high-speed devices on an adapter, the characteristics of both the adapter and devices need to be considered. For example, SCSI adapters can support multiple devices operating in either synchronous or asynchronous modes (see Small Computer System Interface Adapter for

information on SCSI technology). To achieve maximum throughput for a synchronous disk device, only other synchronous devices should be attached to the adapter, and the total bandwidth (or throughput) of these devices should not exceed the capabilities of the adapter itself. The same considerations apply to adapters of other types. If multiple devices are supported on the adapter, the total bandwidth available should not be exceeded.

Also, the fastest available adapter that meets the environmental requirements of the site, in terms of cable lengths and devices supported, should be selected to maximize performance. Other functions, such as command tag queuing and differential interfaces, can also improve performance.

8.2.1.2 Physical Disk Devices

Physical disk drives themselves support different levels of functionality in their hardware. For example, some drives support bad block relocation and elevator seek functions internally. Off-loading these functions from the Logical Volume Manager (LVM) to the drives themselves will increase performance. Also some disk subsystems, such as the IBM 7135, support striping (RAID 0) within the subsystem itself, which also increases performance.

Again, selecting disks with the fastest overall performance ratings should be the policy for maximizing performance.

8.2.1.3 Logical Volume Manager

While high performance hardware goes a long way to maximizing the performance of a disk subsystem, the software implementation in terms of data placement on the disks and access methods (random or sequential) are also vital to the overall result.

Under AIX Version 4, the LVM supports striping, which means that the logical partitions of a logical volume can be spread across multiple disks and therefore accessed concurrently. Striping will maximize performance for sequential reads and writes where the LVM can schedule consecutive reads and writes simultaneously to blocks on different disks. Performance will be further enhanced when the disks are on different adapters, thereby allowing full concurrency.

Whether striping is to be used or not, the placement of the data on the disk surface itself affects the performance of the subsystem. The LVM provides a number of parameters at logical volume setup that govern the policies it will enforce in terms of data placement and access. In order to maximize performance, the following policies should be adopted:

8.2.1.4 Intra-Physical Volume Allocation Policy

For best performance, logical partitions should be selected in the center of the disk.

8.2.1.5 Inter-Physical Volume Allocation Policy

For maximum performance, the maximum number of physical volumes available should be used for the logical volumes logical partitions. This allows the LVM to schedule requests for long sequential reads or writes across multiple physical disks in parallel.

8.2.1.6 Mirroring

Mirroring should generally be disabled for maximum performance. If it is required, however, then the scheduling policy should be set to `parallel` and the allocation policy set to `strict`. This will cause the LVM to place copies on separate physical volumes and to perform writes in parallel, thereby maximizing performance. In addition, reads will be scheduled from the copy of the data that is closest to a disk read/write head thereby improving read performance. Write verification and mirror write consistency should also be set to `no`. This will prevent the LVM from wasting a disk revolution on every write to read back the data for validity, and also it prevents the LVM from waiting for all writes to copies to succeed before returning successful completion of the write.

Adopting these policy settings in the LVM will maximize performance, but at the expense of availability. If availability is of equal importance, then compromises will be necessary.

8.2.1.7 File System

With regard to maximizing performance from the file system point of view, there are several configuration options that can be taken at file system creation time:

Fragment Size

Using the largest fragment size of 4096 KB will minimize allocation operations and maximize throughput of the file system. This could be at the expense of space utilization within the file system, depending upon the sizes of files they contain (see 8.1.1, "Disk Utilization Strategies" on page 116, for a discussion of maximizing disk-space utilization). Fragmentation of the file system will have an adverse effect on I/O performance since it will increase the number of seeks required to access data. The smaller the fragment size selected, the worse this problem can become. Regular defragmentation of the file system, will alleviate this problem, and can be accomplished using the `defragfs` command.

Compression

Using compression increases the overhead for reads and writes to the file system; therefore when maximum performance is desired, compression should not be used.

Log Devices

If many file systems are using the same log device, this can introduce a bottleneck. Reducing the number of file systems that will be concurrently accessing a log device will avoid this problem. In order to do this, multiple log devices should be created within the volume group. Further, to maximize performance, the log device should be on a different physical volume and preferably using a different adapter to the file systems sharing the log.

JFS File Buffering

The JFS uses 4 KB buffers for reading and writing data and returns `success` to a requesting application on receipt of the data. The actual physical write to disk is not performed until the buffer is full. This means that just using the JFS can improve disk I/O performance.

Special Note

Correct operation of some applications, databases for example, requires that when a write is requested, it is actually done immediately without buffering. In these cases, using the JFS may speed up performance, but will introduce inconsistencies if a crash occurs before the data is physically written to disk. The database logs would be out of sync with the JFS logs, resulting in an inconsistent state. This type of application should write directly to a logical volume. In all cases, checking with the application provider makes good sense.

8.2.1.8 Operating System Parameters

There are a number of operating system parameters that affect the performance of I/O subsystems. These parameters should be adjusted with caution as they have systemwide scope. This means that, although they may radically improve performance for one application, they may have a detrimental effect on others:

Sequential Read Ahead

This is a Virtual Memory Manager (VMM) feature that allows the VMM to read in pages of information from disk before they are actually required. If the VMM suspects that a large sequential read is about to take place, it will use the values set in the `minpgahead` and `maxpgahead` parameters to decide on how many extra pages of data beyond the current one it should read in. This

means that when requests for subsequent pages arrive, the required pages are already in memory and an I/O operation is not required, thereby saving time.

Disk I/O Pacing

This feature is intended to prevent those programs that generate very large amounts of I/O from saturating the I/O queues with requests and thereby causing the response time of less demanding applications to deteriorate. Disk I/O pacing enforces high- and low-water mark values on the number of I/O requests that can be outstanding for any memory segment (this effectively means for any file). When the number of outstanding I/O requests for a segment reaches the high water mark, the process making the requests is put to sleep until the number of requests has reached the low-water mark.

This feature is set to `off` by default. See the article in the online documentation on Use of Disk-I/O Pacing for further details on tuning these parameters.

SCSI Device Driver `max_coalesce` Parameter

When there are multiple requests in a SCSI device driver queue, it will attempt to reduce, or coalesce, these requests into a smaller number of larger requests. The largest request size, in terms of data actually transmitted, that the device driver will build is limited by the `max_coalesce` parameter.

Setting SCSI Adapter and Disk Device Queue Limits

It is possible to enforce a limit on the maximum number of outstanding requests on a queue for a given SCSI bus or disk drive. Setting these parameters can improve performance for those devices that do not provide sophisticated queue handling algorithms.

Controlling the Number of System pbufs

The LVM uses a construct called a pbuf to control pending disk I/O. In AIX Version 3, a pbuf is required for each page being read or written, which for applications with heavy I/O can result in pbuf pool depletion. In AIX Version 4, a pbuf is used for every sequential I/O request regardless of the number of pages involved, thereby reducing the load on the pbuf pool. It is possible to tune the number of pbufs available, and in some cases this can improve performance.

8.2.1.9 Applications

The final performance considerations, and probably the most important, are at the application level itself. The design of an application can have a major effect upon performance. It is not always possible to affect the way in which

applications operate, but on those occasions where it is, the following considerations should be taken into account.

Asynchronous Disk I/O

Applications may be able to use asynchronous disk I/O, which means that control returns to the application, from a read or write, as soon as the request has been queued. The application can then continue working while the physical disk operation takes place. Obviously, not all applications will be able to take advantage of this feature, but for those that can, the performance benefits can be significant.

sync and fsync

In a similar fashion to asynchronous disk I/O, the `sync()` system call schedules a write of all modified memory data pages to disk, but returns to the caller immediately. Conversely, the `fsync()` call does not return until the writing is actually completed. Those applications that absolutely *must* know whether a write was successful before they can continue will not be able to take advantage of the scheduling nature of `sync()`, but for those that can, again the performance benefits can be significant.

8.2.2 Availability Strategies

Designing a disk subsystem for availability rather than performance also involves a number of considerations, including:

8.2.2.1 Adapters

From an availability standpoint, it is better to design a storage system using more rather than less adapters. This is of particular benefit in cases where mirroring is to be used. Configuring mirrored copies on separate adapters means that failure of a single adapter will still leave the information accessible from the copy on the other adapter.

8.2.2.2 Redundancy

Redundancy is one of the most important mechanisms for ensuring availability. This entails having backups for all vital system components in much the same way as multiple adapters and mirroring above. Within storage subsystem components, this really means having backup power supplies, cooling fans, adapters, data paths, and spare disk drives that can be automatically switched in when required, with no service or information loss.

At a pure operating system level, redundancy is limited to mirroring and multiple adapters. Much greater availability guarantees can be achieved by using the features of external devices that provide many of the backup

features discussed. Devices available that support these features include the IBM 7135 and the 9570.

8.2.2.3 RAID

RAID levels 1, 3 and 5 provide increasing levels of availability and performance external to the operating system. The subsystems perform all of the RAID functionality under the covers and present an ordinary disk drive interface to the operating system. Subsystems which support RAID to varying degrees include the IBM 7135, IBM 3514 and IBM 9570.

8.2.2.4 Logical Volume Manager

As in the case of performance, there are several options that can be taken at logical volume creation time to maximize availability of data. These options include policies governing the placement of data on the physical disks and mirroring. Data can be divided into two categories: operating system data and user data. The mirroring setup is slightly different for each case.

Mirroring The Root Volume Group

This procedure will maximize availability of the operating system. A minimum of three physical disks should be in the rootvg to ensure that a quorum will always be available in the event of a single disk failure.

Note:

A full system backup should always be taken before performing any disk reorganization procedures.

Mirroring the root volume group involves setting up one or two copies of each logical volume in the volume group.

Important Note:

The mirrored copies must each be on a bootable physical volume, or a failure in the main bootable copy will not be easily recoverable. The boot logical volume should not be mirrored as this can cause problems. Instead, a new boot logical volume should be created on each physical disk containing a mirror copy.

The bootlist must be updated to reflect the new disks as boot devices so that in the event of failure of the main copy of the rootvg, a reboot can be effected from another copy.

Mirroring User Data

Mirroring user data also involves creating copies of all of those logical volumes requiring high availability. For maximum availability, the following policies should be selected:

Number of Mirrored Copies:

The number of copies of a logical volume maintained by the Logical Volume Manager can be one, two or three. Maximum protection against failure is provided by using three copies, though at increased overhead. Again, availability is mainly achieved at the cost of performance, though this will depend on the usage of the mirrored logical volume. If the volume is mainly used for read operations, then performance can actually be enhanced since the LVM will schedule reads from the disk where the read/write head is closest to the required data.

Inter-Physical Allocation Policy:

Having the logical partitions comprising the mirrored logical volume spread across the minimum number of disks will optimize availability. Ideally, each copy should be on a separate physical volume, which is itself on a separate adapter. To enable this, the `range` parameter should be set to `minimum`, and the `strict` parameter to `yes`. This will force the LVM to restrict each copy of the logical volume to as few disks as possible and to maintain the copies separately (no copy may share a disk). Prior planning to ensure adequate space exists on the physical disks to hold the entire logical volume will ensure each copy can be successfully kept on a single physical volume.

Intra-Physical Allocation Policy:

The actual location of the data on each physical disk will have no direct impact on availability. If, however, a center policy is selected, then although the LVM will try and fulfill the request on all of the mirrored copies, the inter-disk allocation policy will take preference. This essentially means that if there are not enough center located logical partitions on a disk, then rather than look at spreading the logical volume to another disk, edge or middle located partitions will be used instead.

Scheduling Policy:

For maximum availability, a sequential policy should be adopted. This means that writes will be scheduled one after the other to all copies of the logical volume, each write having to complete before the next occurs. This maximizes the chances of at least one copy surviving in the event of a system crash during the process.

Write Verification:

This feature should be switched on for maximum availability. Write verification

means that after every write to a disk, the data written is read back again to ensure its validity. This does have performance implications since every write will involve one extra disk revolution for the read verify operation.

File System:

Using the JFS provides some availability advantages over writing to raw logical volumes or using NFS, for example. The JFS records all changes to the meta-data of a file system into a log. If there should be a system crash, on reboot, the log is replayed, and the file system returned to its last consistent state. This prevents corruption of the file system and thereby assists in maintaining higher availability.

Application:

Applications themselves can be designed to be availability-aware. As the reverse of requirements for high performance, applications should avoid asynchronous I/O to ensure that any data written is committed to disk before continuing and risking inconsistencies. In addition, the `fsync()` system call should be used rather than `sync()`, so that the application can be sure that all modified pages in memory have been written before continuing.

The section on application-oriented performance considerations earlier in this section gives additional details on these system calls.

8.2.3 Backup Strategies

As soon as the system has been set up and the operating environment configured as required, a sensible backup strategy should be implemented immediately. During operation, valuable data will be created and stored within the storage subsystem that represents time and effort and in most cases, supports the business. The organization of the system and the user information created are subject to damage, no matter how carefully managed. Files can be accidentally erased, and hardware or software faults can destroy information or even the entire system. For these reasons, it is vitally important to have a procedure in place that will allow you to be able to recover the system back to a point at which work can continue. Backing up the system involves making copies of all the information contained within it onto some medium that can be stored separately. The copies can then be used to re-create the system after a failure has been repaired, or information accidentally lost. The information in the system is usually highly dynamic, and therefore frequent copies or updates to changed information, also known as incremental backups, should be taken. The frequency and content of the updates or backups is unique for each business and depends upon the rate of change of information and the relative importance of that information.

Evaluating this is part of the process of developing a backup strategy. The following points should be considered:

Ensuring Recovery from Major Losses

Consider every potential catastrophe, however unlikely, and determine whether recovery would be possible. If the backup media was lost in some natural disaster, would recovery be possible? Obviously, it is necessary to factor in the likelihood of a particular disaster, but this must be done in conjunction with consideration for the value of the data. It's not much comfort to reflect how unlikely the ball of lightning that destroyed the backup media inside a safe was when the business is ruined as a result.

Check Backups Periodically

There are many different types of backup media, each with varying degrees of reliability and longevity. Ensure that you regularly check the condition of your backups on a basis that is consistent with the characteristics of your backup media.

Keep Old Backups

Although it is a good policy to develop a regular cycle for re-using backup media, complete copies should be maintained for some time as it can often be a while before it is noticed that a particular file is damaged or unusable, by which time the backup copies may contain copies of the damage. It is therefore a good plan to implement a recycling policy such as the following:

- Recycle all media except Friday backups, weekly.
- Recycle all Friday media except the last in the month, monthly.
- Recycle all monthly media except the last in the quarter, quarterly.
- Keep the quarterly backups indefinitely. This will always ensure the ability to access information up to three months old at various levels of currency.

Check File Systems before Backing Up

Making a backup of a damaged file system achieves nothing and can turn into a disaster if the data is needed for recovery. It is therefore a good idea to check file systems before backing up to ensure integrity.

Ensure Files are Not in Use During Backup

Using standard tools, it is impossible to know the state of backed-up files if the files were actually in use at the time of the backup. Backups should therefore be taken when the system, or files in question, are not in use.

Back Up the System before Implementing Any Major Changes

Major changes always introduce the possibility of errors and hence loss of data. It is always sensible to take a backup prior to any such activity.

8.2.3.1 Backup Planning

There are essentially two types of backup: a complete system backup and an incremental backup. A complete system backup policy should be used when data does not change frequently. The backups should be scheduled at a frequency that allows complete recovery of business-critical information. For example, if database update runs are done weekly, then a backup after each update run is sensible. An incremental policy should be used when information is extremely dynamic. Full system backups are taken at fixed intervals; then backups of only the information that has changed are taken at shorter intervals. The frequency of the incremental backups depends upon the criticality of the data and the volume of data that has changed. Since recovery from incremental backups requires reloading the last full backup, followed by application of the incremental backups between then and the point of failure, the frequency of incremental backups should be set at a value which is a balance between criticality of information and the number of incremental backups that will need to be applied.

Complete System Backup:

In a complete system backup, a copy is made of everything on the system. This can then be used to restore the complete system in the event of a failure. The complete backup can contain operating system and user data, although as we mentioned previously, it is more sensible to maintain these two separately for the following reasons:

- User data changes more regularly than system data, and the backup will be smaller if the two are kept separate.
- It is quicker and easier to restore user data when kept separate from the operating system. Damage that only affects the operating system only requires the operating system backup to be restored and vice versa.

Incremental Backup:

In an incremental backup, only the data that has changed since the last backup is copied. This can significantly reduce the amount of data that is copied and consequently the backup time. It does, however, require a little more discipline, since the media that reflects the latest state of your system will include at least one full backup and a number of smaller incremental backups that will need to be tracked.

8.2.3.2 Backup Methods

There are several methods and tools available for backing up data. The following commands are available in AIX and can be used to implement whatever backup policy you have decided best fits your environment.

backup:

The `backup` command allows backup by file name or by file system.

mksysb:

The `mksysb` command creates a complete installable image of the root volume group. It can be used as boot media for recovering a system with severe problems.

savevg:

This command backs up a user volume group. If it is used to back up the root volume group, it will not create a bootable image.

cpio:

The `cpio` command copies files into and out of archive storage. The `cpio` format is common across many platforms and so can be used for exchange of information between systems.

dd:

The `dd` command converts and copies information from one device to another. It does not group multiple files in any particular format; it just streams the data and performs any supported conversion from the source to the target device. The `dd` command is commonly used with raw devices.

tar:

The `tar` command manipulates archives of files and directories. It will create an archive on the output device, write files and directories to it, and then extract them when required.

rdump:

The `rdump` command backs up files by file system to a device on a remote machine.

pax:

This POSIX-conformant command reads and writes `tar-` and `cpio-`compliant archives.

8.2.3.3 Backup Media

So far, backup purposes, policies, and commands have been discussed. This leaves the important topic of the actual media that the backup will be stored on. Although magnetic tape devices are the most common form of backup medium, the design of these devices can vary dramatically. When choosing a backup device, you should take the following points into consideration.

Performance

It is important to consider the length of time that a backup will need to complete. This is a function of the volume of data and the speed at which the device can write it to the media. If backups need to be taken every evening, then a device capable of completing the process in a reasonable amount of time should be chosen.

Capacity

This is a question of cost, storage space, and ease of use. The more information that can be packed onto the media, the better, generally speaking, as this means that less media will be required for backups. Storage space is therefore less and if a single cartridge is sufficient, no operator intervention may be required. If multiple cartridges will be required, then a tape library should be considered since a backup procedure that relies upon manual changes and cataloging of tapes can often lead to mistakes.

Longevity

As mentioned earlier in this section, the length of time that the media can be safely stored is important. This governs not only the backup cycles but also how long the media can be safely reused.

Reliability

This is probably the most important issue when considering a backup device. Although checks on the success of a backup can and should be performed, unreliable devices that have a high percentage of errors and produce occasional unreadable backups are time-consuming and dangerous. Some devices may also encounter read-back problems, even though the media copy may be good.

Compatibility

Device technology improves and changes with time. If you intend to change your backup devices, it can make the change much easier if your new devices support existing archive and backup media.

Device Technology

Although cost per megabyte is often the deciding factor here, you should really take the factors mentioned above into account before deciding upon

the device technology to use. You may also benefit from using a combination of technologies. For example, you may make use of tape for full system backups and combine that with optical storage for archiving short-lived user data.

8.3 Network Install Manager (NIM)

This section provides a step-by-step guide to setting up a minimal NIM environment on AIX Version 4.3. It is not intended as a replacement for the official NIM documentation, but is simply meant to assist you in setting up a basic NIM environment. The main focus is to setup NIM in such a way that it can be used to migrate and update other systems to AIX 4.3. Other features of NIM will not be covered here, but can be found in the *AIX Version 4.3 Network Installation Management Guide and Reference*, SC23-4113.

8.3.1 NIM Overview

Network Installation Manager (NIM) was introduced with AIX 4.1 as a more sophisticated successor to the `netinstl` function available with AIX Version 3. NIM covers a wide area of system management activities, ranging from installation of machines, installation and updating of software, rebooting systems or switching them to diagnostics or maintenance mode. As the term NIM implies, all of this is done over the network. NIM is also an important building block for the SP environment as PSSP uses NIM to install the nodes.

The terms and definitions used by NIM are as follows:

NIM master

The system which contains the NIM database is called the NIM master. It controls all of the NIM definitions and stores them in an ODM database. Normally, the master also holds most of the data, for example the filesets, that are to be installed, but this task may be shared among multiple servers by using NFS if required. The master is the only machine that is permitted to execute commands on the other machines in the NIM environment.

NIM client

A NIM client is a system which has a subset of the NIM filesets installed and uses remote resources provided by the NIM master. Usually, a system becomes a NIM client by being installed or migrated by a NIM server, although you can also add existing systems to a NIM environment. In most cases, the NIM client is controlled by the NIM master.

NIM Objects

NIM objects are the machines, networks, filesets, and other resources that have to be defined before they can be used. For example, to install a machine, NIM needs to know about the machine, how to reach it, what boot image is required, a SPOT (Shared Product Object Tree) and a directory with filesets or a mkysyb file.

NIM Operations

NIM allows an administrator to perform a wide variety of operations of machines that are part of the NIM environment. However, the operation we will focus on here is the operation to install the base operating system on a machine. Other operations supported by NIM are: capturing a mkysyb, rebooting a system, performing an `update_all` on a machine, checking for certain fixes on remote systems, and much more.

8.3.2 NIM Setup Process

The setup of a NIM server can be a complex process. If you need to define lots of existing machines, with the ability to deliver and install many different versions of AIX, it can be quite time-consuming. However, to support only a few systems with a limited number of AIX versions, or possibly the same operating system version the NIM server is running, NIM provides an easy setup procedure that greatly simplifies the process.

8.3.2.1 Installation of the NIM Filesets

NIM consists of the following filesets. If they are not already installed on your intended NIM server, use SMIT or the `installp` command to install them at the latest available level

```
# lsllpp -L bos.sysmgt.nim.*
Fileset                Level  State  Description
-----
bos.sysmgt.nim.client  4.3.1.1  A      Network Install Manager - Client
                        Tools
bos.sysmgt.nim.master  4.3.1.1  A      Network Install Manager - Master
                        Tools
bos.sysmgt.nim.master_gui 4.3.1.0  C      Network Install Manager - GUI
bos.sysmgt.nim.spot    4.3.1.1  A      Network Install Manager - SPOT
#
```

8.3.2.2 Configuration of The NIM Master

Once the filesets are installed, use the following command to configure a basic NIM environment capable of migrating and installing systems.

```
# smit nim_config_env
```

SMIT will then display the following screen:

```
Configure a Basic NIM Environment (Easy Startup)

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

                                     [Entry Fields]

  Initialize the NIM Master:
* Primary Network Interface for the NIM Master      []          +

  Basic Installation Resources:
* Input device for installation images              []          +
* LPP_SOURCE Name                                  [lpp_source1]
* LPP_SOURCE Directory                             [/export/lpp_source] +
  Create new filesystem for LPP_SOURCE?            [yes]          +
  Filesystem SIZE (MB)                             [400]          #
  VOLUME GROUP for new filesystem                  [rootvg]       +
* SPOT Name                                         [spot1]
* SPOT Directory                                   [/export/spot] +
  Create new filesystem for SPOT?                  [yes]          +
  Filesystem SIZE (MB)                             [200]          #
  VOLUME GROUP for new filesystem                  [rootvg]       +

  Create Diskless/Dataless Machine Resources?      [no]           +
Specify Resource Name to Define:
  ROOT (required for diskless and dataless)       [root1]
  DUMP (required for diskless and dataless)       [dump1]
  PAGING (required for diskless)                  [paging1]
  HOME (optional)                                  [home1]
  SHARED_HOME (optional)                          [shared_home1]
  TMP (optional)                                   [tmp1]
Diskless/Dataless resource directory              [/export/dd_resource]
  Create new filesystem for resources?             [yes]          +
  Filesystem SIZE (MB)                             [150]          #
  VOLUME GROUP for new filesystem                  [rootvg]       +

  Define NIM System Bundles?                      [yes]          +

  Add Machines from a Definition File?            [no]           +
Specify Filename                                   []

* Remove all newly added NIM definitions          [no]           +
and filesystems if any part of this
operation fails.

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

The parameters that need to be customized for your own particular environment are as follows; others can be left at their default values.

1. Primary Network Interface for the NIM Master.
This is the network interface that will be used for NIM operations. Use the **F4** function key to display a list of available options, for example your token-ring adapter.
2. Input device for installation images.
For example, CD-ROM.
3. LPP_SOURCE Name.
This can be any name and is used to uniquely identify this resource within the NIM environment. A suitable name would be "AIX431".
4. LPP_SOURCE Directory.
This is the directory where you want the lpp_source to be created. It is advisable that you do not use the root volume group to store NIM resources. If necessary, create a separate volume group dedicated to NIM resources.
5. SPOT Name.
This is a name to uniquely identify the SPOT resource. It can be any meaningful name you choose. For example, "spot_AIX431."
6. SPOT Directory.
This is the directory where the SPOT resource will be created. Again, we recommend you do not store NIM data in the rootvg.
7. Remove all newly added NIM definitions and file systems if any part of this operation fails. By setting this option to `yes`, it allows you to retry the complete operation again if any portion fails.

8.3.2.3 Configuration of a Machine Resource

As soon as the basic set up of the NIM master is completed, you can then configure the machine or machines you want to install or migrate with NIM. The easiest way to do this is by issuing the following command.

```
# smit nim_mkmac
```

SMIT then displays the Define a Machine panel.

```

Define a Machine

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

                                     [Entry Fields]
* NIM Machine Name                    [km1060g]
* Machine Type                        [standalone]      +
* Hardware Platform Type              [rs6k]           +
  Kernel to use for Network Boot      [up]             +
  Primary Network Install Interface
*   Ring Speed                        []                +
*   NIM Network                       network1
*   Host Name                          km1060g
  Network Adapter Hardware Address    [0]
  Network Adapter Logical Device Name []
  IPL ROM Emulation Device            []                +/
  CPU Id                               []
  Machine Group                       []                +
  Comments                             []

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

```

You will need to input the following information to define the client machine to NIM. Note that NIM derives the required network information by using the machine name and standard name resolution.

1. NIM Machine Name.
The hostname of the machine you wish to define as a client for installation and migration purposes.
2. Hardware Platform Type.
This field specifies the hardware architecture of the client machine. Pressing the **F4** function key displays a list of available options, for example, rs6k, rspc, chrp, and so on.
3. Kernel to use for Network Boot.
This field specifies the type of kernel to use for booting the client machine. It can be either `up` or `mp` depending upon whether the machine is a single processor or multiprocessor machine.
4. Ring Speed.
This is used to specify the interface speed if using a token-ring network.
5. Network Adapter Hardware Address.
This is the hardware address, in hexadecimal, of the network adapter on the client machine. A value of 0 (zero) can also be entered if the address is not known. In this case, the IP address of the client machine must be specified in the IPL ROM bootp packets. See the SMIT help screen for

more information about this option. The hardware address of the primary token-ring adapter of your machine can be displayed with the command:

```
# lscfg -v -l tok0
```

8.3.2.4 Configuration of a Bundle Resource

If you want to install a specific set of filesets on a client machine, it is possible to define a Bundle Resource. This can be used during initial installation of a system, during migration, or for software install operations. A Bundle is simply a list of individual filesets that you want to install on the client machine. The Bundle is defined in a text file by entering each fileset on a line of its own. See the predefined bundles in `/usr/sys/inst.data/sys_bundles` for an example.

For migration of a machine, no Bundle file is necessary, but one can be specified in order to install additional software during the migration.

8.3.2.5 Configuration of a mksysb Resource

Since initial installation can be done by applying a mksysb backup to a machine, it is also possible to define a mksysb as a resource to NIM and use that system backup to install or recover a machine. Migration does not make use of a mksysb resource.

8.3.3 Migrating with NIM

Once you have configured your NIM master and client machines, you can then use the following steps to install or migrate the client.

1. Log in as root on the NIM master and enter the following command

```
# smitty nim_tasks
```
2. Select **Install and Update Software**.
3. Select **Install the Base Operating System on Stand-alone Clients**.
4. Select the client machine that you wish to migrate.
5. Select **Install from installation images**.
6. Select the **SPOT** and **LPP_SOURCE** that you have defined.
7. Select any additional Bundles or filesets that you have configured.
8. Press **Enter** to execute the NIM operation.

The client machine should now be booted in Service mode. Note that, on older machine types, for example 3XX and 5XX models, you will have to create and use the IPL ROM Emulation Media, which allows the machine to boot across a network. A SMIT option is available under the NIM menus to allow you to do this. You will need to ensure that your Service-mode bootlist

is set to allow a network, or IPL ROM emulation, boot if necessary and also that the network settings are correct.

The system will then boot from the NIM master using bootp and tftp and will present you with the standard installation menus. From this stage on, it appears exactly as if you had booted from the AIX Version 4.3 installation media.

8.4 Updating from AIX Version 4.3.0

The term *migration* really only applies to updating machines from one version of AIX to another by means of an actual installation. But there is also the situation where your system is running AIX Version 4.3.0 and you would like to update it to the latest available level. This is termed an *update* and is accomplished using the `installp` command.

Important Reminder !!

Be sure to read the AIX Version 4.3 Release Notes before starting the update. The Release Notes come with the package that contains the installation media.

8.4.1 Using SMIT to “Update all”

The easiest way to update all the installed software on your system to the latest available level is to use the `update_all` procedure. `Update_all` then checks what software is installed on the system and searches the installation media for filesets that are later versions than those installed. `Update_all` can also be done in a NIM environment.

Before updating all your filesets, you should make sure that you have already installed everything you want to have on the system. The `update_all` process does not add any new filesets. Also, be sure to make a backup of the system before beginning the update.

To perform an update that updates your system from AIX Version 4.3.0 to AIX Version 4.3.1, do the following:

1. Log in as root on the system to be updated.
2. Insert the installation media. For example, a CD-ROM.
3. Update and commit the `bos.rte.install` fileset first, either by using SMIT or the `installp` command.

4. Now start the update all procedure by entering the command:

```
smit update_all
```

After selecting the INPUT device/directory for software, you may continue by pressing the **Enter** key and accepting all the installation defaults.

```
Update Installed Software to Latest Level (Update All)

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 update                        _update_all
PREVIEW only? (update 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
VERIFY install and check file sizes?         no
DETAILED output?                             no
Process multiple volumes?                    yes

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

Since the filesets that are being updated may be spread over two or three CD-ROMs, with the AIX Version 4.3.2 multi-volume CD-ROM sets, you may be prompted to install the next CD-ROM if the procedure detects that the fileset to be updated is not on the current one. With older, non-multi-volume media, you may receive the following error message during the update_all procedure:

```
Not found on installation media
```

To recover from this error, do the following:

1. Remove the current CD-ROM.
2. Insert the next CD-ROM into the drive.
3. Issue the command again.

8.4.2 Obtaining the Latest Fixes

When migrating or updating your system, it is advisable to install the very latest version of the AIX filesets that are available. You can contact the IBM Software Download FTP Server at the following URL or one of its mirrors, which are available worldwide.

```
ftp://service.software.ibm.com
```

You may also use `fixdist`, a tool provided by IBM to support customers with downloading the fixes they need based on APAR or Fix numbers. The `fixdist` tool is also available through anonymous FTP from `service.software.ibm.com`.

For more information on your nearest FTP server or on the `fixdist` tool, refer to the AIX Version 4.3 Release Notes or visit the URL.

```
http://service.boulder.ibm.com/rs6000/
```

8.4.3 Multiple Volume CD-ROMs

AIX Version 4.3 supports multiple volume CD-ROMs. During installation of a fileset or a bundle of filesets, you may be prompted to insert another CD-ROM volume to complete the installation. You can disable this feature by adding the `-s` flag to the `installp` command or set the Process multiple volumes? field in SMIT or Web-SM to `no`; NIM does this automatically.

Please note that during a BOS installation of AIX there is no support for multiple volume CD-ROMs; so you will not be asked to switch CD-ROMs.

8.4.4 The `bos.content_list` Fileset and `which_fileset` Command

AIX Version 4.3 provides you with a new fileset called `bos.content_list` which includes one file, `/usr/lpp/bos/AIX_file_list`. This file contains a list of all AIX files and the fileset to which the file belongs. To access the information, there is a new command, `/usr/sbin/which_fileset`, shipped with the `bos.rte.install` fileset. This allows you to easily establish which fileset any given file belongs to.

For example, to check which fileset the `installp` command is shipped in, enter:

```
# which_fileset installp
/usr/sbin/installp      bos.rte.install 4.3.1.0
```

8.5 Alternate Disk Install Utility

The `alt_disk_install` command gives users another way to update AIX to the next release or maintenance level without having to schedule an extended period of system downtime.

The update can be performed in two ways.

From a mksysb image

Installing a mksysb requires an AIX Version 4.3 mksysb image or Version 4.3 mksysb tape. The `alt_disk_install` command is called, specifying a disk or disks that are installed in the system but are not currently in use. The mksysb is restored to those disks such that, if the user chooses, the next reboot will boot the system from the new image.

Note: If needed, the `bootlist` command can be run after the new disk has been booted, and the bootlist can be changed to boot back to the older version of AIX.

Cloning

Cloning allows the user to create a backup copy of the root volume group. Once created, the copy may be used either as a back up or it can be modified by installing additional updates. One possible use might be to clone a running production system and then install updates to bring the cloned rootvg to a later maintenance level. This would update the cloned rootvg while the system was still in production. Rebooting from the new rootvg would then bring the level of the running system up to the newly installed maintenance level. If there was a problem with this level, simply changing the bootlist back to the original disk and rebooting would bring the system back to the old level.

Currently, you can run the `alt_disk_install` command on AIX Version 4.1.4 and higher systems for both of these functions. The `bos.alt_disk_install.rte` fileset must be installed on the system to do cloning to an alternate disk, and the `bos.alt_disk_install.boot_images` fileset must be installed to allow a mksysb install to an alternate disk.

The mksysb image that is used must be created before installation and must include all the necessary device and kernel support required for the system on which it is installed. No new device or kernel support can be installed before the system is rebooted from the newly installed disk.

Note: The level of mksysb that you are installing must match the level of the `bos.alt_disk_install.boot_images` fileset. At this time, only AIX Version 4.3 mksysb images are supported.

When cloning the rootvg volume group, a new boot image is created with the `bosboot` command. When installing a mksysb image, a boot image for the level of mksysb and platform type is copied to the boot logical volume for the new alternate rootvg. When the system is rebooted, the `bosboot` command is run in the early stage of boot, and the system will be rebooted again. This is to synchronize the boot image with the mksysb that was just restored. The system will then boot in normal mode.

At the end of the install, a volume group, `altinst_rootvg`, is left on the target disks in the varied off state as a place holder. If varied on, it will show as owning no logical volumes, but it does in fact contain logical volumes. Their definitions have been removed from the ODM because their names now conflict with the names of the logical volumes on the running system. It is recommended that you do not vary on the `altinst_rootvg` volume group, but just leave the definition there as a place holder.

When the system reboots from the new disk, the former rootvg will show up in an `lspv` listing as `old_rootvg`. To remove this definition, for example, when you are ready to use the disks for something else, run the following command:

```
alt_disk_install -x old_rootvg
```

While the definition still exists, you can use the `bootlist` command to change the bootlist to reboot from the old rootvg if necessary.

The alternate root file system is mounted as `/alt_inst`; so other file systems also have that prefix (`/alt_inst/usr`, `/alt_inst/var`). This is how they must be accessed if using a customization script.

Note: If you have created an alternate rootvg with `alt_disk_install` but no longer want use it, or you want to run `alt_disk_install` commands again, do not run `exportvg` on `altinst_rootvg`. Simply run the `alt_disk_install -x` command to remove the `altinst_rootvg` definition from the ODM database.

The reason you cannot run the `exportvg` command (or the `reducevg` command) is that the logical volume names and file systems now have the real names, and `exportvg` removes the stanzas for the real file system from `/etc/filesystems` for the real rootvg.

If `exportvg` is run by accident, be sure to re-create the `/etc/filesystems` file before rebooting the system. The system will not reboot without a correct `/etc/filesystems` file.

The AIX Version 4.3.1 or later version of `alt_disk_install` allows phases in the install. The install is broken into three phases, the default being to do all three phases.

Phase 1 creates the `altinst_rootvg` volume group, the `alt_logical` volumes, the `/alt_inst` file systems, and restores the `mksysb` or `rootvg` data.

Phase 2 runs any specified customization script, installs updates, new filesets, fixes or bundles (cloning only), copies a `resolv.conf` file, if specified, and copies files over to remain a NIM client, if specified.

Phase 3 unmounts the `/alt_inst` file systems, renames the file systems and logical volumes, removes the `alt_logical` volumes, names ODM and varies off the `altinst_rootvg`. It sets the bootlist and reboots, if specified.

You can run each phase separately, run Phases 1 and 2 together, or run Phases 2 and 3 together. Phase 2 can be run multiple times before Phase 3 is run. You must run Phase 3 to get a volume group that is a usable `rootvg`. Running Phase 1 and 2 leaves the `/alt_inst` file systems mounted.

If you have run Phase 1 and or Phase 2 and want to start over (remove the `altinst_rootvg`), run the `alt_disk_install-x` command to clean up.

8.5.1 Migrating with `alt_disk_install`

In order to use the alternate disk install utility for a migration or update, the running system must be at AIX Version 4.1.4 or later. You will also need to install the `alt_disk_install` fileset from the AIX Version 4.3 installation media.

8.5.1.1 Migration Using a `mksysb` Backup

This procedure allows you to install AIX Version 4.3 onto a spare disk or disks in your system, providing you with the possibility to switch between the old and the new operating system.

1. Create an AIX Version 4.3 `mksysb` on a system with the same device configuration and hardware as the system you will be migrating. This will normally be from a test platform that you have used for migration validation.
2. Go to the machine to be migrated and make sure that the fileset `bos.sysmgmt.sysbr` is installed at the level of the running operating system.

3. Install the bos.alt_disk_install fileset at the level of the mksysb (AIX 4.3.0 or higher).
4. Create the new alternate disk on the spare disks in your system using SMIT or the command line, for example,

```
alt_disk_install -d <mksysb location> <target disk(s)>
```

The `alt_disk_install` command will install the mksysb on the alternate disks, and on the next reboot, the machine will boot from the AIX Version 4.3 image.

If you experience problems, you can switch back at any time by using the following command and rebooting.

```
# bootlist -m normal <original_boot_disk>
```

8.5.1.2 Migration and Cloning

The `alt_disk_install` command can also be used to clone a running system. This gives you the ability to make a copy of your root volume group while the system is still in production. You can then migrate the cloned copy, leaving your original root volume group untouched. To clone your root volume group, do the following:

1. Select the target disks to be used for cloned copy of your rootvg.
2. Make sure that the bos.sysmgt.sysbr fileset is installed at the level of the running operating system.
3. Install the bos.alt_disk_install fileset from the AIX installation media, (AIX 4.3.0 or higher).
4. Clone your system using SMIT or the command line.

```
# alt_disk_install -C <target disk(s)>
```

5. On reboot, the system will boot from the cloned disk.

You now have two identical rootvgs and boot disks. You can then migrate one of them to AIX Version 4.3 and perform any testing that may be required. If you experience problems, you can switch back to the other boot disk where the old version of AIX is still unchanged and runnable.

During cloning of your current rootvg, you are also able to perform an `update_all` to the cloned rootvg, for example cloning AIX 4.3.0 and simultaneously updating it to AIX 4.3.1.

8.6 Online AIX Documentation

The online documentation supplied with AIX Version 4.3 is now in HTML format as compared to the use of InfoExplorer hypertext format in earlier releases. This means that the documentation can now be accessed from virtually any client platform with a Web browser. However, you will need to do some basic configuration before the documentation is available.

For more information, please refer to the *AIX Version 4.3 Installation Guide*, SC23-4112. You can also point your browser to www.rs6000.ibm.com/resource/aix_resource/Pubs/ and access the AIX documentation using the Web.

8.6.1 Online Documentation CD-ROMs

The AIX Version 4.3 documentation is available on two CDs:

1. AIX Version 4.3 Base Documentation CD.
2. AIX Version 4.3 Extended Documentation CD.

The CDs can either be mounted or installed. In each case, you will need to use a browser, such as the Netscape Navigator that is shipped with the AIX Version 4.3 Bonus Pack, to access the information on them.

8.6.2 Installing the AIX Documentation

To access the documentation on CD-ROM do the following:

1. Insert the documentation CD-ROM in the CD-ROM drive.
2. Create a CD-ROM file system, for example, using `smit crcdrfs`. When asked for the mount points, please specify `/infocd` for the base and `/exinfocd` for the extended documentation CD.
3. Mount the CD-ROM file system.
4. Run the script (`linkbased` or `linkextcd`) located in the `/infocd` or `/exinfocd` directory to create the documentation links.

You are now ready to access the AIX documentation from the CD-ROM by using the `man` command.

Note: Before unmounting the CD-ROM, make sure that you run the `unlinkbased` or `unlinkextcd` script in order to remove the links from the file system pointing to the CD-ROM. After unmounting, you will not be able to access the online documentation.

You are also able to install the documentation on a local hard drive, which is usually much faster and ensures that the documentation is available at all times. To install on a hard drive:

1. Insert the base documentation CD-ROM into the CD-ROM drive.
2. Run the command `smit install_latest`.
3. Select the CD-ROM drive as the input device.
4. Choose the individual filesets to be installed for a selective installation or keep “_all_latest” in order to install all the documentation filesets.
5. Once the installation has completed, remove the CD-ROM from the drive.
6. Repeat the above steps with the Extended Documentation CD, if required.

8.6.3 Installing a Browser

In order to access the documentation through a browser in addition to the `man` command, you must install a Web browser, such as Netscape Navigator, which is provided in the AIX Bonus Pack. To install Netscape Navigator from the Bonus Pack CD-ROM, do the following:

1. Insert the Bonus Pack CD-ROM in the CD-ROM drive.
2. Run the command `smit install_latest`.
3. Select the CD-ROM drive as the input device.
4. Select the “Netscape Navigator” fileset and allow the install to complete.

You can then start Netscape and point the browser to

```
/usr/share/man/info/en_US/a_doc_lib/aixgen/topnav/topnav.htm
```

to access the top-level navigation entry that provides links to all the available documentation.

8.6.4 Installing a Documentation http Server

In order to make the HTML-based documentation available to other systems in the network, you will have to install and configure an HTTP server. Using an HTTP server has the advantage that the documentation need only be installed on one system. All other machines on the network equipped with a browser, workstations or PCs for example, are also able to access the documentation.

The AIX Bonus Pack includes the Lotus Domino GO Webserver as well as the Netscape FastTrack Server, both of which may be used for serving the documents on the network. To configure an http documentation server:

1. Install the Web server software, for example the `internet_server.*` packages for Lotus Domino Go, using SMIT, WebSM or the `installp` command.
2. To perform the basic setup and configuration of the HTTP server, access the Lotus Domino Go Server from a browser by specifying the hostname as the URL. Your browser will then display a welcome page with a link to the configuration and administration forms that allow you to configure the server. Complete server documentation is also available from the welcome page.
3. To begin serving the AIX documentation from the HTTP server, you must link the directory containing the documentation to the directory served by the HTTPD process. This can be done by running the command `smitty system` or `wsm system` and selecting Internet and Documentation Services. You must then specify that your documentation information is local and the type of Web server you are running. This will then create the necessary links.

You are now ready to access the on-line documentation from the network by pointing your browser to the following URL:

http://yourhost/doc_link/en_US/a_doc_lib/aixgen/topnav/topnav.htm

8.7 Web-Based System Manager

Starting with AIX Version 4.3, AIX provides a new set of tools for day-to-day system administration called Web-based System Manager. These tools offer virtually the same functionality that is available with SMIT, but are based on state-of-the-art technology. By exploiting HTML and Java, it is possible to manage a system over a network from any platform that supports a Java-enabled browser. Note that SMIT is still available for users of non-graphical displays.

Set up and use of Web-based System Manager are well documented in the *AIX Version 4.3 System Management Guide: Operating System and Devices*, SC23-4126, Chapter 15, "Setting Up and Running Web-based System Manager."

8.7.1 Installing and Using Web-Based System Manager

To use Web-based System Manager in a local-only mode requires installation of the `sysmgt.websm.apps` fileset and its necessary requisites. In AIX Version 4.3.1 and later, these filesets are installed automatically. No additional configuration is necessary for local use.

To invoke the Web-based System Manager Launchpad, use the command `wsm`. As with SMIT, fastpaths are also available, for example, `wsm users` for direct access to the user management application.

Since `wsm` behaves like a normal X-based application, you may redirect the output by means of the `DISPLAY` environment variable to another workstation or a PC running an X-server.

To configure Web-based System Manager for remote operation, you should consult the Web-based System Manager README file located in `/usr/websm`. This file also includes the latest information about the product.

8.8 Migrating to Different Hardware

Migration from an early release of AIX to a later one is often combined with migration from older hardware platforms to the latest models. Migration of both AIX and the hardware has to be separated into two distinct steps. One is to migrate the current environment to the latest available level of AIX. The next is to transfer the complete environment to the new hardware by using a `mksysb` backup.

Note:

Whenever possible, we recommend that you install the new hardware as a "clean" AIX Version 4.3 system and migrate the configuration and data from the old to the new system. This must be done manually, for example, adding users, transferring applications and so on.

The biggest advantage is that you can use the new system for test purposes until you feel comfortable with the new configuration.

8.8.1 Migrate the Existing System

Migrating an existing system is covered in detail throughout this redbook. Start by carefully reading the planning and preparation chapters. Then perform the migration procedure as described in Chapter 7, "Migrating Your System" on page 97.

Assuming everything goes well, your system should soon be up and running with AIX Version 4.3 and the same configuration it had before. Now, use the `mksysb` command to save the new root volume group and then save your user data using your preferred tool.

8.8.2 Installing on the New System

Once you have migrated and backed up your existing environment, you can transfer the configuration to your new system by doing the following:

1. Boot the new system from the AIX Version 4.3 installation media or through NIM and when presented with the Installation Menu, select to restore the system from a mksysb.
2. Insert the mksysb tape you created after migrating your old system.
3. Begin the installation.

Any filesets that are required for the new hardware that are not present on your mksysb tape will be automatically read from the installation media during the installation. No user intervention is required.

Of course, any software that requires license keys will have to be re-registered and the new keys entered since the CPU ID will have changed.

8.9 UP to SMP Migration and AIX Version 4.3

Migration from a uniprocessor system to a multiprocessor system is not simply a case of loading a different version of the operating system and testing the environment. The SMP technology is very different from UP technology, and going from one to the other must be done carefully.

Because of the differences between the two architectures, there are some additional questions about the system environment that must be answered before starting a migration to an SMP system.

- If my application has been verified to work with AIX Version 4.3, is it SMP safe?
- Are the IBM LPPs I need available and SMP safe?
- Can I transfer my existing adapters and associated hardware to the SMP system?
- If the adapters and hardware cannot be transferred, what is available to take their place?
- If there is third-party hardware installed, is the hardware supported on the SMP system running AIX V4.3 and do I need additional device drivers?

8.9.1 Planning the Upgrade

In order to help you in preparing your SMP upgrade, you will find below a list of items that should be checked. This is not an exhaustive list and should be

used as a guideline. The rest of this section assumes that your uniprocessor system is running AIX V3.2.5.

Third-party applications:

Check with the vendor of each third-party application that the application has been certified for AIX Version 4.3 and is SMP safe. If the application has not been certified for AIX Version 4.3, the migration cannot be performed. Also, if the application has been certified for AIX Version 4.3 but is not SMP safe, the migration cannot be performed.

Custom-made applications:

Check for any custom-made applications. These custom-made applications might have to be ported to AIX Version 4.3 in order for them to run on an SMP system. If the custom-made applications have not, or cannot, be ported to AIX Version 4.3, the migration cannot be performed.

LPP migration paths:

Check the installed LPPs, and verify that they are available in AIX V4.3. If yes, check the actual upgrade path to the AIX V4.3 version of each LPP (same or new product, free or fee upgrade). Check also to see if the AIX V4.3 equivalent LPP is SMP safe.

License keys:

Check for any products that have an iFOR/LS license key. The CPU-ID will not be kept through the upgrade to the SMP; thus new keys for installed products requiring a license key will be needed. Check also to see if installed products that do not require license keys in AIX V3.2.5, V4.1 and V4.2 will require license keys in AIX V4.3. Please refer to the Chapter 5, "Planning For Your Migration" on page 37, for more information regarding licensing.

IBM hardware compatibility:

Check all installed adapters and I/O devices for compatibility with the SMP system. If the installed adapters and I/O devices are not compatible, have replacement adapters and I/O devices been ordered? If the replacement adapters and I/O devices have not been ordered and delivered, the migration cannot be performed. If the installed adapters and I/O devices are not compatible with the SMP system, and there are no substitute adapters and I/O devices, are you aware of this? Do you have an alternative to the non-compatible adapters and I/O devices? If you do not have any alternatives to the non-compatible adapters and I/O devices, then the migration cannot be performed. Please verify any doubts you have with your IBM representative.

Third-party hardware compatibility:

The list of third-party hardware vendors that manufacture hardware for the IBM RISC System/6000 is quite large; therefore IBM has no way of verifying what third-party hardware will work with new versions of AIX. If you have any third-party hardware installed in your system, IBM recommends that you contact the hardware manufacturer, and ask the manufacturer if his product has been tested with the version of AIX that you are installing. If the hardware has been tested and certified with the version of AIX that you are installing, check if there are any additional device drivers for the hardware or if a generic device driver that is standard with AIX can be used.

8.9.2 Terminal and Printer Migration Considerations

When a system is migrated from a uniprocessor to a multiprocessor, the tty and printer configurations will have to be re-created. This is because the system numbering of the asynchronous ports and adapters changes. The uniprocessor systems normally have two serial ports, while multiprocessor systems usually have three. This means that the numbering of serial ports will be displaced by one. For example,

Uniprocessor

sa0	Available 00-00-S1	Standard I/O Serial Port 1
sa1	Available 00-00-S2	Standard I/O Serial Port 2

Multiprocessor

sa0	Available 00-00-S1	Standard I/O Serial Port 1
sa1	Available 00-00-S2	Standard I/O Serial Port 2
sa2	Available 00-00-S3	Standard I/O Serial Port 3

If the system has a 128-port adapter installed, the system numbering on a uniprocessor for the first 16-port Remote Asynchronous Node (RAN) EIA-232 will be sa2. On a multiprocessor, the system numbering will be sa3.

Uniprocessor

sa0	Available 00-00-S1	Standard I/O Serial Port 1
sa1	Available 00-00-S2	Standard I/O Serial Port 2
cxma0	Available 00-01	128-Port Asynchronous Adapter
sa2	Available 00-01-11	16-Port RAN EIA-232 for 128-Port Adapter

Multiprocessor

sa0	Available 00-00-S1	Standard I/O Serial Port 1
sa1	Available 00-00-S2	Standard I/O Serial Port 2
sa2	Available 00-00-S3	Standard I/O Serial Port 3
cxma0	Available 00-01	128-Port Asynchronous Adapter
sa3	Available 00-01-11	16-Port RAN EIA-232 for 128-Port Adapter

Therefore, when a mksysb backup from a uniprocessor system tries to restore the tty and printer definitions onto sa2 for the multiprocessor machine, (trying to duplicate the uniprocessors configuration), the configuration methods routines will fail when they try to rebuild the Object Data Manager (ODM). This is because sa2 on the uniprocessor is the 16-port RAN for the 128-port adapter, and sa2 on the multiprocessor is the standard I/O serial port number 3.

All the ttys and printers that should have been configured onto the 16-port RAN for the 128-port asynchronous adapter will be deleted and will not be configured. When the multiprocessor is rebooted, none of the ttys or printers that should have been configured for the 128-port adapter will be available and will have to be reconfigured.

To assist with the manual reconfiguration after a system has been installed from a uniprocessor mksysb, two shell scripts are created in /tmp; these shell scripts are called /tmp/reconfig1 and /tmp/reconfig2.

A typical example of the /tmp/reconfig1 file that will be created on the multiprocessor machine is listed here.

```
#!/bin/ksh
export TALLY=
cmd_1='/etc/methods/define -l tty1 -c tty -s rs232 -t tty -p sa2 -w 0 '
cmd_2='/etc/methods/cfgtty -l tty1 '
cmd_3='/etc/methods/define -l tty2 -c tty -s rs232 -t tty -p sa2 -w 1 '
cmd_4='/etc/methods/cfgtty -l tty2 '
cmd_5='/etc/methods/define -l tty3 -c tty -s rs232 -t tty -p sa2 -w 2 '
cmd_6='/etc/methods/cfgtty -l tty3 '
cmd_7='/etc/methods/define -l tty4 -c tty -s rs232 -t tty -p sa2 -w 3 '
cmd_8='/etc/methods/cfgtty -l tty4 '
cmd_9='/etc/methods/define -l tty5 -c tty -s rs232 -t tty -p sa2 -w 4 '
cmd_10='/etc/methods/cfgtty -l tty5 '
cmd_11='/etc/methods/define -l tty6 -c tty -s rs232 -t tty -p sa2 -w 5 '
cmd_12='/etc/methods/cfgtty -l tty6 '
cmd_13='/etc/methods/define -l tty7 -c tty -s rs232 -t tty -p sa2 -w 6 '
cmd_14='/etc/methods/cfgtty -l tty7 '
cmd_15='/etc/methods/define -l tty8 -c tty -s rs232 -t tty -p sa2 -w 7 '
cmd_16='/etc/methods/cfgtty -l tty8 '
cmd_17='/etc/methods/define -l tty9 -c tty -s rs232 -t tty -p sa2 -w 8 '
cmd_18='/etc/methods/cfgtty -l tty9 '
cmd_19='/etc/methods/define -l tty10 -c tty -s rs232 -t tty -p sa2 -w 9 '
cmd_20='/etc/methods/cfgtty -l tty10 '
cmd_21='/etc/methods/define -l tty11 -c tty -s rs232 -t tty -p sa2 -w 10 '
cmd_22='/etc/methods/cfgtty -l tty11 '
cmd_23='/etc/methods/define -l tty12 -c tty -s rs232 -t tty -p sa2 -w 11 '
```

```

cmd_24='/etc/methods/cfgtty -l tty12 '
cmd_25='/etc/methods/define -l tty13 -c tty -s rs232 -t tty -p sa2 -w 12 '
cmd_26='/etc/methods/cfgtty -l tty13 '
cmd_27='/etc/methods/define -l tty14 -c tty -s rs232 -t tty -p sa2 -w 13 '
cmd_27='/etc/methods/cfgtty -l tty14 '
cmd_29='/etc/methods/define -l tty15 -c tty -s rs232 -t tty -p sa2 -w 14 '
cmd_30='/etc/methods/cfgtty -l tty15 '
cmd_31='/etc/methods/define -l tty16 -c tty -s rs232 -t tty -p sa2 -w 15 '
cmd_32='/etc/methods/cfgtty -l tty16 '
cmd_33='chdev -l tty0 -a login=enable -a term=ibm3151'
cmd_34='chdev -l tty1 -a login=enable -a term=ibm3151'
cmd_35='chdev -l tty2 -a login=enable -a term=ibm3151'
cmd_36='chdev -l tty3 -a login=enable -a term=ibm3151'
cmd_37='chdev -l tty4 -a login=enable -a term=ibm3151'
cmd_38='chdev -l tty5 -a login=enable -a term=ibm3151'
cmd_39='chdev -l tty6 -a login=enable -a term=ibm3151'
cmd_40='chdev -l tty7 -a login=enable -a term=ibm3151'
cmd_41='chdev -l tty8 -a login=enable -a term=ibm3151'
cmd_42='chdev -l tty9 -a login=enable -a term=ibm3151'
cmd_43='chdev -l tty10 -a login=enable -a term=ibm3151'
cmd_44='chdev -l tty11 -a login=enable -a term=ibm3151'
cmd_45='chdev -l tty12 -a login=enable -a term=ibm3151'
cmd_46='chdev -l tty13 -a login=enable -a term=ibm3151'
cmd_47='chdev -l tty14 -a login=enable -a term=ibm3151'
cmd_48='chdev -l tty15 -a login=enable -a term=ibm3151'
cmd_49='chdev -l tty16 -a login=enable -a term=ibm3151'
num_cmds=50
i=0
while [ $i -lt $num_cmds ]
do
    eval \${cmd}_$i > /dev/null
    if [ $? -ne 0 ]
    then
        TALLY="$TALLY$(eval echo \${cmd}_$i)\n"
    fi
    (( i+=1 ))
done
if [ -n "$TALLY" ]
then
echo "Machine not identical to previous configuration. echo The following
items failed:"
    echo $TALLY
fi

```

8.9.3 UP and MP Kernels

AIX Version 4.3 is shipped with two kernels: a multiprocessor kernel and a uniprocessor kernel. The two kernels have common code, but the extra locking mechanisms required for an SMP environment is eliminated for the uniprocessor kernel.

8.9.4 CPU ID and Licensing Issues

On uniprocessor systems, the output of the `uname -m`, which gives the CPU ID, is tied to the CPU card.

On a multiprocessor system, the CPU ID is not tied to a particular processor card. It is part of the VPD (Vital Product Data) of the system and is stored in the system EEPROM. The `uname` command on a multiprocessor machine uses the information stored in the EEPROM to build the CPU ID.

As with any complete system replacement, the CPU ID cannot be maintained through a uniprocessor to multiprocessor upgrade. This means that it will be necessary to obtain new keys for licensed products. For more information on the SMP CPU ID, refer to the *IBM RISC System/6000 SMP Servers Architecture and Implementation*, SG24-2583, redbook.

Chapter 9. License Management

A number of IBM Licensed Program Products use license management software to control access to the products. Originally, the standard AIX license management software was called NetLS. This product was superseded by iFOR/LS, which is gradually being replaced by License Use Management (LUM). iFOR/LS remains the default license management tool supplied with AIX, but as more products become enabled for LUM, the latter will become the standard. This chapter explains what you need to do to request a license for an iFOR/LS-controlled product and also gives an introduction to LUM.

9.1 iFOR/LS

iFOR/LS is an application for managing and distributing software licenses electronically. The primary purpose of iFOR/LS is for software license compliance. It allows software vendors to distribute CD-ROMs or tapes while protecting the assets on them.

9.1.1 iFOR/LS License Types

There are five types of software licenses controlled by iFOR/LS.

1. Nodelock
2. Concurrent Use
3. Compound License
4. License Combinations
5. Developer License

Note:

Concurrent Use, Compound, Combination, and Developer Licenses need an iFOR/LS license server to be set up and configured in order to operate; this should be included in your migration plan, if appropriate.

9.1.2 Requesting an iFOR/LS Password

If you used iFOR/LS or NetLS controlled products at your previous version of AIX and those products remain the same at AIX Version 4.3, or are simply being upgraded, you may not need to obtain new license keys. However, you should call the iFOR/LS registration center for confirmation. Products which

are being replaced completely, or possibly with a different version, will probably require a new license key to be obtained.

License keys can only be requested once the iFOR/LS license server has been installed. If you are upgrading a product to a new version that uses iFOR/LS or LUM, it is imperative that you are aware that the product will not be enabled until the license key has been obtained and installed.

9.1.2.1 Completing the Registration Information Form

To obtain a license key for a particular product, as soon as the product has been delivered, you should complete the information on the IBM Product Registration Information Forms and then contact the Registration Center. The product and machine information is required for each product that is to be registered with IBM. If you have not used the Registration Center before, you will also need to give them information about your company and your IBM representative or Business Partner. The registration form is provided both with the product and also usually in softcopy format in a README file.

9.1.2.2 Product and Machine Information Needed for Registration

The following information is required by the Key Center to enable them to process your registration. You will need to complete this section of the registration form for each product and server required.

Product Information:

- IBM Program Name
- IBM Program Number
- Version
- Release

Machine Information:

- Target Operating System (for example: AIX Version 4.3.1)
- iFOR/LS Target ID (see below)
- Number of Concurrent Accesses
- Machine Model

Company Data Needed for Registration

This information is only required if you have not used the Registration Center before or when you want to change the company profile maintained by the Registration Center.

Note:

Please include International Country codes and area codes for phone numbers where appropriate.

Your Company Information:

- Your IBM Customer Number
- Company Name
- Company Address
- Your License Administrator's name
- Country Code
- Phone number for License Administrator
- FAX number for sending license passwords

Your IBM Representative Information (Optional):

- Branch Office Number
- Name
- Address
- Country Code
- Phone

Part of the information required on the Product Registration Form includes the target IDs of the iFOR/LS license server nodes where you intend to install the product licenses. You can obtain the iFOR/LS target IDs for the license server nodes by running the `ls_targetid` program that is supplied iFOR/LS. The information returned is unique for each iFOR/LS license server node. You must install the iFOR/LS License Server code before the iFOR/LS target ID can be obtained successfully.

After you have completed the registration forms, you will be ready to contact the IBM Registration Center to obtain your license keys.

9.2 License Use Management Runtime for AIX

SystemView License Use Management (LUM) is a new license management tool that was introduced with AIX Version 4.2. It is intended to be the new standard on OS/2 and AIX platforms to help customers keep track of software licenses in a distributed environment and allow software vendors to control

the distribution of their products. The existing iFOR/LS product, developed by Gradient Technology under license from Hewlett Packard is still the AIX default license manager, but LUM will become the default tool as soon as new versions of current iFOR/LS- based products become available. Gradient iFOR/LS- and Net/LS-enabled applications are totally compatible with LUM.

License Use Management retains all the previous features of iFOR/LS and improves ease of use and configuration for the end user. LUM is provided with a new graphical user interface (GUI) that makes the installation and configuration of both servers and clients much easier and more user-friendly. Shell script-based command line interfaces are also supplied to satisfy the requirements of environments that do not support graphics terminals.

LUM still relies on the Network Computing System (NCS) to provide binding features. It can be installed in existing NCS cells and coexist with other NCS served applications. However, a new feature of LUM is the ability to perform direct binding between servers and clients, without using the Global Location Broker daemon to advertise services. In these situations, license clients can be set up without installing bos.net.ncs as a prerequisite. Such configurations are recommended for small network configurations.

LUM uses two types of licensing models: *nodelocked licensing* and *server-based licensing*. A product can be license-enabled using one or both licensing models.

9.2.1 License Use Runtime Installation

LUM consists of three main components:

- Server Runtime Kit (SRK)
- Client Runtime Kit (CRK)
- Network Computing System (NCS)

To install License Use Runtime, you must provide the following prerequisites:

- 6.2 MB of free disk space to install the SRK package
- 4.1 MB of free disk space to install the CRK package
- 2 MB of free disk space to install NCS
- A system running AIX Version 4.2 or later

In addition, both the SRK and CRK base packages require the installation of TCP/IP Base for AIX (bos.net.tcp). The SRK and CRK GUI packages (ifor_ls.server.gui and ifor_ls.client.gui) also require installation of IPF/X Runtime Support (ipfx.base.rte) and Xwindows Runtime (X11.base.rte).

9.2.2 LUM Licenses

Licensed products developed using IBM's License Use Toolkit or Gradient's Application Developer's Kit can be managed by LUM and total backward compatibility is guaranteed. This allows customers to migrate to a LUM environment porting NET/LS and iFOR/LS licenses without modification.

9.2.2.1 Nodelocked License

A nodelocked license allows the use of a product at the particular node for which the license was created and for as long as the license remains valid. When you purchase a nodelocked license for a product, the vendor associates the license with the unique identifier (target ID) of the system where the license and the product itself will reside.

A license server is not required to install or manage nodelocked licenses. The Nodelock Administration Tool (NAT) on the client permits you to install and manage nodelocked licenses.

9.2.2.2 Dynamic Nodelocked License

Dynamic nodelocked licenses are similar to classic nodelocked licenses, but they differ in the way that they are installed on the client.

Dynamic nodelocked licenses are installed on the license server using the Basic License Tool (BLT). The first time the end user uses the licensed product on the client, the client workstation requests the dynamic nodelocked license from the server, and, if available, it is granted to the client where it gets installed. For later uses of the licensed product, the client has its own nodelocked license, and there is no need to request the license from the server.

9.2.2.3 Concurrent Nodelocked License

Similar to a nodelocked license, the concurrent nodelocked license is bound to a particular node. It can be installed and managed by the Nodelock Administration Tool (NAT) on the client. Furthermore, it allows a limited number of users to run the licensed application simultaneously and provides a way of controlling the distribution of a product both on a per user and per system basis.

9.2.2.4 Concurrent Access License

A concurrent-access license is a server-based license which, under the direction of the license server on which it is installed, can be temporarily granted to run the product for which the license was created, on a client.

Concurrent access licenses allow controlled distribution of products on a per user basis over networks.

When the product is running, that license remains unavailable to other instances of the product. When the application exits, the license is returned to the server, where it again becomes available to other users.

Concurrent access licenses allow as many users to run a licensed software application simultaneously as there are valid licenses for the product available from the license servers in your licensing environment.

9.2.2.5 Use-Once License

A use-once license is a server-based license that permits the single use of a particular licensed product within the period for which the license is valid. Use of a use-once license typically begins when the licensed product is started and typically ends when the licensed product stops running.

9.2.3 LUM Passwords

Vendors of license-enabled software deliver licenses to use their products in the form of a license password. A license password (or license key) is an encrypted character string that specifies the actual functional characteristics of the license that it contains. This information, determined by the manufacturer, includes the specific number and type of licenses contained in the password, the date when the licenses become active, and the date when the licenses expire.

The vendor includes the password, along with other important information about their product in a file that is sent to you after you purchase the licenses.

Software vendors can create two distinct types of passwords: simple and compound.

9.2.3.1 Simple Password

Vendors of license-enabled software use simple passwords to provide multiple concurrent-use and use-once licenses for vendor-managed use products and to provide nodelocked licenses for nodelock-licensed products.

Simple passwords contain a specific number of licenses with a finite life span determined at or before the product sale.

9.2.3.2 Compound Password

Compound passwords allow the subsequent creation of concurrent access licenses, use-once licenses, and nodelocked (dynamic nodelocked) licenses.

9.2.4 Security Levels

Software vendors can license their products to the following IBM predefined security levels:

- Vendor-Managed Use Control
- Customer-Managed Use Control

9.2.4.1 Vendor-Managed Use Control

Vendor-managed use products have the highest level of protection provided by the SystemView License Use Management Runtime for AIX. With vendor-managed use products, you are technically bound to stay within the limits of the purchase agreement. When you purchase licenses for a vendor-managed use product, the product vendor will ask you to supply the unique identifier (target ID) of each machine where you intend to install the product licenses. For nodelocked licenses, this is the identification of the workstation where the enabled product is to be installed; for the other types of licenses, this is the license server. You must also supply the license type and the number of licenses you want to make available. The vendor uses this information to create the password that you use to install and activate the licenses that you have purchased.

The passwords are contained in an enrollment certificate, which the vendor gives you with the product. The password, tied to the specified workstation, cannot be used on another workstation.

Every time you want to change the terms and conditions of the contract, (the most frequent change being an increase in the number of licences), you have to provide the vendor with similar information for each of the machines on which you intend to install the licenses to get a new password.

9.2.4.2 Customer-Managed Use Products

To provide vendors with greater flexibility in the way they deliver licensed software, LUM supports a customer-managed product security level. With this level, licenses are not directly associated by the vendor with a particular license server (or group of license servers), nor do they set an upper limit on the number of licenses that you are entitled to use. LUM provides the customer with information on the usage of the enabled products, thereby allowing them to determine the maximum number of users and stay within the boundaries of the signed contract.

All license usage events are recorded in the server log.

9.2.5 Hardstop and Softstop on License Request

When an LUM client application is started and asks for a license from the license server, if no more licenses are available, three different behaviors are allowed by the LUM Developer's Kit:

- Client application hardstop
- Client application softstop
- Client application enqueueing

It is up to the application developer to set the appropriate strategy according to the level of protection they intend to implement.

A hardstop strategy stops the client application starting if there are no available licenses in the server repository. It is the normal solution for high value, vendor-managed products.

A softstop strategy lets the client application start even if no licenses are available. Interactive messages or event logging can be implemented to record this event. This solution suits low value products, demos, and customer-managed products.

Finally, LUM supports Wait Queue mechanisms. In this case, when a user invokes the client product and there are no concurrent-access licenses currently available, the product asks if the user wants to wait for a license and eventually prompts those licenses in use and the user IDs and hosts owning those keys. If the user responds affirmatively, that user's name is added to the wait queue on each of the LUM servers that provide concurrent-access licenses to use the product. User names are added to the wait queues in chronological order.

When a license becomes available, it is released to the user. The user is then removed from all of the wait queues, and the next user in the queue becomes eligible for the next available license.

9.2.6 Network Configuration of License Use Management

License Use Management allows two options for network configuration:

- Namespace Binding
- Direct Binding

Direct binding allows clients to bind directly to the license server without use of the Global Location Broker daemon. This means that the client does not need to have the Network Computing System (NCS) filesets installed.

iFOR/LS does not allow direct binding configurations and requires the configuration of an NCS cell even for small and simple networks.

9.2.7 Network Computing System

The Network Computing System (NCS) is a set of tools for heterogeneous distributed computing. License Use Runtime runs on top of the Network Computing Kernel (NCK) of NCS, which is included in the LUM Runtime.

The NCK includes:

- Remote Procedure Call (RPC) Runtime Library

RPC is the backbone of the network computing system. It provides the calls that enable local programs to execute procedures on remote hosts. These calls transfer requests and responses between clients (the programs calling the procedures) and servers (the programs executing the procedures). The RPC embedded in all license servers and enabled products provides a common mechanism for supporting the request and acquisition of licenses.

- Location Broker

A mechanism that allows the enabled products to locate license servers in the network. Location broker software includes the Global Location Broker (GLB), the Local Location Broker (LLB), and administrative tools. The location broker software is included in the License Use Runtime.

If you intend to use LUM within an NCS environment, you should plan your network and cell layout carefully to ensure that clients can connect to the server correctly. Consult the NCS documentation for an explanation of cell configurations.

9.2.8 License Use Management Runtime Subsystems

LUM has two new subsystems to manage the licensing system. They are:

- Administration Database Server
- License Server

9.2.8.1 Administration Database Server (i4gdb)

The administration database server subsystem provides a mechanism for storing licensing information in a database common to all the servers. It is used for the administration of customer-managed use products. It is called i4gdb. There must be one and only one administration database subsystem running in a cell when using namespace binding and one and only one running in all the license use management environment when direct or mixed

binding is used. That is, only one server node must have the i4gdb started. This ensures the data is accurate and complete.

This subsystem is totally new and is not available with iFOR/LS.

9.2.8.2 License Server (i4lmd)

The license server subsystem provides the actual license services, and is called i4lmd. A node that works as a license server must run this subsystem.

This important subsystem replaces the netlsd daemon, and they cannot coexist on the same server. This does not cause a problem since i4lmd transparently serves licenses previously managed by netlsd and allows easy and simple migration to the new license manager.

9.2.9 Migration from NetLS or iFOR/LS

At installation time, the license database, the nodelock file, and the user file are moved to License Use Runtime directories. The Global Location Broker database and the NCS configuration files are preserved and the netlsd subsystem is removed from the system.

The License Use Runtime installation deletes the automatic start-up of old subsystems.

All the machines where License Use Runtime is installed (CRK or SRK) are by default configured as clients; so no further action is required on client machines. To maintain the same configuration on server machines, enter the following command:

```
i4cfg -script
```

This command starts the script configuration command, which asks some basic questions. Specify that you want to:

- Configure your system as server and client.
- Use NCS namespace and direct binding.
- Keep your current NCS configuration.
- Leave the license server configuration unchanged.
- Skip the client configuration.
- Save the configuration.
- Have the subsystems start up automatically.

Remember to update your `PATH` environment variable to include the LUM executables directory. Shell scripts used by LUM runtime all refer to files without their fully qualified pathnames.

A migration from NetLS or iFOR/LS is transparent and does not affect the usability of applications enabled for the previous license managers. However, be aware of possible impacts of an LUM migration on customer-implemented shell scripts that could still be referencing the old daemons or file system locations for executables or database files. These problems can be easily fixed by using symbolic links pointing to the new directories or updating the names of the executables.

Note that you cannot support concurrent NetLS or iFOR/LS licenses using LUM direct binding mode; only NCS namespace binding is supported for those licenses.

9.2.10 Product Documentation

License Use Management originally used Interactive Presentation Facility eXtended (IPF/X) to provide online documentation and help texts. There was no support for InfoExplorer documentation with LUM. Recently, however, HTML translations have been provided, allowing you to use a conventional Web browser and even incorporate the LUM documentation into the standard AIX online documentation.

To use IPF/X to retrieve the command syntax for LUM commands, run one of the following utilities from the `/usr/opt/ifor/ls/doc` directory:

```
xview lumcmd <command_name>
man <command_name>
```

To obtain help for LUM utilities messages, run:

```
xview lummsg <message_number>
```

from the same directory.

An installation manual is available in IPF/X format in the `/usr/opt/ifor/ls/doc` directory. To view it, run the following command:

```
xview lumsg
```

`xview` is the IPF/X browser. IPF/X is included in AIX Version 4.3 packages as the fileset `ipfx.rte`. It is available on AIX, OS/2 and Windows platforms.

To use a Web browser to access LUM documentation, simply point your browser at the lumcmd.htm, lummsg.htm and lumusg.htm files in the /usr/opt/ifor/ls/doc directory.

Appendix A. Unsupported Hardware on AIX Version 4.3

The following systems are no longer supported:

- RS/6000 7016 POWERserver (R) Model 730
- RS/6000 7007 Notebook Workstation Model N40
- POWERnetwork Dataserver 7051
- RS/6000 7249 Models 851 and 860
- RS/6000 7247 Models 821, 822, and 823
- 9076 POWERparallel System SP1 (SP2 or RS/6000 SP is supported)

The following graphic adapters are not supported on AIX Version 4.3:

- POWER GTO Accelerator Adapter
- POWER Gt1 Graphic Adapter 1-Bit
- POWER Gt1b ISO Graphic Adapter 1-Bit
- POWER Gt1x Graphic Adapter
- 2780 High-Performance 8-bit 3D Color Graphics Processor
- 2781 High-Performance 24-bit 3D Color Graphics Processor
- 2782 24-bit Z-Buffer Solid Rendering Option
- 2783 24-bit Color Graphics Frame Buffer Upgrade
- 7235 GTO accelerator, feature 4350
- Gt1 Graphics Adapter, feature 4208
- Gt1b Graphics Adapter, feature 2804
- Gt1x Graphics Adapter, feature 9280
- High Performance 24-Bit 3D Color Graphics Processor
- High Performance 8-Bit 3D Color Graphics Processor

Note:

Customers who have non-IBM graphics adapters must verify that the adapter is supported on AIX Version 4.3 by the adapter's manufacturer.

- Network Terminal Accelerator is not supported on AIX Version 4.3.
The Network Terminal Accelerator (NTX) support function, currently supported by AIX Version 4.2.1, is not supported by AIX Version 4.3.

Appendix B. Unsupported Filesets

The following filesets are no longer included in AIX Version 4.3:

- devices.mca.0072.rte
- devices.mca.0072.diag
- devices.mca.0095.rte
- devices.mca.0095.diag
- devices.common.IBM.ntx.rte
- devices.common.IBM.ntx.asw
- M-Video Capture Adapter (VCA) - NTSC
- M-Video Capture Adapter (VCA) - PAL
- M-Audio Capture and Playback Adapter (ACPA)
- Speech Accelerator 1 Adapter
- Speech Accelerator 2 Adapter
- Lago Datawheel
- Legato Prestoserve
- ICL Accelerator
- Fiber Channel Adapter/266

Appendix C. AIX Version 4.3 CD-ROM Contents

Here a list of approximate sizes of filesets on the AIX 4.3 installation media.

C.1 Base System Installation CD-ROM Volume 1

Approximate Space Used - 648 MB

Table 12. AIX CD-ROM Volume 1 Fileset Contents and Sizes

Fileset Name	KB	Fileset Name	KB
X11.Dt	37434	X11.loc.be_BY	286
X11.fnt	32759	X11.loc.Vi_VN	286
bos.loc.iso	30405	X11.loc.VI_VN	286
bos	28157	X11.loc.Uk_UA	286
bos.net	19621	X11.loc.TH_TH	286
bos.adt	14493	X11.loc.LV_LV	286
ifor_ls.base	14481	X11.loc.LT_LT	286
Java.rte	12801	X11.loc.ET_EE	286
bos.txt	10777	devices.pci.48110040.diagsa	281
X11.compat	10171	U453329.bff	279
sysmgt.websm	9146	bos.rte_4.3.1.0.bff	278
X11.motif	8787	bos.help.msg.de_DE	277
xlC.rte_3.6.3.0	8492	bos.help.msg.Ja_JP	277
bos.loc.utf	8477	devices.mca.8efc	276
bos.sysmgt	8152	bos.help.msg.ja_JP	273
X11.base	6473	bos.help.msg.it_IT	271
X11.vsm	6413	bos.help.msg.hu_HU	270
bos.iconv	5699	bos.help.msg.fr_FR	270
bos.loc.com	5515	devices.pci.4f111b00	269
bos.rte.libc_4.3.1.0.bff	4613	bos.help.msg.ru_RU	269
X11.adt	4053	devices.mca.8f9d	268

Fileset Name	KB	Fileset Name	KB
devices.mca.8ee3	3916	bos.help.msg.pl_PL	268
U453268.bff	3153	bos.help.msg.ca_ES	268
bos.msg.es_ES	3120	bos.help.msg.es_ES	266
bos.msg.de_DE	3113	devices.mca.8787	265
bos.msg.Ja_JP	3092	bos.help.msg.ko_KR	263
bos.msg.it_IT	3090	devices.pci.2b101a05	262
bos.msg.fr_FR	3089	bos.help.msg.pt_BR	262
bos.msg.ja_JP	3064	devices.isa.mm2	259
U453247.bff	3051	bos.help.msg.ZH_CN	259
bos.msg.ru_RU	3033	devices.mca.8f70	258
bos.msg.ca_ES	3017	bos.help.msg.cs_CZ	258
bos.msg.pt_BR	3012	devices.tty	256
bos.msg.ko_KR	2999	devices.AS4D_rspc.base	254
bos.msg.pl_PL	2992	bos.help.msg.en_US	252
bos.msg.hu_HU	2963	devices.pci.3353c088	242
X11.apps	2929	devices.mca.8fc8	236
U453300.bff	2915	bos.help.msg.zh_TW	232
bos.msg.cs_CZ	2894	bos.help.msg.Zh_TW	232
bos.msg.ZH_CN	2869	bos.powermgmt	229
bos.msg.en_US	2849	bos.rte.commands_4.3.1.0.bff	228
bos.msg.sv_SE	2819	bos.rte.methods_4.3.1.0.bff	219
bos.msg.zh_TW	2588	devices.common.IBM.cx	217
bos.msg.Zh_TW	2588	bos.help.msg.zh_CN	217
bos.msg.Zh_CN	2467	bos.help.msg.Zh_CN	217
bos.msg.zh_CN	2466	devices.common.IBM.bbl	214
bos.mp	2216	devices.mca.8ef5	207
X11.msg.ko_KR	2111	devices.mca.8ef2	203

Fileset Name	KB	Fileset Name	KB
U453263.bff	2105	bos.rte.streams_4.3.1.0.bff	197
bos.up	2015	devices.mca.8ee5	195
U453277.bff	1967	devices.isa_sio.PNP0E00	189
X11.msg.de_DE	1958	devices.mca.8fa2	182
X11.msg.ca_ES	1923	devices.pci.14101800	180
X11.msg.es_ES	1863	bos.terminfo	180
X11.msg.Ja_JP	1794	bos.rte.odm_4.3.1.0.bff	180
X11.msg.ja_JP	1779	bos.rte.ILS_4.3.1.0.bff	179
ifor_ls.compat	1763	bos.rte.SRC_4.3.1.0.bff	178
X11.msg.pl_PL	1752	devices.mca.deff	177
devices.mca.8fbc	1745	U449974.bff	177
X11.msg.zh_TW	1730	devices.pci.14103e00	176
X11.msg.Zh_TW	1725	bos.rte.man_4.3.1.0.bff	175
X11.msg.ru_RU	1718	bos.rte.iconv_4.3.1.0.bff	175
bos.loc.pc_compat	1709	devices.pci.331121b9	167
U453324.bff	1687	devices.sys.mca	162
X11.msg.pt_BR	1685	devices.mca.8f62	162
X11.msg.it_IT	1667	devices.isa.cxia	160
X11.msg.cs_CZ	1667	devices.common.IBM.ARTIC	159
X11.msg.fr_FR	1616	devices.mca.ffe1	156
X11.msg.ZH_CN	1607	bos.docsearch	155
bos.loc.pc	1594	devices.pci.23100020	154
X11.msg.hu_HU	1576	devices.sys.slc	153
printers.rte	1571	devices.pci.14102000	152
X11.msg.en_US	1529	devices.serial.gio	151
X11.msg.sv_SE	1528	bos.rte.boot_4.3.1.0.bff	151
bos.rte.install_4.3.1.0.bff	1526	devices.isa_sio.chrp.ecp	144

Fileset Name	KB	Fileset Name	KB
X11.msg.Zh_CN	1525	devices.ssa.network_agent	142
X11.msg.zh_CN	1506	bos.rte.misc_cmds_4.3.1.0.bff	140
devices.pci.b7105090	1440	bos.rte.cron_4.3.1.0.bff	138
bos.diag	1332	devices.mca.edd5	134
U453310.bff	1314	devices.mca.8f95	131
bos.rte.libcur_4.3.1.0.bff	1310	devices.common.IBM.hdlc	129
U453286.bff	1226	devices.common.IBM.async	129
devices.common.IBM.atm	1112	bos.64bit	120
bos.rte.lvm_4.3.1.0.bff	1069	devices.ssa.tm	117
devices.scsi.scarrray	1013	devices.mca.0210	115
bos.help.msg.en_US.smit	994	devices.pci.00100f00	114
bos.rte.security_4.3.1.0.bff	983	devices.mca.e1ff	111
devices.ssa.IBM_raid	974	devices.common.IBM.rby	111
devices.pci.14105e00	885	devices.pci.22100020	108
devices.mca.8f61	880	devices.pci.00100100	104
devices.msg.es_ES	876	bos.rte.libcfg_4.3.1.0.bff	102
devices.pci.14105400	875	devices.mca.edd0	101
devices.msg.it_IT	867	devices.common.IBM.tokenring	101
bos.rte.bind_cmds_4.3.1.0.bff	865	U453334.bff	101
bos.lNed	858	ipfx.msg.zh_TW.rte	100
devices.msg.de_DE	850	ipfx.msg.zh_CN.rte	100
bos.rte.shell_4.3.1.0.bff	850	ipfx.msg.sv_SE.rte	100
devices.msg.fr_FR	826	ipfx.msg.pt_PT.rte	100
devices.common.IBM.ssa	819	ipfx.msg.no_NO.rte	100
devices.msg.pl_PL	815	ipfx.msg.nl_NL.rte	100
devices.msg.ru_RU	808	ipfx.msg.ko_KR.rte	100
devices.msg.pt_BR	808	ipfx.msg.ja_JP.rte	100

Fileset Name	KB	Fileset Name	KB
devices.msg.ja_JP	804	ipfx.msg.it_IT.rte	100
devices.msg.Ja_JP	804	ipfx.msg.fr_FR.rte	100
devices.msg.en_US	803	ipfx.msg.fi_FI.rte	100
devices.msg.ca_ES	801	ipfx.msg.es_ES.rte	100
devices.msg.hu_HU	789	ipfx.msg.en_US.rte	100
devices.msg.cs_CZ	789	ipfx.msg.en_GB.rte	100
devices.msg.ZH_CN	785	ipfx.msg.de_DE.rte	100
devices.msg.ko_KR	783	ipfx.msg.da_DK.rte	100
devices.msg.sv_SE	771	ipfx.msg.Sv_SE.rte	100
ipfx.rte	750	ipfx.msg.Pt_PT.rte	100
devices.msg.zh_TW	737	ipfx.msg.No_NO.rte	100
devices.msg.Zh_TW	737	ipfx.msg.NI_NL.rte	100
devices.msg.zh_CN	735	ipfx.msg.Ja_JP.rte	100
devices.msg.Zh_CN	735	ipfx.msg.It_IT.rte	100
devices.scsi.disk	709	ipfx.msg.Fr_FR.rte	100
U449649.bff	707	ipfx.msg.Fi_FI.rte	100
bos.rte.printers_4.3.1.0.bff	706	ipfx.msg.Es_ES.rte	100
devices.pci.14103c00	695	ipfx.msg.En_US.rte	100
sysmgt.msg.ja_JP.websm	674	ipfx.msg.En_GB.rte	100
sysmgt.msg.Ja_JP.websm	674	ipfx.msg.De_DE.rte	100
U443551.bff	674	ipfx.msg.Da_DK.rte	100
sysmgt.msg.ru_RU.websm	669	devices.mca.61fd	100
devices.mca.8f67	653	devices.common.IBM.ktm_std	99
sysmgt.msg.ko_KR.websm	633	devices.isa_sio.chrp.8042	97
sysmgt.msg.hu_HU.websm	626	devices.mca.8f96	96
sysmgt.msg.de_DE.websm	626	devices.isa_sio.PNP0600	96
ifor_ls.msg.Ja_JP	626	devices.mca.8fba	95

Fileset Name	KB	Fileset Name	KB
bos.terminfo.data	618	devices.isa_sio.km	95
sysmgt.msg.fr_FR.websm	616	devices.isa.cxia128	95
sysmgt.msg.pl_PL.websm	615	devices.common.IBM.fddi	95
sysmgt.msg.it_IT.websm	615	devices.common.IBM.ethernet	95
devices.buc.00004002	615	bos.html.en_US.topnav	95
sysmgt.msg.ca_ES.websm	614	devices.isa_sio.PNP0501	93
sysmgt.msg.es_ES.websm	613	devices.isa.c1x	91
sysmgt.msg.ZH_CN.websm	612	devices.ide.cdrom	91
devices.buc.00004001	612	bos.rte.loc_4.3.1.0.bff	91
sysmgt.msg.pt_BR.websm	611	devices.pci.33531188	89
devices.pci.14105600	604	devices.mca.df9f	89
sysmgt.msg.cs_CZ.websm	596	devices.isa.PNP80CC	87
sysmgt.msg.en_US.websm	586	devices.isa.IBM0010	85
ifor_ls.msg.fr_FR	584	devices.common.IBM.fda	84
sysmgt.msg.zh_TW.websm	583	devices.isa_sio.IBM001F	82
ifor_ls.msg.pt_BR	583	devices.pcmcia.tokenring	81
devices.mca.8f78	582	devices.ide.disk	79
sysmgt.msg.Zh_TW.websm	581	devices.raid_vsm	77
ifor_ls.msg.ko_KR	580	devices.isa_sio.IBM0019	76
ifor_ls.msg.de_DE	578	devices.common.base	75
sysmgt.msg.sv_SE.websm	577	devices.common.IBM.scsi	75
ifor_ls.msg.es_ES	574	devices.pci.00100300	74
devices.mca.8f9a	574	devices.mca.8ff4	69
sysmgt.msg.Zh_CN.websm	572	devices.isa_sio.baud	67
sysmgt.msg.zh_CN.websm	571	devices.mca.dfe5	65
ifor_ls.msg.it_IT	562	bos.rte.aio_4.3.1.0.bff	65
ifor_ls.msg.zh_TW	552	devices.scsi.tm	64

Fileset Name	KB	Fileset Name	KB
bos.rte.tty_4.3.1.0.bff	547	devices.isa_sio.PNP0700	64
devices.pci.14102e00	544	bos.rte.compare_4.3.1.0.bff	63
ifor_ls.msg.en_US	535	xlC.msg.Ja_JP.cpp	62
ifor_ls.msg.zh_CN	508	devices.sio.fda	62
devices.base	497	U454594.bff	62
bos.rte.archive_4.3.1.0.bff	492	devices.pcmcia.serial	61
devices.pci.14105300	489	xlC.msg.ja_JP.cpp	60
devices.mca.8d77	474	devices.pcmcia.ethernet	60
bos.rte.filesystem_4.3.1.0.bff	470	devices.pci.86808404	60
bos.rte.ifor_ls_4.3.1.0.bff	466	devices.common.IBM.modemcfg.data	58
bos.rte.control_4.3.1.0.bff	461	devices.mca.8ef3	57
sysmgt.sgguide	456	devices.scsi.ses	56
devices.chrp.base	452	devices.common.IBM.ppa	56
X11.loc.ja_JP	447	devices.pci.31114571	55
X11.loc.Ja_JP	447	devices.isa_sio.IBM0017.diag	55
U449973.bff	447	xlC.msg.en_US.cpp	53
xlC.cpp	443	devices.common.IBM.disk	52
bos.rte.edit_4.3.1.0.bff	435	bos.rte.diag_4.3.1.0.bff	52
devices.mca.8f7f	428	U449640.bff	50
devices.rspc.base	416	devices.isa_sio.PNP0400	49
devices.graphics	414	bos.rte.im_4.3.1.0.bff	49
X11.loc.ko_KR	400	devices.sys.pci	48
X11.loc.ru_RU	396	bos.rte.devices_msg_4.3.1.0.bff	48
devices.ssa.disk	395	devices.sys.pci_AS4D_rspc	47
X11.loc.ZH_CN	392	devices.sio.ppa	47
sysmgt.help.msg.Ja_JP	388	devices.pci.31114671	46
devices.rs6ksmp.base	386	U449956.bff	45

Fileset Name	KB	Fileset Name	KB
X11.loc.Zh_TW	385	devices.isa_sio.IBM0005.IBM8301	44
X11.loc.zh_TW	383	bos.rte.libqb_4.3.1.0.bff	44
sysmgt.help.msg.de_DE	380	devices.serial.tablet1	41
X11.loc.pl_PL	380	devices.mca.fff0	37
bos.rte.libpthreads_4.3.1.0.bff	377	devices.common.IBM.pmmd_chrp	36
X11.loc.de_DE	376	devices.sio.sa	35
bos.txt.data	375	devices.pci.31114671.diag	35
X11.loc.es_ES	375	bos.rte.devices_4.3.1.0.bff	35
sysmgt.help.msg.ja_JP	374	devices.pci.31114571.diag	34
X11.loc.it_IT	374	devices.mca.df5f	34
X11.loc.hu_HU	374	devices.common.rspcbase	34
sysmgt.help.msg.ru_RU	373	bos.rte.net_4.3.1.0.bff	34
sysmgt.help.msg.hu_HU	372	bos.rte.console_4.3.1.0.bff	32
X11.loc.pt_BR	372	devices.pci.isa	31
X11.loc.fr_FR	372	devices.mca.f6f8	31
X11.loc.cs_CZ	372	devices.sys.sgabus	30
X11.loc.ca_ES	372	devices.mca.f6f4	30
devices.mca.8ef4	370	devices.isa.pc8s	30
sysmgt.help.msg.pl_PL	367	bos.rte.libdbm_4.3.1.0.bff	30
X11.loc.zh_CN	366	devices.isa_sio.pnpPNP.700	28
U445370.bff	364	devices.isa_sio.PNP0303	28
X11.loc.sv_SE	363	devices.buc.00004007	28
sysmgt.help.msg.it_IT	362	devices.buc.00004006	28
sysmgt.help.msg.es_ES	362	devices.buc.00004005	28
devices.pci.14107c00	360	devices.mca.0200	27
sysmgt.help.msg.fr_FR	359	devices.isa_sio.PNP0F03	26
sysmgt.help.msg.ca_ES	359	devices.chrp.pci	26

Fileset Name	KB	Fileset Name	KB
sysmgt.help.msg.cs_CZ	358	devices.pci.3353c388	25
devices.mca.8ee4	358	devices.pci.3353c188	25
sysmgt.help.msg.pt_BR	357	devices.pci.3353c288	24
sysmgt.help.msg.ko_KR	357	devices.mca.8f97	24
sysmgt.help.msg.ZH_CN	351	bos.rte.date_4.3.1.0.bff	24
U453291.bff	351	X11.vfb	24
X11.loc.Zh_CN	350	U445321.bff	23
bos.rte.serv_aid_4.3.1.0.bff	347	devices.serial.sb1	19
sysmgt.help.msg.en_US	342	bos.rte.jfscomp_4.3.1.0.bff	19
devices.pci.4f111100	327	xlC.msg.en_US.rte_3.6.3.0	18
sysmgt.help.msg.zh_TW	319	devices.isa_sio.pnpPNP.501	18
sysmgt.help.msg.Zh_TW	319	U443586.bff	18
sysmgt.help.msg.zh_CN	317	devices.pcmcia.a4001e00	17
sysmgt.help.msg.Zh_CN	317	devices.mca.edd6	17
X11.loc.no_NO	307	devices.mca.edd3	17
X11.loc.nl_BE	307	devices.mca.edd2	17
devices.pci.0e100091	294	devices.mca.edd1	17
devices.sio.ktma	293	devices.pci.14105000	14
X11.loc.lw_IL	292	devices.pci.14104f00	14
X11.loc.Ar_AA	292	devices.pci.14104e00	14
devices.scsi.tape	291	devices.pci.14104500	14
X11.loc.iw_IL	289	devices.mca.8f98	14
X11.loc.en_US	289	devices.isa_sio.PNP0401	14
X11.loc.ar_AA	289	U445352.bff	14
X11.loc.nl_NL	287	U445304.bff	13
X11.loc.fr_CH	287	devices.pcmcia.a4001d00	12
X11.loc.fr_CA	287	devices.pcmcia.a4000200	12

Fileset Name	KB	Fileset Name	KB
X11.loc.fr_BE	287	devices.mca.8f64	12
X11.loc.de_CH	287	devices.pcmcia.a4003900	11
devices.pci.14101b00	286	devices.isa_sio.IBM000E	10
bos.rte.bosinst_4.3.1.0.bff	286	U445302.bff	10
X11.loc.tr_TR	286	devices.isa_sio.pnpPNP.400	9
X11.loc.th_TH	286	devices.isa_sio.IBM001E	9
X11.loc.sr_SP	286	devices.mca.f6fe	8
X11.loc.sq_AL	286	devices.mca.dee6	8
X11.loc.sl_SI	286	devices.isa_sio.IBM0017	8
X11.loc.sk_SK	286	devices.pci.pci	7
X11.loc.sh_SP	286	devices.pci.PNP0A03	7
X11.loc.ro_RO	286	devices.isa_sio.IBM001C	7
X11.loc.pt_PT	286	devices.mca.fed9	6
X11.loc.mk_MK	286	U449954.bff	5
X11.loc.is_IS	286	ifor_ls.client	4
X11.loc.hr_HR	286	devices.pci.PNP0A00	4
X11.loc.fi_FI	286	devices.mca.efbd	4
X11.loc.en_GB	286	devices.sys.PNP0A03	2
X11.loc.el_GR	286	devices.isa_sio.IBM001D.NA	2
X11.loc.da_DK	286	devices.isa_sio.IBM0013.NA	2
X11.loc.bg_BG	286	devices.isa_sio.IBM0012.NA	2

C.2 Base AIX CD-ROM Volume 2

Approximate Space Used - 276 MB

Table 13. AIX CD-ROM Volume 2 Fileset Contents and Sizes

Fileset Name	KB	Fileset Name	KB
os.loc.adt	33754	X11.loc.NI_BE	306

Fileset Name	KB	Fileset Name	KB
db2_02_01.dd_4.1.2.2	21000	X11.loc.NI_NL	287
db2_02_01.db2_4.1.2.2	19750	X11.loc.Fr_CH	287
IMNSearch.rte	18950	X11.loc.Fr_CA	287
db2_02_01.client_4.1.2.2	18700	X11.loc.Fr_BE	287
X11.samples	17921	X11.loc.De_CH	287
db2_02_01.pm_4.1.2.2	12800	X11.loc.Pt_PT	286
ldap.server	12592	X11.loc.Lv_LV	286
bos.alt_disk_install	10193	X11.loc.Lt_LT	286
db2_02_01.ve_4.1.2.2	9400	X11.loc.Is_IS	286
X11.x_st_mgr	7488	X11.loc.Fi_FI	286
ipx.base	5878	X11.loc.Et_EE	286
db2_02_01.conv_4.1.2.2	4750	X11.loc.En_GB	286
bos.som	4400	X11.loc.Da_DK	286
Java.adt	3855	bos.rcs	262
Java.samples	3528	bos.perf	250
bos.msg.Es_ES	3120	bos.atm	249
bos.msg.De_DE	3113	ldap.msg.en_US	235
bos.msg.lt_IT	3090	printers.epson	200
bos.msg.Fr_FR	3089	printers.ibm_3	197
bos.msg.Ca_ES	3018	bos.msg.alt_disk_install	172
bos.msg.Sv_SE	2820	db2_02_01.clp_4.1.2.2	150
bos.msg.En_US	2795	bos.data	138
bos.cns	2386	printers.msg.fr_FR	125
pkg_gd	2312	printers.msg.Fr_FR	125
bos.mh	2256	printers.msg.es_ES	121
bos.content_list	2125	printers.msg.Es_ES	121
X11.msg.De_DE	1962	printers.msg.it_IT	119

Fileset Name	KB	Fileset Name	KB
X11.msg.Ca_ES	1923	printers.msg.ca_ES	119
X11.msg.Es_ES	1865	printers.msg.lt_IT	119
X11.msg.lt_IT	1669	printers.msg.Ca_ES	119
X11.msg.Fr_FR	1618	printers.msg.Ja_JP	118
X11.msg.Sv_SE	1531	printers.msg.ru_RU	117
X11.msg.En_US	1530	printers.msg.de_DE	117
perfagent.tools	1498	printers.msg.De_DE	117
ldap.client	1444	printers.msg.pt_BR	116
printers.ibm_2	1022	printers.msg.pl_PL	116
bos.lrn.data	990	printers.msg.ja_JP	116
bos.compat	912	printers.msg.ko_KR	112
IMNSearch.bld	900	printers.msg.hu_HU	112
devices.msg.Es_ES	876	printers.msg.ZH_CN	110
devices.msg.lt_IT	867	printers.msg.sv_SE	108
devices.msg.De_DE	850	printers.msg.Sv_SE	108
devices.msg.Fr_FR	825	printers.msg.cs_CZ	107
bos.dlc	816	printers.msg.en_US	104
devices.msg.Ca_ES	801	printers.msg.En_US	104
printers.bull	800	printers.ibm_plot	101
devices.msg.En_US	787	printers.msg.zh_TW	100
devices.msg.Sv_SE	771	printers.msg.Zh_TW	100
ldap.html.en_US	694	printers.can	98
printers.hp	646	printers.msg.zh_CN	90
printers.ibm_1	552	printers.msg.Zh_CN	90
printers.lex	545	printers.star	84
bos.pci	519	bos.twintail	75
ipx.rte	513	bos.adt.data	59

Fileset Name	KB	Fileset Name	KB
bos.games	385	bos.dosutil	56
X11.loc.Es_ES	376	bos.loc.fnt	52
X11.loc.De_DE	376	printers.dp	45
X11.loc.It_IT	375	printers.qms	41
X11.loc.Ca_ES	372	printers.ti	39
X11.loc.Fr_FR	371	bos.lrn	34
X11.loc.Sv_SE	363	xiC.msg.De_DE	31
X11.loc.En_US	353	printers.pt	25
printers.ibm_asian	334	printers.oki	19
bos.acct	328	bos.compat.data	7
X11.loc.No_NO	306	ipx.msg.en_US	6

C.3 Base AIX CD-ROM Volume 3

Approximate Space Used - 353 MB

Table 14. AIX CD-ROM Volume 3 Fileset Contents and Sizes

X11.help.ca_ES	18314	X11.help.Sv_SE	9608
X11.help.Ca_ES	18312	X11.man.en_US	3920
X11.help.de_DE	15461	X11.man.en_US.base	2150
X11.help.De_DE	15460	ifor_ls.ipf.Ja_JP	1293
X11.help.pl_PL	15059	ifor_ls.html.Ja_JP	1173
X11.help.zh_TW	14683	ifor_ls.html.zh_CN	1152
X11.help.Zh_TW	14682	ifor_ls.html.pt_BR	1116
X11.help.Es_ES	14614	ifor_ls.html.fr_FR	1113
X11.help.ko_KR	14522	ifor_ls.ipf.zh_TW	1099
X11.help.es_ES	14467	ifor_ls.html.de_DE	1096
X11.help.Fr_FR	12017	ifor_ls.ipf.zh_CN	1093

X11.help.fr_FR	11841	ifor_ls.html.zh_TW	1023
X11.help.Ja_JP	11639	ifor_ls.html.it_IT	1022
X11.help.ja_JP	11633	ifor_ls.ipf.pt_BR	966
X11.help.hu_HU	11061	ifor_ls.ipf.de_DE	949
X11.help.cs_CZ	10625	ifor_ls.ipf.en_US	941
X11.help.pt_BR	10348	ifor_ls.ipf.fr_FR	923
X11.help.ZH_CN	10347	ifor_ls.ipf.it_IT	911
X11.help.ru_RU	10320	sysmgmt.help.en_US	900
X11.help.zh_CN	10210	ifor_ls.ipf.ko_KR	894
X11.help.Zh_CN	10206	ifor_ls.html.ko_KR	884
X11.help.en_US	10001	ifor_ls.html.es_ES	808
X11.help.En_US	9994	ifor_ls.ipf.es_ES	750
X11.help.it_IT	9875	sysback.rte.update	650
X11.help.It_IT	9873	ifor_ls.html.en_US	615
X11.help.sv_SE	9612	sysback.sbom.update	50

Table 17. Installed SCSI Devices Environment Table

Other SCSI Devices		
Name	Location	Description and Comments

Table 18. Memory Environment Table

Memory Configuration		
Name	Location	Description and Comments

Table 20. Non-IBM Software Environment Table

Non- IBM Software Products			
Program Number	Product Name	Version	Replacement Product

Appendix E. Special Notices

This publication is intended to help administrators of RS/6000 systems running earlier releases of AIX plan a migration to AIX Version 4.3. The information in this publication is not intended as the specification of any programming interfaces that are provided by the AIX operating system. See the PUBLICATIONS section of the IBM Programming Announcement for AIX Version 4.3 for more information about what publications are considered to be product documentation.

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Appendix F. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

F.1 International Technical Support Organization Publications

For information on ordering these ITSO publications, see “How to Get ITSO Redbooks” on page 197.

- *A Technical Introduction to PCI-Based RS/6000 Servers*, SG24-4690
- *Managing AIX V4 on PCI-Based RISC System/6000 Workstations*, SG24-2581
- *AIX Version 4.1 Software Problem Debugging and Reporting for the RISC System/6000*, GG24-2513
- *AIX Version 4.2 Differences Guide*, SG24-4807
- *AIX Version 4.3 Differences Guide*, SG24-2014
- *Managing One or More AIX Systems*, GG24-4160
- *TCP/IP Tutorial and Technical Overview*, GG24-3376
- *Practical TCP/IP for AIX V3.2/4.1 Users: Hints and Tips for Debugging and Tuning*, SG24-4381

F.2 Redbooks on CD-ROMs

Redbooks are also available on CD-ROMs. **Order a subscription** and receive updates 2-4 times a year at significant savings.

CD-ROM Title	Subscription Number	Collection Kit Number
System/390 Redbooks Collection	SBOF-7201	SK2T-2177
Networking and Systems Management Redbooks Collection	SBOF-7370	SK2T-6022
Transaction Processing and Data Management Redbook	SBOF-7240	SK2T-8038
Lotus Redbooks Collection	SBOF-6899	SK2T-8039
Tivoli Redbooks Collection	SBOF-6898	SK2T-8044
AS/400 Redbooks Collection	SBOF-7270	SK2T-2849
RS/6000 Redbooks Collection (HTML, BkMgr)	SBOF-7230	SK2T-8040
RS/6000 Redbooks Collection (PostScript)	SBOF-7205	SK2T-8041
RS/6000 Redbooks Collection (PDF Format)	SBOF-8700	SK2T-8043
Application Development Redbooks Collection	SBOF-7290	SK2T-8037

F.3 Other Publications

These publications are also relevant as further information sources:

- *AIX Version 4.3 Installation Guide*, SC23-4112
- *AIX Version 4.3 Network Installation Management Guide and Reference*, SC23-4113
- *AIX Version 4.3 Quick Installation and Startup Guide*, SC23-4111

A full list of AIX and RS/6000 publications available from IBM can be found at the following URL:

http://www.rs6000.ibm.com/resource/aix_resource/pubs.html

How to Get ITSO Redbooks

This section explains how both customers and IBM employees can find out about ITSO redbooks, CD-ROMs, workshops, and residencies. A form for ordering books and CD-ROMs is also provided.

This information was current at the time of publication, but is continually subject to change. The latest information may be found at <http://www.redbooks.ibm.com/>.

How IBM Employees Can Get ITSO Redbooks

Employees may request ITSO deliverables (redbooks, BookManager BOOKs, and CD-ROMs) and information about redbooks, workshops, and residencies in the following ways:

- **Redbooks Web Site on the World Wide Web**

<http://w3.itso.ibm.com/>

- **PUBORDER** – to order hardcopies in the United States
- **Tools Disks**

To get LIST3820s of redbooks, type one of the following commands:

```
TOOLCAT REDPRINT
TOOLS SENDTO EHONE4 TOOLS2 REDPRINT GET SG24xxxx PACKAGE
TOOLS SENDTO CANVM2 TOOLS REDPRINT GET SG24xxxx PACKAGE (Canadian users only)
```

To get BookManager BOOKs of redbooks, type the following command:

```
TOOLCAT REDBOOKS
```

To get lists of redbooks, type the following command:

```
TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET ITSOCAT TXT
```

To register for information on workshops, residencies, and redbooks, type the following command:

```
TOOLS SENDTO WTSCPOK TOOLS ZDISK GET ITSOREGI 1998
```

- **REDBOOKS Category on INEWS**
- **Online** – send orders to: USIB6FPL at IBMMAIL or DKIBMBSH at IBMMAIL

Redpieces

For information so current it is still in the process of being written, look at "Redpieces" on the Redbooks Web Site (<http://www.redbooks.ibm.com/redpieces.html>). Redpieces are redbooks in progress; not all redbooks become redpieces, and sometimes just a few chapters will be published this way. The intent is to get the information out much quicker than the formal publishing process allows.

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Customers may request ITSO deliverables (redbooks, BookManager BOOKs, and CD-ROMs) and information about redbooks, workshops, and residencies in the following ways:

- **Online Orders** – send orders to:

	IBMMAIL	Internet
In United States	usib6fpl at ibmmail	usib6fpl@ibmmail.com
In Canada	caibmbkz at ibmmail	lmannix@vnet.ibm.com
Outside North America	dkibmbsh at ibmmail	bookshop@dk.ibm.com

- **Telephone Orders**

United States (toll free)	1-800-879-2755
Canada (toll free)	1-800-IBM-4YOU
Outside North America	(long distance charges apply)
(+45) 4810-1320 - Danish	(+45) 4810-1020 - German
(+45) 4810-1420 - Dutch	(+45) 4810-1620 - Italian
(+45) 4810-1540 - English	(+45) 4810-1270 - Norwegian
(+45) 4810-1670 - Finnish	(+45) 4810-1120 - Spanish
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- **Fax** – send orders to:

United States (toll free)	1-800-445-9269
Canada	1-800-267-4455
Outside North America	(+45) 48 14 2207 (long distance charge)

- **1-800-IBM-4FAX (United States) or (+1) 408 256 5422 (Outside USA)** – ask for:

Index # 4421 Abstracts of new redbooks
Index # 4422 IBM redbooks
Index # 4420 Redbooks for last six months

- **On the World Wide Web**

Redbooks Web Site	http://www.redbooks.ibm.com
IBM Direct Publications Catalog	http://www.elink.ibm.link.ibm.com/pbl/pbl

Redpieces

For information so current it is still in the process of being written, look at "Redpieces" on the Redbooks Web Site (<http://www.redbooks.ibm.com/redpieces.html>). Redpieces are redbooks in progress; not all redbooks become redpieces, and sometimes just a few chapters will be published this way. The intent is to get the information out much quicker than the formal publishing process allows.

List of Abbreviations

<i>ACL</i>	Access Control List	<i>ISV</i>	Independent Software Vendor
<i>AH</i>	Authentication Header	<i>ITSO</i>	International Technical Support Organization
<i>APA</i>	all points addressable	<i>JDK</i>	Java Development Kit
<i>BLT</i>	Basic License Tool	<i>JIT</i>	Just-in-Time
<i>CDE</i>	Common Desktop Environment	<i>LAN</i>	Local Area Network
<i>CDMF</i>	Common Data Masking Facility	<i>LDAP</i>	Lightweight Directory Access Protocol
<i>CHAP</i>	Challenge Handshake Authentication Protocol	<i>LFT</i>	Low Function Terminal
<i>CIDR</i>	Classless Inter Domain Routing	<i>LLB</i>	Local Location Broker
<i>CRK</i>	Client Runtime Kit	<i>LPP</i>	Licensed Program Product
<i>DCE</i>	Distributed Computing Environment	<i>LUM</i>	License Use Management
<i>DNS</i>	Domain Name System	<i>LVM</i>	Local Volume Manager
<i>ESP</i>	Encapsulation Security Payload	<i>MPA</i>	Multi Protocol Adapter
<i>FDDI</i>	Fiber Distributed Data Interface	<i>MTU</i>	Maximum Transmission Unit
<i>GLB</i>	Global Location Broker	<i>NAT</i>	Network Administration Tool
<i>GUI</i>	Graphical User Interface	<i>NCK</i>	Network Computing Kernel
<i>HTF</i>	High Function Terminal	<i>NCS</i>	Network Computing System
<i>IBM</i>	International Business Machines Corporation	<i>NFS</i>	Network File System
<i>IETF</i>	Internet Engineering Task Force	<i>NIM</i>	Network Installation Manager
<i>IMAP4</i>	Internet Message Access Protocol	<i>NIS</i>	Network Information Service
<i>IP</i>	Internet Protocol	<i>NLS</i>	National Language Support
<i>IPF/X</i>	Interactive Presentation Facility eXtended	<i>NTP</i>	Network Time Protocol
<i>IPLA</i>	International Program License Agreement	<i>NTX</i>	Network Terminal Accelerator
		<i>ODM</i>	Object Data Manager

<i>OPP</i>	Optional Program Product
<i>OSPF</i>	Open Shortest Path First
<i>PAP</i>	Password Authentication Protocol
<i>PMTU</i>	Path Maximum Transmission Unit
<i>POP3</i>	Post Office Protocol 3
<i>PPP</i>	Point-to-Point Protocol
<i>RAN</i>	Remote Asynchronous Node
<i>RPC</i>	Remote Procedure Call
<i>SHA1</i>	Secure Hash Algorithm 1
<i>SMP</i>	Symmetric Multi Processor
<i>SMS</i>	System Management Services
<i>SMTP</i>	Simple Mail Transfer Protocol
<i>SPOT</i>	Shared Product Object Tree
<i>SRK</i>	Server Runtime Kit
<i>SSL</i>	Secure Socket Layer
<i>TCB</i>	Trusted Computer Base
<i>UDP</i>	User Datagram Protocol
<i>VFB</i>	Virtual Frame Buffering
<i>VGDA</i>	Volume Group Descriptor Area
<i>VMM</i>	Virtual Memory Manager
<i>VPD</i>	Vital Product Data
<i>VSM</i>	Visual Systems Manager
<i>XTI</i>	XPG4 Transport Service

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