



# **Unit 1**

## **Introduction to IBM System p servers and AIX system administration**



# Unit objectives

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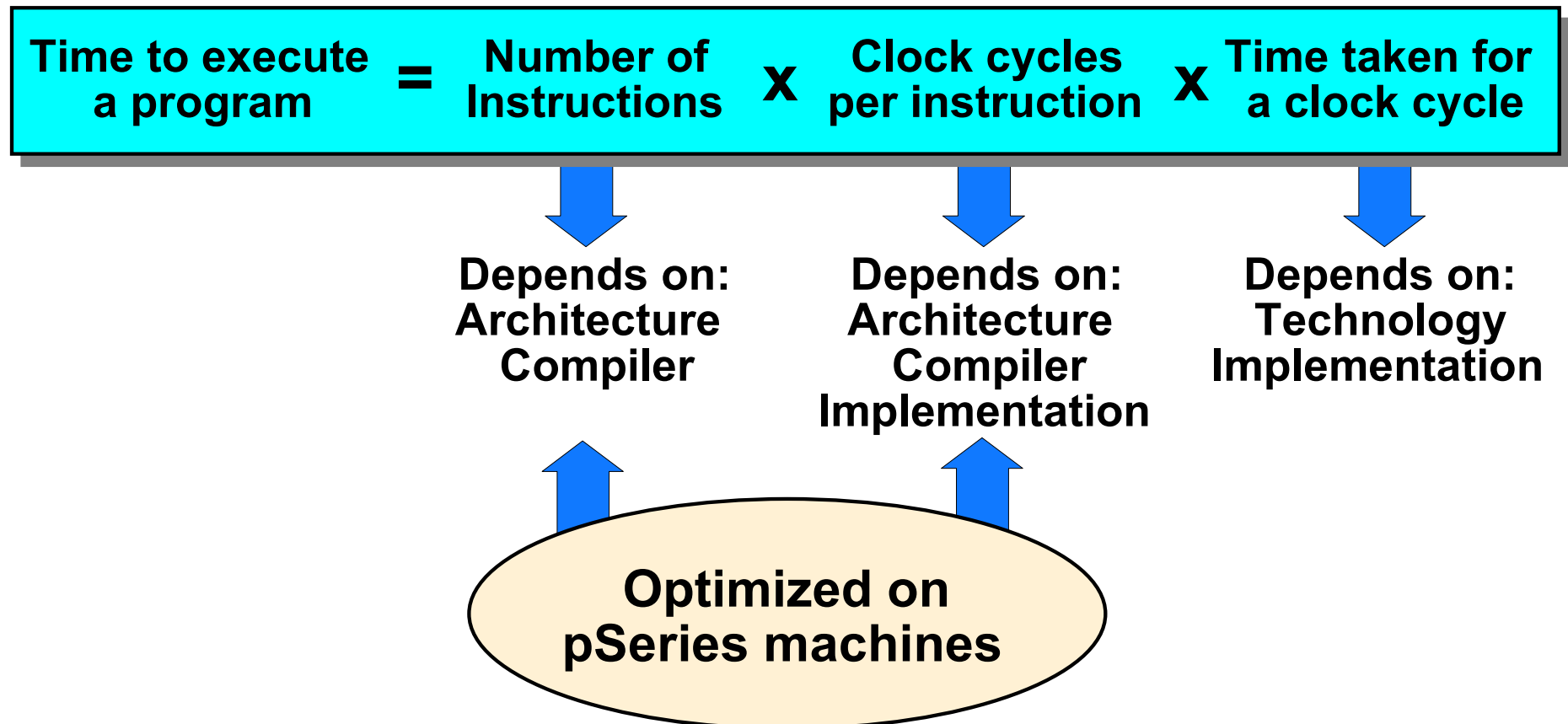
After completing this unit, you should be able to:

- Define terminology and concepts of IBM System p servers
- List common configurations available for IBM System p servers
- Describe the roles of the system administrator
- Obtain root access with the su command

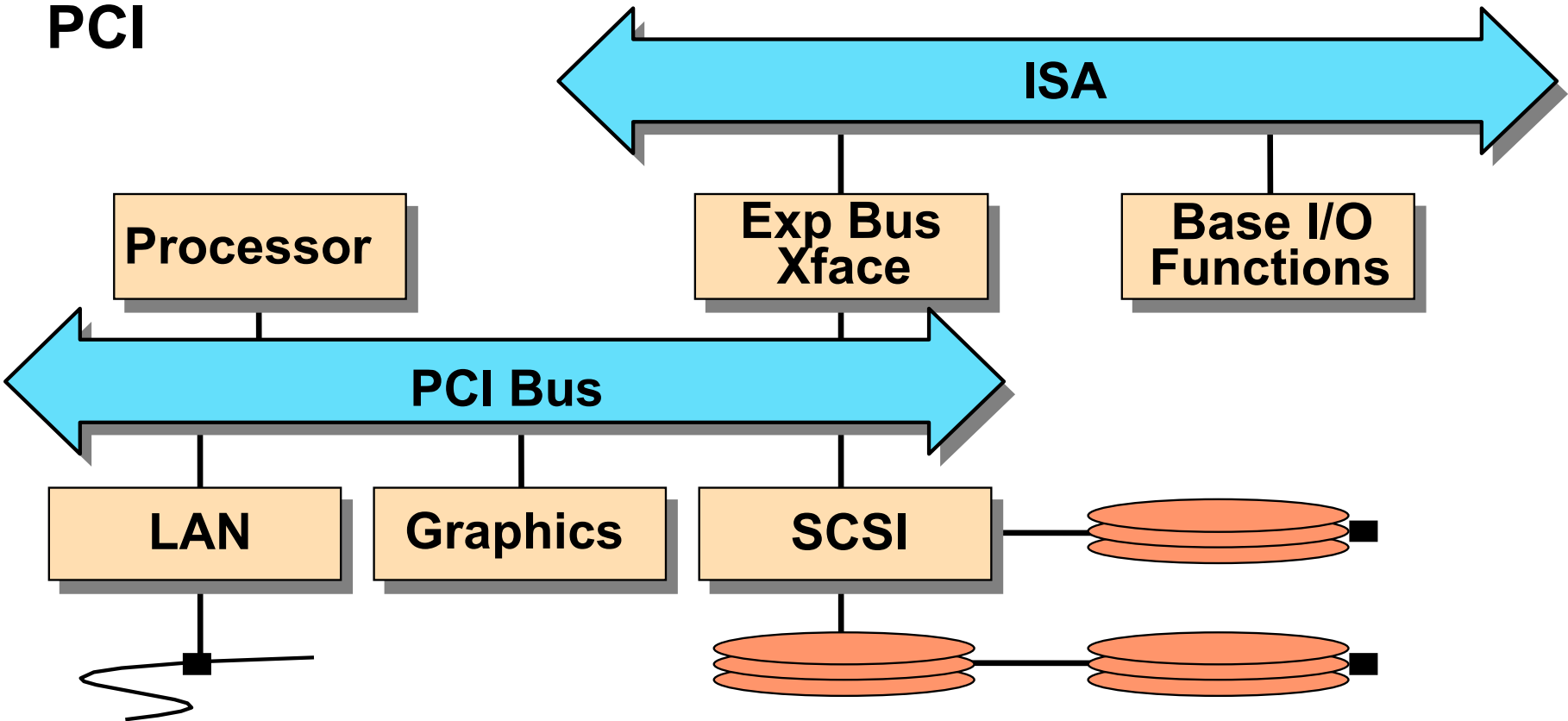
# What is RISC technology?

Reduced Instruction Set Computing (RISC) processors aim to:

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

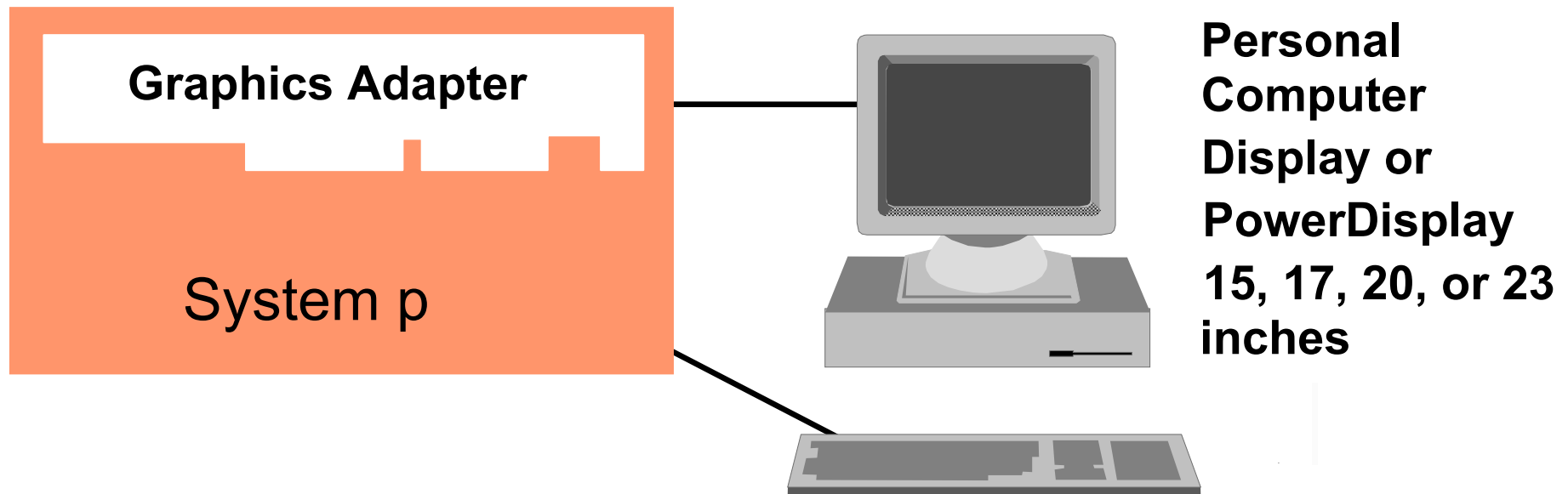


# System p bus types



# Workstation configuration

## Single-User Graphical Workstation



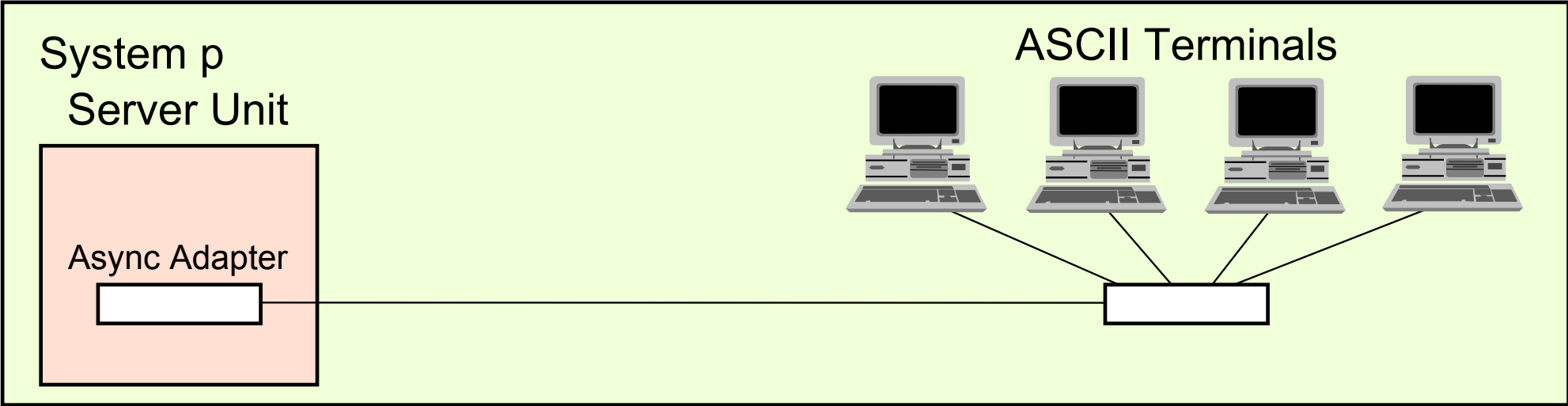
- 1280 x 1024 Resolution
- Up to 16 M colors

### Built-in Adapters

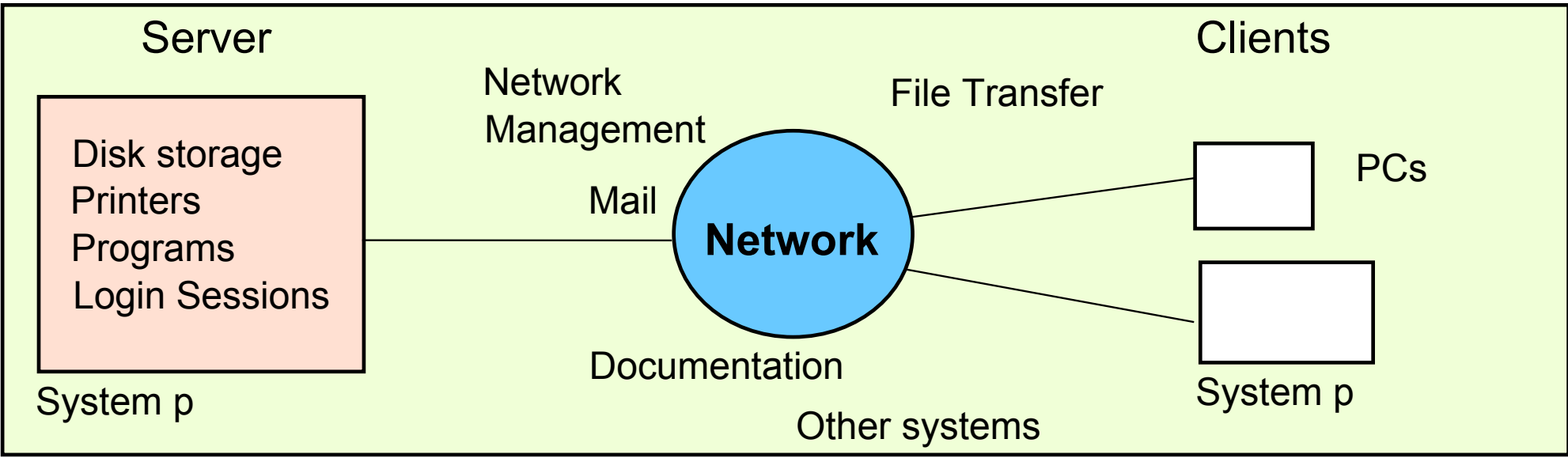
- ▶ Two serial ports
- ▶ SCSI
- ▶ Keyboard
- ▶ Mouse
- ▶ Diskette
- ▶ Ethernet
- ▶ Tablet

# Server configurations

## Multiuser System



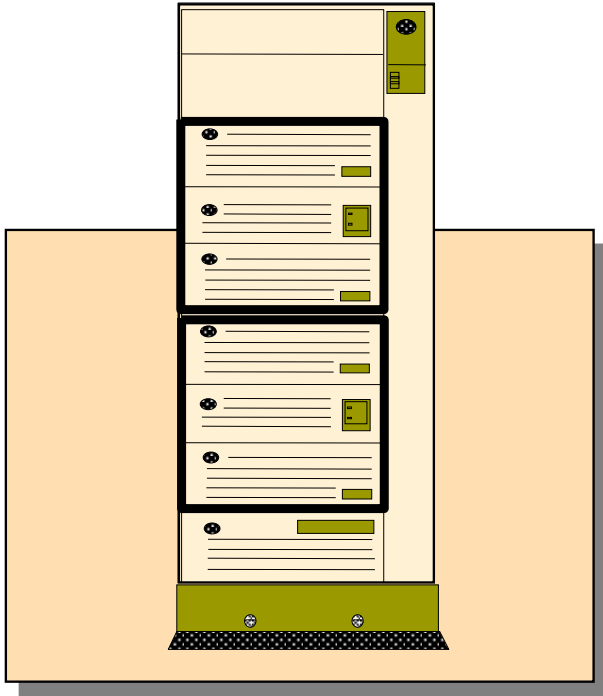
## Networked System



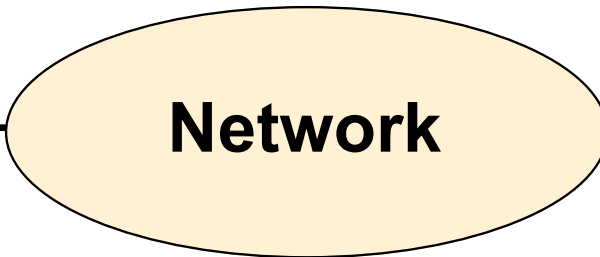
# PC connectivity

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**System p**

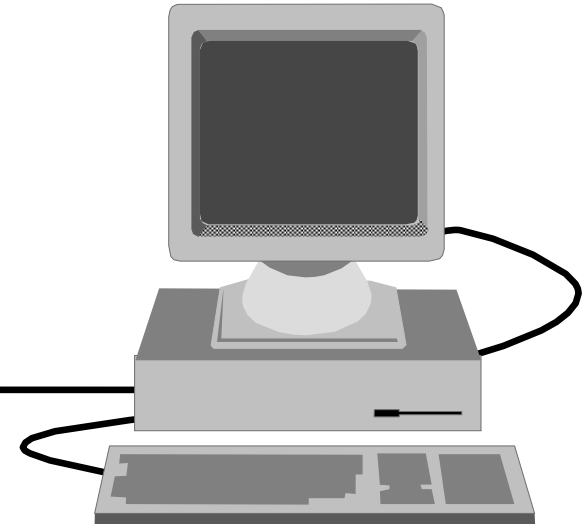


**X Window  
Client  
Programs**



**Network**

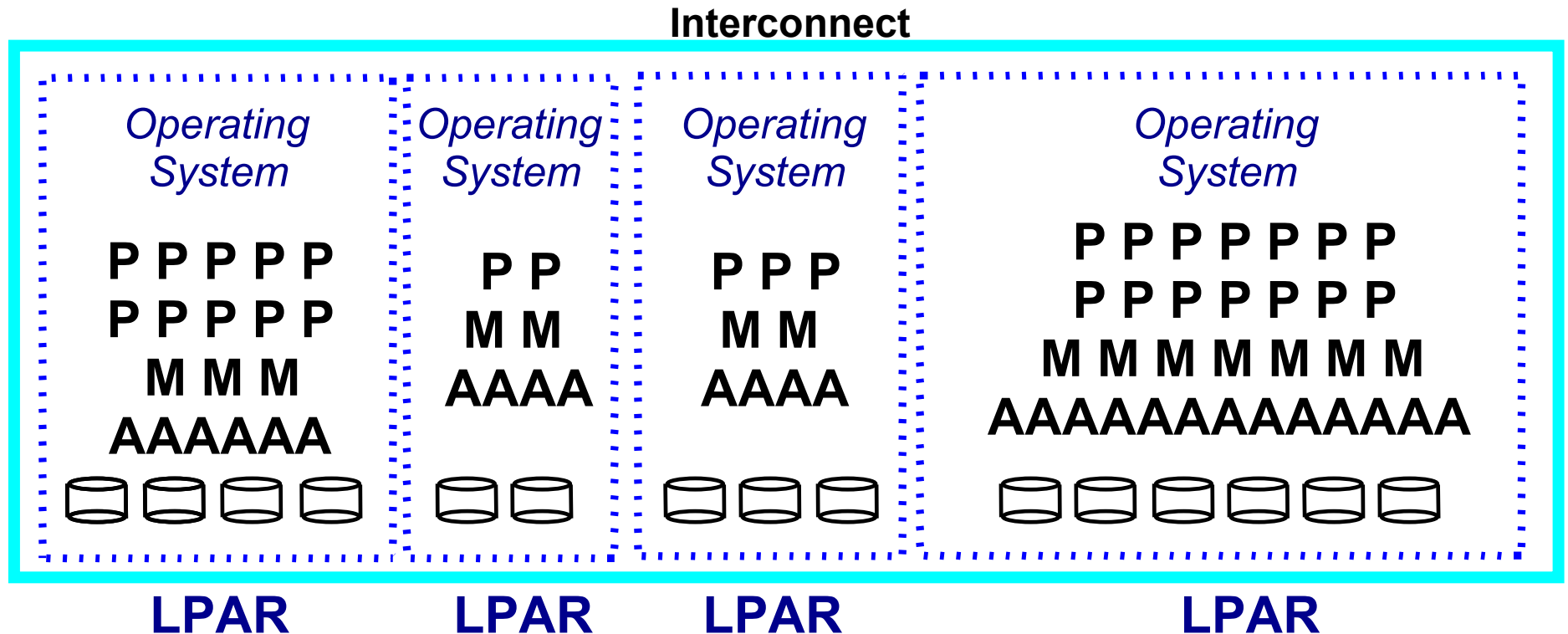
**PC**



**X Window  
Server  
Software**

# Logical partitioning (LPAR)

- Resources allocated in flexible units of granularity



**A = Adapter**

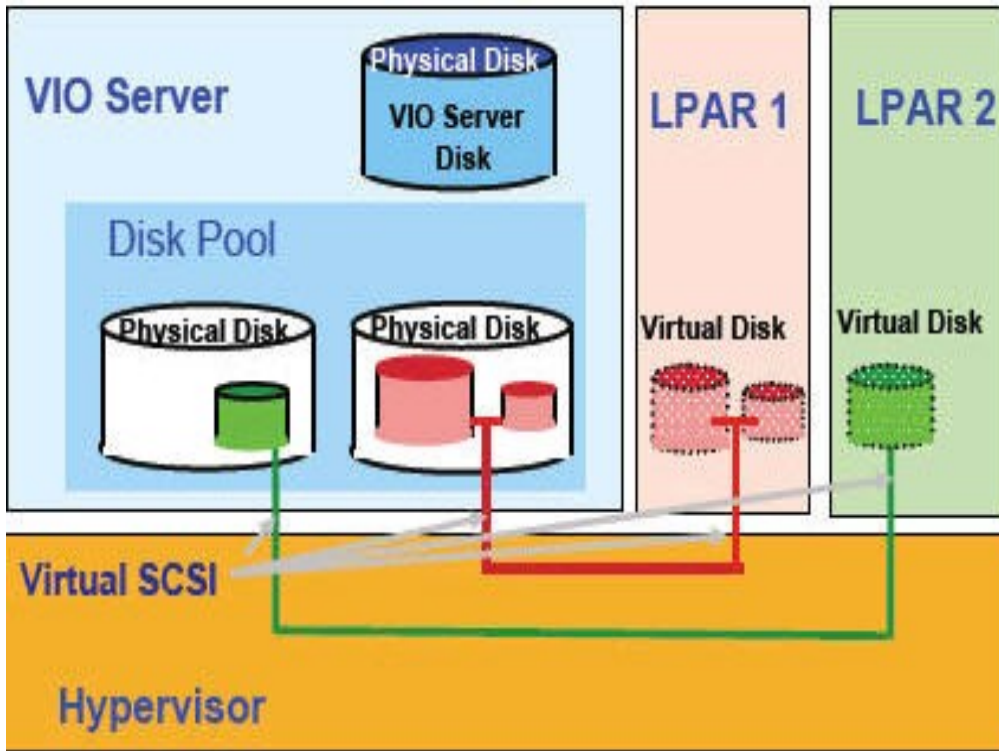
**M = Memory**

**P = Processor**

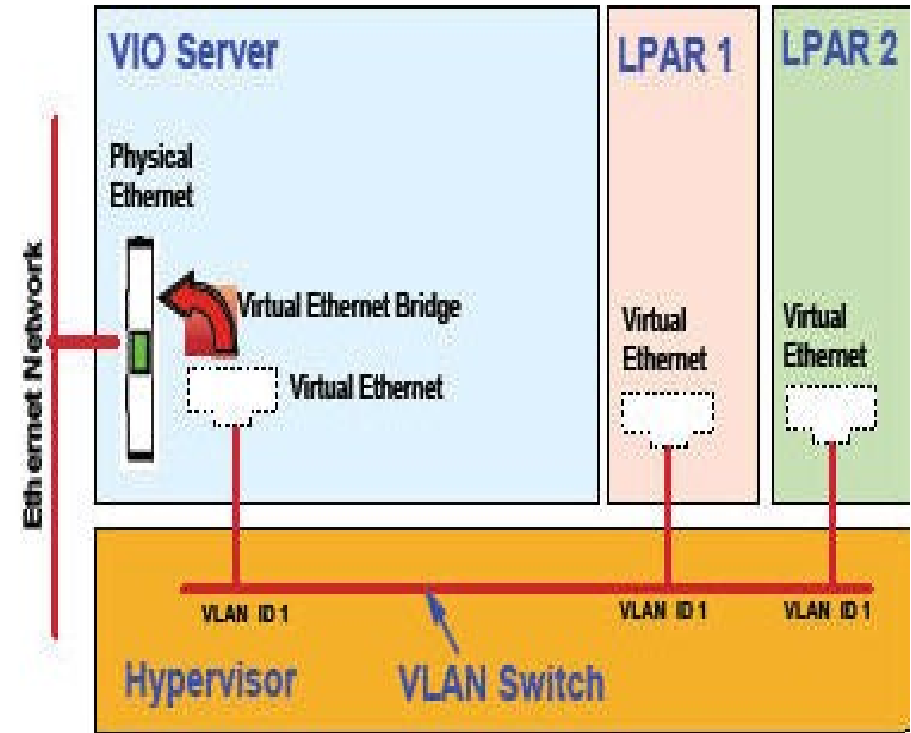
 **= Disk**



# Logical partition virtualization



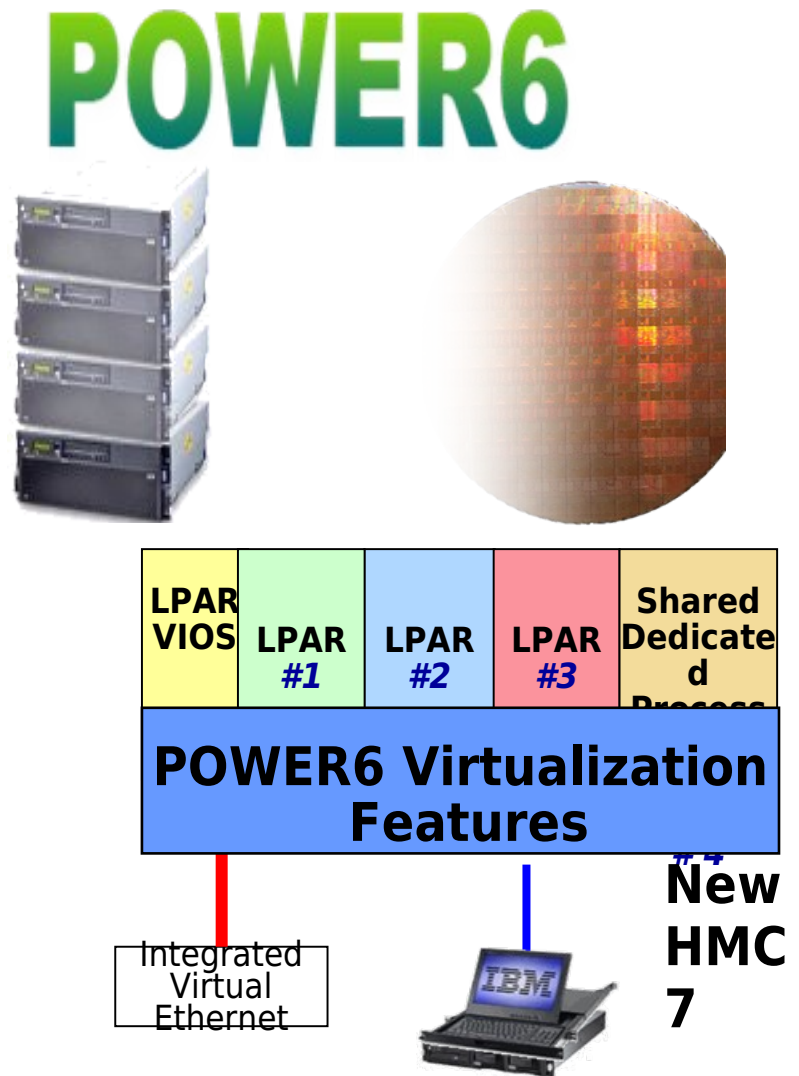
Virtual Disk



Virtual Ethernet

# POWER6 system highlights

- POWER6 processor technology
  - 5th implementation of multi-core design
  - ~100% higher frequencies
- POWER6 system architecture
  - New generation of servers
  - New IO
    - PCIe, SAS / SATA
    - GX+ 12x IO drawers
  - Enhanced power management
- Enhanced virtualization
  - Partition Mobility (SoD)
  - Dedicated shared processors
  - Integrated Virtual Ethernet
- Availability
  - New RAS features
    - Processor instruction retry
  - Power management



# AIX 6 highlights

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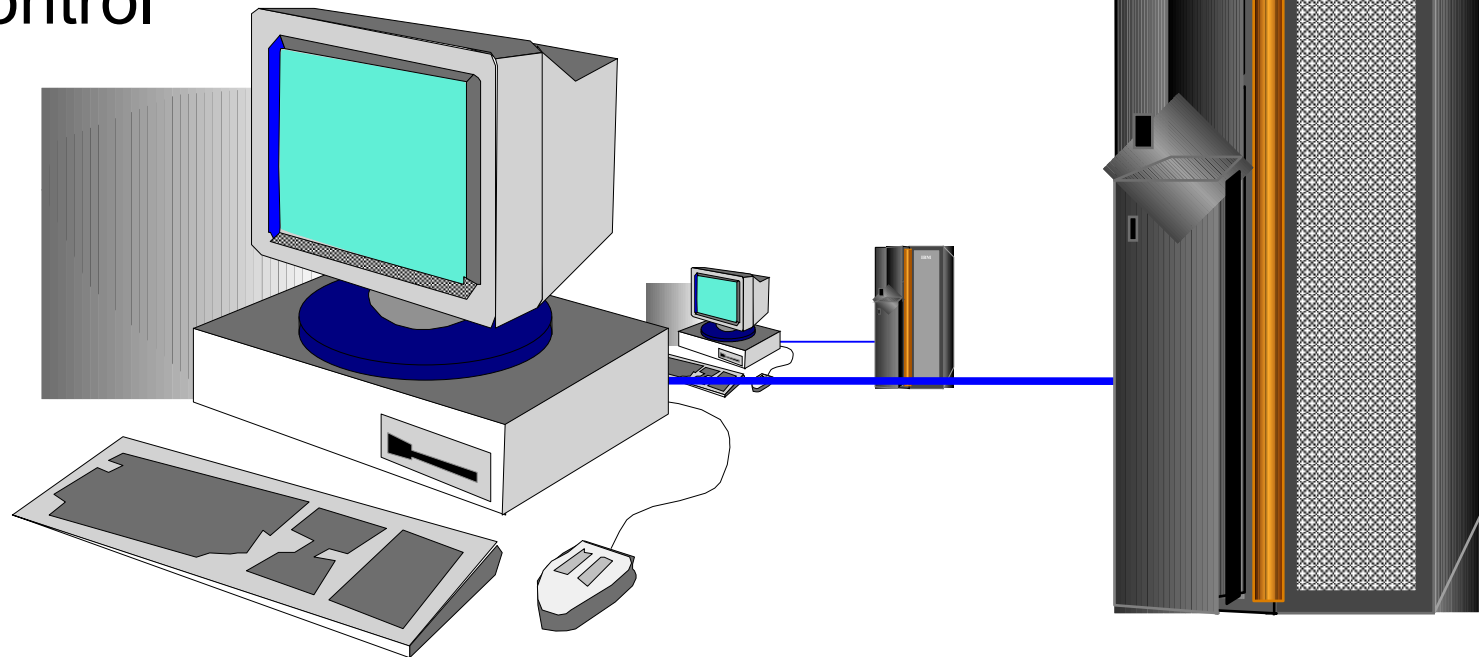
- Workload partitions
  - Multiple instances of AIX images in single LPAR
  - WPAR mobility (on POWER4, POWER5, or POWER6)
  - WLM infrastructure for resource balance and constraint
- Security
  - Enhanced RBAC (roles)
  - Trusted AIX
  - Trusted execution
  - Encrypted filesystems
  - AIX Security Expert enhancements
- RAS
  - Virtual storage protection key
  - Processor recovery
- Performance
  - Dynamic page sizes and 32 TB memory su
  - Processor folding for donating dedicated
  - SPURR accounting for variable clock speeds
  - Math APIs for Decimal Floating Point (DFP)
  - Drivers for POWER6 related hardware
    - SAS, SATA, PCI-Express, HEA, and so forth



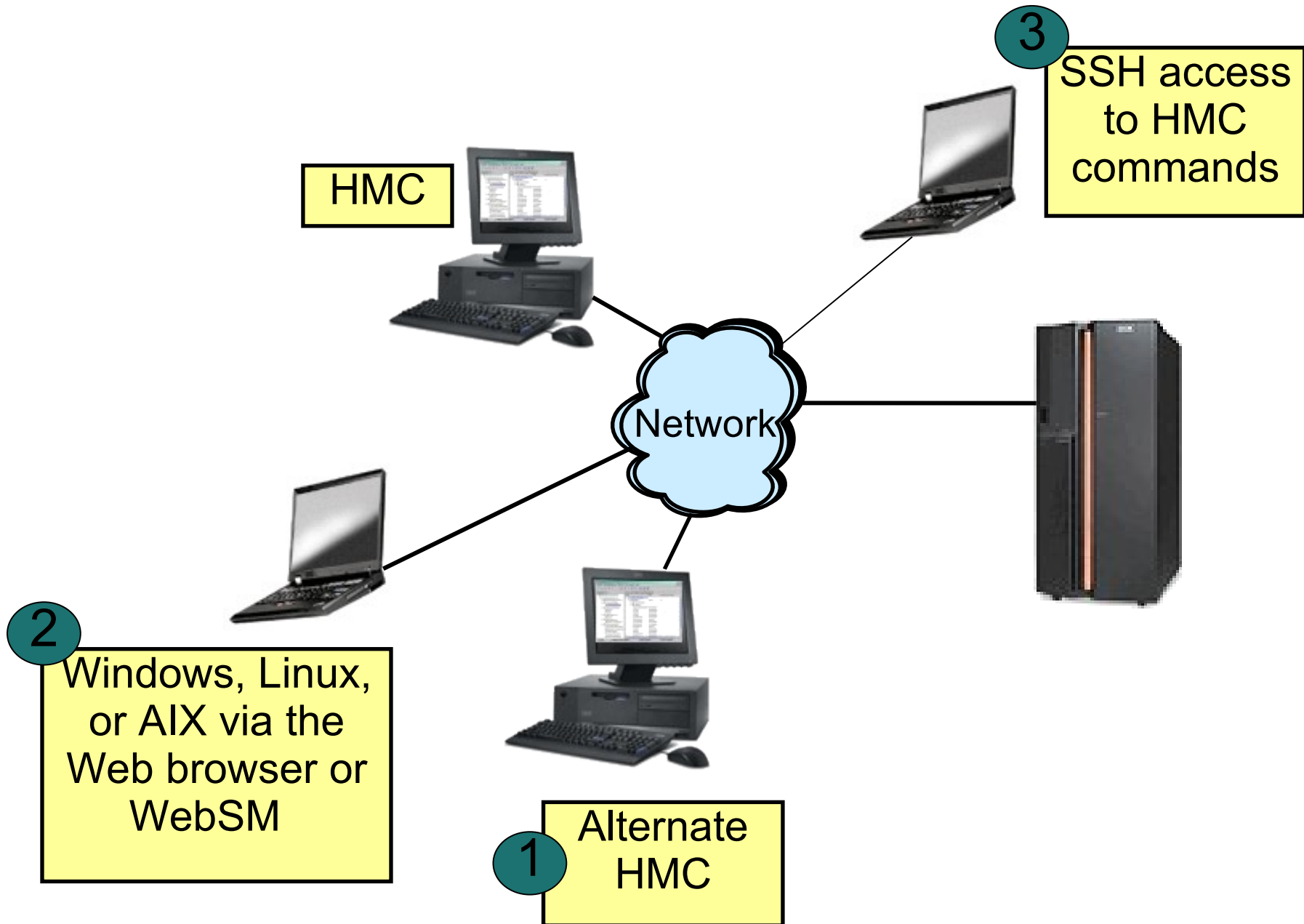
# HMC management

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- Hardware Management Console (HMC)
- Partition configuration and control
  - Dynamic partitioning for LPARs (AIX 5L V5.2 and later)
- Capacity Upgrade on Demand (CUoD)
- Diagnostics
- Operational management
- Remote HMC control



# Remote access to the HMC



# HMC default console view

https://10.31.198.151 - rt1s3hmc: Hardware Management Console Workplac...

## Hardware Management Console

hscroot | Help | Logoff

- Welcome
- Systems Management**
  - Servers
  - Custom Groups
- System Plans
- HMC Management
- Service Management
- Updates

Status: Open Serviceable Event

### Contents of: Systems Management

Select	Name	Description
<input type="checkbox"/>	Servers	Contains managed system objects.
<input type="checkbox"/>	Custom Groups	Contains all custom groups created.

Total: 2 Filtered: 2 Selected: 0

### Tasks: Systems Management

- Manage Custom Groups

Transferring data from 10.31.198.151... 10.31.198.151

# Role of the system administrator

---

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

# Who can perform administration tasks?

---

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

```
$ su root
```

or

```
$ su - root
```



# Checkpoint

1. What type of adapter are you likely to require for communicating from a logical partition?
  - a. Asynchronous
  - b. Graphics
  - c. Ethernet
  
3. True or False? The adapters seen by the AIX operating system, in an LPAR, may be either physical or virtual.

---
  
4. True or False? The su command allows you to get root authority even if you signed on using another user ID.



Welcome to:

# Unit 2

## System Management Interface Tool (SMIT)



# Unit objectives

---

After completing this unit, you should be able to:

- Describe the benefits of the system management tools available with AIX version 6.1
- Discuss the functionality of SMIT
- Explain how SMIT activity is logged

# Early system administration

print mount  
errpt backup  
passwd **Commands** restore  
trace kill update  
penable

## Flat files

/etc/profile  
/etc/qconfig  
/etc/filesystems  
/etc/rc  
/etc/passwd

**System  
Management**

adduser

## Front end menus

devices

minidisks

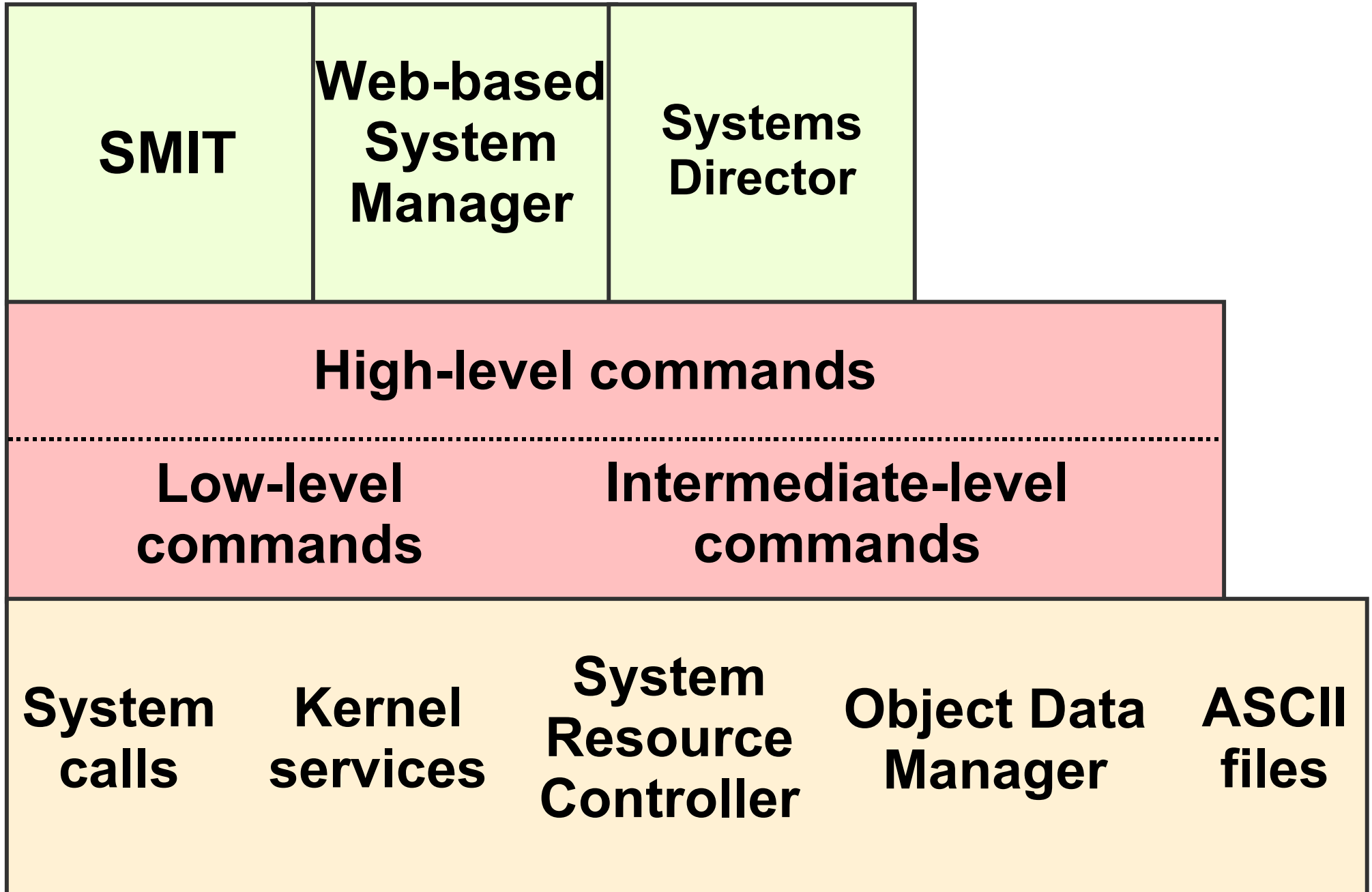
# System management objectives

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

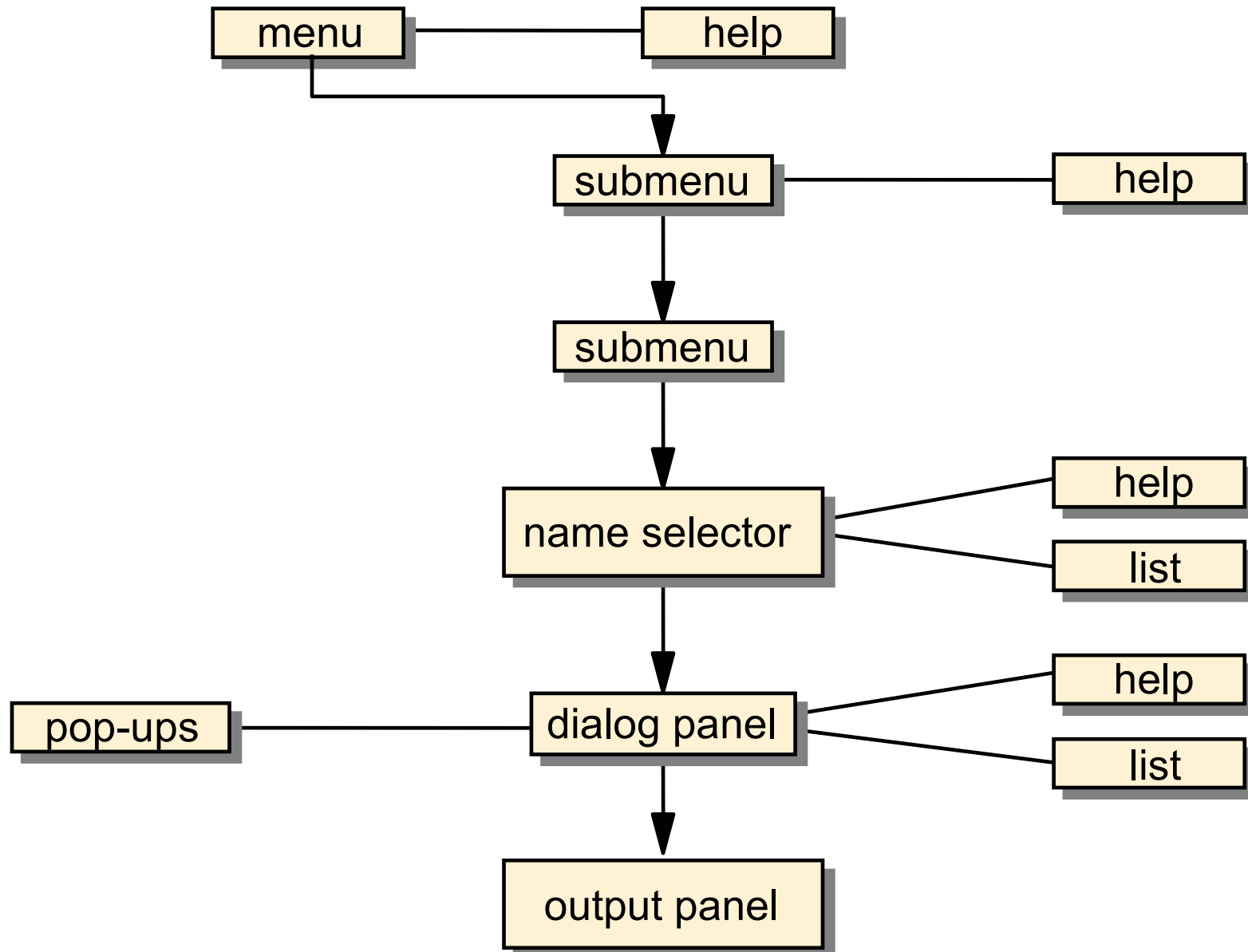


# AIX administration



# System Management Interface Tool (SMIT)

ASCII or AIXwindows (Motif) user interface components



# SMIT main menu (ASCII)

# smit

## System Management

Move cursor to desired item and press Enter.

Software Installation and Maintenance

Software License Management

Devices

System Storage Management (Physical & Logical Storage)

Security & Users

Communications Applications and Services

Workload Partition Administration

Print Spooling

Advanced Accounting

Problem Determination

Performance & Resource Scheduling

System Environments

Processes & Subsystems

Applications

Installation Assistant

Cluster Systems Management

Using SMIT (information only)

F1=Help

F2=Refresh

F3=Cancel

F8=Image

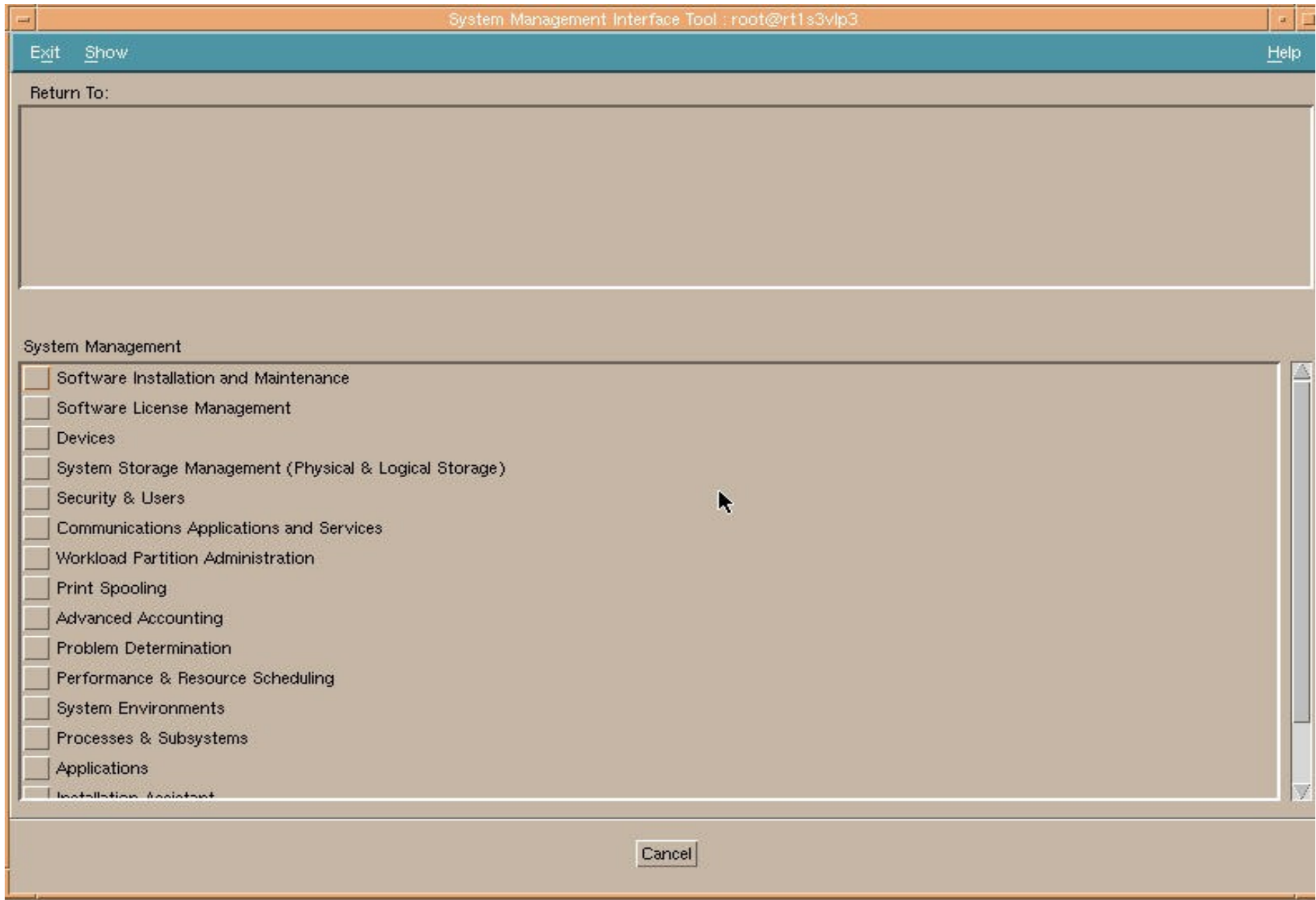
F9=Shell

F10=Exit

Enter=Do



# SMIT main menu (Motif)



# Dialog screen

## Schedule a Job

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

	[Entry Fields]	
YEAR	[07]	#
MONTH	[Jun]	+
DAY (1-31)	[22]	#
* HOUR (0-23)	[ ]	#
* MINUTES (0-59)	[ ]	#
SHELL to use for job execution	Korn (ksh)	+
* COMMAND or SHELL SCRIPT (full pathname)	[ ]	

F1=Help  
F5=Reset  
F9=Shell

F2=Refresh  
F6=Command  
F10=Exit

F3=Cancel  
F7=Edit  
Enter=Do

F4=List  
F8=Image

# Output screen

Command: **OK**

stdout: yes

stderr: no

Before command completion, additional instructions may appear below.

[TOP]

UID	PID	PPID	C	STIME	TTY	TIME	CMD
root	1	0	4	20:15:04	-	1:49	/etc/init
root	1719	1	0	20:16:14	-	0:10	/etc/syncd 60
root	2003	1	0	20:16:19	-	0:00	/etc/srcmstr
root	2233	1	0	17:16:14	-	0:00	/usr/lib/errdemon
ray	3525	1	0	20:01:28	0	0:00	-ksh
root	3806	2003	0	19:16:23	-	0:00	/etc/syslogd
ray	4162	3525	6	20:53:22	0	0:04	smit
root	5355	1	0	20:16:27	-	0:12	/etc/cron
root	6649	2003	0	20:16:32	-	0:00	qdaemon
ray	7303	4162	8	20:09:45	0	0:00	ps -ef

[MORE...6]

F1=Help

F2=Refresh

F3=Cancel

F6=Command

F8=Image

F9=Shell

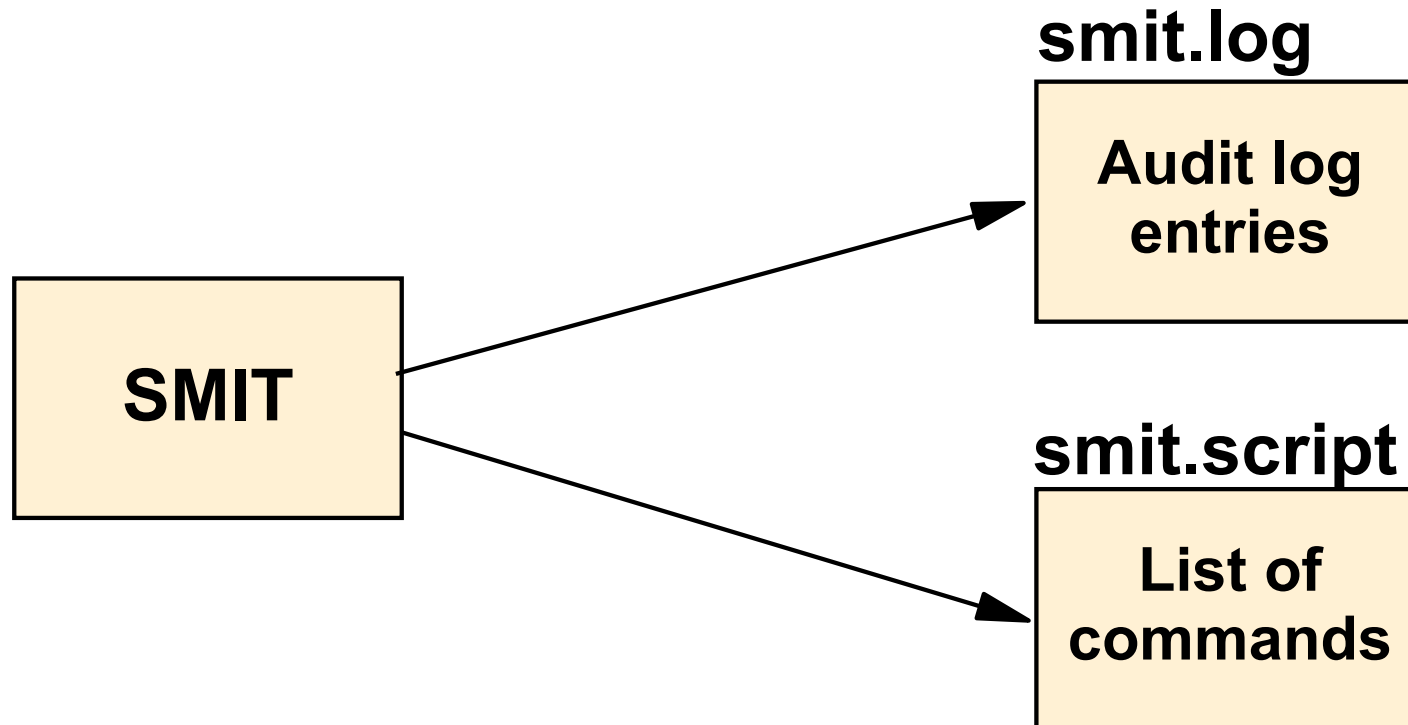
F10=Exit

/=Find

n=Find Next

# SMIT log and script files

---



- **\$HOME/smit.log**

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

- **\$HOME/smit.script**

Shell script containing all AIX commands executed by SMIT.

# ~~smit~~ command options

---

- General syntax:

```
smit [-options] [ FastPath ]
```

- Invoke ASCII version:

```
# smitty
```

*or*

```
# smit -C
```

- Log (but do not actually run) commands:

```
# smit -x
```

- Redirect the log file and script file:

```
# smit -s /u/team1/smit.script -l /u/team1/smit.log
```

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

# IBM Systems Director Console for AIX

The screenshot shows a web browser window titled "nobody's x11 desktop (rt1s3vlp3:1)" displaying the IBM Systems Director Console for AIX. The browser's address bar shows the URL "https://10.31.198.156:5336/ibm/console/login.do?actio". The page header includes "IBM Systems Director Console for AIX", "Welcome root", and "Help | Logout". A left-hand navigation menu is visible, with "OS Management" selected. The main content area displays a "Welcome" message and a "Welcome to IBM Systems Director Console for AIX" section. Below this, there is a "Set Up" section with the heading "Set Up IBM Systems Director Console for AIX".

File Edit View Go Bookmarks Tools Help

https://10.31.198.156:5336/ibm/console/login.do?actio

AIX

IBM Systems Director Console for AIX. Welcome root Help Logout

Welcome

Welcome

### Welcome to IBM Systems Director Console for AIX [About](#)

The IBM Systems Director Console for AIX provides an easy to use interface for administering the web-enabled AIX management tasks, including previous System Management Interface Tool (SMIT) and Web-based System Management tasks. Use the OS Management navigation tab to view your management task categories. Each category will display subcategories that will lead to all of the tasks you can perform using the console. You may also navigate directly to the tasks using the SMIT tool.

For more information about the console, AIX and System p, or hardware, refer to the following information centers:

- [IBM Systems Director Console for AIX Information Center.](#)
- [AIX and System p Information Center.](#)
- [System hardware Information Center.](#)

### Set Up IBM Systems Director Console for AIX

# Checkpoint

1. Specify the SMIT function keys that can be used for the following:
  - a) List the command that will be run: \_\_\_\_\_
  - b) List the screen name which can be used for the fastpath: \_\_\_\_\_
  - c) Take a screen image: \_\_\_\_\_
  - d) Break out into a shell: \_\_\_\_\_
  - e) Return to the previous menu: \_\_\_\_\_
  
2. Specify two ways you can request the ASCII character version of SMIT from an X-windows environment command prompt:
  - \_\_\_\_\_
  - \_\_\_\_\_

# Checkpoint solutions

1. Specify the SMIT function keys that can be used for the following:
  - List the command that will be run: F6
  - List the screen name which can be used for the fastpath: F8
  - Take a screen image: F8
  - Break out into a shell: F9
  - Return to the previous menu: F3
2. Specify two ways you can request the ASCII character version of SMIT from an X-windows environment command prompt:
  - smitty
  - smit -C



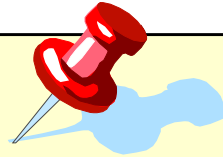
# Exercise 2: Using SMIT



- Using SMIT with the ASCII interface
- Using SMIT with the Motif interface (optional)

# Unit summary

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- Most system administration tasks can be completed using either the **ASCII** or **graphical** (Motif) version of SMIT
- SMIT provides **logging** of activities and generated commands
- SMIT has useful **fastpaths** for bypassing the menu structures

# Checkpoint solutions

1. What type of adapter are you likely to require for communicating from a logical partition?
  - Asynchronous
  - Graphics
  - Ethernet
3. True or False? The adapters seen by the AIX operating system, in an LPAR, may be either physical or virtual.  
True, with POWER5 the LPAR can have virtual SCSI and Virtual Ethernet adapters.
5. **True** or False? The `su` command allows you to get root authority even if you signed on using another user ID.  
But, you must also know the **root** password.

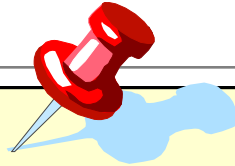
# Exercise 1: root login methods

---



- Direct logins to root
- Using the **su** command

# Unit summary



- Common configurations
  - Single-user graphics workstation
  - Multiuser ASCII
  - Networked system
  - X Window-enabled PC
- New features for:
  - POWER6
  - AIX 6
- System administrator's role:
  - Pre-installation planning
  - Install hardware, software, network
  - Manage user accounts, system resources, licenses
  - Backup/recovery
  - Define subsystems
  - Performance monitoring, capacity planning



# Unit 3

## System startup and shutdown



# Unit objectives

---

After completing this unit, you should be able to:

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

# Startup modes

---

## Normal mode

- Login prompt
- All processes running
- Multi-user mode

## System Management Services

- Not AIX
- Runs from FIRMWARE
- Sets boot list

## Maintenance mode

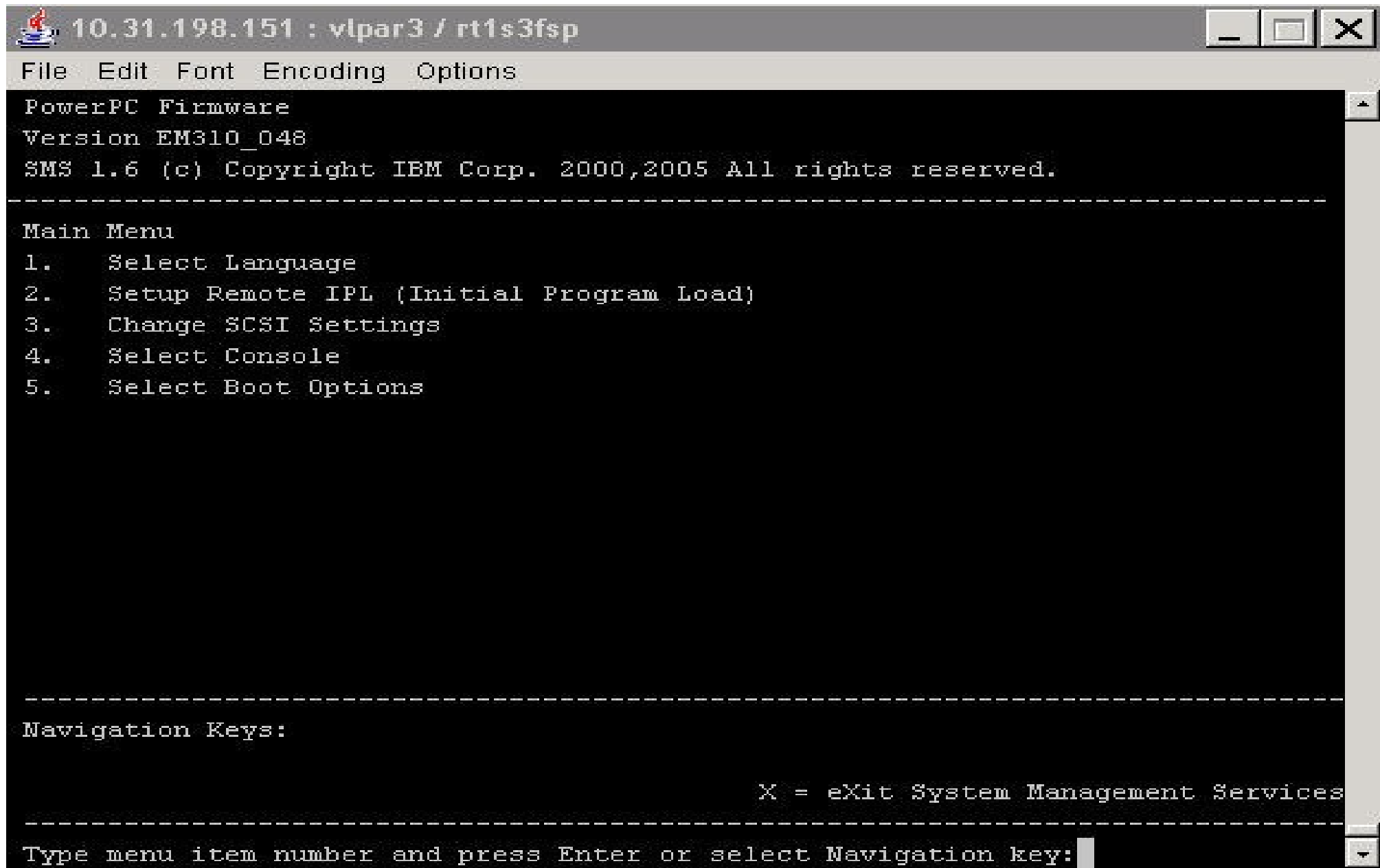
- Maintenance menu
- Recover **root** password
- Fix machine that won't boot

## Diagnostics

- AIX diagnostics



# Starting System Management services



The image shows a terminal window with a title bar that reads "10.31.198.151 : vlp3r3 / rt1s3fsp". The window contains the following text:

```
File Edit Font Encoding Options
PowerPC Firmware
Version EM310_048
SMS 1.6 (c) Copyright IBM Corp. 2000,2005 All rights reserved.
-----
Main Menu
1.  Select Language
2.  Setup Remote IPL (Initial Program Load)
3.  Change SCSI Settings
4.  Select Console
5.  Select Boot Options

-----

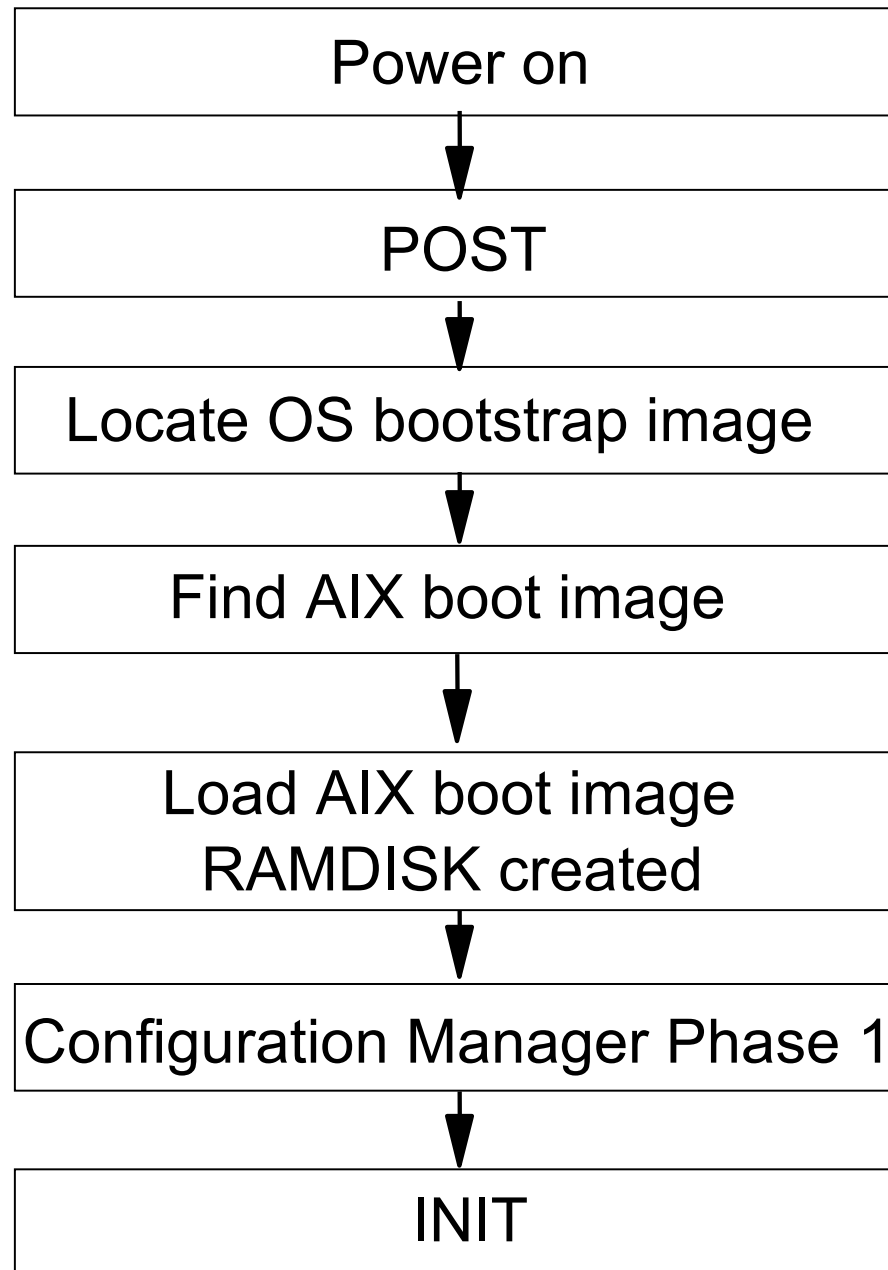
Navigation Keys:

                                     X = eXit System Management Services
-----

Type menu item number and press Enter or select Navigation key: █
```

# System p server start up process overview

---



**Normal IPL**

# The `bootinfo` command

---

- To view the architecture type:

```
# bootinfo -p
```

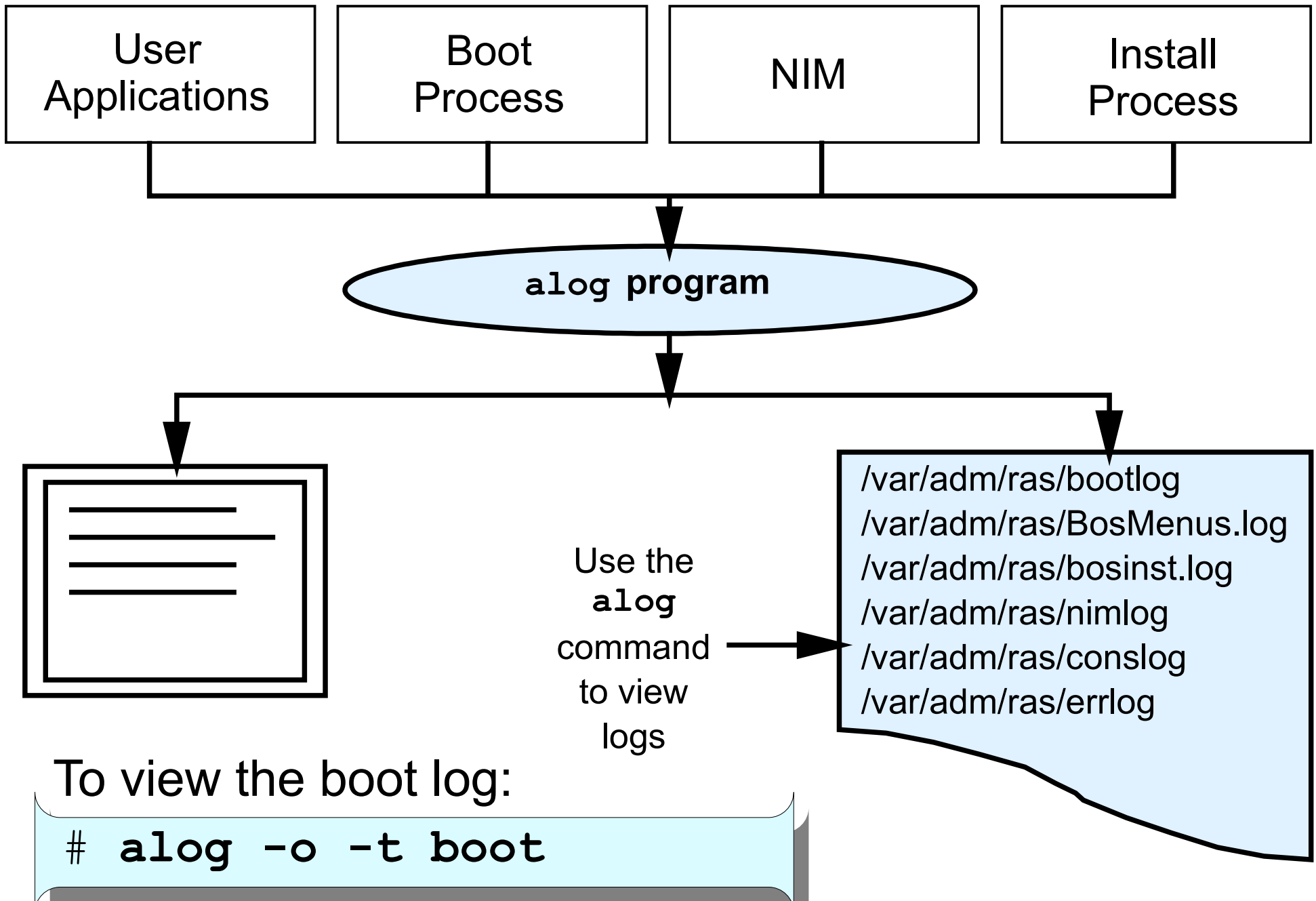
```
rs6k    MCA model  
rspc    PCI model (POWER Reference Platform)  
chrp    PCI model (Common Hardware Reference)
```

- To view the bit addressing:

```
# bootinfo -y
```

```
32      32-bit  
64      64-bit
```

# The alog command



# /etc/inittab

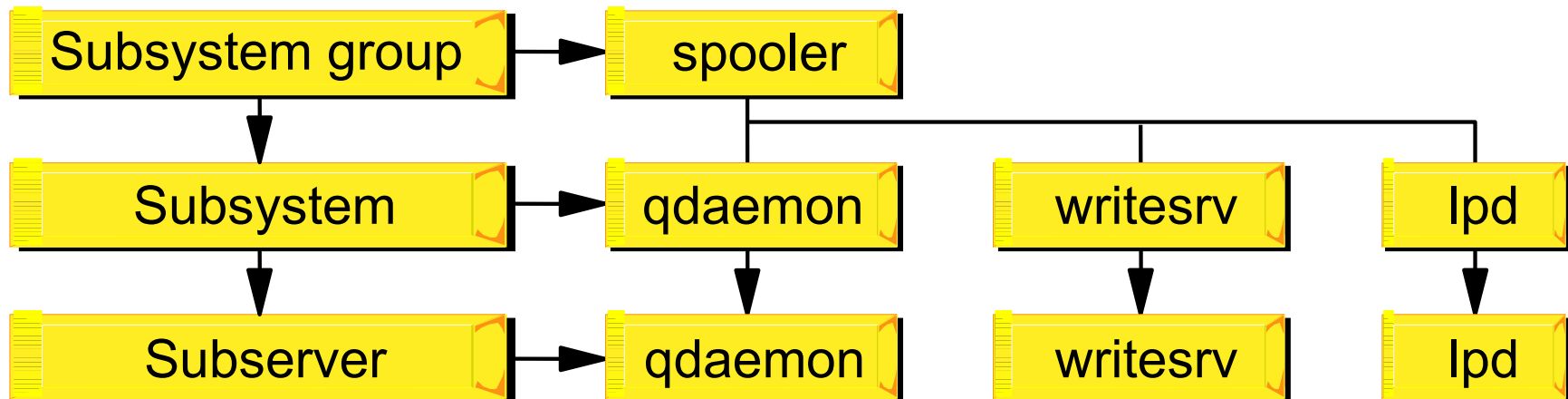
Format of the line: **id:runlevel:action:command**

```
init:2:initdefault:
brc::sysinit:/sbin/rc.boot 3 >/dev/console 2>&1 # Phase 3 of system boot
powerfail::powerfail:/etc/rc.powerfail 2>&1 | alog -tboot > /dev/console ...
mkatmpvc:2:once:/usr/sbin/mkatmpvc >/dev/console 2>&1
atmsvcd:2:once:/usr/sbin/atmsvcd >/dev/console 2>&1
load64bit:2:wait:/etc/methods/cfg64 >/dev/console 2>&1 # Enable 64-bit execs
tunables:23456789:wait:/usr/sbin/tunrestore -R > /dev/console 2>&1 ...
rc:23456789:wait:/etc/rc 2>&1 | alog -tboot > /dev/console # Multi-User checks
fbcheck:23456789:wait:/usr/sbin/fbcheck 2>&1 | alog -tboot > /dev/console ...
srcmstr:23456789:respawn:/usr/sbin/srcmstr # System Resource Controller
rctcpip:23456789:wait:/etc/rc.tcpip > /dev/console 2>&1 # Start TCP/IP daemons
rcnfs:23456789:wait:/etc/rc.nfs > /dev/console 2>&1 # Start NFS Daemons
cron:23456789:respawn:/usr/sbin/cron
piobe:2:wait:/usr/lib/lpd/pio/etc/piointit >/dev/null 2>&1 # pb cleanup
qdaemon:23456789:wait:/usr/bin/startsrc -sqdaemon
writesrv:23456789:wait:/usr/bin/startsrc -swritesrv
uprintfd:23456789:respawn:/usr/sbin/uprintfd
shdaemon:2:off:/usr/sbin/shdaemon >/dev/console 2>&1 # High availability daemon
12:2:wait:/etc/rc.d/rc 2
13:3:wait:/etc/rc.d/rc 3
14:4:wait:/etc/rc.d/rc 4
. . .
```

# System resource controller

---

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



# System resource controller syntax

---

- List SRC status:

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

- Start a subsystem:

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

- Refresh a subsystem:

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

- Stop a subsystem:

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

# Stopping processes

- # ps -ef

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

- For process not started by **srcmstr**:

```
# kill 9345
```

- For processes started by SRC:

```
# stopsrc -s qdaemon
```



# System shutdown

---

- The **shutdown** command:
  - Gracefully stops all activity on the system and advises all logged on users
  - Warns users of an impending shutdown

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

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

```
The system will be down until 3AM
```

```
shutdown: PLEASE LOG OFF NOW!!!
```

```
All processes will be killed in 2 minutes
```

# Manage the system environment

```
# smit system
```

## System Environments

Move cursor to desired item and press Enter.

```
Stop the System
  AIX Security Expert
Assign the Console
Change / Show Date, Time, and Time Zone
Manage Language Environment
Change / Show Characteristics of Operating System
Change / Show Number of Licensed Users
Broadcast Message to all Users
Manage System Logs
Change / Show Characteristics of System Dump
Change/Show Documentation Services
Change System User Interface
Change/Show Default Browser
Change/Show Documentation Services
Web-based System Manager
Enable 64-bit Application Environment
Manage Remote Reboot Facility
Manage System Hang Detection
```

F1=Help  
F9=Shell

F2=Refresh  
F10=Exit

F3=Cancel  
Enter=Do

F8=Image

# Manage Language Environment

---

```
# smit mlang
```

## Manage Language Environment

Move cursor to desired item and press Enter.

Change/Show Primary Language Environment

Add Additional Language Environments

Remove Language Environments

Change/Show Language Hierarchy

Set User Languages

Change/Show Applications for a Language

Convert System Messages and Flat Files

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Hardware Management Console

The screenshot shows a Mozilla Firefox browser window titled "rt1s3hmc: Hardware Management Console (V7R310.0) - Mozilla Firefox". The address bar displays the URL "https://10.31.198.151/preloginmonitor/index.jsp". The page content includes a header "Hardware Management Console (V7R310.0)" and a message: "This web server is hosting the Hardware Management Console application. Click on the link below to begin." Below this is a blue underlined link: "[Log on and launch the Hardware Management Console web application.](#)". The main content area features three status bars: "System Status" with a green checkmark and "Status is good.", "Attention LEDs" with a green checkmark and "Status is good.", and "Serviceable Events" with a red wrench icon and "One or more Serviceable Events." The browser's status bar at the bottom shows "Done" and the IP address "10.31.198.151".

# HMC – LPAR operations menu

The screenshot displays the Hardware Management Console (HMC) interface in a Mozilla Firefox browser window. The address bar shows the URL: `https://10.31.198.151 - rt1s3hmc: Hardware Management Console Workplace (V7R310.0) - Mozilla Firefox`. The main title is "Hardware Management Console".

The interface is divided into several sections:

- Left Navigation Panel:** Contains "Welcome", "Systems Management" (with sub-items "Servers" and "rt1s3fsp"), "Custom Groups", "System Plans", "HMC Management", "Service Management", and "Updates".
- Top Right:** Includes "hscroot", "Help", and "Logoff" links.
- Main Content Area:** Titled "Contents of: rt1s3fsp", it features a toolbar with icons for selection, copy, paste, and other actions. Below the toolbar is a table with columns: "Select", "Name", "IP", "Status", "Processi", "Memo (GB)", "Activ Profil", "Environme", and "Referer Code".

The table lists several LPARs, with "vpar3" selected. A context menu is open over "vpar3", showing the following options:

- Properties
- Change Default Profile
- Operations** (highlighted)
- Configuration
- Hardware Information
- Dynamic Logical Partitioning
- Console Window
- Serviceability

The "Operations" sub-menu is also open, showing the following options:

- Restart
- Shut Down
- Manage Attention LED
- Schedule Operations

Below the table, there is a "Tasks: vpar3 [ Expand All | Collapse All ]" section with a list of tasks:

- Properties
- Change Default Profile
- Operations**
- Configuration**
- Hardware Information**
- Dynamic Logical Partitioning**

At the bottom left, there is a "Status: Open Serviceable Events" indicator and a set of icons (list, close, refresh, and a wrench). The bottom status bar shows "javascript:void(0);", a blue progress bar, and the IP address "10.31.198.151".

# Checkpoint

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

---

---

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

---

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



# Checkpoint solutions

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

The initial process is `init`, which checks `/etc/inittab` for information regarding other processes that have to be started.

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

The System Resource Controller (SRC)

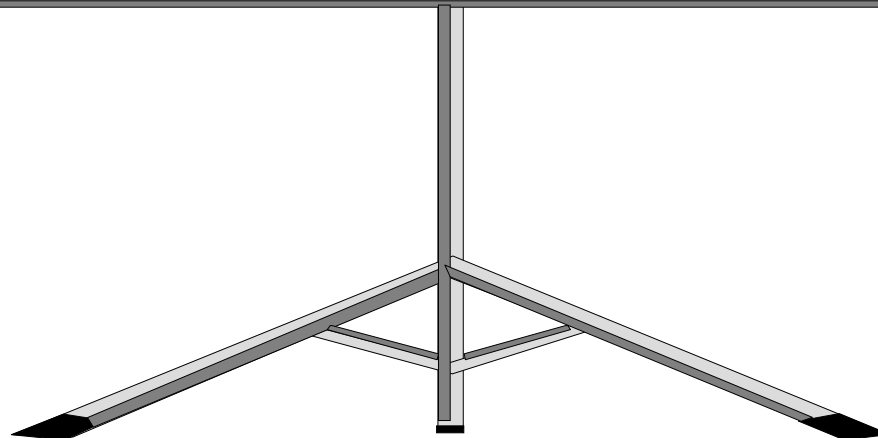
- True or False? You can only execute the shutdown command from the console.

# Exercise 3: System startup and shutdown

---

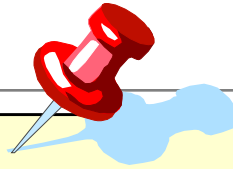


- Multi-user mode
- Boot using System Management Services
- System Resource Controller (SRC)
- Resetting the run level (INIT)





# Unit summary



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



# **Unit 4**

## **AIX software installation and maintenance**



# Unit objectives

---

After completing this unit, you should be able to:

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

# AIX product offerings

---



**AIX**



**LPPs**



**AIX documentation**



**Expansion Pack**



**Bonus Pack Web**

(not available in AIX 6.1)

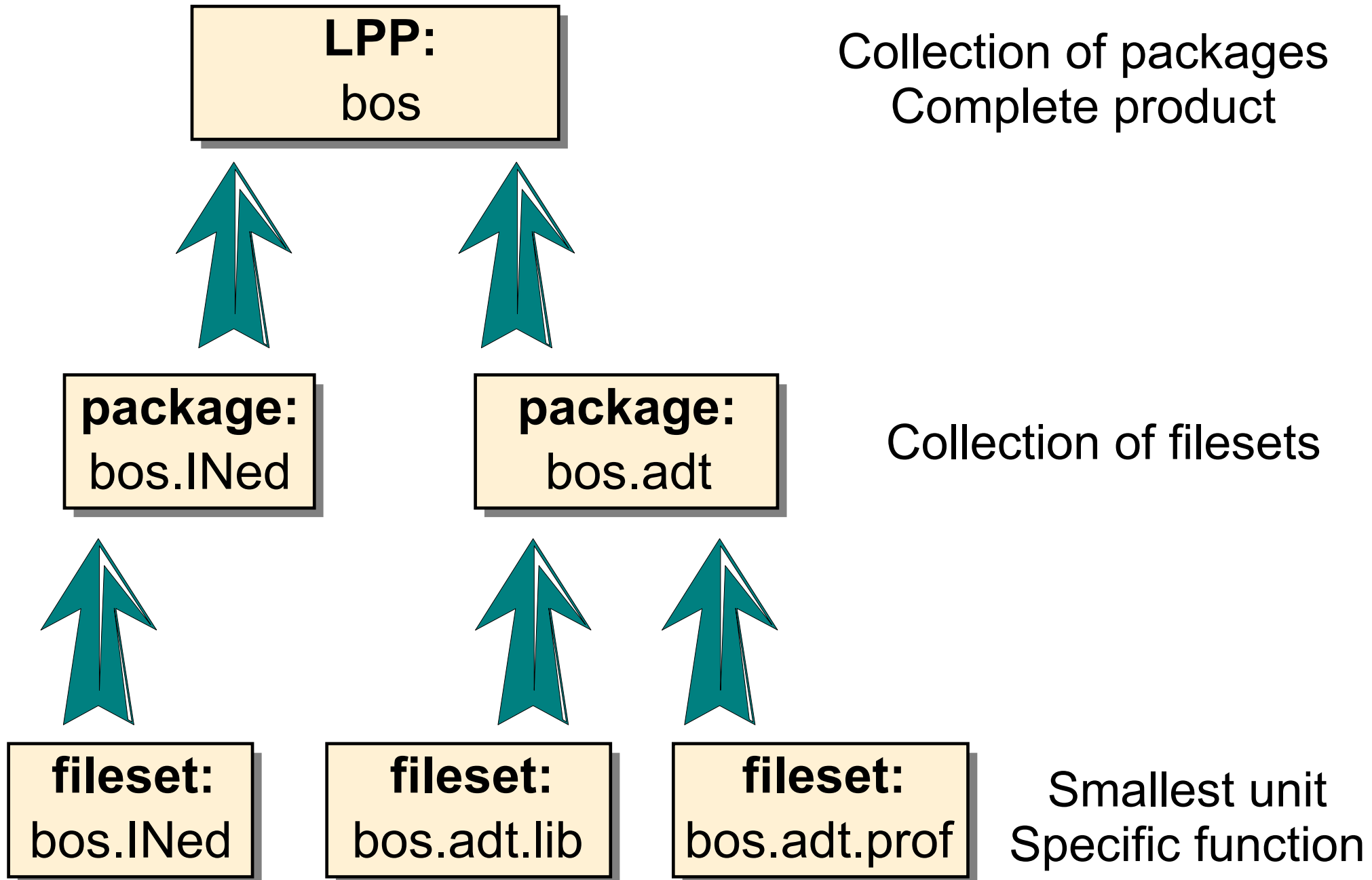


**AIX Toolbox for Linux**

(included in AIX 6.1 Expansion pack)

# Packaging definitions

---



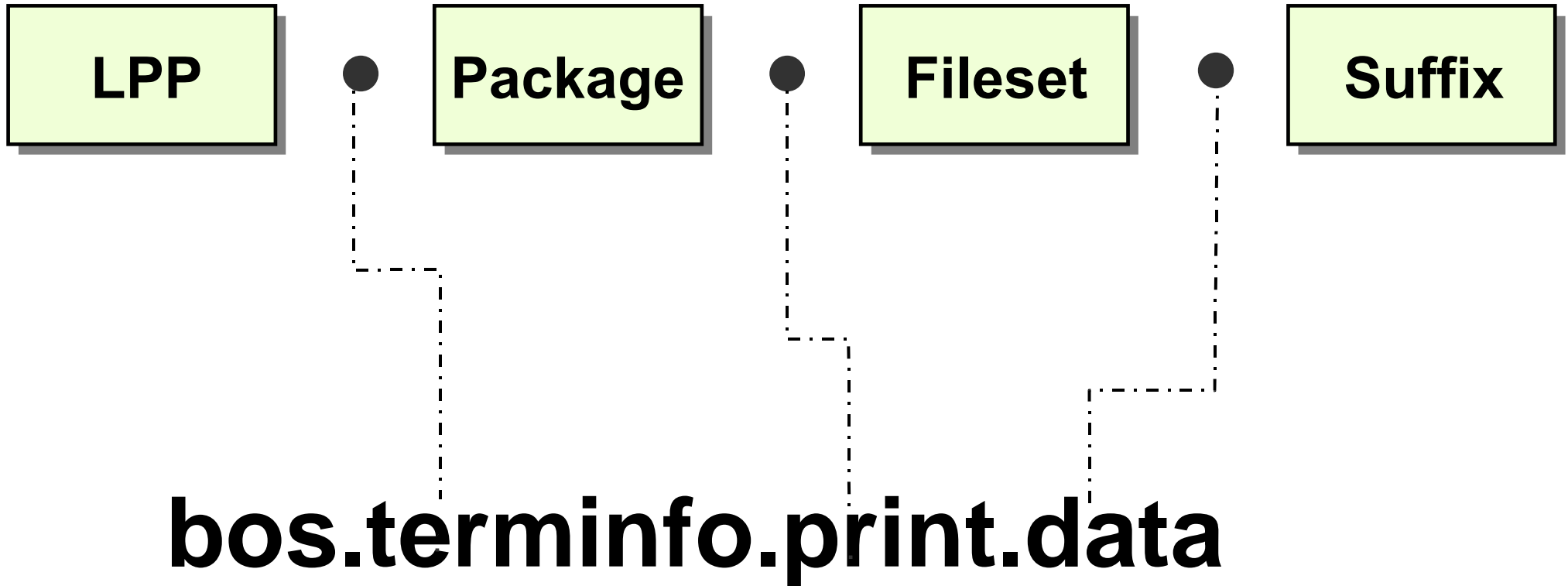
# Bundles

---

- A *bundle* is a collection of packages and filesets suited for a particular environment
- Predefined system bundles in AIX include:
  - AllDevicesKernels
  - Alt\_Disk\_Install
  - App-Dev
  - CC\_Eval.Graphics
  - CDE
  - GNOME
  - Graphics
  - KDE
  - Kerberos\_5
  - Media-Defined
  - Mozilla
  - PerfTools
  - Server
  - cas\_client and cas\_server
  - Devices
  - Infocenter
  - openssh\_client and openssh\_server
  - wsm\_remote

# Fileset naming

---



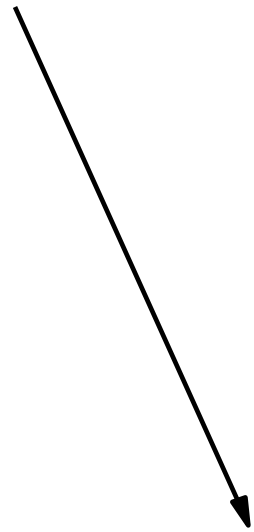
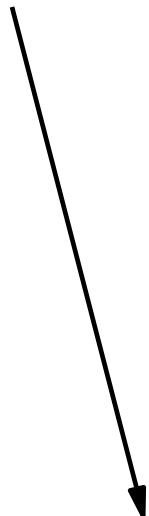
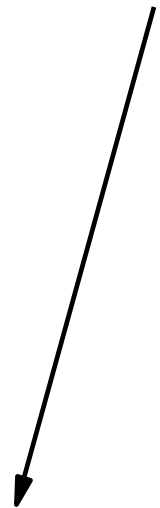
Message convention:

`LPP.msg[.lang].package.fileset`

# Software updates

# oslevel

6 . 1 . 0 . 0



Version

Release

Modification

Fix

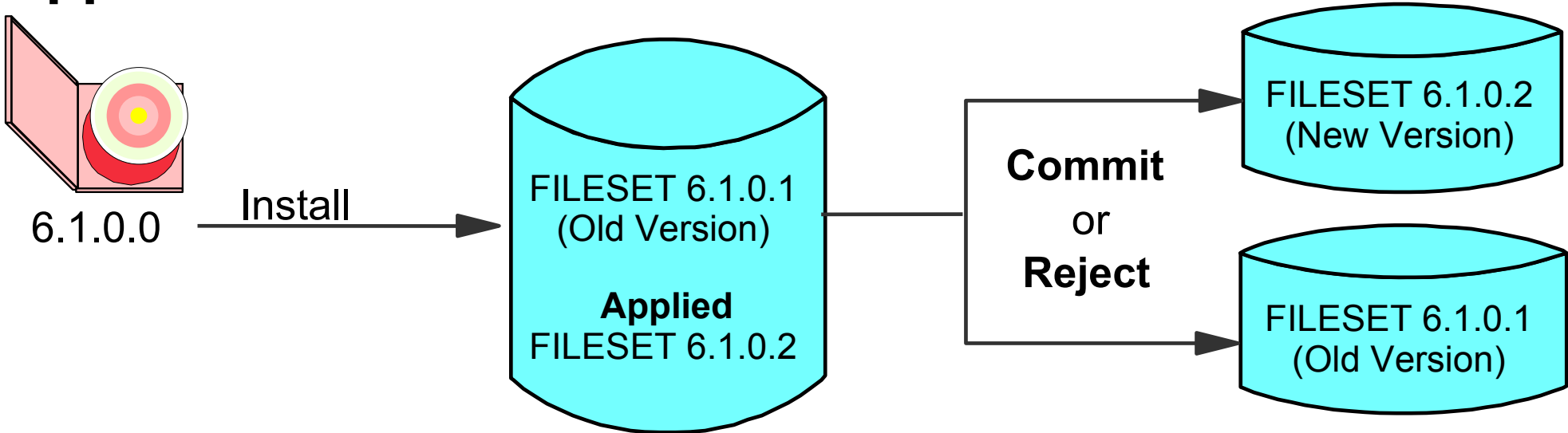
**MIGRATION**

`smit update_all`

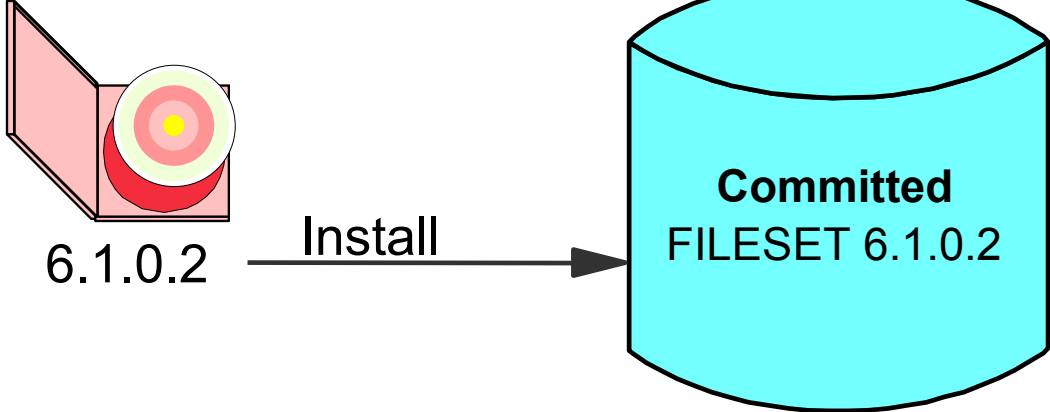


# Software states

## Applied:



## Committed:



# Software Installation and Maintenance

## Software Installation and Maintenance

Move cursor to desired item and press Enter.

Install and Update Software  
List Software and Related Information  
Software Maintenance and Utilities  
Software Service Management  
Relocatable Software Installation and Maintenance  
Network Installation Management  
EZ NIM (Easy NIM Tool)  
System Workload Partition Software Maintenance  
System Backup Manager  
Alternate Disk Installation  
EFIX Management  
Thin Server Maintenance

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Install and Update Software

## Install and Update Software

Move cursor to desired item and press Enter.

Install Software

Update Installed Software to Latest Level (Update All)

Install Software Bundle

Update Software by Fix (APAR)

Install and Update from ALL Available Software

F1=Help

F9=Shell

F2=Refresh

F10=Exit

F3=Cancel

Enter=Do

F8=Image

# Install Software

## Install Software

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

	[Entry Fields]	
* INPUT device / directory for software	/dev/cd0	
* SOFTWARE to install	[_all_latest]	+
PREVIEW only? (install operation will NOT occur)	no	+
COMMIT software updates?	yes	+
SAVE replaced files?	no	+
AUTOMATICALLY install requisite software?	yes	+
EXTEND file systems if space needed?	yes	+
OVERWRITE same or newer versions?	no	+
VERIFY install and check file sizes?	no	+
Include corresponding LANGUAGE filesets?	yes	+
DETAILED output?	no	+
Process multiple volumes?	yes	+
ACCEPT new license agreements?	no	+
PREVIEW new LICENSE agreements?	no	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Software inventory

```
# smit list_installed
```

List Installed Software and Related Information

Move cursor to desired item and press Enter.

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

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

**lslpp** command:

- L Lists the installed software
- h Shows the history of a software product

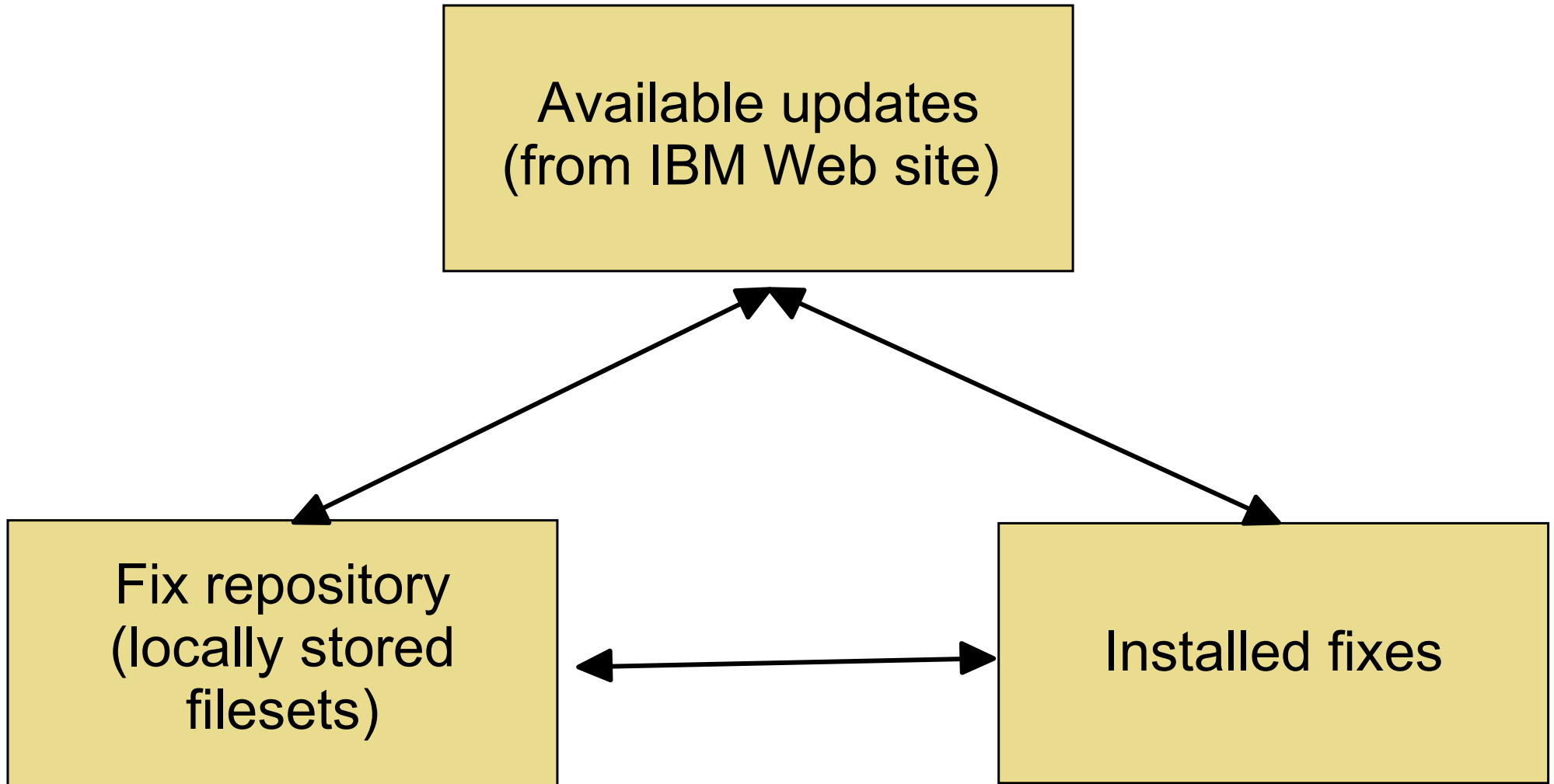
# List installed software

```
# lslpp -l "bos.*"
```

Fileset	Level	State	Description
-----			
Path: /usr/lib/objrepos			
bos.64bit	6.1.0.10	COMMITTED	Base Operating System 64 bit Runtime
bos.acct	6.1.0.10	COMMITTED	Accounting Services
bos.adt.base	6.1.0.10	COMMITTED	Base Application Development Toolkit
bos.adt.include	6.1.0.11	COMMITTED	Base Application Development Include Files
bos.adt.lib	6.1.0.10	COMMITTED	Base Application Development Libraries
bos.alt_disk_install.boot_images			
	6.1.0.10	COMMITTED	Alternate Disk Installation Disk Boot Images
bos.alt_disk_install.rte			
	6.1.0.10	COMMITTED	Alternate Disk Installation Runtime
bos.cdmount	6.1.0.0	COMMITTED	CD/DVD Automount Facility
bos.content_list	6.1.0.0	COMMITTED	AIX Release Content List
bos.diag.com	6.1.0.10	COMMITTED	Common Hardware Diagnostics
bos.diag.rte	6.1.0.10	COMMITTED	Hardware Diagnostics
bos.diag.util	6.1.0.10	COMMITTED	Hardware Diagnostics Utilities
... (rest of output omitted) ...			

# Fix repository

---



# Fix Central Web site

The screenshot shows a Microsoft Internet Explorer browser window displaying the IBM Fix Central website. The browser's address bar shows the URL: <http://www-912.ibm.com/eserver/support/fixes/fixcentral>. The website's navigation menu includes links for Home, Products, Services & industry solutions, Support & downloads, and My account. The main content area is titled "Fix Central" and provides a description: "Fix Central provides fixes and updates for your system's software, hardware, and operating system." Below this description are four dropdown menus for filtering search results: "Product family" (set to System p), "Product" (set to AIX), "Version" (set to 6.1), and "Fix type" (set to Fix packs). A "Continue" button is located at the bottom of the search filters. On the right side of the page, there are two promotional boxes: "Best practice" with the text "Administrative guidance for servers." and "Subscribe to" with the text "Sign up for notification of PEs, security advisories, fixes." The browser's toolbar includes standard navigation buttons (Back, Forward, Stop, Refresh, Home), search, favorites, and various utility icons like SnagIt and Bluetooth.



# More fix services screen (from Fix Central)

The screenshot shows a Microsoft Internet Explorer browser window titled "IBM Support: Fix Central". The address bar displays the URL: <http://www-912.ibm.com/eserver/support/fixes/fixcentral/p>. The browser's menu bar includes File, Edit, View, Favorites, Tools, and Help. The toolbar contains icons for Back, Forward, Stop, Refresh, Home, Search, Favorites, Print, and other utilities. The page content is organized into a header with navigation links: Home, Products, Services & industry solutions, Support & downloads, and My account. A left sidebar contains "Systems support", "Fix Central", and "Feedback". The main content area features the heading "Fix packs for AIX 6.1 operating system" and a descriptive paragraph: "AIX updates are provided as Technology Level packages or Service Packs. These generally available updates have been tested to operate best when all updates in a fix pack are installed. IBM recommends installing the complete fix pack." Below this is a "Select a Technology Level" section with a dropdown menu set to "All 6.1" and a "Go" button. A right sidebar titled "What is a fix" provides a definition: "A fix pack is a combination of single fixes, components, dependent components, and related on-line content. It can include new features, full enhancements, and bug fixes." At the bottom, a table titled "Fix packs" lists available updates.

Name	Type	Prereqs	Date
<a href="#">6100-00-01-0748</a>	Service Pack		November 2007

# Software Service Management

---

```
# smit service_software
```

## Software Service Management

Move cursor to desired item and press Enter.

Service Update Management Assistant (SUMA)

Comparison Reports

Rename Software Images in Repository

Clean Up Software Images in Repository

F1=Help

F9=Shell

F2=Refresh

F10=Exit

F3=Cancel

Enter=Do

F8=Image

# Comparison Reports

---

```
# smit compare_report
```

## Comparison Reports

Move cursor to desired item and press Enter.

Compare Installed Software to Fix Repository

Compare Installed Software to List of Available Updates

Compare Fix Repository to List of Available Updates

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Software Maintenance and Utilities

```
# smit maintain_software
```

## Software Maintenance and Utilities

Move cursor to desired item and press Enter.

Commit Applied Software Updates (Remove Saved Files)  
Reject Applied Software Updates (Use Previous Version)  
Remove Installed Software

Rename Software Images in Repository  
Clean Up Software Images in Repository

Copy Software to Hard Disk for Future Installation  
Copy Software Bundle to Hard Disk for Future Installation

Check Software File Sizes After Installation  
Verify Software Installation and Requisites

Clean Up After Failed or Interrupted Installation

Service Update Management Assistant (SUMA)

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# instfix command

---

- Installs a fix:

```
# instfix -k IY58143 -d /dev/cd0
```

- Searches for a fix:

```
# instfix -ik IY58143
```

```
All filesets for IY58143 were found.
```

- Searches for a fix by keyword:

```
# instfix -s SCSI -d /dev/cd0
```

- Lists which AIX BOS maintenance levels are partly or fully installed:

```
# instfix -i | grep ML
```

```
All filesets for 6.1.0.0_AIX_ML were found.
```

```
All filesets for 6100-01_AIX_ML were found.
```

- Lists which filesets are missing in a partly installed AIX BOS maintenance level:

```
# instfix -ciqk 6100-01_AIX_ML | grep :-:
```

# Checkpoint

1. Which of the following states can your software be in, in order for you to be able to use it? (Select all that apply)
  - a. Applied state
  - b. Removed state
  - c. Install state
  - Commit state
2. What command is used to list all installed software on your system? \_\_\_\_\_
4. Which of the following can you install as an entity? (Select all that apply)
  - a. Fileset
  - b. LPP
  - c. Package
  - d. Bundle
- What is the difference between the SMIT menus: **Install Software** and **Update Installed Software to Latest Level (Update All)**?

\_\_\_\_\_

\_\_\_\_\_

# Checkpoint solutions

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

- Applied state
- Removed state
- Install state
- Commit state

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

lslpp -l

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

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

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

Install Software by default installs everything from the installation media (except printer and devices) onto the system.

Update Installed Software to Latest Level (Update All) installs only updates to filesets already installed on your system.

# Exercise 4: AIX software installation

---

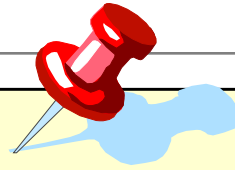


- List and install AIX software
- Working with AIX fixes (optional)



# Unit summary

---



- AIX package naming conventions include the following terms:
  - LPP
  - Package
  - Fileset
  - Suffix
- The easiest way to install software is to use SMIT. The **geninstall** and **installp** commands are also available.
- Use the **lspp** command, SMIT or the Web-based System Manager to list all software products installed on the system.



Welcome to:

# Unit 5

## AIX 6 installation



# Unit objectives

---

After completing this unit, you should be able to:

- List the different installation and media options available
- List the steps necessary to install the AIX version 6.1 base operating system
- Identify the tasks that can be carried out using the Configuration Assistant

# Installation methods

---

- CD-ROM
- Tape (not available for AIX 6.1 installation)
  - 4 mm
  - 8 mm
- Preinstallation option (for a new system order)
- Network Installation Manager (NIM)
  - Token Ring
  - Ethernet
  - FDDI

# Installation process (from CD)

---

Insert CD in CD-ROM drive

```
graph TD; A[Insert CD in CD-ROM drive] --> B[Power on peripheral SCSI devices]; B --> C[Power on system]; C --> D[Press <5>];
```

Power on peripheral SCSI devices

Power on system

Press <5>

# Installation process (from NIM)

---

Prepare the NIM server



Boot system to SMS mode



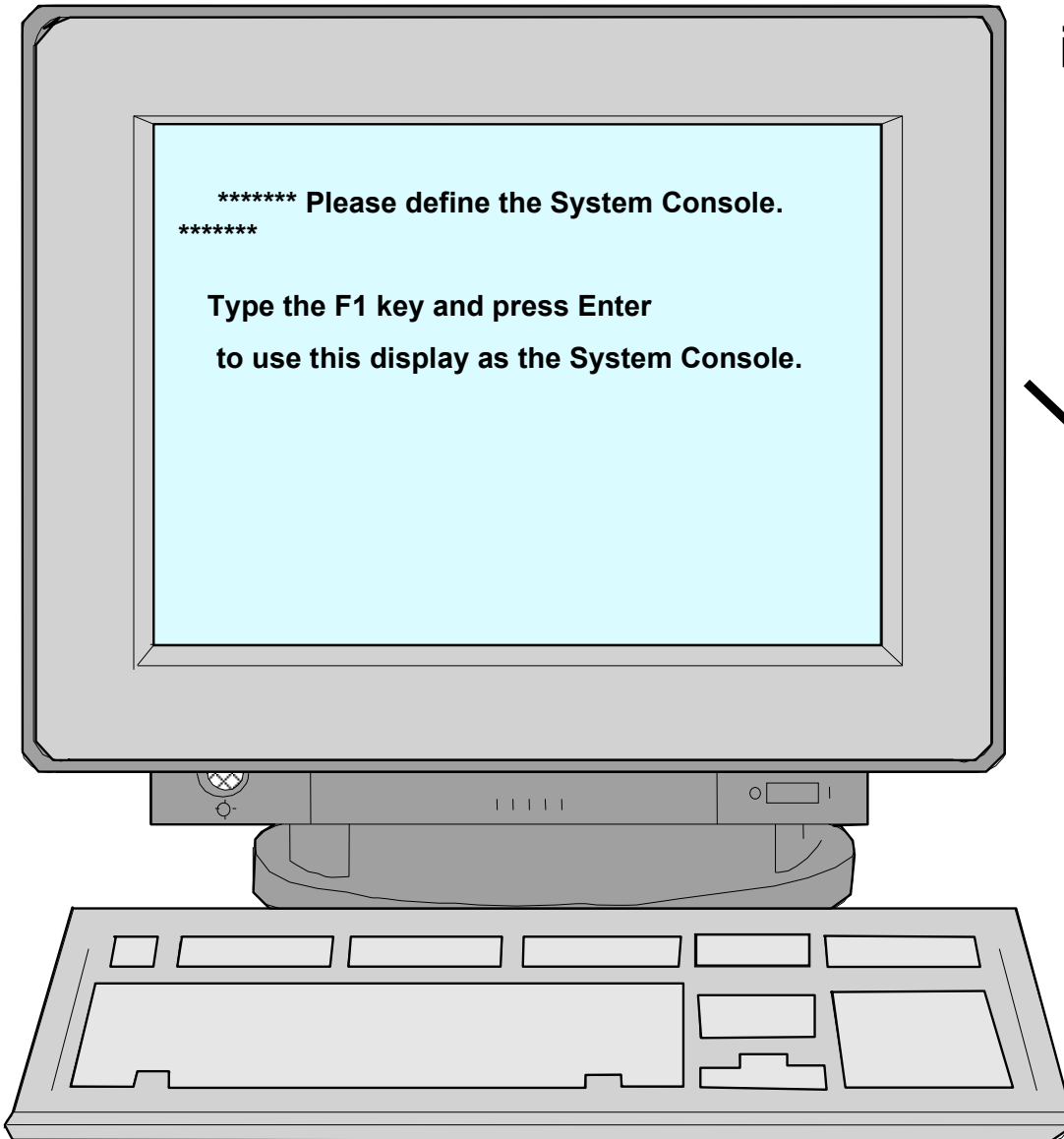
Configure for network boot



Initiate boot (exit SMS)

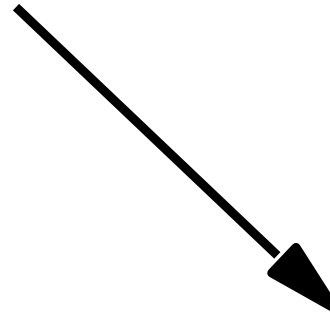
# Console and language definition

## Select your console



This message is displayed in different languages to:

- All native graphics displays
- Terminal on serial



**NEXT:**

Select the language for installation

# Installation and Maintenance menu

At the **Installation and Maintenance** menu, check all the installation settings:

## Welcome to Base Operating System Installation and Maintenance

Type the number of your choice and press Enter. Choice indicated by >>>

- 1 Start Install Now with Default Settings
- >>> 2 Change/Show Installation Settings and Install
- 3 Start Maintenance Mode for System Recovery
- 4 Configure Network Disks (iSCSI)

- 88 Help ?
- 99 Previous Menu
- >>> Choice [1]: 2



# Installation and Settings

## 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 ..... New and Complete Overwrite  
Disk where you want to Install ..... Hdisk0

### 2 Primary Language Environment Settings (AFTER Install):

Cultural Convention ..... English (United States)  
Language ..... English (United States)  
Keyboard ..... English (United States)  
Keyboard Type ..... Default

### 3 Security Model ..... Default

### 4 More Options (Software install options)

0 Install with the settings listed above

88 Help ?

99 Previous Menu

>>> Choice [1]:

Warning: Base operating system installation  
will destroy or impair recovery of SOME data  
on the destination disk hdisk0

# Method of installation

Option 1 of the **Installation and Settings** menu:

## Change Method of Installation

Type the number of your choice and press Enter.

### 1 New and Complete Overwrite

Overwrites **EVERYTHING** on the disk selected for installation.

**Warning:** Only use this method if the disk is totally empty or there is nothing on the disk you want to preserve.

### 2 Preservation Install

Preserves **SOME** of the existing data on the disk selected for installation.

**Warning:** This method overwrites the user (/usr), variable (/var), temporary (/tmp), and root (/) file systems. Other product (application) files and configuration data will be destroyed.

### 3 Migration Install

Upgrades the Base Operating System to current release. Other product (application) files and configuration data are saved.

88 Help ?

99 Previous Menu

>>> Choice [2]: 1

# Installation disks

## Change Disks Where You Want to Install

Type one or more numbers for the disk(s) to be used for installation and press Enter. To cancel a choice, type the corresponding number and press Enter. At least one bootable disk must be selected. The current choice is indicated by >>>.

	Name	Location Code	Size (MB)	VG Status	Bootable
>>>1	hdisk0	10-80-00-4,0	2063	rootvg	yes
2	hdisk1	10-80-00-5,0	2063	rootvg	no

>>> 0 Continue with choices indicated above

55 More Disk Options

66 Disks not known to Base Operating System Installation

77 Display Alternative Disk Attributes

88 Help?

99 Previous Menu

>>> Choice [0]:

# Erasure Options for Disks

## Erasure Options for Disks

Select the number of times the disk(s) will be erased, and select the corresponding pattern to use for each disk erasure. If the number of patterns to write is 0 then no disk erasure will occur. This will be a time consuming process. Either type 0 and press Enter to continue with the current settings, or type the number of the setting you want to change and press Enter.

- 1 Number of patterns to write..... 0
  - 2 Pattern #1..... 00
  - 3 Pattern #2..... ff
  - 4 Pattern #3..... a5
  - 5 Pattern #4..... 5a
  - 6 Pattern #5..... 00
  - 7 Pattern #6..... ff
  - 8 Pattern #7..... a5
  - 9 Pattern #8..... 5a
- >>> 0 Continue with choices indicated above
- 88 Help ?
  - 99 Previous Menu
- >>> Choice[0]:

# Primary language environment

Option 2 of the **Installation and Settings** menu:

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

Cultural Convention	Language	Keyboard
>> 1. C (POSIX)	C (POSIX)	C (POSIX)
2. Albanian	English (United States)	Albanian
3. Arabic	Arabic (Bahrain)	Arabic (Bahrain)
----		
----		
10. MORE CHOICES .....		
88 Help ?		
99 Previous menu		

Choice [1]:

# Install Options

Option 4 of the **Installation and Settings** menu:

## Install Options

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

- 1. Graphics Software..... Yes
- 2. System Management Client Software ..... Yes
- 3. Create JFS2 File Systems ..... Yes
- 4. Enable System Backups to install any system ..... Yes  
( Install all devices)

>>> 5. Install More Software

0 Install with the current settings listed above.

88 Help ?

99 Previous Menu

>>> Choice [5]: \_

# Install More Software

## Install More Software

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

- 1. Firefox (Firefox CD) ..... No
- 2. Kerberos\_5 (Expansion Pack)..... No
- 3. Server (Volume 2)..... No

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

88 Help ?

99 Previous Menu

>>> Choice [0]: \_

# Begin installation

## Installing Base Operating System

Please wait . . . . .

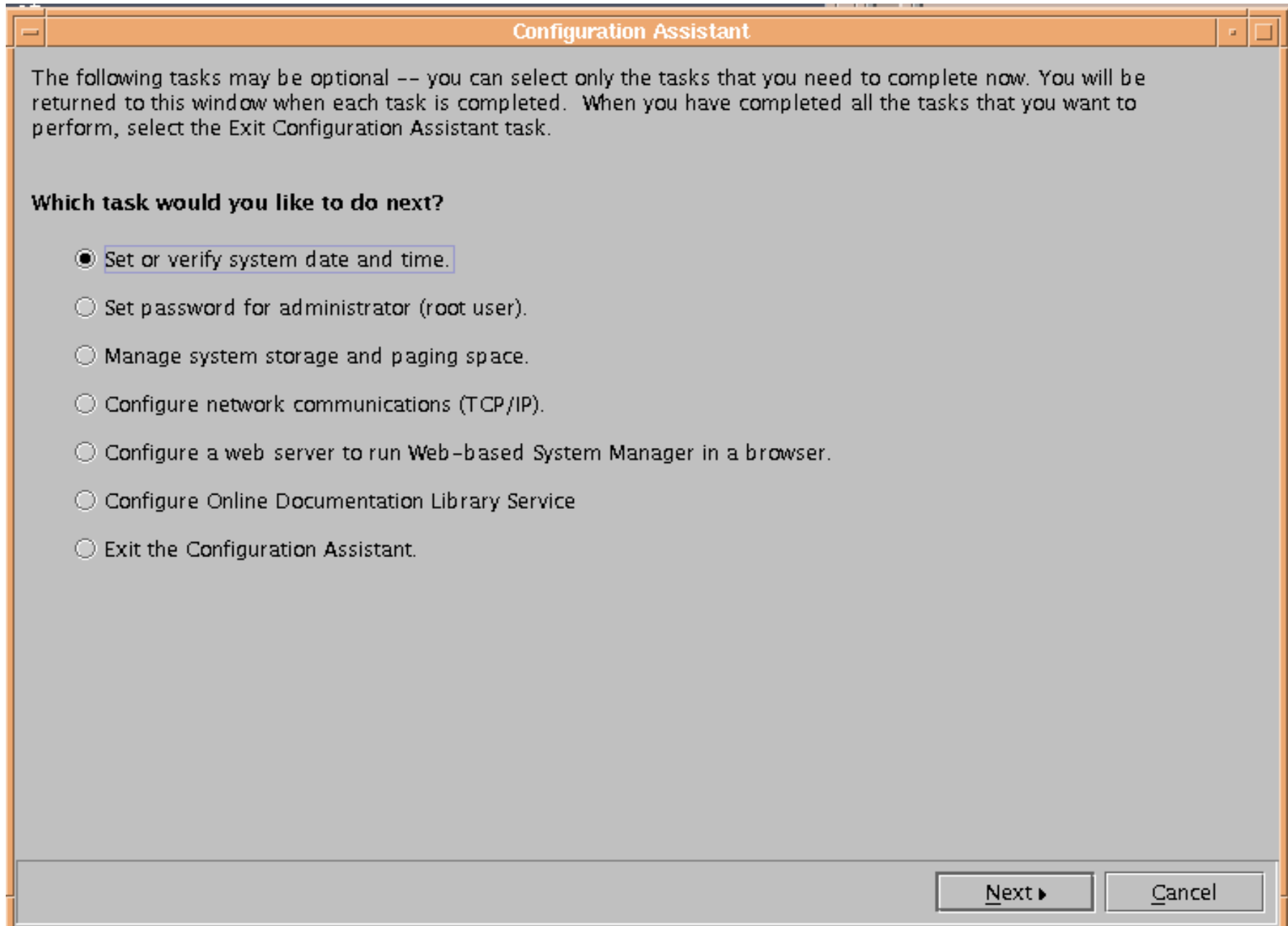
**Approximate  
% tasks completed**  
**16**

**Elapsed Time  
(in minutes)**  
**1**

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



# Configuration Assistant menu



# Checkpoint

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

---

---

# Checkpoint solutions

1. AIX V6.1 can that be installed from which of the following? (Select all are correct)

- 8 mm tape

CD-ROM

Diskette

- 4 mm tape

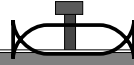
- True or **False**? A Preservation Install preserves all data on the disks.

Preserves **SOME** of the existing data on the disk selected for installation.  
Warning: This method overwrites the user (/usr), \_\_\_\_\_ variable (/var), temporary (/tmp), and root (/) file systems. Other product (application) files and configuration data are destroyed.

4. What is the console used for during the installation process?

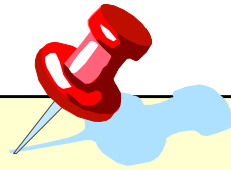
The console is used to display all the system messages and interact with the installation.

# **Exercise 5: AIX install and Configuration Assistant**



- Installing AIX 6.1
- Configuration Assistant

# Unit summary



- AIX V6.1 is only distributed on CD-ROM.
- In order to install the base operating system, system specific questions have to be answered before the process can begin.
- The Configuration Assistant is used by the system administrator to further customize the system.



# Unit 7

## Devices



# Unit objectives

---

After completing this unit, you should be able to:

- Describe the difference between logical and physical devices
- Describe the purpose of the ODM predefined and customized databases
- Describe the different states of a device
- Describe the format of device location codes
- Use SMIT to add/show/change/delete devices

# Device terminology

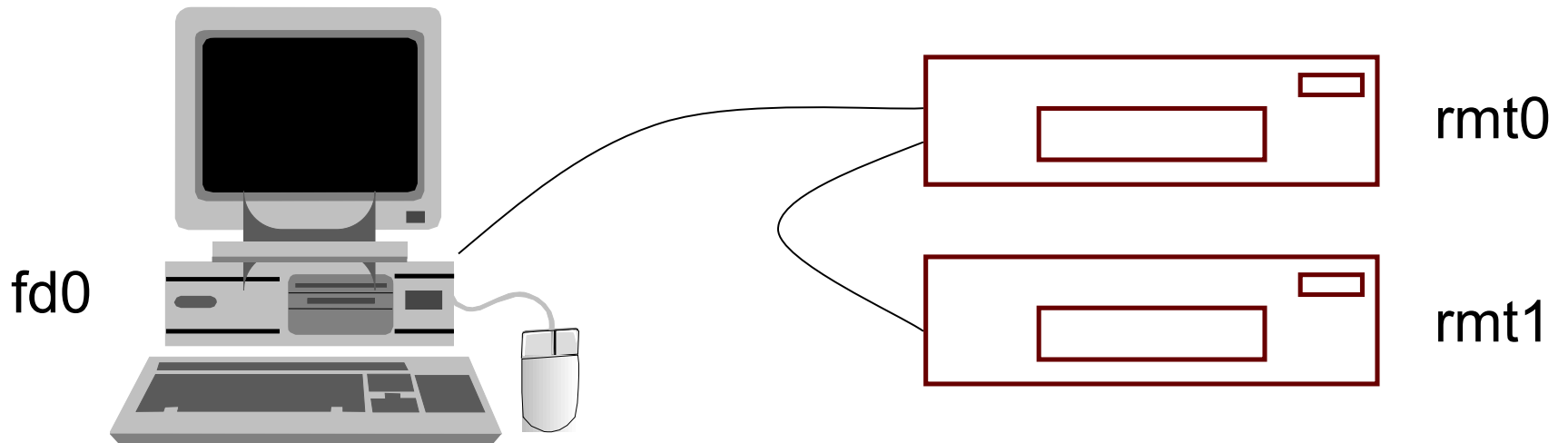
---

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



# Listing of /dev directory

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



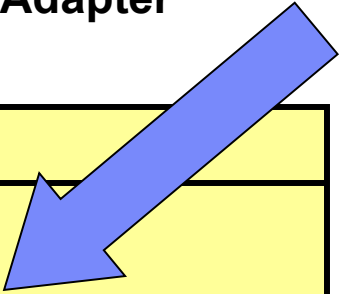
# Device configuration database

## Predefined Configuration Database

Class	Type	Subclass	Description
memory	totmem	sys	Memory
tape	4mm4gb	scsi	4.0 GB 4mm Tape Drive
disk	osdisk	scsi	Other SCSI Disk Drive
adapter	23100020	pci	IBM 10/100Mbps Ethernet PCI Adapter (23100020)
adapter	14101800	pci	IBM PCI Tokenring Adapter (14101800)
adapter	chrp_ecp	isa_sio	CHRP IEEE1284 (ECP) Parallel Port Adapter
adapter	keyboard	kma_chrp	Keyboard Adapter

## Customized Configuration Database

Name	Status	Location	Description
sa0	Available	01-S1	Standard I/O Serial Port
sioka0	Available	01-K1-00	Keyboard Adapter
rmt0	Available	10-80-00-0.0	SCSI 4mm Tape Drive
hdisk0	Available	10-80-00-4,0	16 Bit SCSI Disk Drive
hdisk1	Available	10-80-00-5,0	16 Bit SCSI Disk Drive
mem0	Available		Memory
ent0	Available	10-60	IBM 10/100 Mbps Ethernet PC Adapter (23100020)
lft	lft	node	Low Function Terminal Subsystem
diskette	fd	siofd	Diskette Drive
printer	ibm4019	parallel	IBM 4019 LaserPrinter



# List all supported devices

## *PdDv (Predefined Devices)*

```
# lsdev -P -H

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

# lsdev -Pc tape

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

# List all defined devices

## *CuDv (Customized Devices)*

```
# lsdev -C -H
```

name	status	location	description
sys0	Available	System	Object
pci0	Available	PCI Bus	
isa0	Available	10-58	ISA Bus
sa0	Available	01-S1	Standard I/O Serial Port
scsi0	Available	10-80	Wide/Fast-20 SCSI I/O Controller
cd0	Available	10-80-00-3,0	SCSI Multimedia CD-ROM Drive
rmt0	Defined	10-80-00-6,0	4.0 GB 4mm Tape Drive
hdisk0	Available	10-80-00-4,0	16 Bit SCSI Disk Drive
hdisk1	Available	10-80-00-5,0	16 Bit SCSI Disk Drive
mem0	Available		Memory
ent0	Available	10-60	IBM 10/100 Mbps Ethernet PCI
tok0	Available	10-90	IBM PCI Tokenring Adapter

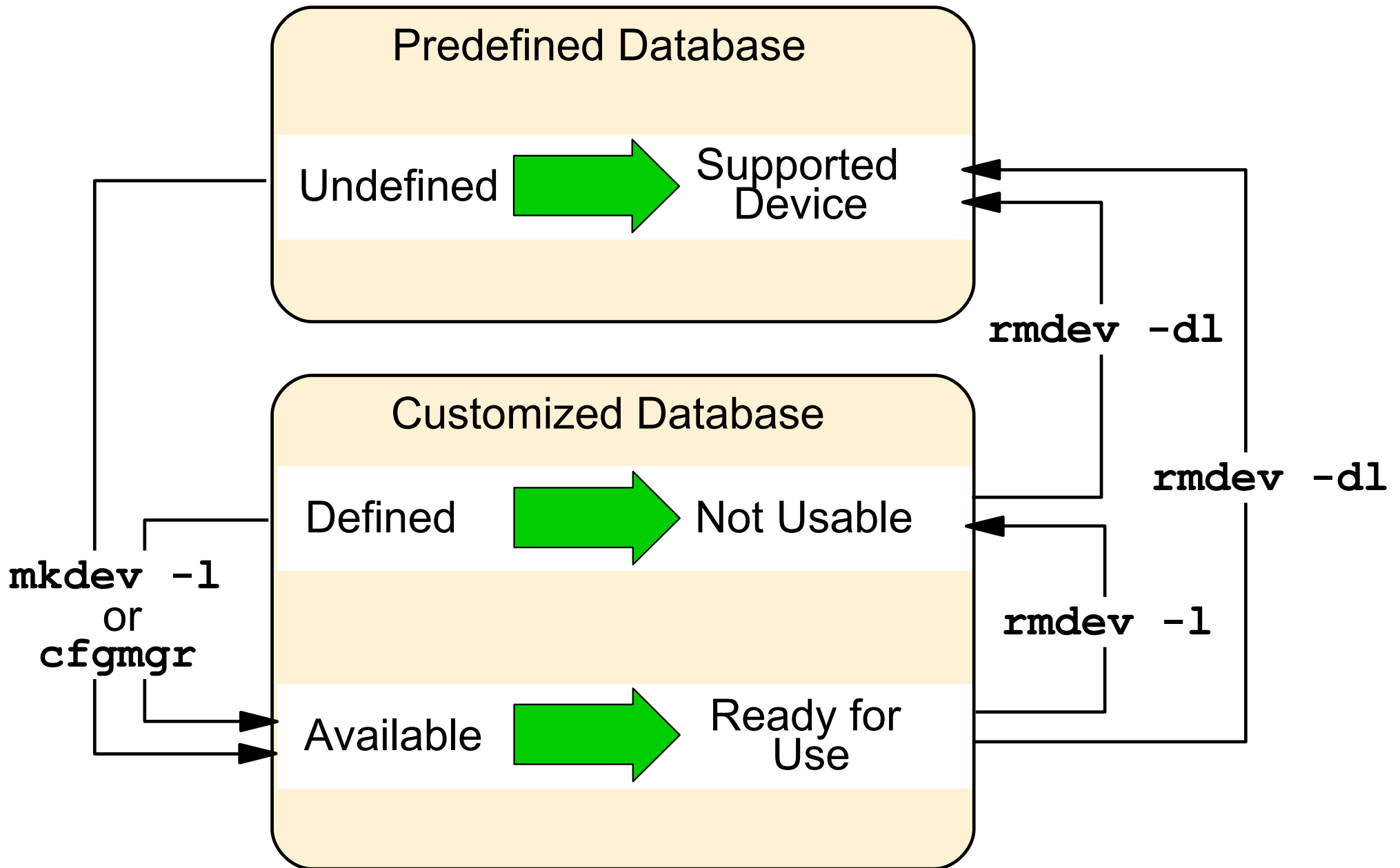
```
# lsattr -EH -l sys0
```

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

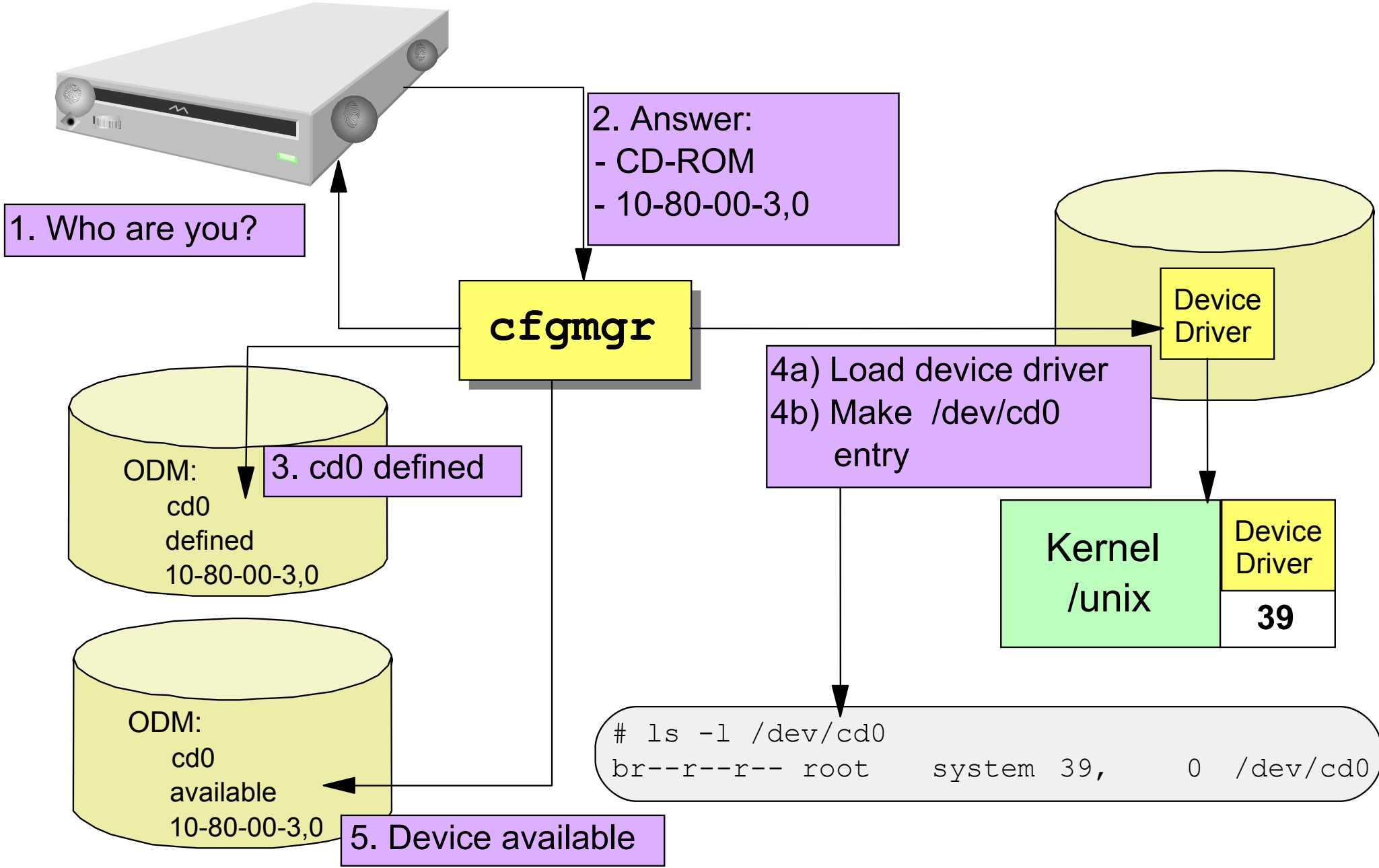
```
# lsattr -E -l sys0 -a realmem
```

realmem	131072	Amount of usable physical memory in Kbytes	False
---------	--------	--	-------

# Device states



# Self-configuring devices



# SMIT Devices menu

---

# smit devices

## Devices

Move cursor to desired item and press Enter.  
Install/Configure Devices Added After IPL  
Printer/Plotter  
TTY  
Asynchronous Adapters  
PTY  
Console  
MPIO Management  
Fixed Disk  
Disk Array  
CD ROM Drive  
Read/Write Optical Drive  
Diskette Drive  
Tape Drive  
Communications  
Graphic Displays  
Graphic Input Devices  
Low Function Terminal (LFT)  
SCSI Initiator Device  
SCSI Adapter  
FC Adapter  
IDE Adapter  
iSCSI  
Asynchronous I/O  
Multimedia  
List Devices  
Configure/Unconfigure Devices  
Install Additional Device Software  
PCI Hot Plug Manager  
SSA Disks  
SSA RAID Arrays

# Device addressing

---

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



# Location code format for PCI devices

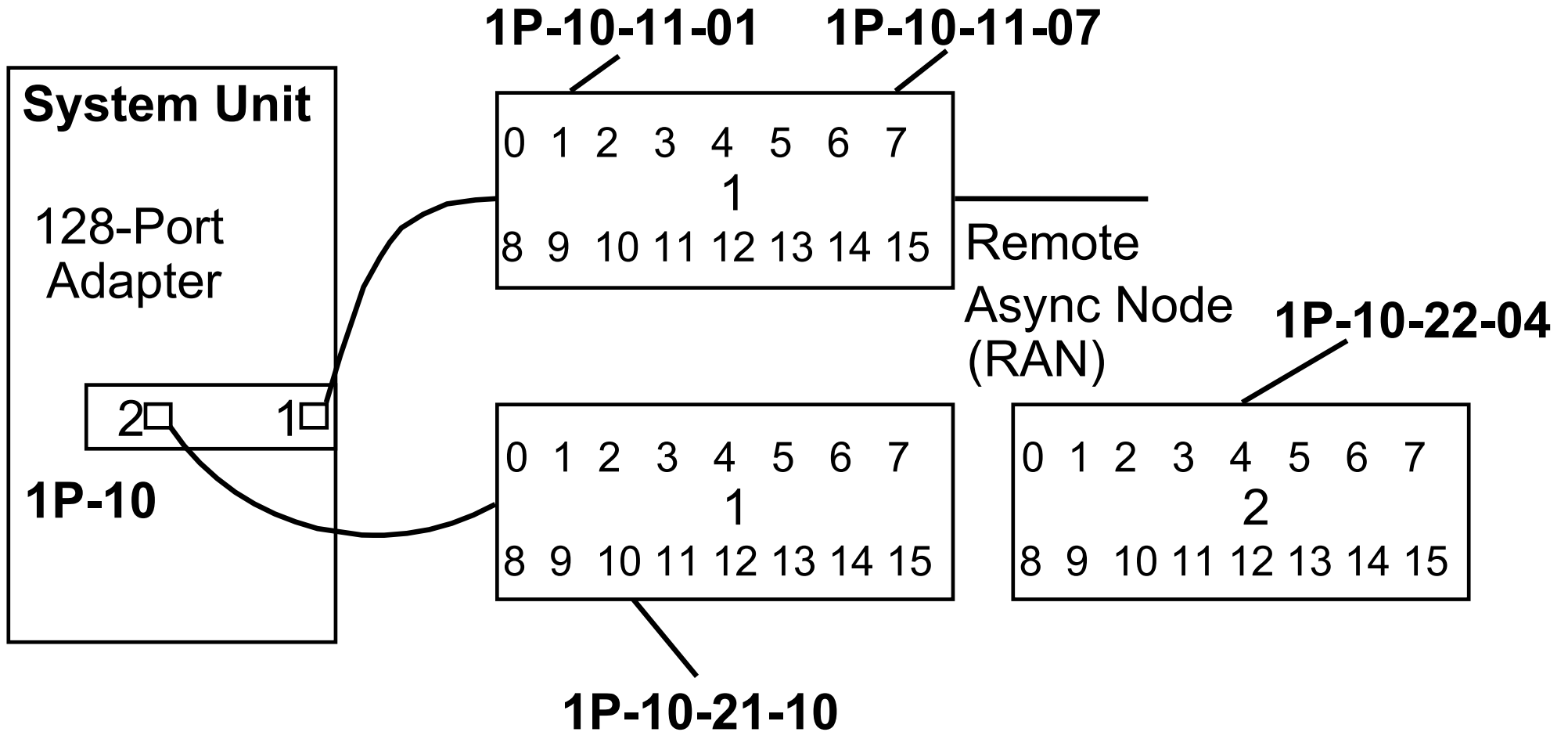
---

## AB-CD-EF-GH

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

# Location code example: Non-SCSI

128-Port Asynchronous Controller



# Location code format for SCSI devices

---

## AB-CD-EF-G,H

### AB-CD

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

### EF

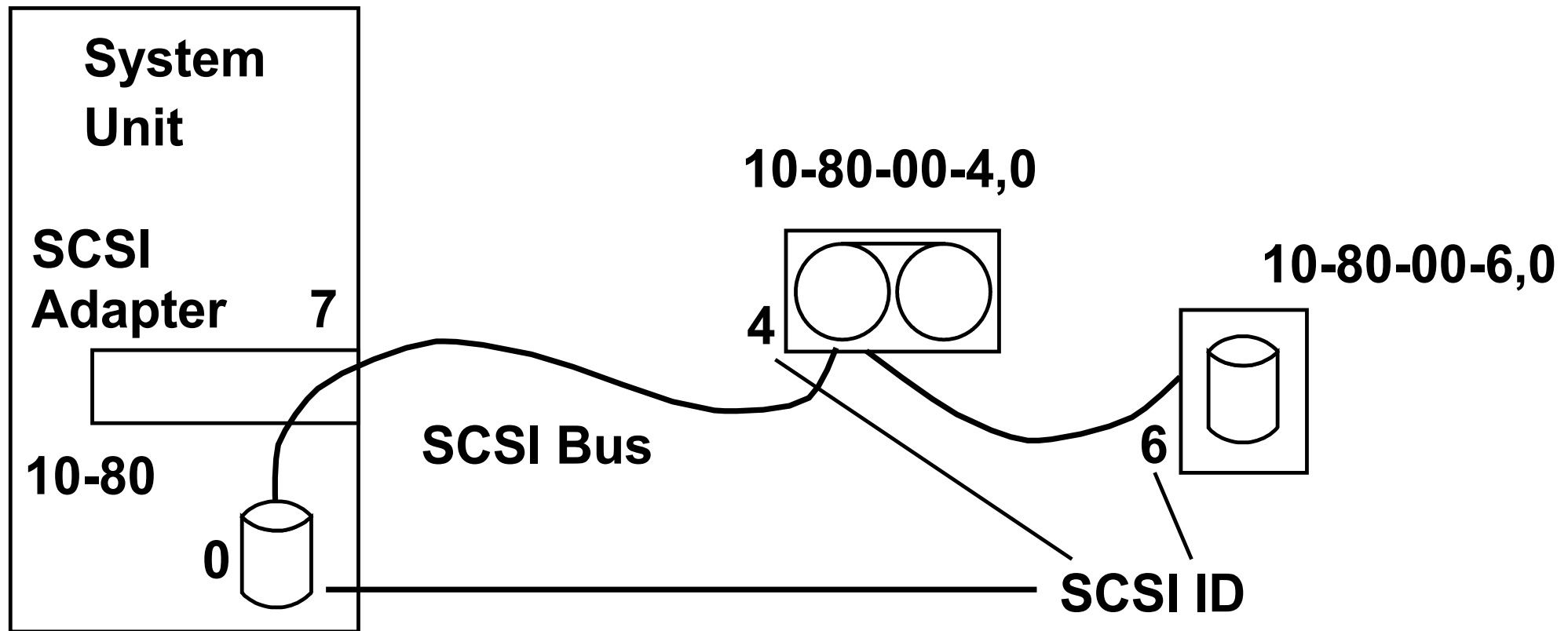
For a single SCSI bus - 00  
For a dual SCSI bus:  
    Internal bus - 00  
    External bus - 01

### G,H

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

# Location code example for SCSI device

## *SCSI Devices (Disk, Tape, CD-ROM)*



# Physical location codes

---

- Assigned by system firmware
- Used to uniquely identify hardware for:
  - Assigning adapters to logical partitions
  - Identifying field replaceable units (FRU)
- Structure of a physical location code:
  - <enclosure>.<planar>.<slot>-<port>-<logical location>
  - Enclosure is usually:  
    <machine type>.<model>.<serial#>
  - Example, **U787A.001.DNZ0713-P1-C3**
- Displayed by default with **lscfg** command

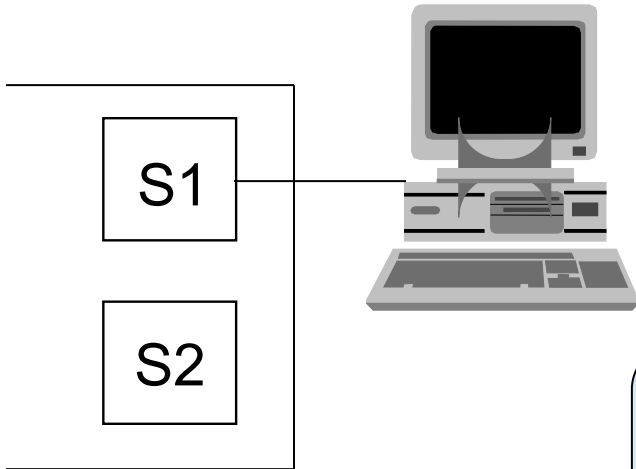
# Listing device physical locations

## *CuDv Customized Devices*

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

name	status	physloc	location	description
en1	Defined		01-08	Standard Ethernet Network
ent1	Defined	U789D.001.DQDWAYT-P1-C4-T1	01-08	10/100/1000 Base-TX
et1	Defined		01-08	IEEE 802.3 Ethernet
hdisk2	Defined	U7311.D20.107F67B-P1-C04-A8	02-08-01-8,0	16 Bit LVD SCSI Disk
hdisk3	Defined	U7311.D20.107F67B-P1-C04-A9	02-08-01-9,0	16 Bit LVD SCSI Disk
scsi0	Defined	U7311.D20.107F67B-P1-C04	02-08-00	PCI X Dual Channel
scsi1	Defined	U7311.D20.107F67B-P1-C04	02-08-01	PCI X Dual Channel
ses0	Defined	U7311.D20.107F67B-P1-C04-AF	02-08-01-15,0	SCS Enclosure Services
<del>sis</del> scsia0	<del>Defined</del>	<del>U7311.D20.107F67B-P1-C04</del>	<del>02-08</del>	<del>PCI XDDR Dual Channel</del>

# Adding an ASCII terminal



## TTY

Move cursor to desired item and press Enter.

List All Defined TTYS

Add a TTY

Move a TTY to Another Port

Change / Show Characteristics of a TTY

Remove a TTY

Configure a Defined TTY

Generate an Error Report

Trace a TTY

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Attachment

---

## TTY Type

Move cursor to desired item and press Enter.

```
tty rs232 Asynchronous Terminal
tty rs422 Asynchronous Terminal
```

## Parent Adapter

Move cursor to desired item and press Enter.

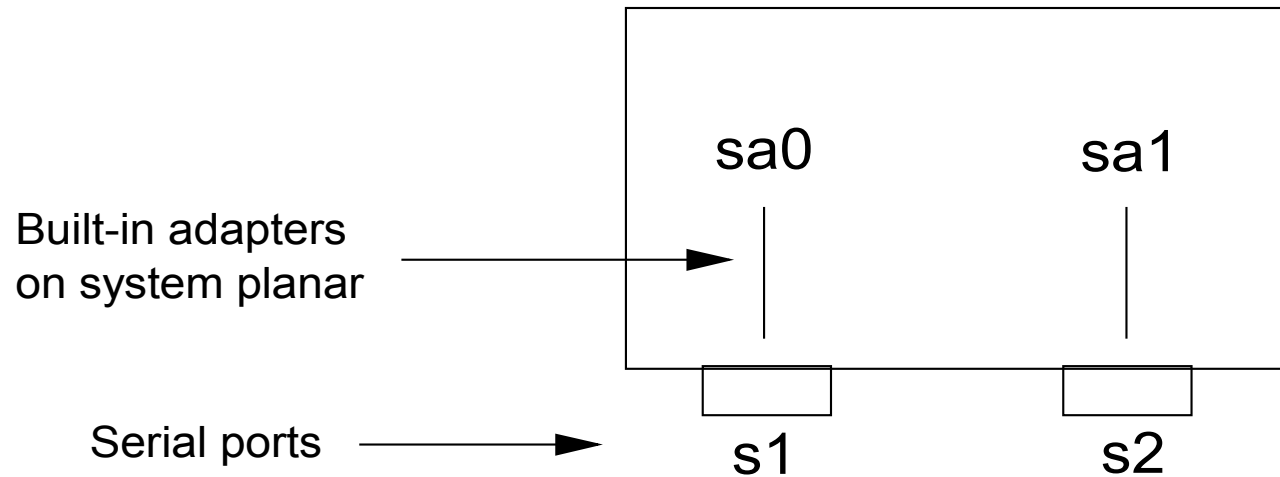
```
sa0 Available 01-S1 Standard I/O Serial Port 1
sa1 Available 01-S2 Standard I/O Serial Port 2
sa2 Available 1P-03-11 16-Port RAN EIA-232 for 128-Port
adapter
sa3 Available 1P-03-12 16-Port RAN EIA-232 for 128-Port
adapter
sa4 Available 1P-03-13 16-Port RAN EIA-232 for 128 Port
adapter
```



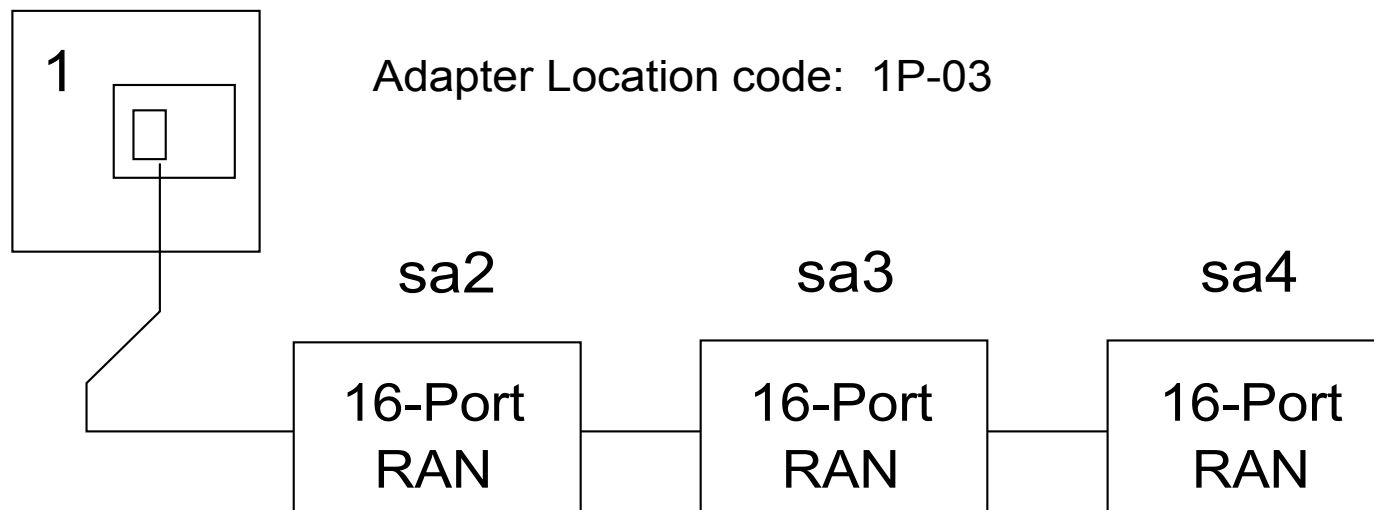
# Device nomenclature

---

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



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



# Add a TTY

## Add a TTY

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

[TOP]	[Entry Fields]
TTY type	tty
TTY interface	rs232
Description	Asynchronous Terminal
Parent adapter	sa0
* PORT number	[ ] + ←
Enable LOGIN	disable + ←
BAUD rate	[ ] + ←
PARITY	[none] +
BITS per character	[8] +
Number of STOP BITS	[1] +
TIME before advancing to next port setting	[0] + #
TERMINAL type	[dumb]
FLOW CONTROL to be used	[xon] + ←

[MORE...31]

F1=Help

F2=Refresh

F3=Cancel

F4=List

Esc+5=Reset

Esc+6=Command

Esc+7=Edit

Esc+8=Image

Esc+9=Shell

Esc+0=Exit

Enter=Do

# Documenting hardware configuration

---

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

# Checkpoint (1 of 2)

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

---

---

---

3. Use the output on the next visual (`lsdev -C -H`) to answer the following four questions.

a) What happens if we attempt to add another device with the SCSI address set to 4?

---

---

b) Can the 8 mm tape drive be currently used? Why?

---

---

• Where is the printer connected? \_\_\_\_\_

d) The Ethernet adapter is installed in what slot?

---

---

# Checkpoint (2 of 2)

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

# Checkpoint solutions

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

No. The SCSI adapter itself uses ID 7. So, it cannot be used for other devices.

3. Use the output on the next visual (`lsdev -C -H`) to answer the following four questions.

a) What happens if we attempt to add another device with the SCSI address set to 4?

The operation fails as there is already a device (SCSI Disk Drive) configured at this location.

c) Can the 8 mm tape drive be currently used? Why?

No, because it is in the defined state. You have to first make it available by either using SMIT or the `mkdev` command.

• Where is the printer connected? The parallel port

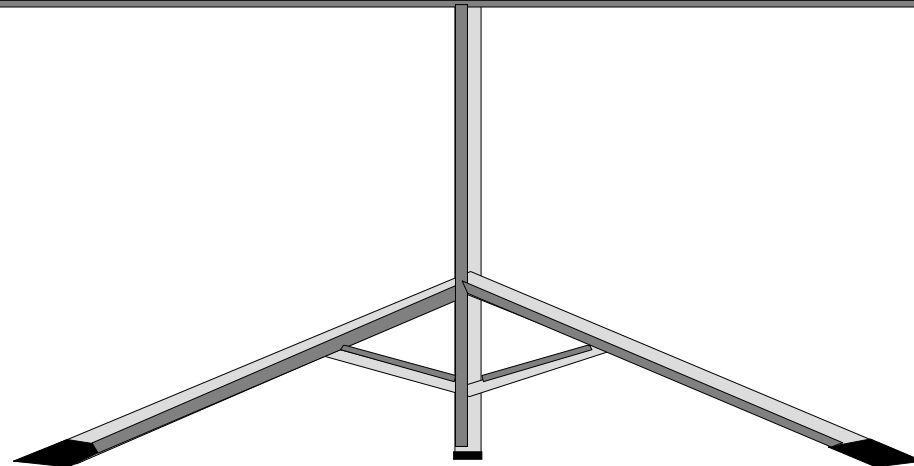
• The Ethernet adapter is installed in what slot?

It is an integrated adapter which does not occupy a slot on the PCI bus.

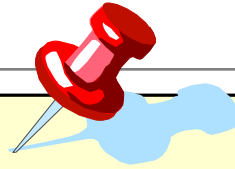
# Exercise 7: Devices



- List device configuration
- List and change system parameters
- Configure a tape device
- Configure a CD-ROM device



# Unit summary



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





Welcome to:

# **Unit 9**

## **Working with the Logical Volume Manager**



# Unit objectives

---

After completing this unit, you should be able to:

- Add, change, and delete:
  - Volume groups
  - Logical volumes
  - Physical volumes
- Describe mirroring
- Describe striping

# Logical Volume Manager

```
# smit lvm
```

## Logical Volume Manager

Move cursor to desired item and press Enter.

Volume Groups  
Logical Volumes  
Physical Volumes  
Paging Space

F1=Help  
F9=Shell

F2=Refresh  
F10=Exit

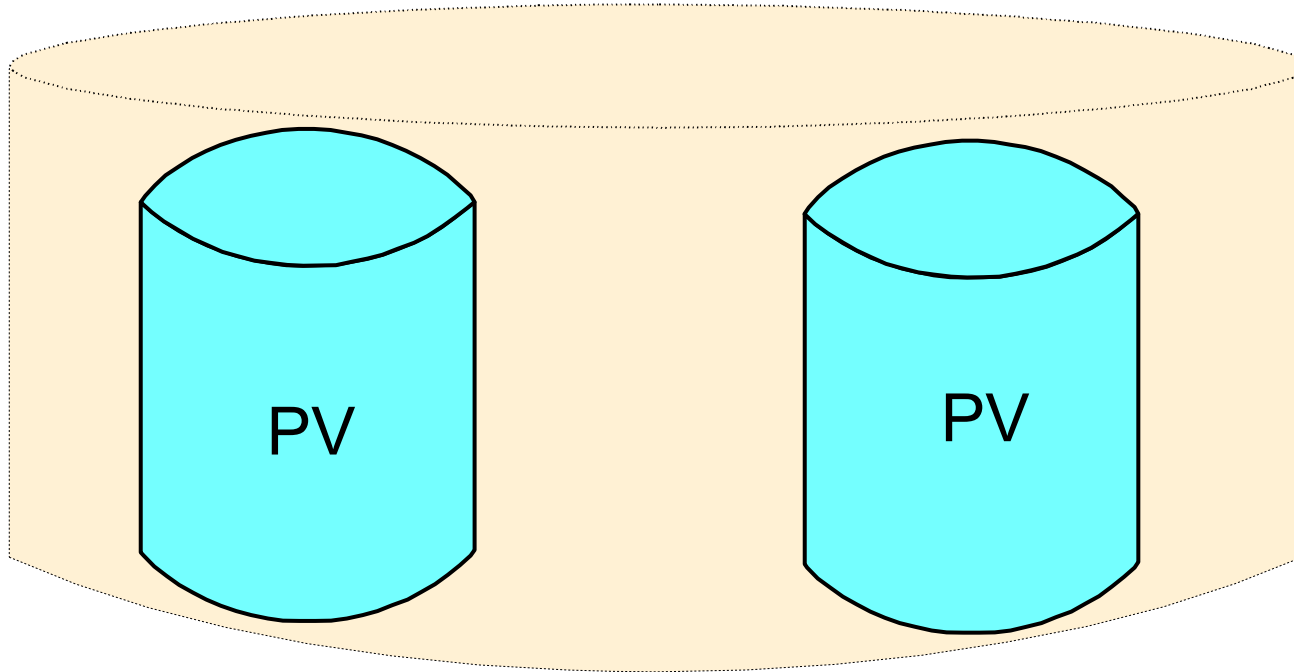
F3=Cancel  
Enter=Do

F8=Image

# Volume groups

---

Volume group



- Physical Volume (PV)
  - Hard disk
- Volume Group (VG)
  - Collection of related disks (PVs)

# SMIT Volume Groups menu

# smit vg

## Volume Groups

Move cursor to desired item and press Enter.

- List All Volume Groups
- Add a Volume Group
- Set Characteristics of a Volume Group
- List Contents of a Volume Group
- Remove a Volume Group
- Activate a Volume Group
- Deactivate a Volume Group
- Import a Volume Group
- Export a Volume Group
- Mirror a Volume Group
- Unmirror a Volume Group
- Synchronize LVM Mirrors
- Back Up a Volume Group
- Remake a Volume Group
- Preview Information about a Backup
- Verify the Readability of a Backup (Tape only)
- View the Backup Log
- List Files in a Volume Group Backup
- Restore Files in a Volume Group Backup

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# List all volume groups

---

```
# lsvg  
rootvg  
payrollvg
```

```
# lsvg -o  
rootvg
```

# List volume group contents

```
# lsvg rootvg
```

```
VOLUME GROUP:      rootvg          VG IDENTIFIER:    000bc6fd00004c00000000e10fdd7f52
VG STATE:          active          PP SIZE:          16 megabyte(s)
VG PERMISSION:    read/write      TOTAL PPs:        1084 (17344 megabytes)
MAX LVs:          256            FREE PPs:         1032 (16512 megabytes)
LVs:              11            USED PPs:         52 (832 megabytes)
OPEN LVs:         10            QUORUM:           2
TOTAL PVs:        2            VG DESCRIPTORS:   3
STALE PVs:        0            STALE PPs:        0
ACTIVE PVs:       2            AUTO ON:          yes
MAX PPs per VG:   32512
MAX PPs per PV:   1016
LTG size (Dynamic): 256 kilobyte(s)
HOT SPARE:        no            MAX PVs:          32
                  no            AUTO SYNC:        no
                  no            BB POLICY:        relocatable
```

# List volume group information (physical volumes)

---

```
# lsvg -p rootvg
```

```
rootvg:
```

PV_NAME	PV STATE	TOTAL PPs	FREE PPs	FREE DISTRIBUTION
hdisk0	active	159	52	24..00..00..00..28
hdisk1	active	159	78	32..02..00..12..32



# List volume group information (logical volumes)

```
# lsvg -l rootvg
```

```
rootvg:
```

LVNAME	TYPE	LPs	PPs	PVs	LV STATE	MOUNT POINT
hd6	paging	32	32	1	open/syncd	N/A
hd5	boot	2	2	1	closed/syncd	N/A
hd8	jfslog	1	1	1	open/syncd	N/A
hd9var	jfs2	1	1	1	open/syncd	/var
hd4	jfs2	9	9	1	open/syncd	/
hd2	jfs2	101	101	1	open/syncd	/usr
hd3	jfs2	4	4	1	open/syncd	/tmp
hd1	jfs2	1	1	1	open/syncd	/home
hd10opt	jfs2	5	5	1	open/syncd	/opt
hd11admin	jfs2	8	8	1	open/syncd	/admin
lv00	jfs2	1	2	2	open/syncd	/home/john
lv01	jfs2	4	4	2	open/syncd	/home/fred

# Add a Volume Group

```
# smit mkvg
```

## Add a Volume Group

Move cursor to desired item and press Enter.

```
Add an Original Volume Group
Add a Big Volume Group
Add a Scalable Volume Group
```

## Add an Original Volume Group

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

### [Entry Fields]

VOLUME GROUP name	[]	
Physical partition SIZE in megabytes		+
* PHYSICAL VOLUME names	[]	+
FORCE the creation of volume group?	no	+
Activate volume group AUTOMATICALLY at system restart?	yes	+
Volume group MAJOR NUMBER	[]	+#
Create VG Concurrent Capable?	no	+

# Add a Scalable Volume Group

```
# smit mkvg
```

## Add a Scalable Volume Group

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

	[Entry Fields]	
VOLUME GROUP name	[]	
Physical partition SIZE in megabytes		+
* PHYSICAL VOLUME names	[]	+
FORCE the creation of volume group?	no	+
Activate volume group AUTOMATICALLY at system restart?	yes	+
Volume group MAJOR NUMBER	[]	+#
Create VG Concurrent Capable?	no	+
Max PPs per VG in units of 1024	32	+
Max Logical Volumes	256	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Set Characteristics of a Volume Group

```
# smit vgsc
```

Set Characteristics of a Volume Group

Move cursor to desired item and press Enter.

Change a Volume Group

Add a Physical Volume to a Volume Group

Remove a Physical Volume from a Volume Group

Reorganize a Volume Group

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Change a Volume Group

```
# smit chvg
```

## Change a Volume Group

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

	[Entry Fields]	
* VOLUME GROUP name	rootvg	
* Activate volume group AUTOMATICALLY at system restart?	yes	+
* A QUORUM of disks required to keep the volume group on-line ?	yes	+
Convert this VG to Concurrent Capable?	no	+
Change to big VG format?	no	+
Change to scalable VG format?	no	+
LTG Size in kbytes	128	+
Set hotspare characteristics	n	+
Set synchronization characteristics of stale partitions	n	+
Max PPs per VG in units of 1024	32	+
Max Logical Volumes	256	+

F1=Help

F5=Reset

F9=Shell

F2=Refresh

F6=Command

F10=Exit

F3=Cancel

F7=Edit

Enter=Do

F4=List

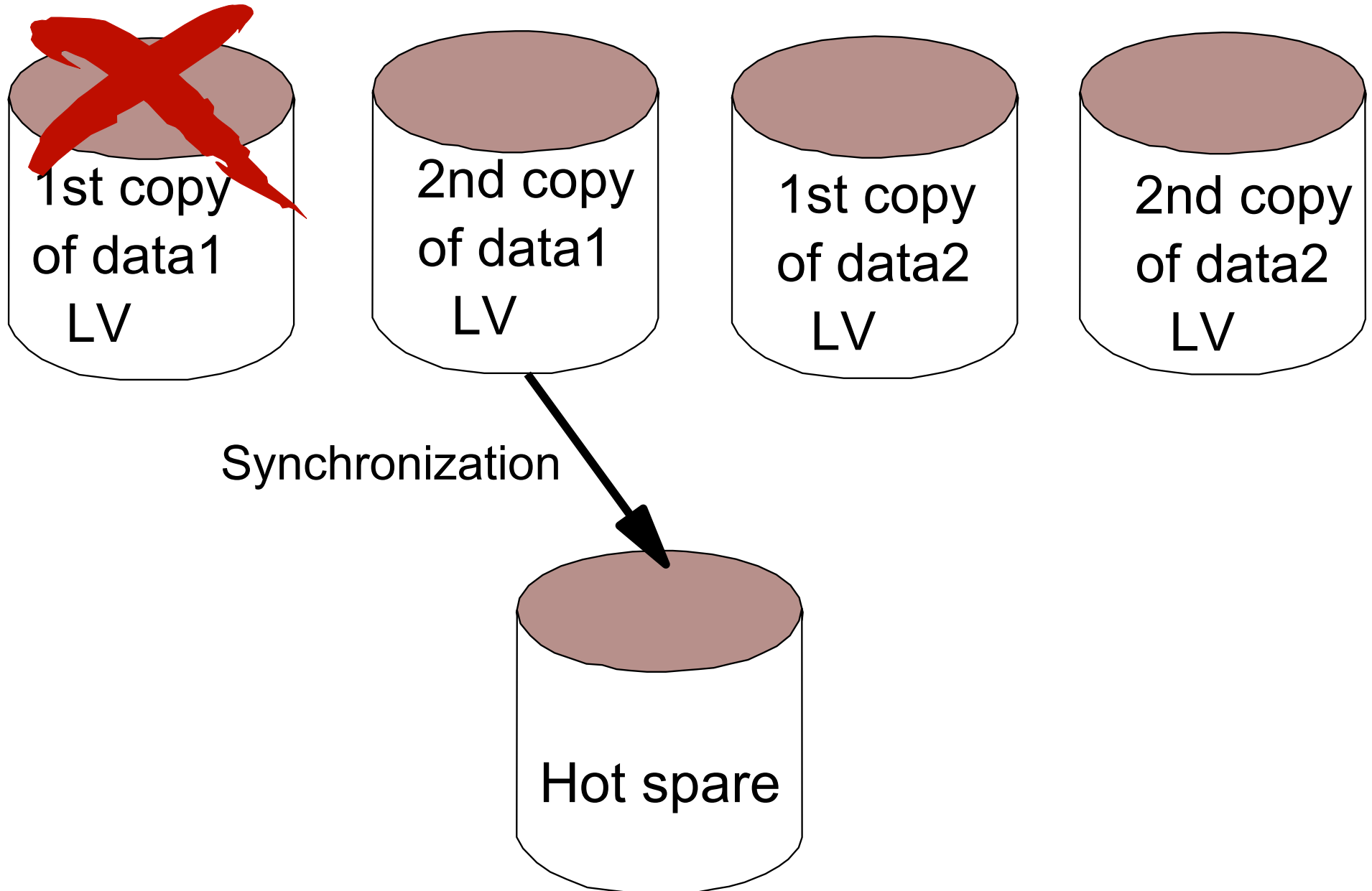
F8=Image

# Logical track group (LTG) size

---

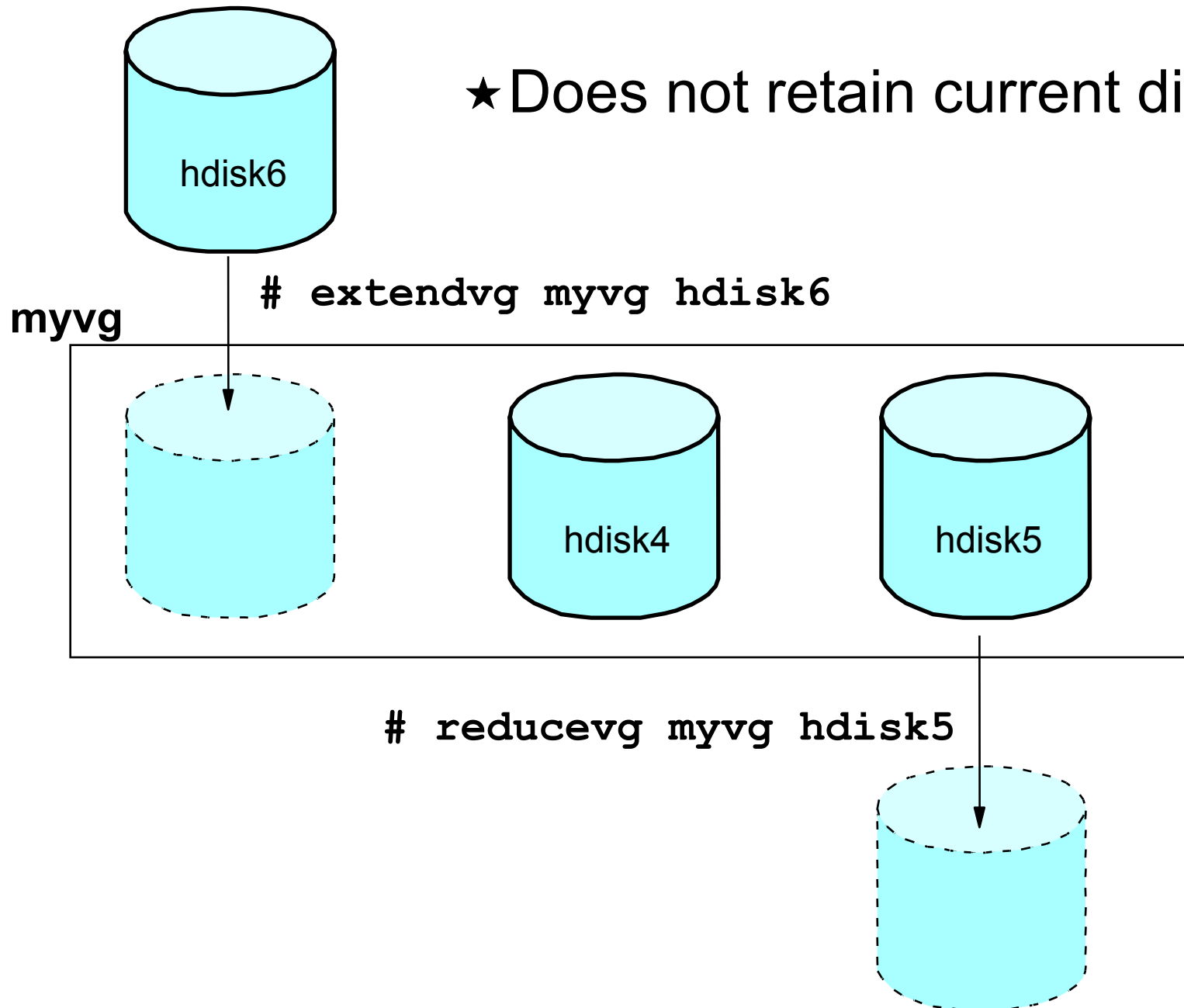
- LTG is the maximum transfer size of a logical volume
- Prior to AIX 5L V5.3:
  - Default LTG size is 128 KB
  - LTG size can be changed by the **-L** flag on the **chvg** or **mkvg** command
- AIX 5L V5.3 and V6.1:
  - AIX dynamically sets the LTG size (calculated at each volume group activation)
  - LTG size can be changed with the command:  
**varyonvg -M <LTGsize>**
  - The **mkvg -L** flag is no longer supported
  - The **chvg -L** flag has no effect on volume groups created in AIX 5L V5.3 or later
  - Enable variable LTG on old volume groups using **chvg -L 0**
- To display the LTG size of a disk, use the command:  
**# /usr/sbin/lquerypv -M <hdisk#>**

# Hot spare



# Extending and reducing volume groups

★ Does not retain current disk contents





# Remove a Volume Group

```
# smit reducevg2
```

## Remove a Volume Group

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

\* VOLUME GROUP name

[Entry Fields]  
[ ] +

F1=Help

F5=Reset

F9=Shell

F2=Refresh

F6=Command

F10=Exit

F3=Cancel

F7=Edit

Enter=Do

F4=List

F8=Image

# Activate/Deactivate a volume group

---

- Activate a volume group (make it available for use):

```
varyonvg [ -f ] VolumeGroup
```

```
# varyonvg datavg
```

- Deactivate a volume group (make it unavailable for use):

```
varyoffvg VolumeGroup
```

```
# varyoffvg datavg
```

# Import/Export a Volume Group

```
# smit importvg
```

## Import a Volume Group

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

	[Entry Fields]	
VOLUME GROUP name	[]	
* PHYSICAL VOLUME name	[]	+
Volume Group MAJOR NUMBER	[]	+ #

F1=Help

F5=Reset

F9=Shell

F2=Refresh

F6=Command

F10=Exit

F3=Cancel

F7=Edit

Enter=Do

F4=List

F8=Image

# Advanced RAID support

---

- Checks all disks in a volume group if they have grown in size:

```
chvg -g Volumegroup
```

```
# chvg -g datavg
```

- Turns on bad block relocation policy of a volume group:

```
chvg -b [ y/n ] Volumegroup
```

```
# chvg -b y datavg
```

- Turns off bad block relocation policy of a volume group:

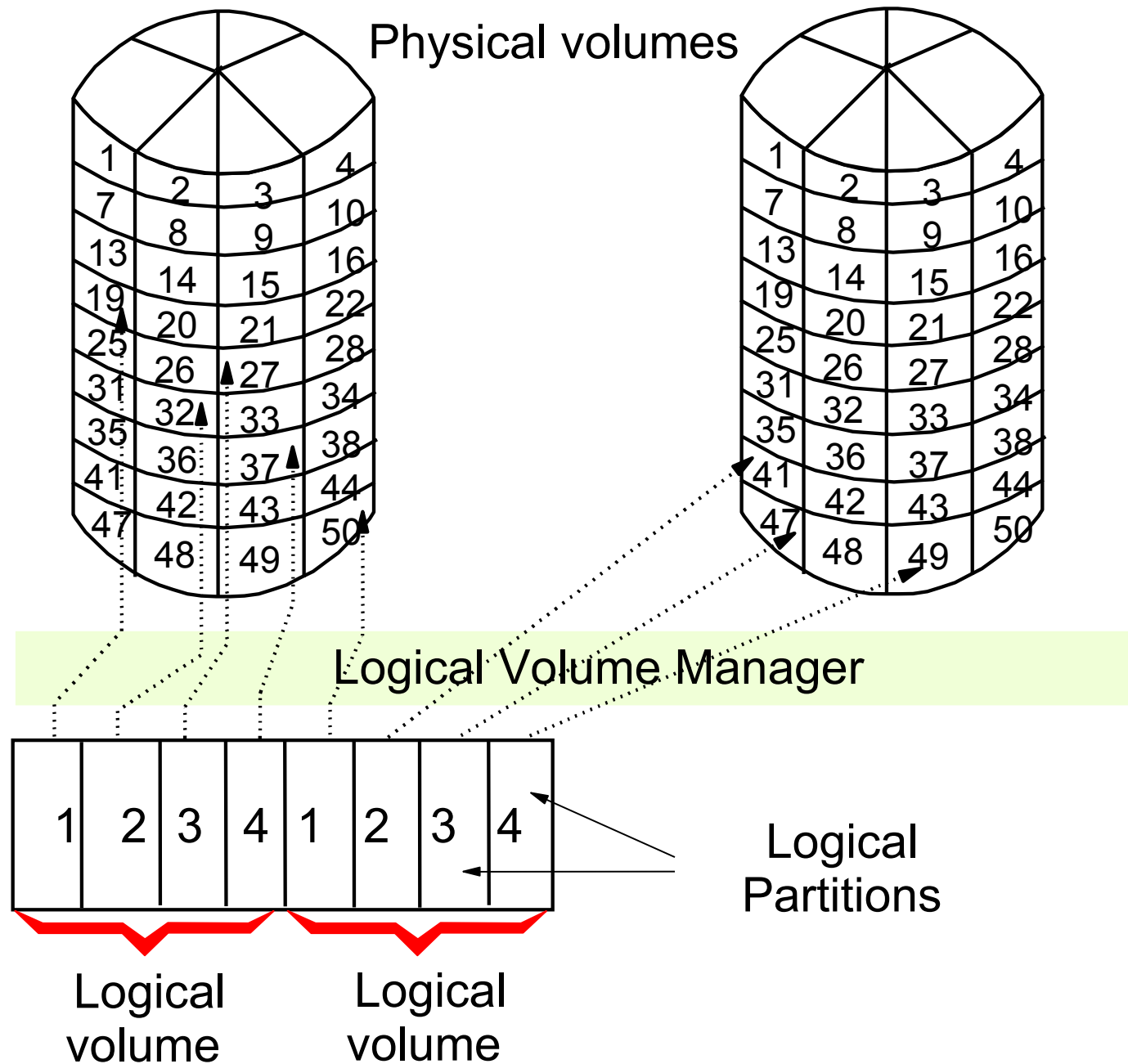
```
# chvg -b n datavg
```

# ~~Exercise 9: Working with LVM (parts 1-2)~~

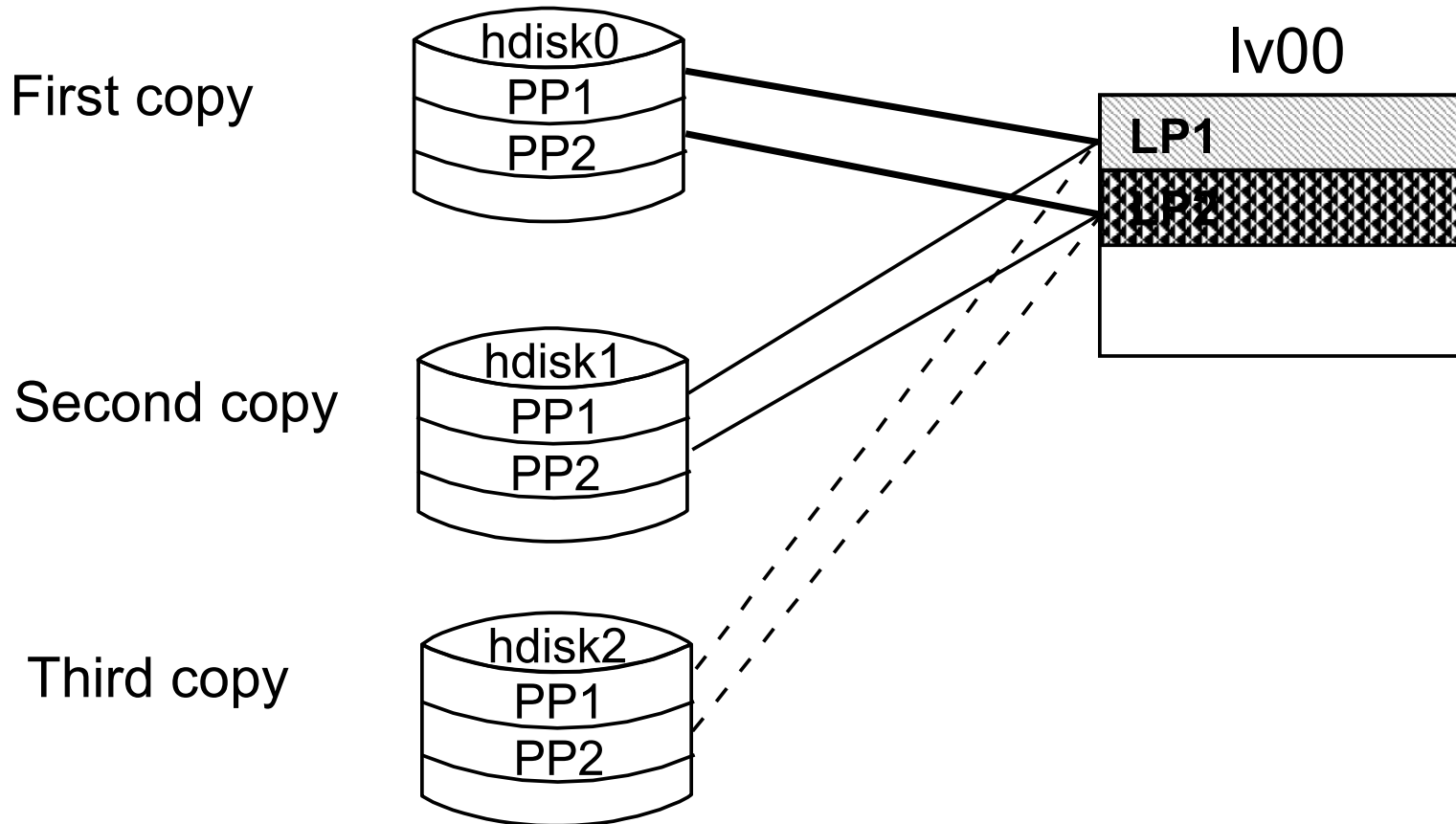


- Part 1 - Adding and removing a disk from a volume group
- Part 2 - Creating and removing a volume group

# Logical storage

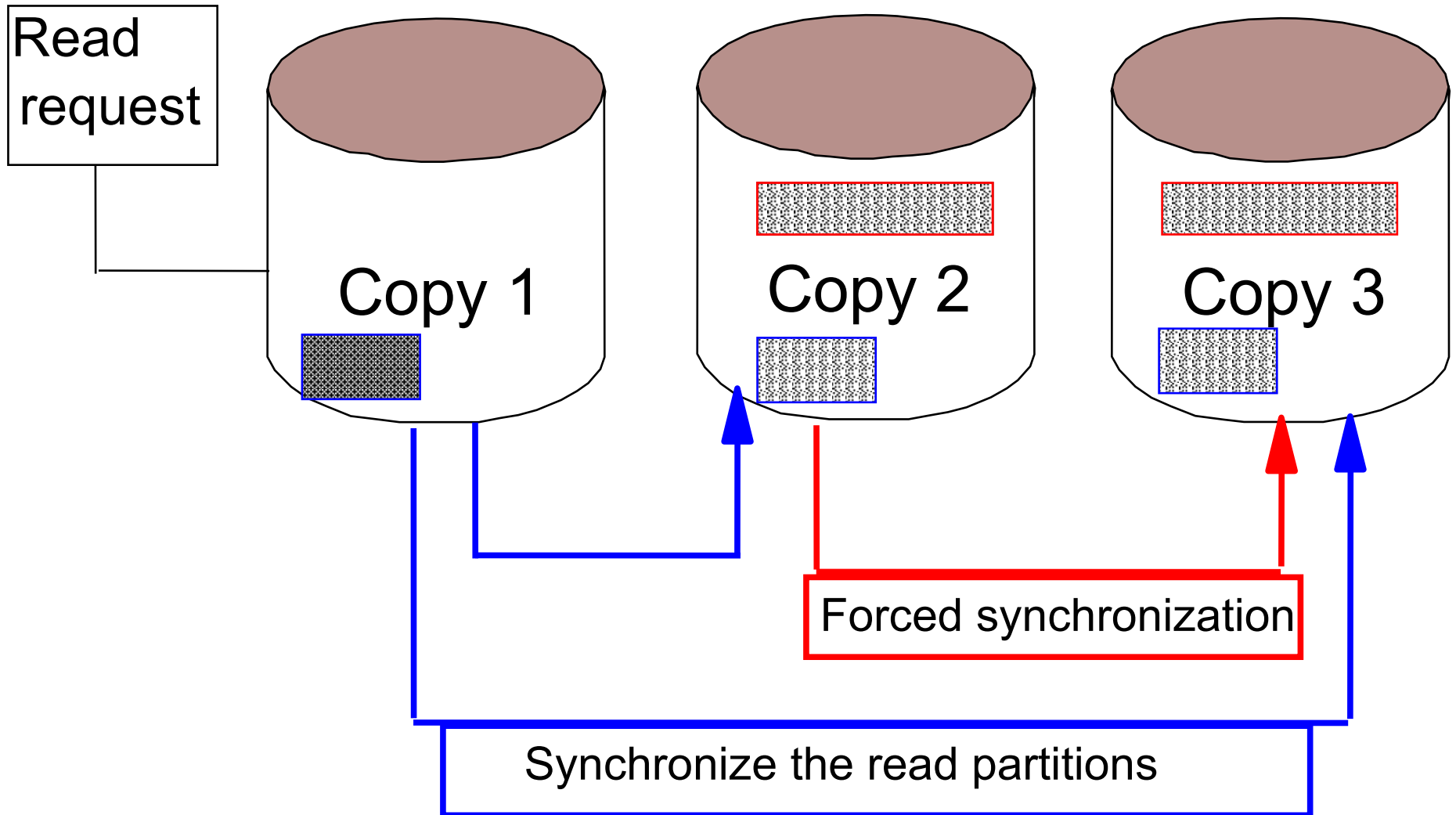


# Mirroring



- Mirroring is when a logical partition maps to more than one physical partition of the same volume group
- Scheduling policy:
  - Parallel: Physical partitions written simultaneously
  - Sequential: Physical partitions written in sequence

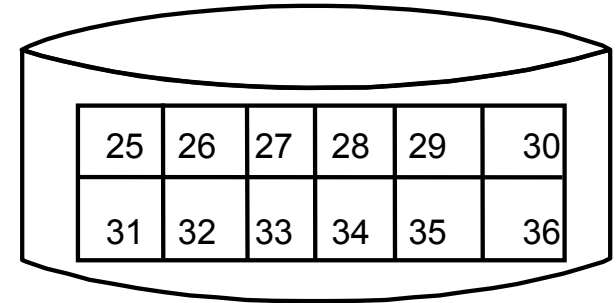
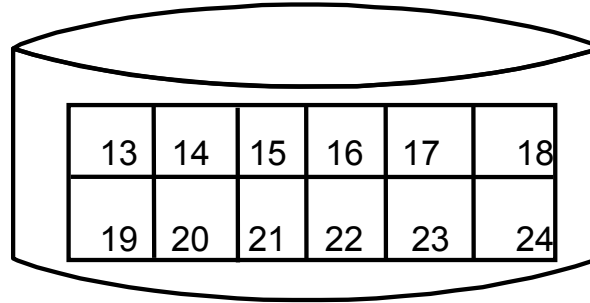
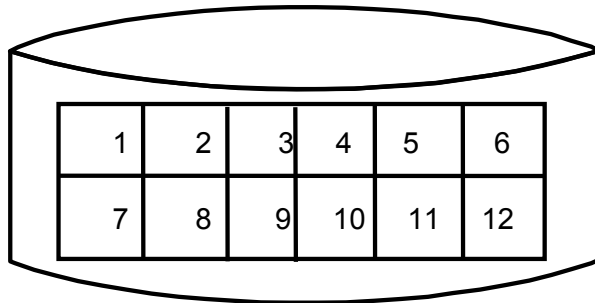
# Mirror write consistency



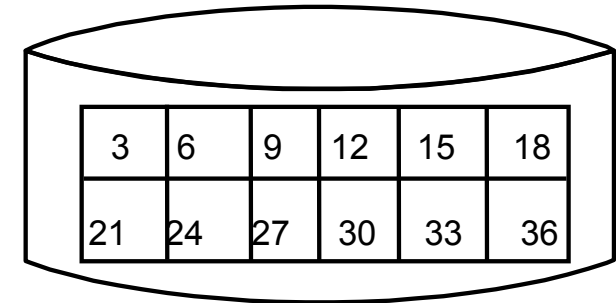
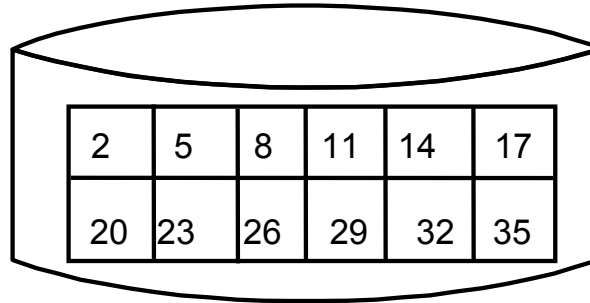
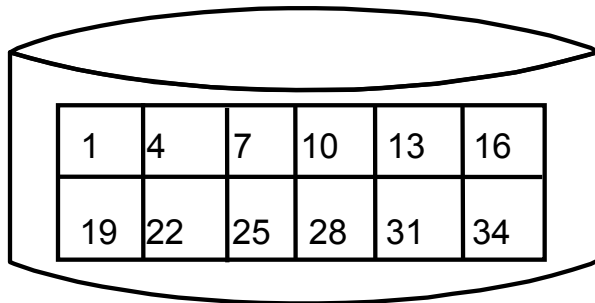


# Striping

- Normal flow of data blocks when a logical volume is spread across physical volumes:



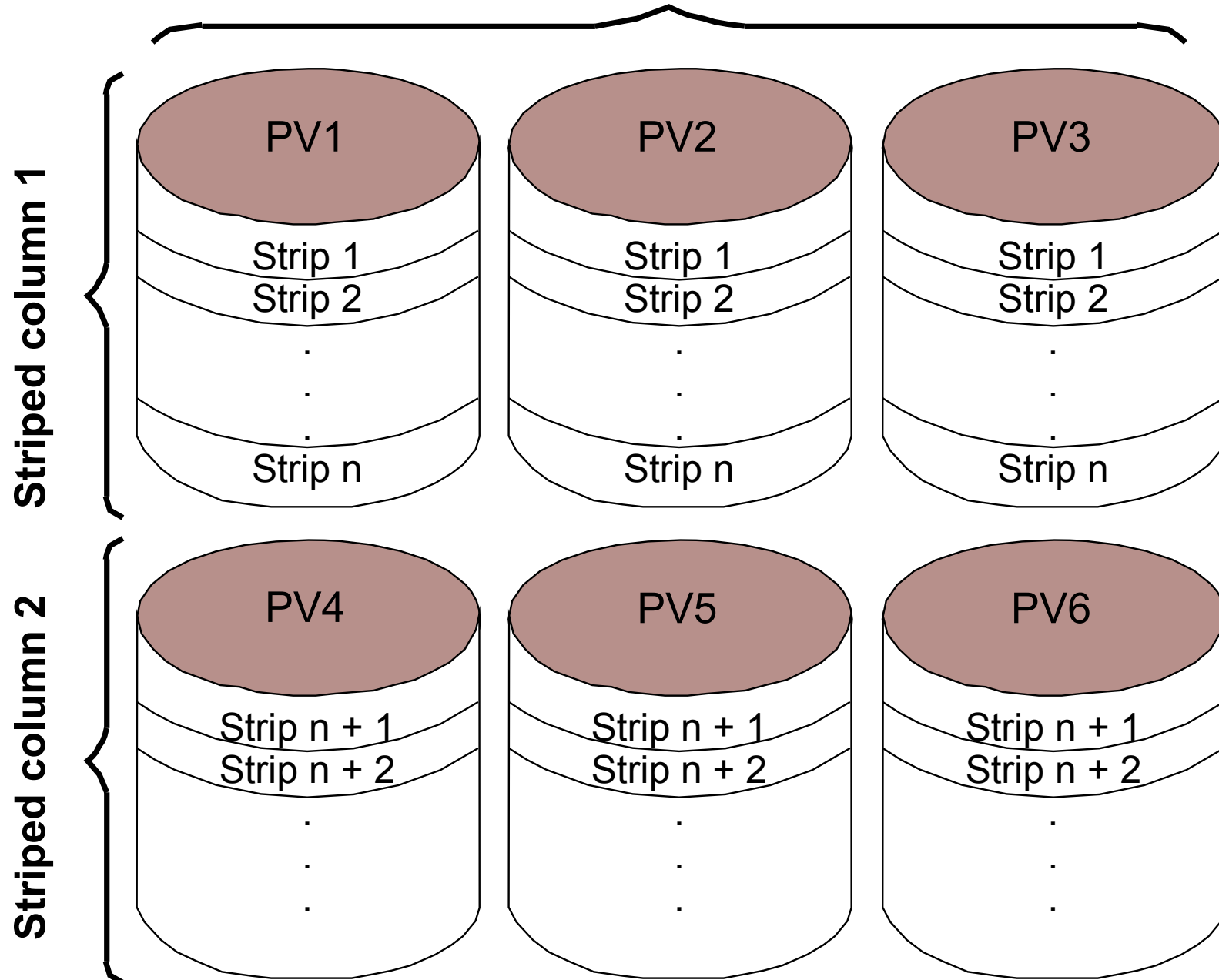
- The layout of stripe units when a logical volume is set up to stripe:



- Consecutive stripe units are created on different physical volumes
- Striping increases read/write sequential throughput by evenly distributing stripe units among disks
- Stripe unit size is specified at creation time

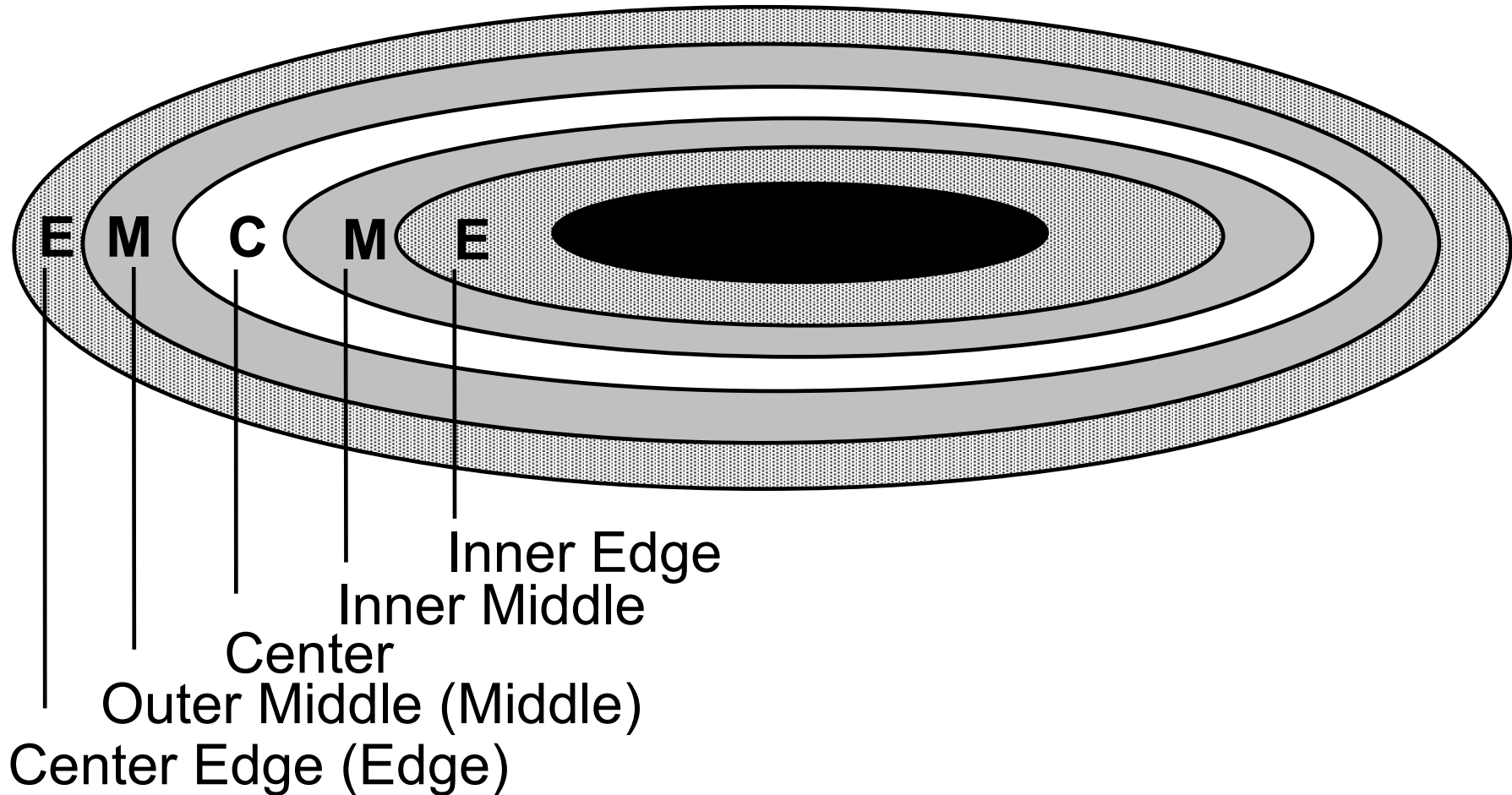
# Striped columns

Striped logical volume: strip width = 3, upper bound = 6



# Logical volume policies

Intra-physical volume allocation policy:



Inter-physical volume allocation policy:

- ▶ Maximum number of physical volumes to use
- ▶ Range of physical volumes to use

# SMIT Logical Volumes menu

```
# smit lv
```

## Logical Volumes

Move cursor to desired item and press Enter.

```
List All Logical Volumes by Volume Group
Add a Logical Volume
Set Characteristic of a Logical Volume
Show Characteristics of a Logical Volume
Remove a Logical Volume
Copy a Logical Volume
```

```
F1=Help
F9=Shell
```

```
F2=Refresh
F10=Exit
```

```
F3=Cancel
Enter=Do
```

```
F8=Image
```

# Show logical volume characteristics

- Physical volume map:

```
# lslv -l lv00

lv00:/home/john
PV          COPIES          IN BAND          DISTRIBUTION
hdisk0     010:000:000      70%              000:000:007:003:000
```

- Logical partition map:

```
# lslv -m lv00

lv00:/home/john
LP          PP1      PV1          PP2      PV2          PP3      PV3
00010134   hdisk0
0002       0135     hdisk0
00030136   hdisk0
```

# Add a Logical Volume

```
# smit mklv
```

## Add a Logical Volume

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

[TOP]	[Entry Fields]	
Logical volume NAME	[]	
* VOLUME GROUP name	rootvg	
* Number of LOGICAL PARTITIONS	[]	#
PHYSICAL VOLUME names	[]	+
Logical volume TYPE	[]	+
POSITION on physical volume	outer_middle	+
RANGE of physical volumes	minimum	+
MAXIMUM NUMBER of PHYSICAL VOLUMES to use for allocation	[]	#
Number of COPIES of each logical partition	1	+
Mirror Write Consistency?	active	+
Allocate each logical partition copy	yes	+

[MORE...11]

F1=Help	F2=Refresh	F3=Cancel	F4=List
F5=Reset	F6=Command	F7=Edit	F8=Image
F9=Shell	F0=Exit	Enter=Do	

# Remove a Logical Volume

```
# smit rmlv
```

## Remove a Logical Volume

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

[TOP]

LOGICAL VOLUME name

[Entry Fields]

[] +

F1=Help

F5=Reset

F9=Shell

F2=Refresh

F6=Command

F0=Exit

F3=Cancel

F7=Edit

Enter=Do

F4=List

F8=Image

# Set Characteristics of a Logical Volume

```
# smit lvsc
```

## Set Characteristics of a Logical Volume

Move cursor to desired item and press Enter.

Change a Logical Volume

Rename a Logical Volume

Increase the Size of a Logical Volume

Add a Copy to a Logical Volume

Remove a Copy from a Logical Volume

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do



# List all logical volumes by volume group

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

```
rootvg:
```

LVNAME	TYPE	LPs	PPs	PVs	LV STATE MOUNT POINT
hd6	paging	32	32	1	open/syncd N/A
hd5	boot	2	2	1	closed/syncd N/A
hd8	jfslog	1	1	1	open/syncd N/A
hd9var	jfs2	2	2	1	open/syncd /var
hd4	jfs2	9	9	1	open/syncd /
hd2	jfs2	101	101	1	open/syncd /usr
hd3	jfs2	4	1	1	open/syncd /tmp
hd1	jfs2	1	1	1	open/syncd /home
hd10opt	jfs2	5	5	1	open/syncd /opt
hd11admin	jfs2	8	8	1	open/syncd /admin
lv00	jfs2	1	2	2	open/syncd /home/john
lv01	jfs2	4	4	2	open/syncd /home/fred

# Show logical volume characteristics

```
# lslv lv02
```

```
LOGICAL VOLUME:    lv02                VOLUME GROUP:    course
LV IDENTIFIER:     00000000000004c00000000e5cf75106f.4  PERMISSION:      read/write
VG STATE:          active/complete      LV STATE:         opened/syncd
TYPE:              jfs2                 WRITE VERIFY:     off
MAX LPs:           128                   PP SIZE:          4 megabyte(s)
COPIES:            1                     SCHED POLICY:    parallel
LPs:               10                    PPs:              10
STALE PPs:         0                     BB POLICY:        relocatable
INTER-POLICY:      minimum                RELOCATABLE:     yes
INTRA-POLICY:      middle                 UPPER BOUND:     32
MOUNT POINT:       /home/malcolm          LABEL:            /home/malcolm
MIRROR WRITE CONSISTENCY: on/ACTIVE
EACH LP COPY ON A SEPARATE PV ?: yes
Serialize IO ?    NO
```

# Add Copies to a Logical Volume

```
# smit mklvcopy
```

## Add Copies to a Logical Volume

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

	[Entry Fields]	
* LOGICAL VOLUME name	lv00	
* NEW TOTAL number of logical partition copies	2	+
PHYSICAL VOLUME names	[]	+
POSITION on physical volume	middle	+
RANGE of physical volumes	minimum	+
MAXIMUM NUMBER of PHYSICAL VOLUMES to use for allocation	[32]	#
Allocate each logical partition copy on a SEPARATE physical volume?	yes	+
File containing ALLOCATION MAP	[]	
SYNCHRONIZE the data in the new logical partition copies?	no	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Reorganize a Volume Group

```
# smit reorgvg
```

## Reorganize a Volume Group

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

```
                                [Entry Fields]
* VOLUME GROUP name           vg3
  LOGICAL VOLUMES              [lv04 lv07]          +
```

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

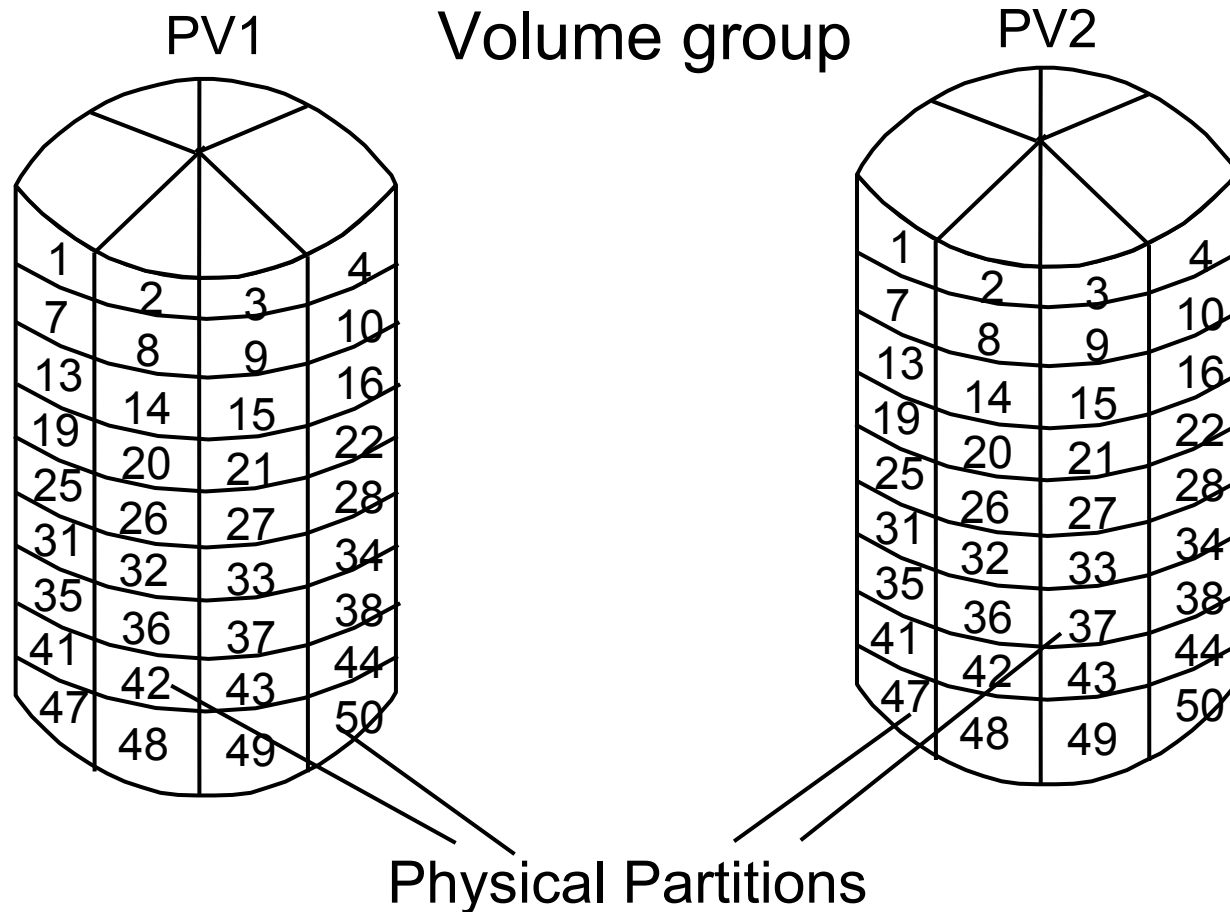
F8=Image

F9=Shell

F10=Exit

Enter=Do

# Physical volumes



- Physical volume (PV)
  - [Hard disk](#)
- Physical partition (PP)
  - [Smallest assignable unit of allocation on a physical disk](#)

# ~~SMIT Physical Volumes menu~~

```
# smit pv
```

## Physical Volumes

Move cursor to desired item and press Enter.

List All Physical Volumes in System

Add a Disk

Change Characteristics of a Physical Volume

List Contents of a Physical Volume

Move Contents of a Physical Volume

F1=Help

F9=Shell

F2=Refresh

F10=Exit

F3=Cancel

Enter=Do

F8=Image

# List physical volume information

- List all physical volumes in system:

```
# lspv

hdisk0    da1c923411d52ec91cd600802eda72c9      rootvg    active
hdisk1    bebc800000000000000000000802evg79c9    rootvg    active
```

- List the contents of a physical volume:

```
# lspv hdisk0

PHYSICAL VOLUME:    hdisk0                VOLUME GROUP:    rootvg
PV IDENTIFIER:     da1c923411d52ec91cd600802eda72c9
VG IDENTIFIER:     000bc6fd00004c00000000e10fdd7f52
PV STATE:          active
STALE PARTITIONS:  0                    ALLOCATABLE:     yes
PP SIZE:           4 megabyte(s)        LOGICAL VOLUMES: 6
TOTAL PPs:         95 (380 megabytes)    VG DESCRIPTORS:  2
FREE PPs:          3 (12 megabytes)     HOT SPARE:       no
USED PPs:          92 (368 megabytes)    MAX REQUEST      256 KB
FREE DISTRIBUTION: 00..03..00..00..00
USED DISTRIBUTION: 19..16..19..19..19
```

# List logical volumes on a physical volume

```
# lspv -l hdisk0
hdisk0:
LV NAME      LPs      PPs      DISTRIBUTION      MOUNT POINT
hd1          1        1        00..00..00..12..00  /home
hd3          4        4        00..03..00..00..00  /tmp
hd2         101      101      00..00..17..12..00  /usr
hd4          9        9        00..00..13..00..00  /
hd8          1        1        00..00..01..00..00  N/A
hd6          8        8        00..00..00..08..00  N/A
hd5          2        2        01..00..00..00..00  N/A
hd9var       2        2        00..00..02..00..00  /var
hd10opt      5        5        00..00..02..00..00  /opt
hd11admin   8        8        00..00..02..00..00  /admin
```



# List a physical volume partition map

```
# lspv -p hdisk0
hdisk0:
PP RANGE      STATE      REGION      LV NAME      TYPE      MOUNT POINT
1-2           used      outer edge  hd5          boot     N/A
3-154        free      outer edge
155-186      used      outer middle hd6          paging   N/A
187-307      free      outer middle
308-308      used      center      hd8          jfslog   N/A
309-309      used      center      hd4          jfs2     /
310-313      used      center      hd2          jfs2     /usr
314-314      used      center      hd9var       jfs2     /var
315-317      used      center      hd3          jfs2     /tmp
318-318      used      center      hd1          jfs2     /home
319-319      used      center      hd10opt      jf22     /opt
320-360      used      center      hd2          jfs2     /usr
361-363      used      center      hd10opt      jfs2     /opt
364-364      used      center      hd3          jfs2     /tmp
365-372      used      center      hd4          jfs2     /
373-380      used      center      hd11admin    jfs2     /admin
381-423      used      center      hd2          jfs2     /usr
424-424      used      center      hd9var       jfs2     /var
425-425      used      center      hd10opt      jfs2     /opt
426-438      used      center      hd2          jfs2     /usr
439-460      free      center
461-613      free      inner middle
614-767      free      inner edge
```

# ~~Add or move contents of physical volumes~~

- A disk can be either added:
  - Through SMIT
  - Configured through configuration manager when the system boots up
- Move the contents of a physical volume:

```
migratepv [ -l lvname ] sourcePV targetPV ..
```

```
# migratepv -l lv02 hdisk0 hdisk6
```

# Documenting the disk storage setup

---

- List of the disks on the system (PVID and volume group):

```
# lspv
```

- List the volume groups:

```
# lsvg
```

- List what logical volumes are contained in each volume group:

```
# lsvg -l vgname
```

- List the logical volumes on each disk:

```
# lspv -l pvname
```

# Checkpoint

1. True or False? A logical volume can span more than one physical volume.
2. True or False? A logical volume can span more than one volume group.
3. True or False? The contents of a physical volume can be divided between two volume groups.
4. True or False? If mirroring logical volumes, it is not necessary to perform a backup.
5. True or False? SMIT can be used to easily increase or decrease the size of a logical volume.
6. True or False? Striping is done at a logical partition level.

# Checkpoint solutions

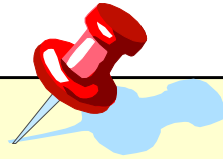
- True or False? A logical volume can span more than one physical volume.
- True or False? A logical volume can span more than one volume group.
- True or False? The contents of a physical volume can be divided between two volume groups.
- True or False? If mirroring logical volumes, it is not necessary to perform a backup. False. You still need to back up to external media.
- True or False? SMIT can be used to easily increase or decrease the size of a logical volume. False. SMIT can only be used to increase a file system. Decreasing one requires backing up the file system, removing it, re-creating it, and then restoring.
- True or False? Striping is done at a logical partition level. False. It is done at a stripe unit level.

# ~~Exercise 9: Working with LVM (parts 3-5)~~



- Part 3 - Exploring your storage environment
- Part 4 - Adding a volume group
- Part 5 - Adding a logical volume

# Unit summary



- SMIT or high-level commands can be used to add, change, or delete volume groups, physical volumes and logical volumes.
- Mirroring is a way to have two or three copies of a logical volume for high availability requirements.
- Disk striping is used to provide high performance in large, sequentially accessed file systems.



Welcome to:

# Unit 10

## Working with file systems





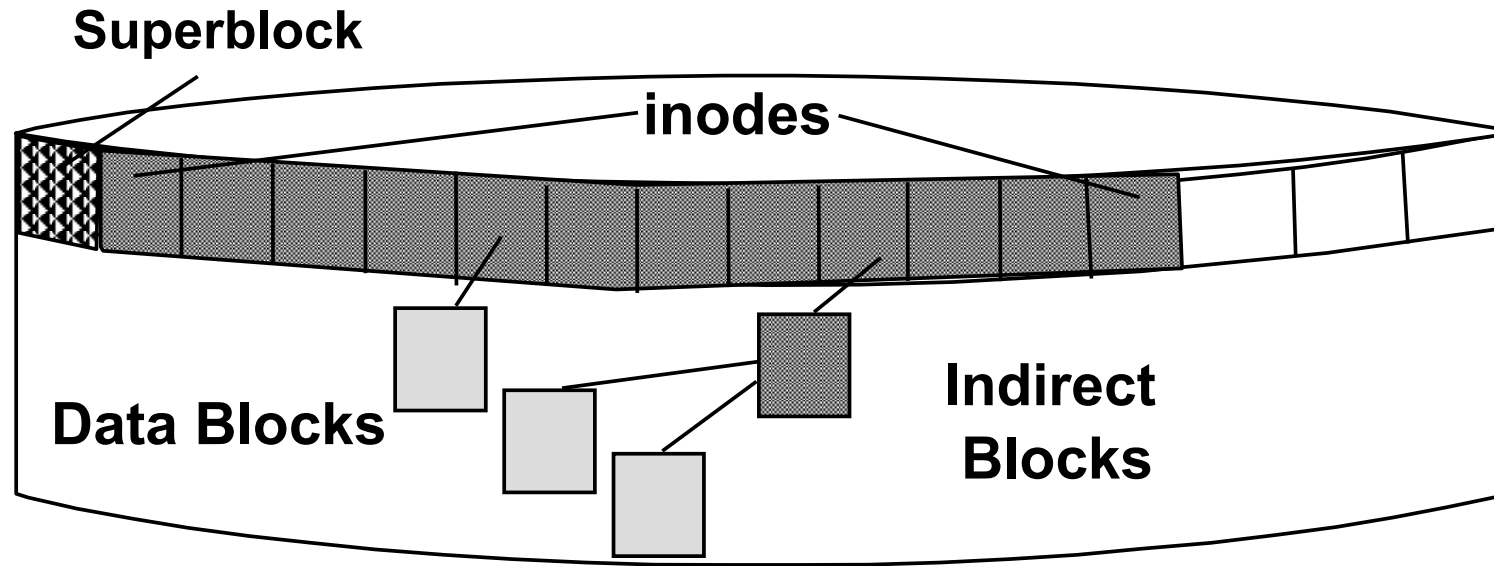
# Unit objectives

---

After completing this unit, you should be able to:

- Identify the components of an AIX file system
- Add an enhanced journaled file system
- Change characteristics of a file system
- Add a RAM file system
- Add a UDF file system on a DVD-RAM

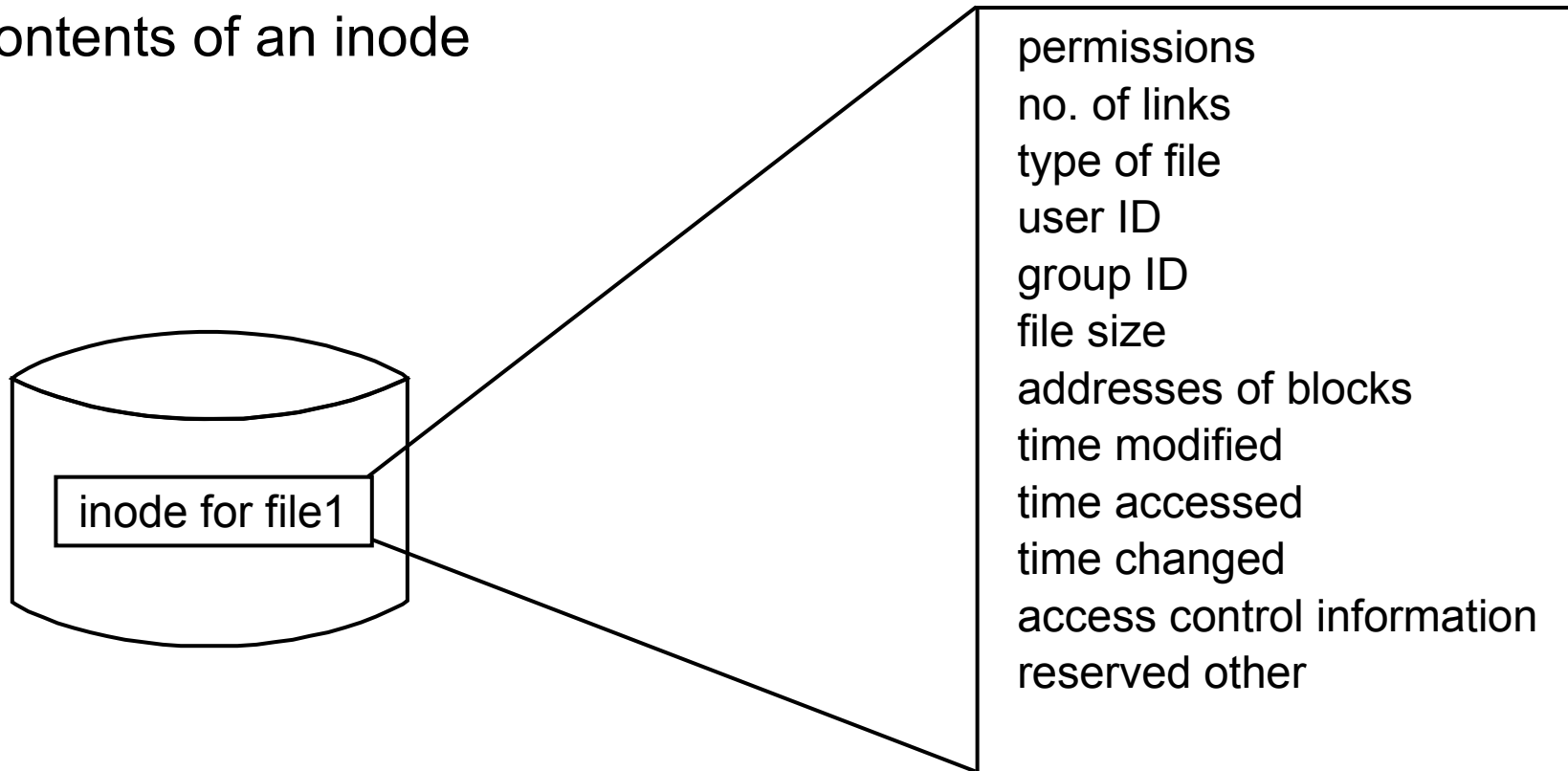
# Structure of a journaled file system



- Superblock
  - File system size and identification
  - Free list, fragment size, nbpi
- inodes
  - File size, ownership, permissions, times
  - Pointers to data blocks
- Blocks
  - Data blocks contain data
  - Indirect blocks contain pointers to data blocks

# Structure of an inode

- Contents of an inode



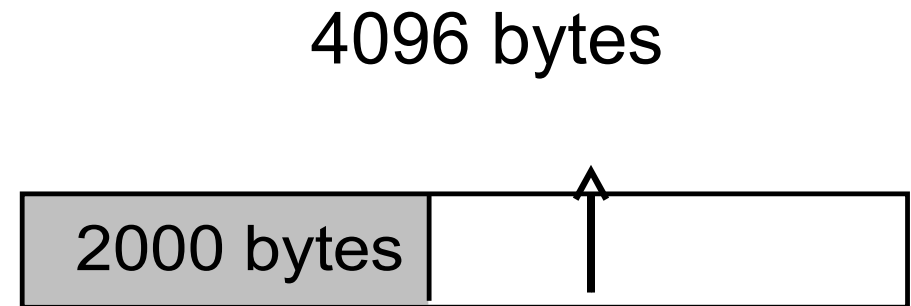
- This information can be seen with `ls -li`:

```
$ ls -li /home/team01
2132 drwxr-xr-x  2 team01 staff 512  May  2  14:33  c
2136 drwxr-xr-x  2 team01 staff 512  May  2  14:33  doc
2141 -rw-r--r--  1 team01 staff  28  May 16  10:11  Manuals
```

# File system fragmentation

## No fragmentation

File size = 2000 bytes

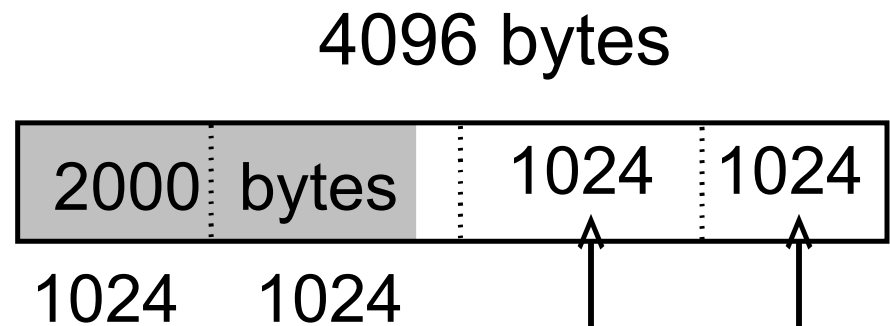


This free space cannot be used by another file

## Fragmentation enabled

File size = 2000 bytes

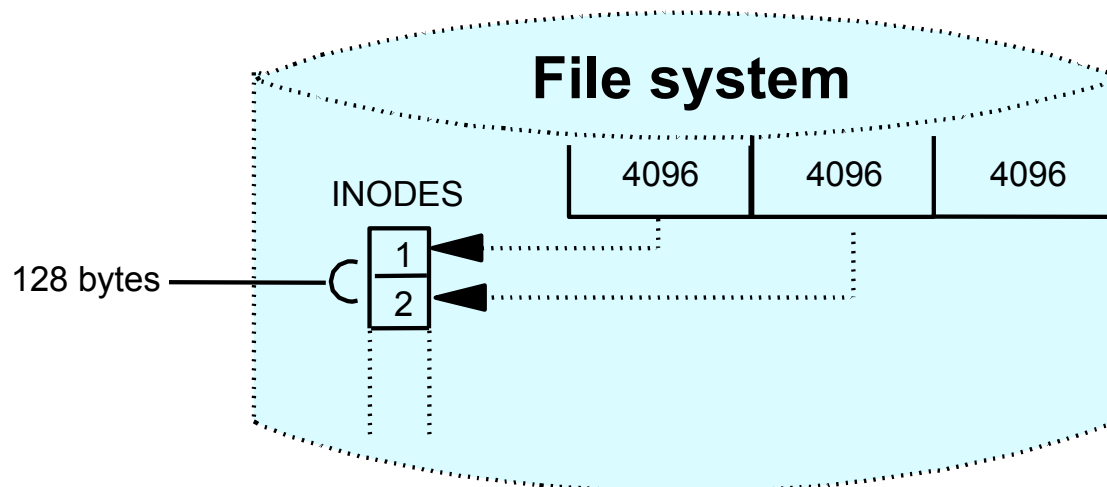
Fragment size = 1024 bytes



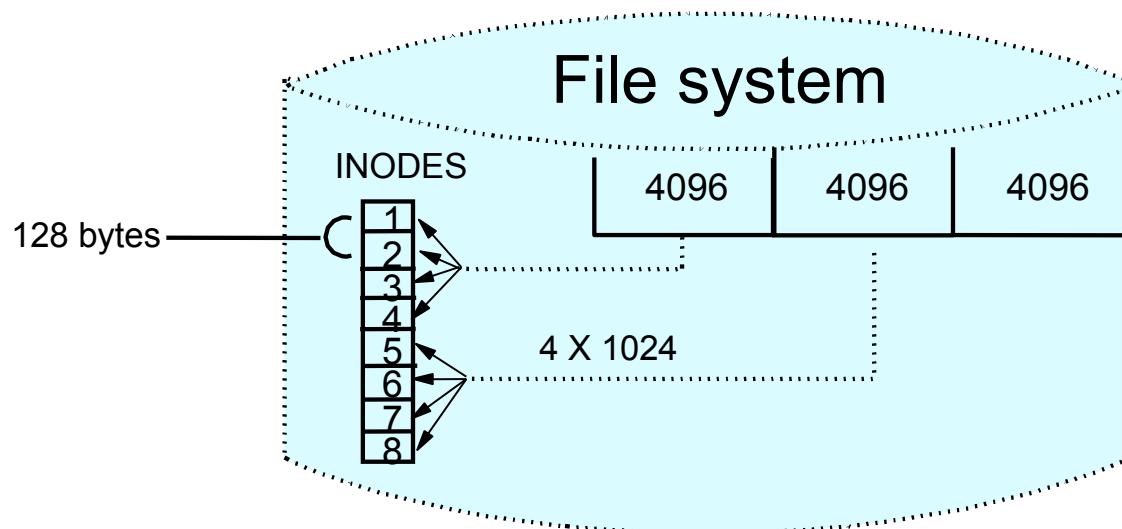
These free fragments can be used by other files

# Variable number of inodes

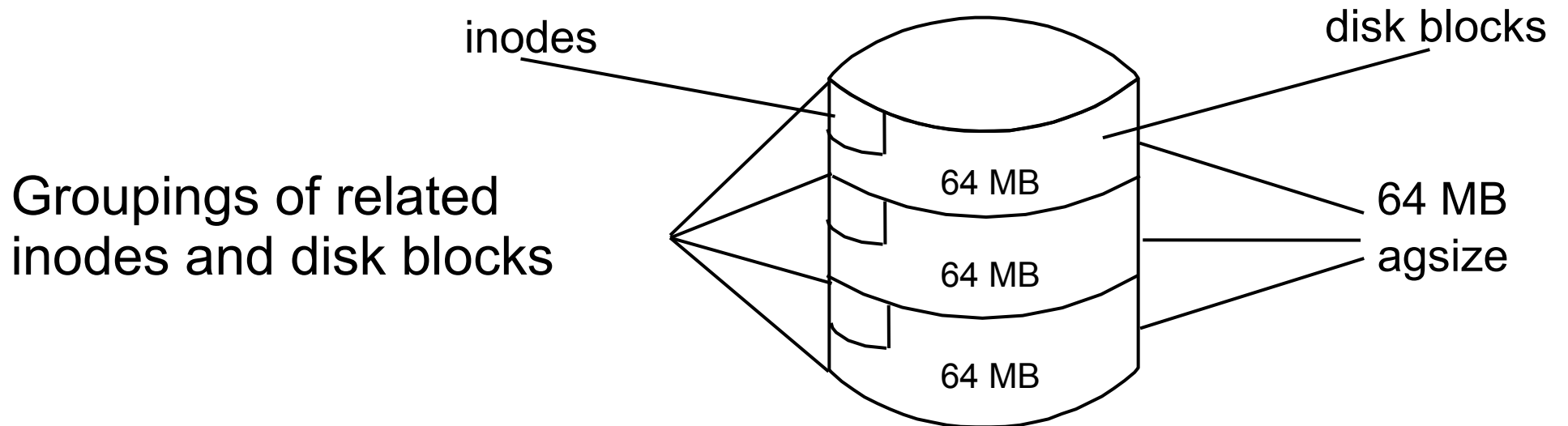
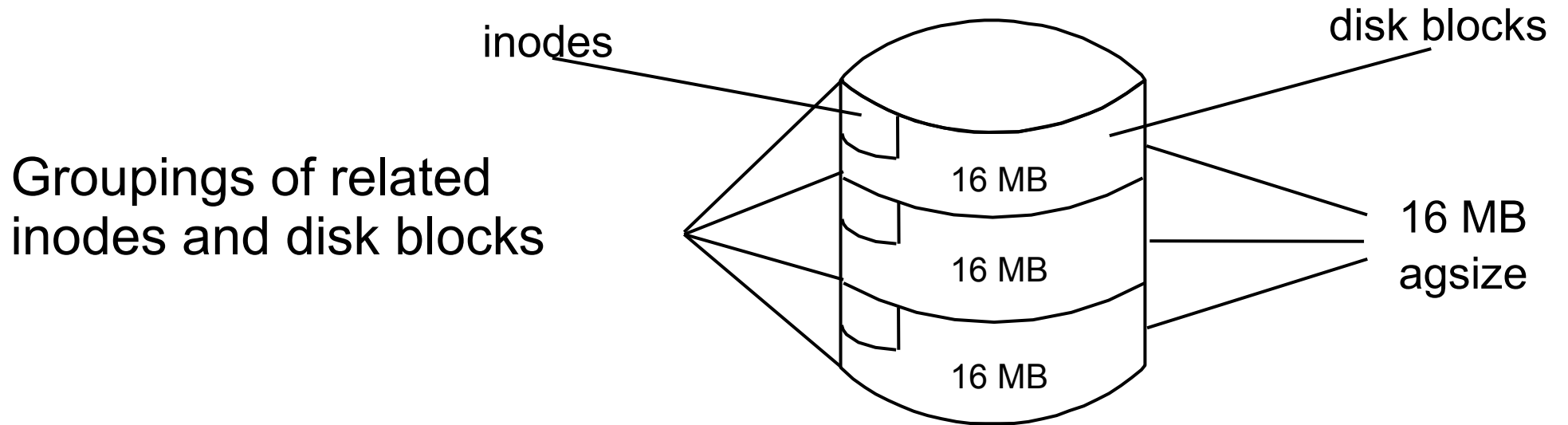
With the default nbpi = 4096 an inode is created for every 4096 bytes of file system.



Using the value nbpi = 1024 an inode is created for every 1024 bytes of file system.



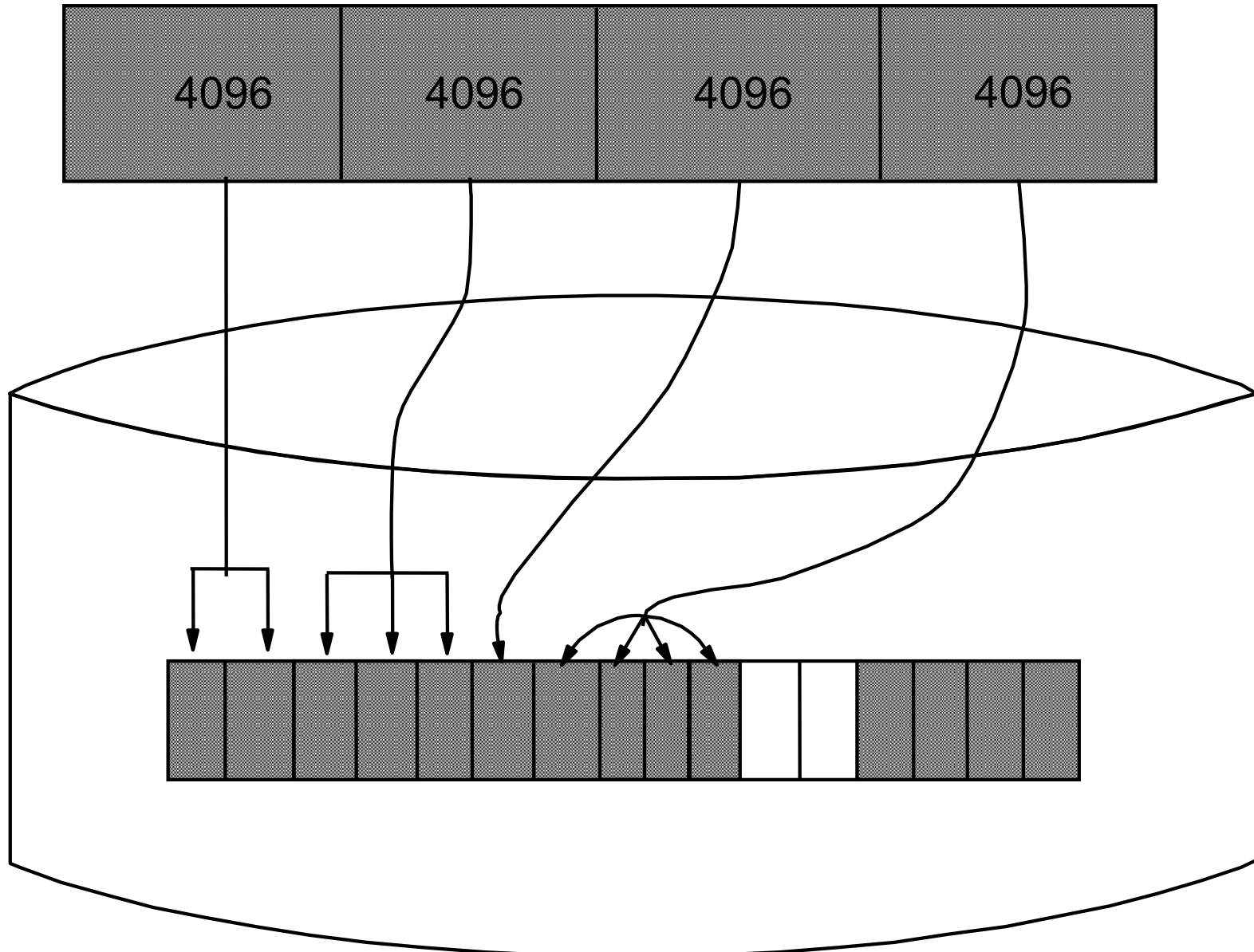
# Allocation group size



# Compressed file systems

compression = LZ (yes)

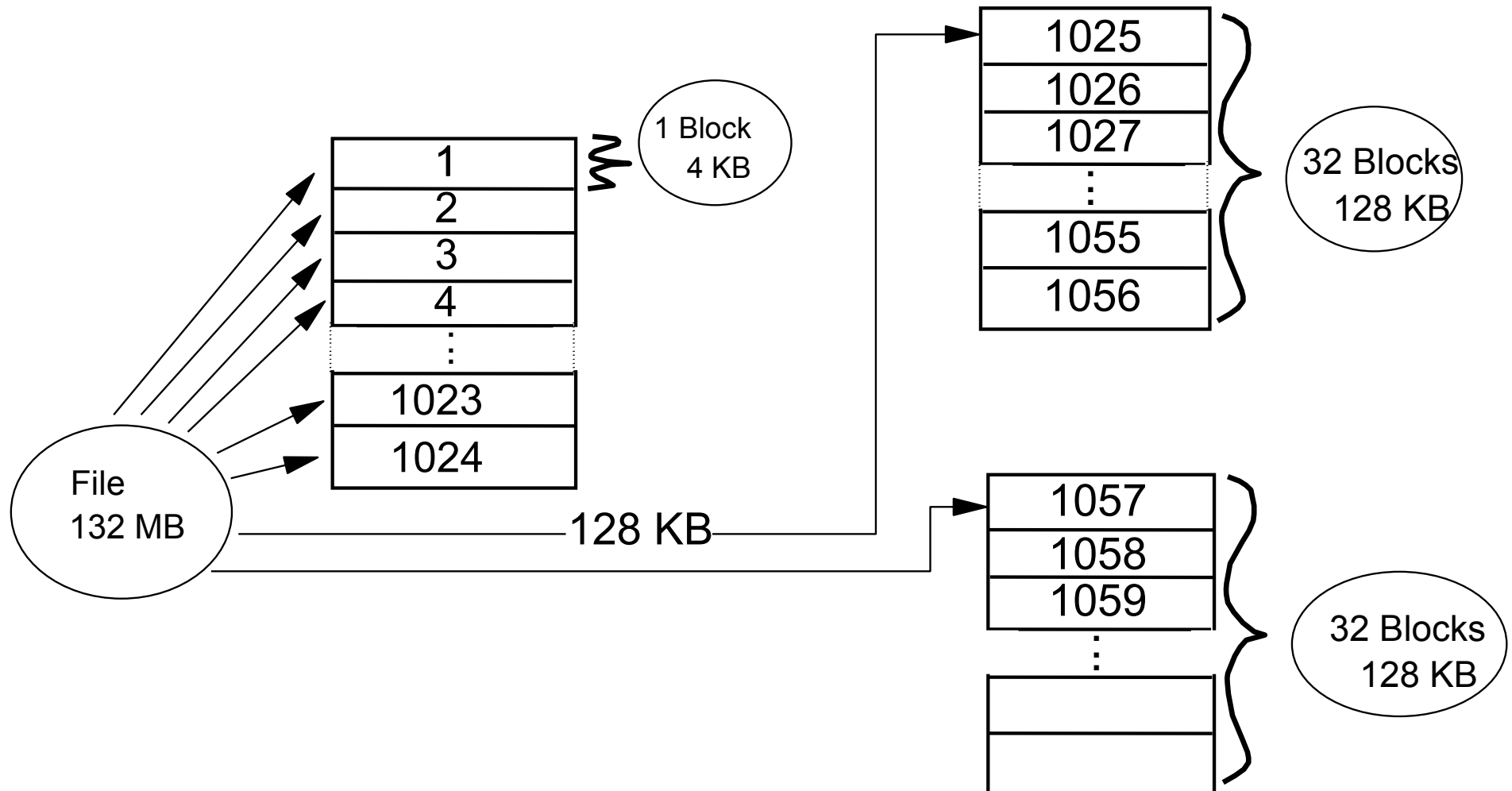
fragment size = 1024



# Large file enabled file systems

**File = 132 MB**

$$\begin{array}{rcl} (1024 * 4 \text{ KB blocks}) + (1024 * 128 \text{ KB blocks}) & = & 132 \text{ MB} \\ 4 \text{ MB} & + & 128 \text{ MB} & = & 132 \text{ MB} \end{array}$$



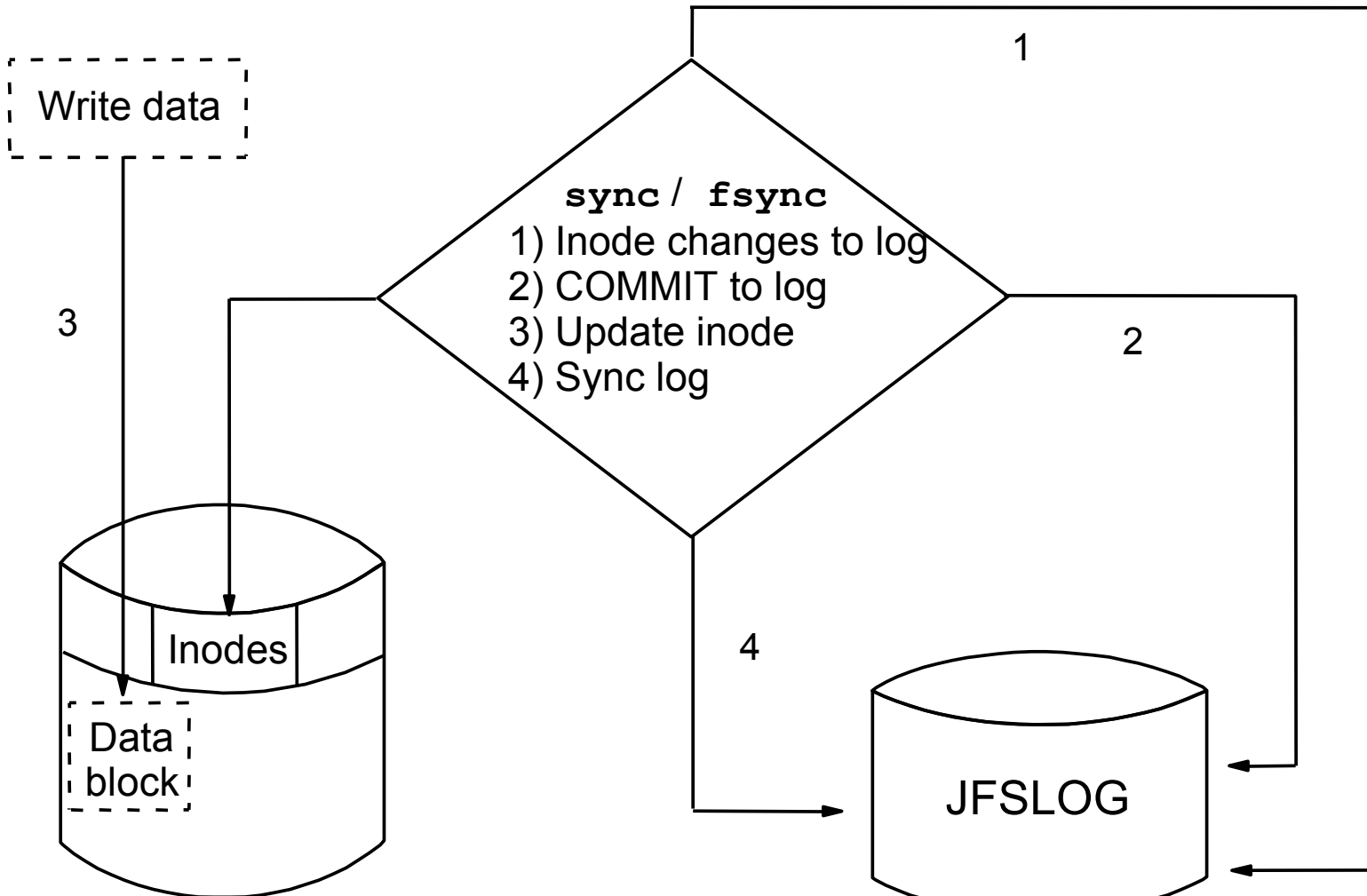


# Exercise 10: Working with file systems (part 1)

---

- 
- A whiteboard on a stand with a single bullet point.
- Part 1: Inodes and NBPI

# Journal log



- No journaling of data blocks - only journals inode information (and indirect block information).

# JFS versus JFS2 file systems

	JFS	JFS2
Maximum File Size Architectural / Tested	64 Gigabytes / 64 Gigabytes	1 Petabyte / 1 Terabyte
Maximum File System Size Architectural / Tested	1 Terabyte / 1 Terabyte	4 Petabytes / 1 Terabyte
Inode Size	128 Bytes	512 Bytes
Number of inodes	Fixed, set at creation	Dynamic
Directory File Access	Sequential	B-tree
Journal Log support	External JFSlog only	Inline or External JFS2log
Compression	Yes	No
Quotas	Yes	AIX 5L V5.3 and later



JFS2 uses extent based allocation for high performance and large file size.

# Extended attributes (EA)

---

- Extensions to regular attributes
- Two versions
  - AIX 5L V5.2 or earlier supported only EAv1
  - EAv1 used for local file permission ACLs
  - EAv2 improved (more and larger attributes)
  - JFS2 under AIX 5L V5.3 and later support both versions
- NFS V4 ACLs stored in JFS2 with EAv2
- User defined information may be in EAv2

```
$ getea HenryVIII  
EAName: Author  
EAValue: Shakespeare
```

# File Systems

```
# smit fs
```

## File Systems

Move cursor to desired item and press Enter

List All File Systems

List All Mounted File Systems

Add/Change/Show/Delete File Systems

Mount a File System

Mount a Group of File Systems

Unmount a File System

Unmount a Group of File Systems

Verify a File System

Backup a File System

Restore a File System

List Contents of a Backup

Create and backup a snapshot

# Listing file systems

```
# lsfs
```

Name	Nodename	Mount Pt	VFS	Size	Options	Auto
/dev/hd4	---	/	jfs2	294912	---	yes
/dev/hd1	---	/home	jfs2	32768	---	yes
/dev/hd2	---	/usr	jfs2	3309568	---	yes
/dev/hd9var	---	/var	jfs2	65536	---	yes
/dev/hd3	---	/tmp	jfs2	131072	---	yes
/proc	---	/proc	procfs		ro	yes
/dev/hd10opt	---	/opt	jfs2	163840	---	yes
/dev/hd11admin	---	/admin	jfs2	262144	---	yes
/budget	sys4	/reports	nfs2		bg,hard,intr	
/dev/cd0	---	/cdrom	cdrfs	---	ro	no

# List all mounted file systems

```
# mount
```

<u>node</u>	<u>mounted</u>	<u>mounted over</u>	<u>vfs</u>	<u>date</u>	<u>options</u>
	/dev/hd4	/	jfs2	Jul 11 20:14	rw,log=/dev/hd8
	/dev/hd2	/usr	jfs2	Jul 11 20:15	rw,log=/dev/hd8
	/dev/hd9var	/var	jfs2	Jul 11 20:15	rw,log=/dev/hd8
	/dev/hd3	/tmp	jfs2	Jul 11 20:15	rw,log=/dev/hd8
	/dev/hd1	/home	jfs2	Jul 11 20:16	rw,log=/dev/loglv00
	/proc	/proc	procfs	Jul 11 20:16	rw
	/dev/hd10opt	/opt	jfs2	Jul 11 20:16	rw,log=/dev/hd8
	/dev/hd11admin	/admin	jfs2	Jul 11 20:16	rw,log=/dev/hd8
sys4	/budget	/reports	nfs	Jul 11 20:16	rw,hard,bg,intr
	/dev/ramdisk	/ramdisk	jfs	Jul 11 20:17	rw,nointegrity
	/dev/project	/project	jfs2	Jul 11 20:18	rw,log=INLINE
	/dev/cd0	/cdrom	cdrfs	Jul 11 20:19	ro

# ~~Add/Change/Show/Delete File Systems~~

```
# smit manfs
```

Add / Change / Show / Delete File Systems

Move cursor to desired item and press Enter

Enhanced Journaled File Systems

Journaled File Systems

CDROM File Systems

Network File Systems (NFS)



# ~~Working with journaled file systems in SMIT~~

## Journalled File Systems

Move cursor to desired item and press Enter.

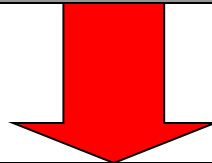
Add a Journalled File System

**Add a Journalled File System on a Previously Defined Logical Volume**

~~Change / Show Characteristics of a Journalled File System~~

Remove a Journalled File System

Defragment a Journalled File System



Add a Journalled File System on a Previously Defined Logical Volume

Move cursor to desired item and press Enter.

Add a Standard Journalled File System

Add a Compressed Journalled File System

Add a Large File Enabled Journalled File System

# Add a standard journaled file system on a previously defined logical volume

## Add a Standard Journaled File System

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

	[Entry Fields]	
* LOGICAL VOLUME name		+
* MOUNT POINT	[ ]	
Mount AUTOMATICALLY at system restart?	no	+
PERMISSIONS	read/write	+
Mount OPTIONS	[ ]	+
Start Disk Accounting ?	no	+
Fragment Size (bytes)	4096	+
Number of bytes per inode	4096	+
Allocation Group Size (MBytes)	8	+
Logical Volume for Log	[ ]	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Add a Standard Journalled File System

## Add a Standard Journalled File System

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

	[Entry Fields]	
Volume group name	rootvg	
SIZE of file system		
Unit Size	Megabytes	+
* Number of units	[ ]	#
* MOUNT POINT	[ ]	
Mount AUTOMATICALLY at system restart?	no	+
PERMISSIONS	read/write	+
Mount OPTIONS	[ ]	+
Start Disk Accounting ?	no	+
Fragment Size (bytes)	4096	+
Number of bytes per inode	4096	+
Allocation Group Size (MBytes)	8	+
Logical Volume for Log	[ ]	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Working with enhanced journaled file systems (JFS2) in SMIT

## Enhanced Journaled File Systems

Move cursor to desired item and press Enter.

Add an Enhanced Journaled File System

Add an Enhanced Journaled File System on a Previously Defined Logical Volume

~~Change / Show Characteristics of an Enhanced Journaled File System~~

Remove an Enhanced Journaled File System

Manage Quotas for an Enhanced Journaled File System

Defragment an Enhanced Journaled File System

List Snapshots for an Enhanced Journaled File System

Create Snapshot for an Enhanced Journaled File System

Mount Snapshot for an Enhanced Journaled File System

Remove Snapshot for an Enhanced Journaled File System

Unmount Snapshot for an Enhanced Journaled File System

Change Snapshot for an Enhanced Journaled File System

Rollback an Enhanced Journaled File System to a Snapshot

F1=Help

F2=Refresh

F3=Cancel

Esc+8=Image

Esc+9=Shell

Esc+0=Exit

Enter=Do

# Add an enhanced journaled file system (JFS2) on a previously defined logical volume

## Add an Enhanced Journaled File System

Type or select values in entry fields.

Press Enter AFTER making all desired changes.

	[Entry Fields]	
* LOGICAL VOLUME name		+
* MOUNT POINT	[ ]	
Mount AUTOMATICALLY at system restart?	no	+
PERMISSIONS	read/write	+
Mount OPTIONS	[ ]	+
Block Size (bytes)	4096	+
Logical Volume for Log	[ ]	+
Inline Log size (MBytes)	[ ]	#
Extended Attribute Format	Version 1	+
Enable Quota Management	no	+
Enable EFS?	no	+
Allow internal snapshots?	no	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Add an Enhanced Journaled File System (JFS2)

## Add an Enhanced Journaled File System

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

	[Entry Fields]	
Volume group name	rootvg	
SIZE of file system		
Unit Size	Megabytes	+
*    Number of units	[ ]	#
* MOUNT POINT	[ ]	
Mount AUTOMATICALLY at system restart?	no	+
PERMISSIONS	read/write	+
Mount OPTIONS	[ ]	+
Block size (bytes)	4096	+
Logical Volume for Log	[ ]	+
Inline Log size (MBytes)	[ ]	#
Extended Attribute Format	Version 1	+
Enable Quota Management	no	+
[MORE...2]		

# Mount a File System

## Mount a File System

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

[Entry Fields]

FILE SYSTEM name	[ ]	+
DIRECTORY over which to mount	[ ]	+
TYPE of file system		+
FORCE the mount?	no	+
REMOTE NODE containing the file system to mount	[ ]	
Mount as a REMOVABLE file system?	no	+
Mount as a READ-ONLY system?	no	+
Disallow DEVICE access via this mount?	no	+
Disallow execution of SUID and sgid programs in this file system?	no	+

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

# Change/Show Characteristics of a Journalled File System

## Change/Show Characteristics of a Journalled File System

Type or select values in entry fields.

Press Enter AFTER making all desired changes.

	[Entry Fields]	
File system name	/var	
NEW mount point	[/var]	
SIZE of file system (in 512-byte blocks)		
Unit Size	512bytes	+
*    Number of units	[65536]	#
Mount GROUP	[bootfs]	
Mount AUTOMATICALLY at system restart ?	yes	+
PERMISSIONS	read/write	+
MOUNT OPTIONS	[ ]	+
Start Disk Accounting ?	no	+
Fragment Size (bytes)	4096	
Number of bytes per inode	4096	
Compression algorithm	no	
Large File Enabled	true	
Allocation Group Size (MBytes)	16	



# Change/Show Characteristics of an Enhanced Journaled File System

Change / Show Characteristics of an Enhanced Journaled File System

Type or select values in entry fields.

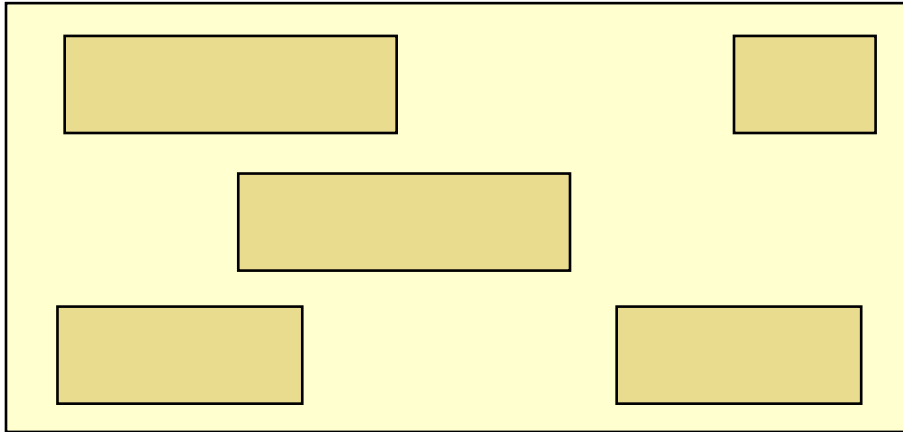
Press Enter AFTER making all desired changes.

	[Entry Fields]	
File system name	/home	
NEW mount point	[/home]	
SIZE of file system		
Unit Size	512bytes	+
*    Number of units	[32768]	#
Mount GROUP	[ ]	
Mount AUTOMATICALLY at system restart ?	yes	+
PERMISSIONS	read/write	+
MOUNT OPTIONS	[ ]	+
Start Disk Accounting?	no	+
Block size (bytes)	4096	
Inline Log?	no	
Inline Log size (MBytes)	[ ]	
Extended Attribute Format	[v1]	+
Enable Quota Management	no	+
Allow Small Inode Extents	no	+
Enable EFS?	no	+

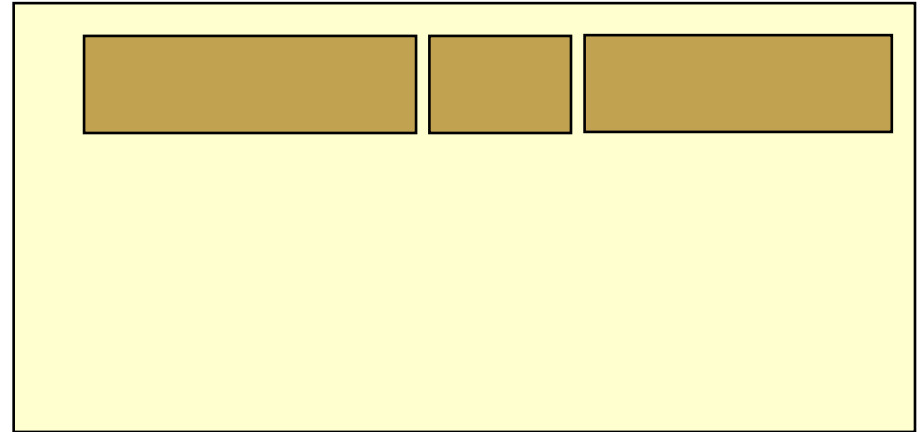
# Dynamically shrinking a JFS2 file system

Before:

LP1

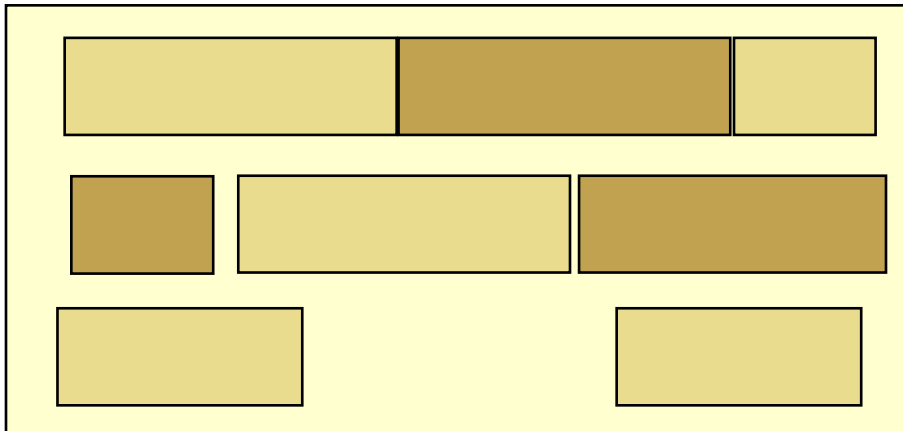


LP2



After:

LP1



```
# chfs -a size="-16M" /myfs
```

# Remove a Journalled File System

## Remove a Journalled File System

Type or select values in entry fields.

Press Enter AFTER making all desired changes.

[Entry Fields]

FILE SYSTEM name		+
Remove Mount Point	no	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Add a RAM file system

- Create a RAM disk of 4 MB

```
# mkramdisk 4M  
/dev/rramdisk0
```

- Create a JFS file system on this RAM disk

```
# mkfs -V jfs /dev/ramdisk0  
mkfs: destroy /dev/ramdisk0 (yes)? y
```

- Create mount point

```
# mkdir /ramdisk
```

- Mount RAM file system

```
# mount -V jfs -o nointegrity /dev/ramdisk0 /ramdisk
```

# Add a UDF file system on a DVD-RAM

- Create a UDF file system

```
# udfcreate -d /dev/cd0
```

- Change the label on a UDF file system

```
# udflabel -d /dev/cd0 -l testdvd
```

- Create a mount point

```
# mkdir /dvddisk
```

- Mount a UDF file system

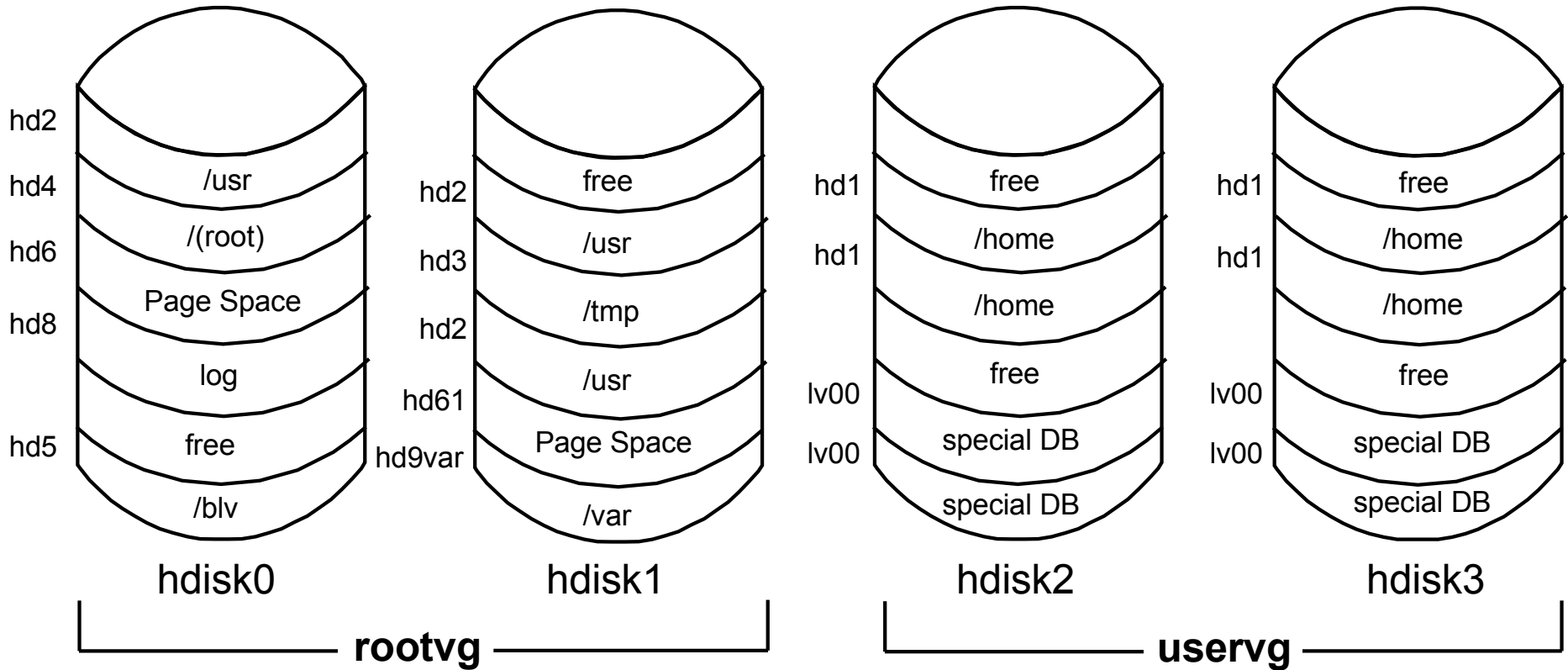
```
# mount -V udfs -o rw /dev/cd0 /dvddisk
```

- Check a UDF file system

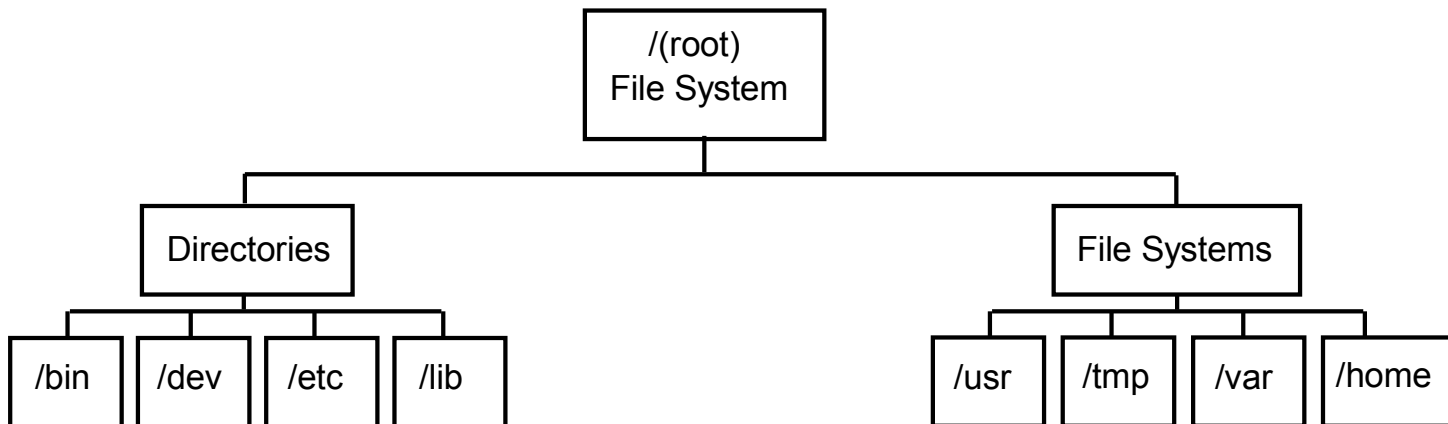
```
# udfcheck -d /dev/cd0
```

# System storage review

## Logical Volume Structure



File Systems



# Checkpoint

1. Does the size of the file system change when the size of the logical volume it is on is increased? \_\_\_\_\_
3. If a file system is the same size as the logical volume on which it sits, does the size of the logical volume increase when the size of the file system that is residing on it increases? \_\_\_\_\_
5. If you remove a logical volume, is the file system that is residing on it removed as well?  
\_\_\_\_\_  
\_\_\_\_\_

# Checkpoint solutions

- Does the size of the file system change when the size of the logical volume it is on is increased? No
  - If a file system is the same size as the logical volume on which it sits, does the size of the logical volume increase when the size of the file system that is residing on it increases? Yes
5. If you remove a logical volume, is the file system that is residing on it removed as well?

The contents are removed, but the information about the file system that is contained in **/etc/filesystems** is not removed.

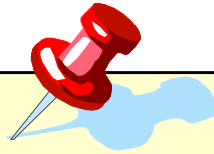


# Exercise 10: Working with file systems (parts 2-6)



- Part 2: Creating a journaled file system
- Part 3: Changing the file system size
- Part 4: Reducing the size of a file system
- Part 5: Removing a file system
- Part 6: Working with mirrors

# Unit summary



- The components of a JFS file system are the superblock, inodes, data blocks, and indirect blocks.
- Important issues to consider when creating a journaled file system are: fragment size, NBPI, allocation group size, compression, and whether it should be large file enabled.
- JFS2 supports large files, large file systems, and improves performance.
- File systems can be added and removed from the system, and their characteristics can also be changed, all through SMIT.



# Unit 11

## Managing file systems



# Unit objectives

---

After completing this unit, you should be able to:

- Monitor file system growth and control growing files
- Manage file system disk space usage
- Implement basic file system integrity checks

# Space management

---

- File systems expand upon notice, NOT automatically
- To keep from running into problems:
  - Monitor file system growth
  - Determine causes
  - Control growing files
  - Manage file system space usage
  - Control user disk usage
  - Defragment file system



# Listing free disk space

---

- The `df` command displays information about total space and available space on a file system

# `df`

Filesystem	512-blocks	Free	%Used	Iused	%lused	Mounted on
/dev/hd4	294912	228088	23%	1925	7%	/
/dev/hd2	3309568	339408	90%	36788	47%	/usr
/dev/hd9var	65536	37600	43%	479	11%	/var
/dev/hd3	131072	129352	2%	54	1%	/tmp
/dev/hd1	32768	32064	3%	5	1%	/home
/proc		-	-	-	-	/proc
/dev/hd10opt	163840	20760	88%	1617	36%	/opt
/dev/hd11admin	262144	261416	1%	5	1%	/admin
/dev/ramdisk0	8192	7848	5%	17	2%	/ramdisk

# Control growing files

---

- **/var/adm/wtmp**
- **/etc/security/failedlogin**
- **/var/adm/sulog**
  
- **/var/spool/\*/\***
  
- **\$HOME/smit.log**
- **\$HOME/smit.script**
- **\$HOME/webasm.log**
- **\$HOME/webasm.script**



# The `skulker` command

---

- The `skulker` command cleans up file systems by removing unwanted or obsolete files
- Candidate files include:
  - Files older than a selected age
  - Files in the `/tmp` directory
  - `a.out` files
  - `core` files
  - `ed.hup` files
- `skulker` is normally invoked daily by the `cron` command as part of the `crontab` file of the `root` user
- Modify the `skulker` shell script to suit local needs for the removal of files



# Listing disk usage

---

- The `du` command can be used to list the number of blocks used by a file or a directory

```
# du /home | sort -r -n  
  
624    /home  
392    /home/fred  
98     /home/tom  
54     /home/mary  
52     /home/liz  
23     /home/suzy  
2      /home/guest  
1      /home/steve
```

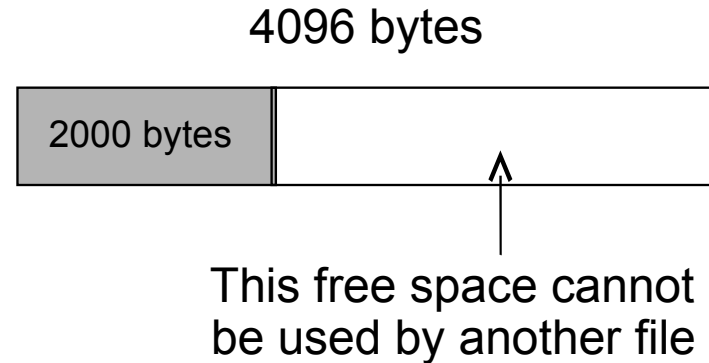
- To view individual file sizes, use the `ls -l` command

# Fragmentation considerations

---

## Without fragmentation

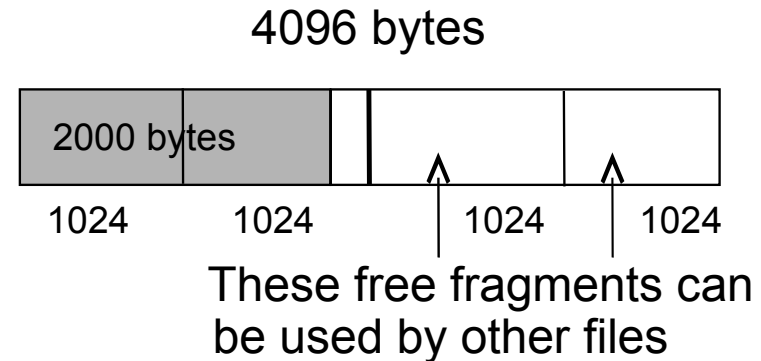
File size = 2000 bytes



## With fragmentation

File size = 2000 bytes

Fragment size = 1024 bytes



Considerations to be made:

- Disk space allocation
- Disk space utilization
- I/O activity
- Free space fragmentation
- Fragment allocation map

# Defragmenting a file system

---

- The **defragfs** command increases a file system's contiguous free space
- The file system must be mounted

```
defragfs [-q | -r | -s] filesystem
```

Options:

- q** Reports the current state of the file system
- r** Reports the current state of the file system and the state that would result if the **defragfs** command is run without either **-q**, **-r** or **-s**
- s** Gives short report regarding the current state of the file system

# Verify a file system

---

- Command syntax:

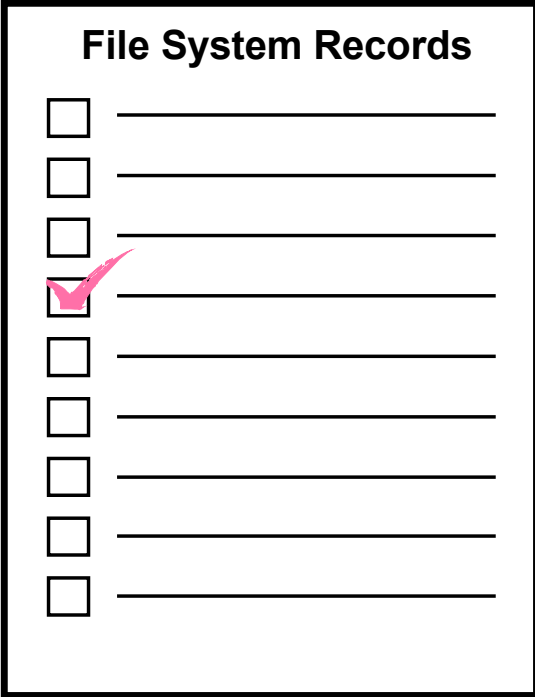
```
fsck [-p | -y | -n] [-f] [ file system ]
```

- Checks journal log
- Checks inodes, indirect blocks, data blocks, free lists
- If no file system name is specified, the **fsck** command checks all file systems which have the **check=true** attribute set in the **/etc/filesystems**
- Orphan files are placed in the **lost+found** directory
- Unmount the file system before running **fsck**

# Documenting file system setup

---

- Run the `lsfs` command
- Get the contents of the `/etc/filesystems` file
- Run the `df` command to check free space
- Check all the mounted file systems by running the `mount` command



**File System Records**

<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input checked="" type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____

# Checkpoint

---

1. What command can you use to determine if a file system is full? \_\_\_\_\_
  
4. What two commands can be used to find the files and users that are taking the most disk space?
  - \_\_\_\_\_
  - \_\_\_\_\_
  
7. True or False? It is good practice to run `fsck -y` on all file systems, even if they are mounted.

# Checkpoint solutions

---

1. What command can you use to determine if a file system is full? df
4. What two commands can be used to find the files and users that are taking the most disk space?
  - du
  - ls -l
7. True or False? It is good practice to run **fsck -y** on all file systems, even if they are mounted.

# Exercise 11: Managing file systems

---

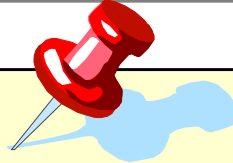


- Part 1 - Determining file system usage
- Part 2 - Using fragments for disk usage efficiency
- Part 3 - Using JFS compression
- Part 4 - Fixing file system problems



# Unit summary

---



- File system **management** does not just happen on the system. File systems need to be regularly **monitored** to ensure that they do not run out of space.
- To ensure the **integrity** of file systems, **checks** have to be carried out whenever file system corruption is suspected.



# Unit 12

## Paging space



# Unit objectives

---

After completing this unit, you should be able to:

- Define why paging space is required in AIX
- List and monitor the paging space utilization of the system
- Perform corrective actions to rectify too little or too much paging space scenarios

# What is paging space?

**RAM = 256 MB**

### RAM Usage

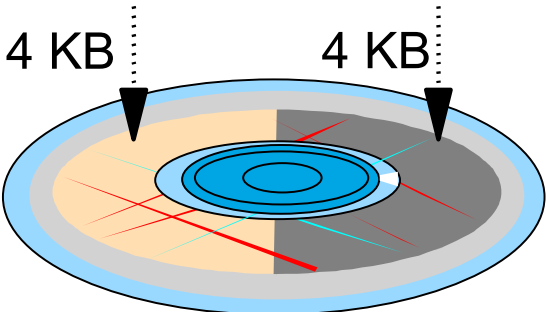
Operating System	Database	TCP/IP	8 MB FREE
------------------	----------	--------	-----------

Current applications  
Total = 248 MB

### RAM Usage

Operating System	Database	TCP/IP	Application
------------------	----------	--------	-------------

New application needs RAM > 8 MB

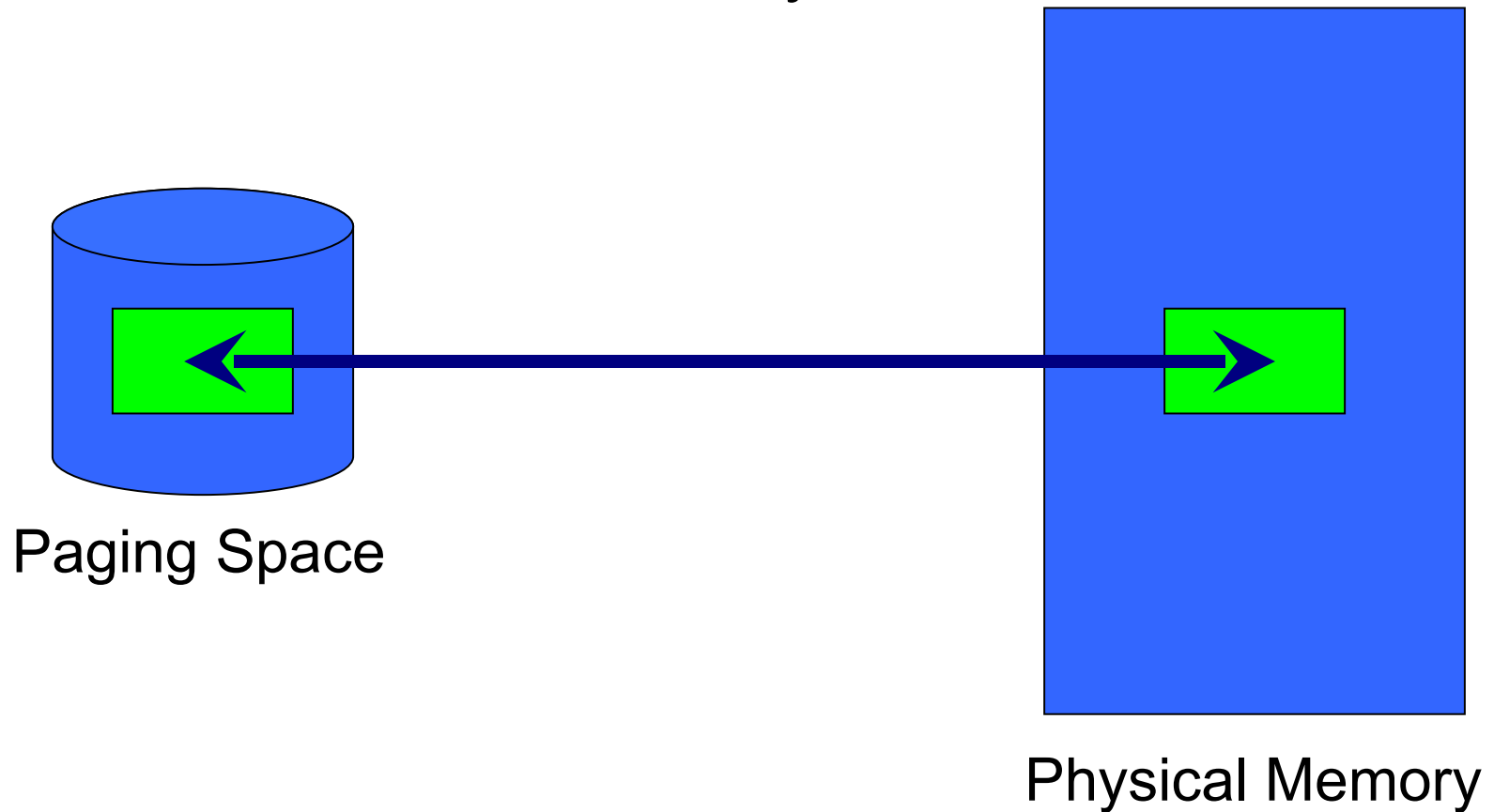


Paging Space

# Paging space

---

- Is a secondary storage area for over-committed memory
- Holds inactive 4 KB pages on disk
- Is not a substitute for real memory



# Sizing paging space

---

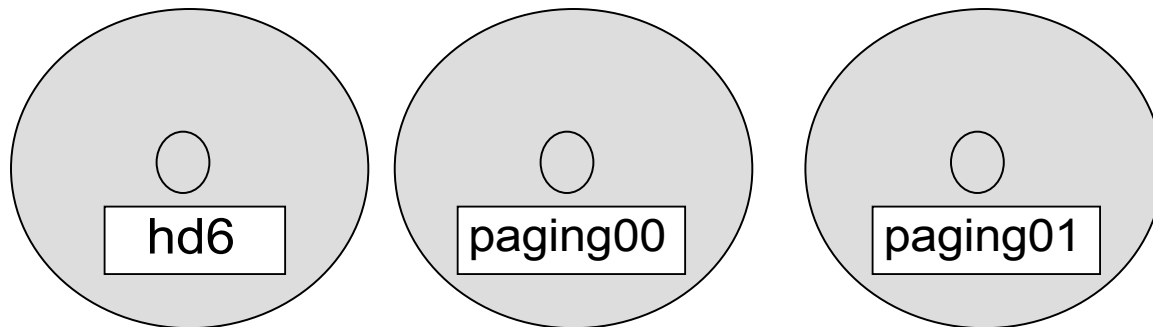
- Created at installation up to twice the size of real memory
- Amount needed is dependent on applications
- Monitor paging space: `lsps -a`
- Running low on paging space is bad

```
#  
ksh: cannot fork no swap space
```

# Paging space placement

---

- Only one paging space per disk
- Use disks with the least activity
- Paging spaces roughly the same size
- Do not extend paging space to multiple physical volumes
- Use multiple disk controllers



# Checking paging space

---

- Check paging activity:

```
# lsps -a
Page Space   Physical Volume   Volume Group   Size   %Used   Active   Auto   Type   checksum
hd6          hdisk0            rootvg         64MB   43      yes      yes    lv     0
paging00    hdisk2            rootvg         64MB   20      yes      yes    lv     0
```

- Check total RAM:

```
# lsattr -El sys0 -a realmem
realmem 262144 Amount of usable physical memory in KB False
```

- Check paging space activated at startup:

```
# cat /etc/swapspaces
...
hd6:
    dev=/dev/hd6
...
paging00:
    dev=/dev/paging00
```



# Adding paging space

```
# smit mkps
```

## Add Another Paging Space

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

```

                                           [Entry Fields]
Volume group name                        rootvg
SIZE of paging space (in logical partitions)  [4]
#
PHYSICAL VOLUME name                     hdisk2      +
Start using this paging space NOW?       no          +
Use this paging space each time the system is
RESTARTED?                               no          +
```

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Change paging space

```
# smit chps
```

Change / Show Characteristics of a Paging Space

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

	[Entry Fields]	
Paging space name	paging00	
Volume group name	rootvg	
Physical volume name	hdisk2	
NUMBER of additional logical partitions	[ ]	#
Or NUMBER of logical partitions to remove	[ ]	#
Use this paging space each time the system is RESTARTED?	yes	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Remove paging space

---

To remove an active paging space:

Make inactive

```
# swapoff /dev/paging00
```

Remove inactive paging space

```
# rmpps paging00
```

**NOTE: /dev/hd6 cannot be removed using this process**

# Problems with paging space

---

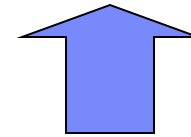
- Paging space too small:

Dynamically increase the size by allocating more partitions

```
chps -s LogicalPartitions PagingSpace
```

Example:

```
# chps -s 1 paging00
```



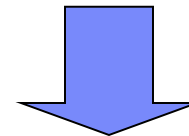
- Paging space too large:

Dynamically decrease the size by deallocating partitions

```
chps -d LogicalPartitions PagingSpace
```

Example:

```
# chps -d 1 paging00
```



# Documenting paging space setup

---

- Run the `lsps` command
- Have a hardcopy of the `/etc/swapspaces` file



**Paging Space Records**

<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input checked="" type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____

# Checkpoint

1. What conclusions regarding potential paging space problems can you reach based on the following listing?

Page Space	Physical Volume	Volume Group	Size	%Used	Active	Auto	Type	chksum
hd6	hdisk0	rootvg	64 MB	43%	yes	yes	lv	0
paging00	hdisk1	rootvg	64 MB	7%	yes	yes	lv	0
paging01	hdisk1	rootvg	16 MB	89%	yes	yes	lv	0

---

---

---

---

---

---

---

---

---

---

- True or False? The size of **paging00** (in the above example) can be dynamically decreased.

# Checkpoint solutions

1. What conclusions regarding potential paging space problems can you reach based on the following listing?

Page Space	Physical Volume	Volume Group	Size	%Used	Active	Auto	Type	chksum
hd6	hdisk0	rootvg	64 MB	43%	yes	yes	lv	0
paging00	hdisk1	rootvg	64 MB	7%	yes	yes	lv	0
paging01	hdisk1	rootvg	16 MB	89%	yes	yes	lv	0

Obviously, it is difficult to come to any conclusions regarding the state of this system just by looking at a snapshot picture like the one above. However, at first glance, the following potential problems can be noticed:

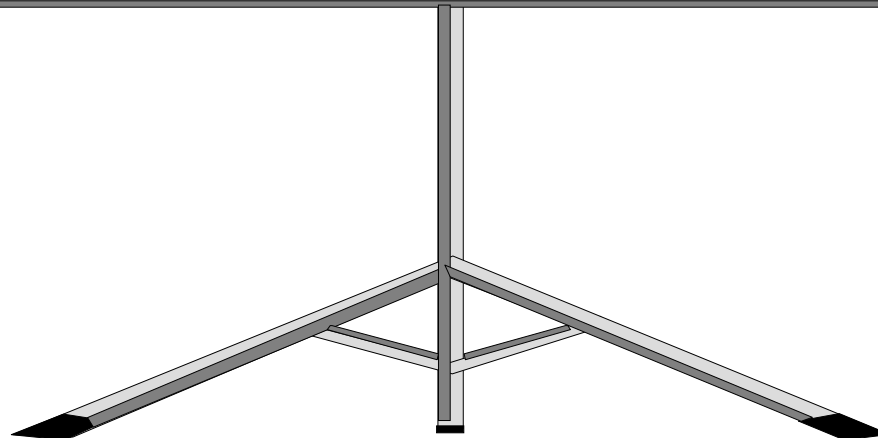
- paging00 is underutilized, and it is too large. It needs to be reduced in size.
  - paging01 is over utilized, and the size seems to be too small. It needs to be increased in size.
  - Both user-defined paging spaces are on the same disk. It would be better if one of them were moved onto a disk which is less utilized.
- True or False? The size of **paging00** (in the above example) can be dynamically decreased.

# Exercise 12: Paging space

---



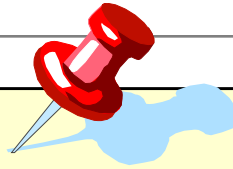
- List paging space
- Add another paging space
- Change the characteristics of a paging space
- Remove paging space





# Unit summary

---



- Paging space is a **requirement** in AIX for the system to boot up. The default paging space is **/dev/hd6**.
- The percent utilization of all the paging spaces should be regularly **monitored** to ensure that the system has the correct amount of page space defined. The **lspcs command** can be used to do this.
- Paging space can be **inactivated** and the **size** can be increased or decreased dynamically.



Welcome to:

# Unit 13

## Backup and Restore



# Unit objectives

After completing this unit, you should be able to:

- Identify issues which have to be considered when deciding which backup policies to implement:
  - Media to be used
  - Frequency of the backup
  - Type of backup
- List the different backup methods supported through SMIT and on the command line
- Create a customized installable system image backup
- Execute other useful commands to manipulate the backed up data on the media

# Why backup?

---

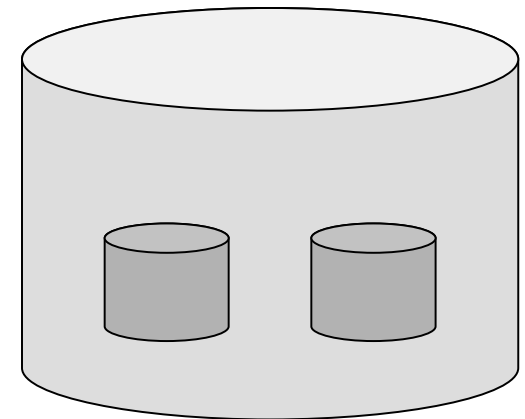
- Data is very important:
  - Expensive to re-create
  - Can it be re-created?
- Disaster recovery:
  - Hardware failure
  - Damage due to installation/repair
  - Accidental deletion
- Transfer of data between systems
- Reorganizing file systems
- Defragmentation to improve performance
- System image for installation
- Checkpoint (before and after upgrade)
- Long term archive

# Types of backup

---

Three types of backup:

- **System**
  - Records image backup of the operating system
- **Full**
  - Preserves all user data and configuration files
- **Incremental**
  - Records changes since previous backups
  - Must be used carefully
  - Very quick

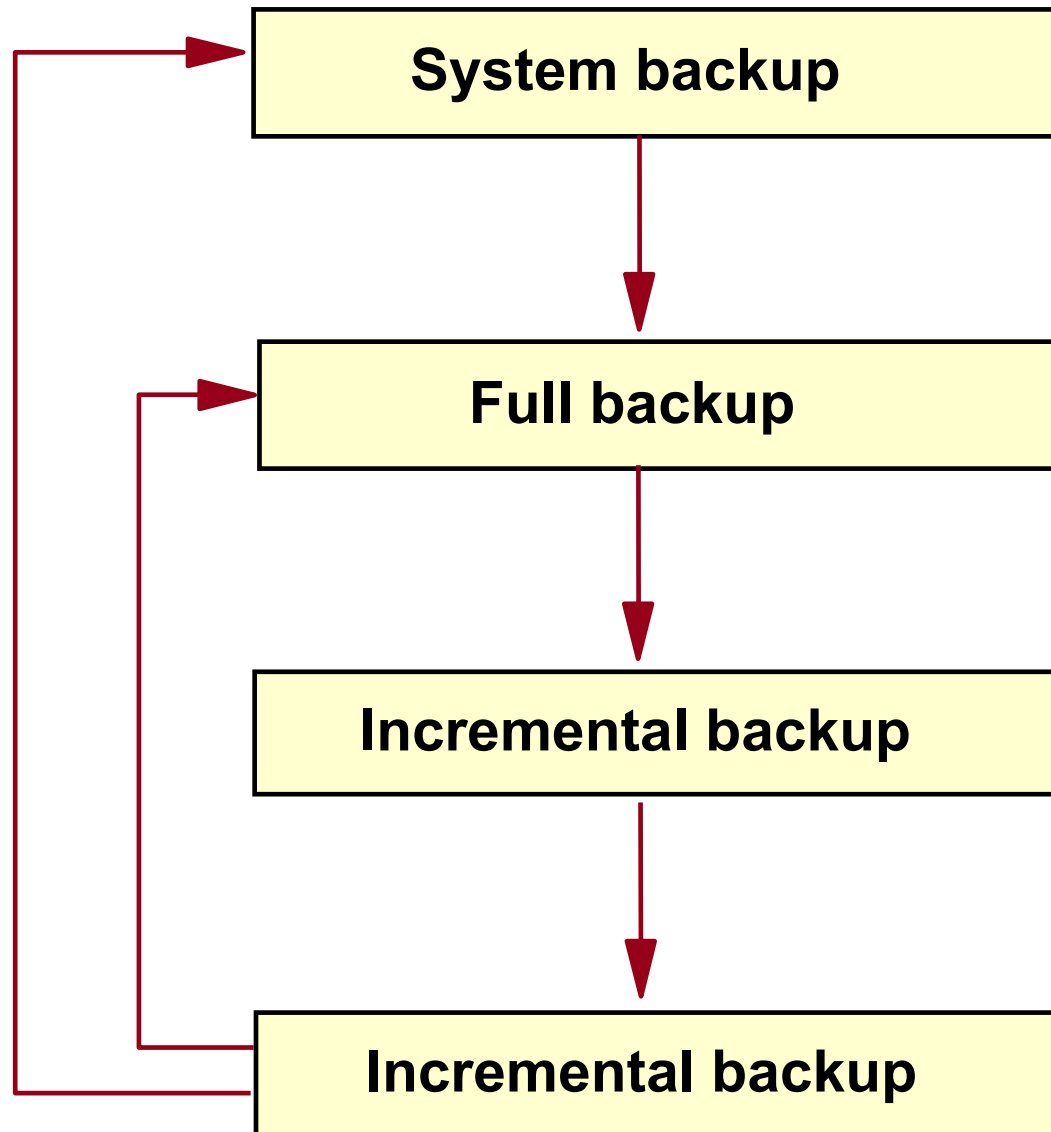


**rootvg**

# Backup strategy

---

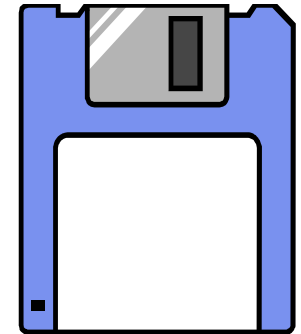
**Backup all data that changes!**



# Backup devices - diskette

**/dev/fd0** - Built in 3 1/2-inch diskette drive

**/dev/fd1** - Second diskette drive

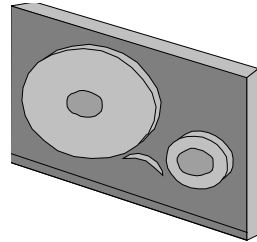


## Drive

	3 1/2-inch (1.44)	3 1/2-inch (2.88)
/dev/fdxl	720 KB	720 KB
/dev/fdxh	1.44 MB	2.88 MB
/dev/fdx.9	720 KB	720 KB
/dev/fdx.18	1.44 MB	1.44 MB
/dev/fdx.36	-	2.88 MB

# Backup devices - tape

- 4 mm DAT
- 8 mm



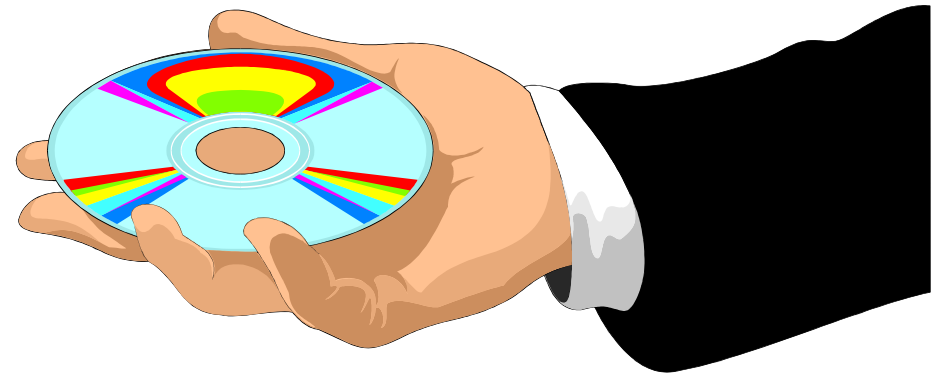
- 1/2 - inch
- DLT
- VXA
- QIC

	Low Capacity	Retension on Open	Rewind on Close
/dev/rmtx	no	no	yes
/dev/rmtx.1	no	no	no
/dev/rmtx.2	no	yes	yes
/dev/rmtx.3	no	yes	no
/dev/rmtx.4	yes	no	yes
/dev/rmtx.5	yes	no	no
/dev/rmtx.6	yes	yes	yes
/dev/rmtx.7	yes	yes	no



# ~~Backup device - read/write optical drive~~

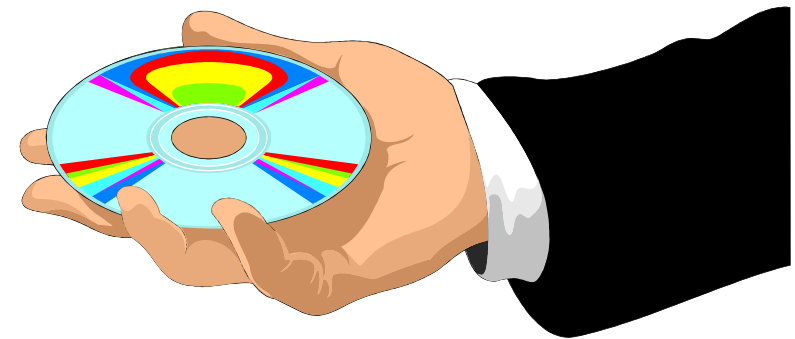
- Use with CD-ROM file system for read only operations
- Use with journal file systems for read/write operation
- For CD:
  - OEM CD-RW drive
  - Third-party CD burn software  
(AIX Toolbox for Linux Applications)
- For DVD:
  - Need 7210 DVD-RAM drive
  - No additional software needed for UDF format



# Backup device – 7210 external DVD-RAM drive

---

- Writes DVD-RAM media
- Reads DVD media in 2.6 GB, 4.7 GB, 5.2 GB, and 9.4 GB
- Supports CD-ROM media in Modes 1 or 2, XA, and CDDA and audio formats
- Reads multi-session disks, CD-R, CD-ROM, and CD-RW disks
- Loading tray accommodates 8 cm and 12 cm media
- SCSI attachable



# SMIT backup menus

## System Storage Management (Physical and Logical)

Logical Volume Manager  
File Systems  
Files and Directories  
System Backup Manager

### File Systems

Back Up a File System  
Restore a File System  
List Contents of a Backup

### Files and Directories

Back Up a File or Directory  
Restore a File or Directory  
List Contents of a Backup

### System Backup Manager

Back Up the System  
Preview Information about a Backup  
Verify the Readability of a Backup  
View the Backup Log  
List Information about Filesets in a System Image  
List Files in a System Image  
Restore Files in a System Image

### Logical Volume Manager

Volume Groups

### Volume Groups

Back Up a Volume Group  
Remake a Volume Group  
List Files in a Volume Group Backup  
Restore Files in a Volume Group Backup

### Back Up the System

Back Up This System to Tape/File  
Back Up This System to CD  
Back Up This System to DVD

### Back Up a Volume Group

Back Up a Volume Group to Tape/File  
Back Up a Volume Group to CD  
Back Up a Volume Group to DVD

# ~~rootvg backup process - mksysb~~

---

- Backs up **rootvg** only
- Unmounted file systems are not backed up
- Bootable tape is created in **backup** format
- Provides facilities for a non-interactive installation
- Saves system-created paging space definitions
- Saves logical volume policies
- There should be minimal user and application activity

# ~~/image.data file for rootvg~~

image data:

```
IMAGE TYPE= bff
DATE TIME= Fri Nov 29 10:23:36 NPT 2007
UNAME INFO= AIX ibm150 2 5 00428DFB4C00
PRODUCT TAPE= no
USERVG LIST=
PLATFORM= chrp
OSLEVEL= 6.1.0.0
CPU ID= 00428DFB4C00
```

logical\_volume\_policy:

```
SHRINK= no
EXACT_FIT= no
```

ils\_data:

```
LANG= en_US
```

**#Command used for vg\_data, /usr/sbin/lsvg**

vg\_data:

```
VGNAME= rootvg
PPSIZE= 16
VARYON= yes
VG SOURCE_DISK_LIST= hdisk0
BIGVG= no
TFACTOR= 1
```

**#Command used for source\_disk\_data: /usr/sbin/bootinfo**

**source\_disk\_data: (stanza is repeated for each disk in rootvg)**

```
PVID=(physical volume id)
LOCATION=(disk location)
SIZE MB=(size of disk in megabytes)
HDISKNAME=(disk name)
```

**#Command used for lv\_data; /usr/sbin/lslv**

**lv\_data: (stanza for each logical volume in rootvg)**

**fs\_data: (stanza for each MOUNTED filesystem in rootvg)**

# ~~/bosinst.data file for rootvg~~

---

## control\_flow:

```
CONSOLE = Default
INSTALL_METHOD = overwrite
PROMPT = yes
EXISTING_SYSTEM_OVERWRITE = yes
INSTALL_X_IF_ADAPTER = yes
RUN_STARTUP = yes
RM_INST_ROOTS = no
ERROR_EXIT =
CUSTOMIZATION_FILE =
TCB = no
INSTALL_TYPE =
BUNDLES =
RECOVER_DEVICES = Default
BOSINST_DEBUG = no
ACCEPT_LICENSES =
DESKTOP = CDE
INSTALL_DEVICES_AND_UPDATES = yes
IMPORT_USER_VGS =
ENABLE_64BIT_KERNEL = no
CREATE_JFS2_FS = no
ALL_DEVICES_KERNELS = yes
(some bundles ....)
```

## target\_disk\_data:

```
LOCATION =
SIZE_MB =
HDISKNAME =
```

## locale:

```
BOSINST_LANG =
CULTURAL_CONVENTION =
MESSAGES =
KEYBOARD =
```

# rootvg - Back Up the System

```
# smit sysbackup
```

## Back Up the System

Move cursor to desired item and press Enter.

Back Up This System to Tape/File

Back Up This System to CD

Create a Generic Backup CD or DVD

Back Up This System to DVD

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# ~~rootvg - Back Up This System to Tape/File~~

```
# smit mksysb
```

## Back Up This System to Tape/File

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

[Entry Fields]

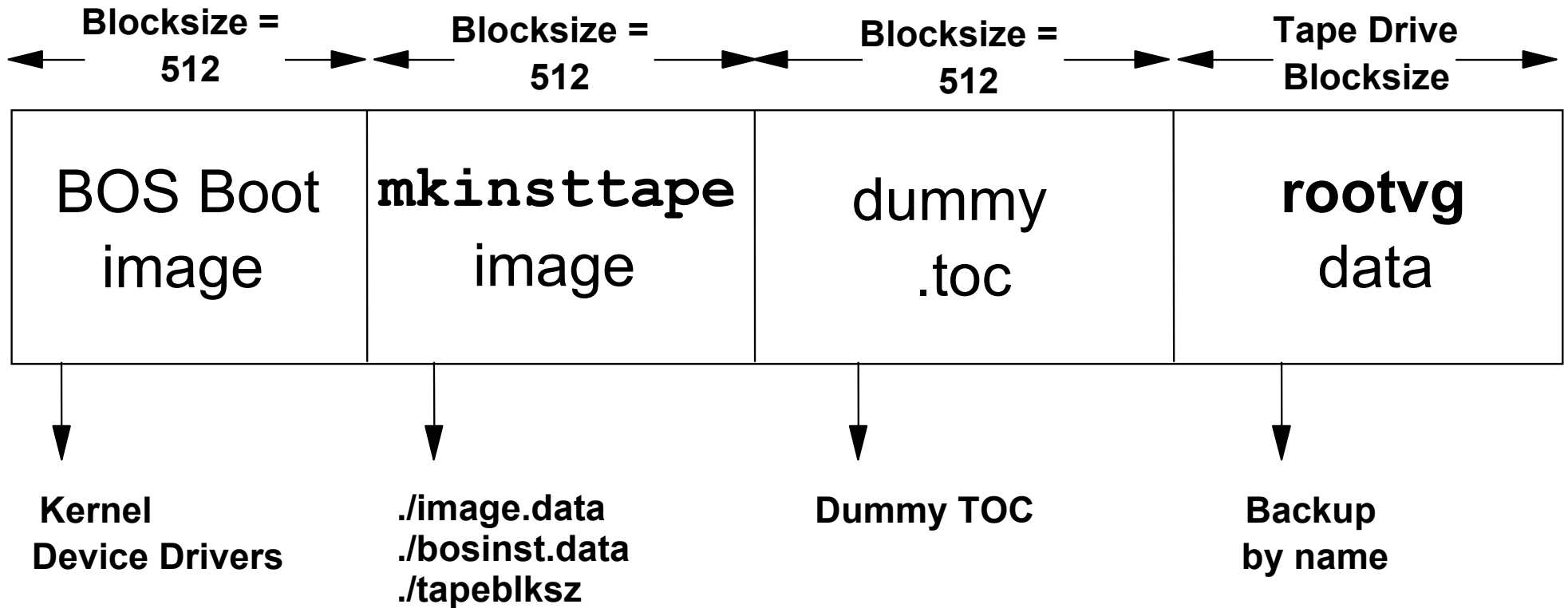
WARNING: Execution of the mksysb command will result in the loss of all material previously stored on the selected output medium. This command backs up only rootvg volume group.

* Backup DEVICE or FILE	[ ]	+ /
Create MAP files?	no	+
EXCLUDE files?	no	+
List files as they are backed up?	no	+
Verify readability if tape device?	no	+
Generate new /image.data file?	yes	+
EXPAND /tmp if needed?	no	+
Disable software packing of backup?	no	+
Backup extended attributes?	yes	+
Number of BLOCKS to write in a single output (Leave blank to use a system default	[ ]	#
Location of existing mksysb image	[ ]	/
File system to use for temporary work space (If blank, /tmp will be used.)	[ ]	/
Backup encrypted files?	yes	+
Back up DMAPI filesystem files?	yes	+

[BOTTOM]



# ~~mksysb~~ image



# Back Up a Volume Group

```
# smit vgbackup
```

## Back Up a Volume Group

Move cursor to desired item and press Enter.

Back Up a Volume Group to Tape/File

Back Up a Volume Group to CD

Back Up a Volume Group to DVD

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Back Up a Volume Group to Tape/File

```
# smit savevg
```

## Back Up a Volume Group to Tape/File

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

[Entry Fields]

WARNING: Execution of the savevg command will  
result in the loss of all material  
previously stored on the selected  
output medium.

* Backup DEVICE or FILE	[ ]	+/
* VOLUME GROUP to back up	[ ]	+
List files as they are backed up?	no	+
Generate new vg.data file?	yes	+
Create MAP files?	no	+
EXCLUDE files?	no	+
EXPAND /tmp if needed?	no	+
Disable software packing of backup?	no	+
Backup extended attributes?	yes	+
Number of BLOCKS to write in a single output (Leave blank to use a system default)	[ ]	#
Verify readability if tape device	no	+
Backup Volume Group information files only?	no	+
Backup encrypted files?	yes	+
Back up DMAPI filesystem files?	yes	+

[BOTTOM]

# Restoring a mksysb (1 of 2)

- Boot the system in install/maintenance mode:

## Welcome to Base Operating System Installation and Maintenance

- ```
>> 1 Start Install Now With Default Settings
    2 Change/Show Installation Settings and Install
    3 Start Maintenance Mode for System Recovery
    4 Configure Network Disks (iSCSI)
```



## Maintenance

- ```
>> 1 Access A Root Volume Group
    2 Copy a System Dump to Removable Media
    3 Access Advanced Maintenance Functions
    4 Erase Disks .....
    6 Install from a System Backup
```



## Choose Tape Drive

- |      | Tape Drive        | Path Name |
|------|-------------------|-----------|
| >> 1 | tape/scsi/4mm/2GB | /dev/rmt0 |

# Restoring a mksysb (2 of 2)

## Welcome to Base Operating System Installation and Maintenance

Type the number of your choice and press Enter. Choice is indicated by >>.

- |    |   |   |
|----|---|---|
|    | 1 | Start Install Now With Default Settings       |
| >> | 2 | Change/Show Installation Settings and Install |
|    | 3 | Start Maintenance Mode for System Recovery    |
|    | 4 | Configure Network Disks (iSCSI)               |

## System Backup Installation and Settings

Type the number of your choice and press Enter.

- |   |  |        |
|---|--|--------|
| 1 | Disk(s) where you want to install      | hdisk0 |
| 2 | Use Maps                               | No     |
| 3 | Shrink Filesystems                     | No     |
| 0 | Install with the settings listed above |        |

# Remake/Restore a non-rootvg volume

## group

### # smit restvg

#### Remake a Volume Group

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

	[Entry Fields]	
* Restore DEVICE or FILE	[/dev/rmt0]	+/
SHRINK the filesystems?	no	+
Recreate logical volumes and filesystems only	no	+
PHYSICAL VOLUME names	[ ]	+
(Leave blank to use the PHYSICAL VOLUMES listed in the vgname.data file in the backup image)		
Use existing MAP files?	yes	+
Physical partition SIZE in megabytes	[ ]	+#
(Leave blank to have the SIZE determined based on disk size)		
Number of BLOCKS to read in a single input	[ ]	#
(Leave blank to use a system default)		
Alternate vg.data file	[ ]	/
(Leave blank to use vg.data stored in backup image)		

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

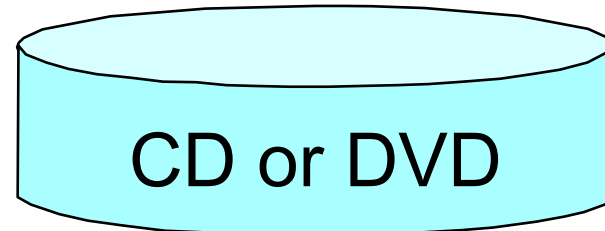
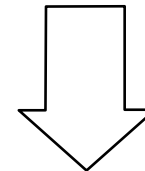
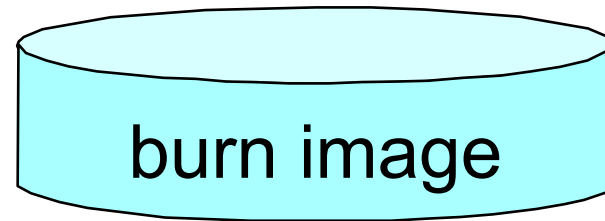
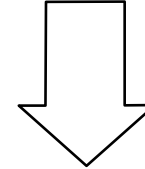
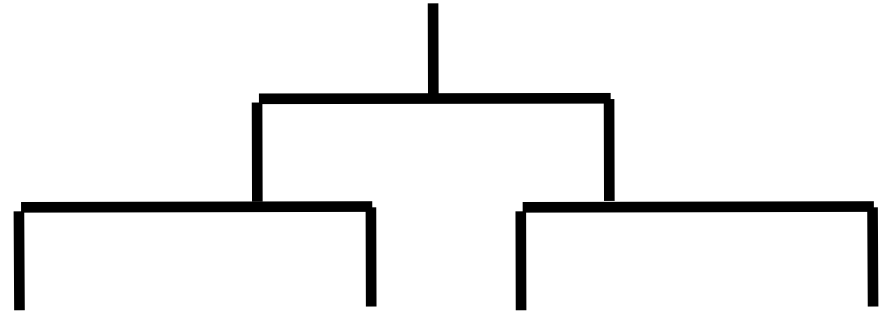
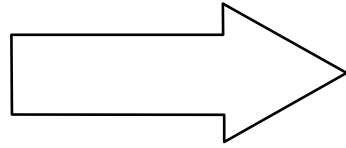
F9=Shell

F10=Exit

Enter=Do

# ~~mksysb - ISO9660 burn image~~

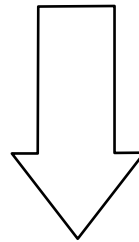
mksysb image  
packages  
bundle file  
cust script  
bosinst.data  
image.data



# ~~mksysb~~ - UDF DVD

---

mksysb image  
packages  
bundle file  
cust script  
bosinst.data  
image.data



UDF DVD  
File system



# rootvg - Back Up This System to CD (ISO9660)

```
# smit mkcd
```

## Back Up This System to CD

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

	[Entry Fields]	
CD-R Device	[]	+
mkysyb creation options:		
Create map files?	no	+
Exclude files?	no	+
Disable software packing of backup?	no	+
Backup extended attributes?	yes	+
File system to store mkysyb image	[]	/
File system to store CD file structure	[]	/
File system to store final CD images	[]	/
If file systems are being created:		
Volume Group for created file systems	[rootvg]	+
Advanced Customization Options:		
Do you want the CD to be bootable?	yes	+
Remove final images after creating CD?	yes	+
Create the CD now?	yes	+
Install bundle file	[]	/
File with list of packages to copy to CD	[]	/
Location of packages to copy to CD	[]	+/
Customization script	[]	/
User supplied bosinst.data file	[]	/
Debug output?	no	+
User supplied image.data file	[]	/
Backup encrypted files?	yes	
Back up DMAPI filesystem files?	Yes	

[BOTTOM]

# rootvg - Back Up This System to ISO9660 DVD

# `smit mkdvd` -> Select 1 ISO9660 (CD format)

## Back Up This System to ISO9660 DVD

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

	[Entry	Fields]
DVD-R or DVD-RAM Device	[ ]	+
mkysyb creation options:		
Create map files?	no	+
Exclude files?	no	+
Disable software packing of backup?	no	+
Backup extended attributes?	yes	+
File system to store mkysyb image	[ ]	/
File system to store DVD file structure	[ ]	/
File system to store final DVD images	[ ]	/
If file systems are being created:		
Volume Group for created file systems	[rootvg]	+
Advanced Customization Options:		
Do you want the DVD to be bootable?	yes	+
Remove final images after creating DVD?	yes	+
Create the DVD now?	yes	+
Install bundle file	[ ]	/
File with list of packages to copy to DVD	[ ]	/
Location of packages to copy to DVD	[ ]	+/
Customization script	[ ]	/
User supplied bosinst.data file	[ ]	/
Debug output?	no	+
User supplied image.data file	[ ]	/
Backup encrypted files?	yes	+
Back up DMAPI filesystem files?	yes	+

[BOTTOM]

# ~~rootvg - Back Up This System to UDF DVD~~

# `smit mkdvd` -> Select 2 UDF (Universal Disk Format)

## Back Up This System to UDF DVD

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

	[Entry Fields]	
DVD-RAM Device	[ ]	+
mkysyb creation options:		
Create map files?	no	+
Exclude files?	no	+
Disable software packing of backup?	no	+
Backup extended attributes?	yes	+
File system to store mkysyb image (If blank, the file system will be created for you.)	[ ]	/
If file system is being created:		
Volume Group for created file system	[rootvg]	+
Advanced Customization Options:		
Do you want the DVD to be bootable?	yes	+
Install bundle file	[ ]	/
File with list of packages to copy to DVD	[ ]	/
Location of packages to copy to DVD	[ ]	+/
Customization script	[ ]	/
User supplied bosinst.data file	[ ]	/
Debug output?	no	+
User supplied image.data file	[ ]	/
Backup encrypted files?	Yes	+
Back up DMAPI filesystem files?	yes	+

[BOTTOM]

# Back Up a Volume Group to CD

```
# smit savevgcd
```

## Back Up a Volume Group to CD

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

```

                                     [Entry Fields]
CD-R Device                          []          +
* Volume Group to back up            []          +

savevg creation options:
  Create map files?                   no         +
  Exclude files?                      no         +
  Disable software packing of backup? no         +
  Backup extended attributes?         yes        +

File system to store savevg image     []          /
File system to store CD file structure []          /
File system to store final CD images  []          /
If file systems are being created:
  Volume Group for created file systems [rootvg]  +

Advanced Customization Options:
Remove final images after creating CD? yes        +
Create the CD now?                    yes        +
Debug output?                          no         +
Backup Volume Group information files only? no        +
Backup encrypted files?                Yes         +
Back up DMAPI filesystem files?        yes         +

[BOTTOM]
```

```
F1=Help
F5=Reset
F9=Shell
```

```
F2=Refresh
F6=Command
F10=Exit
```

```
F3=Cancel
F7=Edit
Enter=Do
```

```
F4=List
F8=Image
```

# Back Up a Volume Group to ISO9660 DVD

```
# smit savevgdvd
```

## Back Up a Volume Group to ISO9660 DVD

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

[Entry Fields]

DVD-R or DVD-RAM Device	[ ]	+
* Volume Group to back up	[ ]	+
savevg creation options:		
Create map files?	no	+
Exclude files?	no	+
Disable software packing of backup?	no	+
Backup extended attributes?	yes	+
File system to store savevg image	[ ]	/
File system to store DVD file structure	[ ]	/
File system to store final DVD images	[ ]	/
If file systems are being created:		
Volume Group for created file systems	[rootvg]	+
Advanced Customization Options:		
Remove final images after creating DVD?	yes	+
Create the DVD now?	yes	+
Debug output?	no	+
Backup encrypted files?	yes	+
Back up DMAPI filesystem files?	yes	+

[BOTTOM]

F1=Help  
F5=Reset  
F9=Shell

F2=Refresh  
F6=Command  
F10=Exit

F3=Cancel  
F7=Edit  
Enter=Do

F4=List  
F8=Image

# Back Up a Volume Group to UDF DVD

```
# smit savevgdvd
```

## Back Up a Volume Group to ISO9660 DVD

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

[Entry Fields]

DVD-RAM Device	[ ]	+
* Volume Group to back up	[ ]	+
savevg creation options:		
Create map files?	no	+
Exclude files?	no	+
Disable software packing of backup?	no	+
Backup extended attributes?	yes	+
File system to store savevg image (If blank, the file system will be created for you.)	[ ]	/
If file systems are being created:		
Volume Group for created file systems	[rootvg]	+
Advanced Customization Options:		
Debug output?	no	+
Backup Volume Group information files only?	no	+
Backup encrypted files?	yes	+
Back up DMAPI filesystem files?	yes	+

[BOTTOM]

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

# Exercise 13: Using backup and restore (part 1)

---

- 
- A whiteboard with a silver frame and a tripod stand. The whiteboard surface is white and contains a single bullet point. The stand has three legs and a central vertical post.
- Part 1 - Using SMIT to backup a non-rootvg volume group

# Back up by filename

---

```
backup -i [-q] [-v] [-p] [-U] [-Z] [-f device]
```

- q Media is ready
- v Verbose - display filenames during backup
- p Pack files which are less than 2 GB
- U Specifies to backup any ACLs
- Z Backs up the Encrypted File System (EFS)

Filenames are read from standard input



# Back up by filename examples

- Example 1: Read input from a file

```
# cat listfile
/home/roy/file1
/home/roy/file2
/home/roy/file3
# backup -iqvf /dev/rmt0 < listfile
```

- Example 2: Use `find` to generate list

```
# find /home/roy | backup -iqvf /dev/rmt0
# cd /home/roy
# find . | backup -iqvf /dev/rmt0
```

Relative versus full filenames will impact location of files on recovery!

# Backup a File or Directory

```
# smit backfile
```

## Backup a File or Directory

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

	[Entry Fields]	
This option will perform a backup by name.		
* Backup DEVICE	[/dev/fd0]	+/
* FILE or DIRECTORY to backup	[.]	
Current working DIRECTORY	[ ]	/
Backup LOCAL files only?	yes	+
VERBOSE output?	no	+
PACK files?	no	+
Backup extended attributes?	yes	+
Back up EFS Attributes?	Yes	+

F1=Help  
F5=Reset  
F9=Shell

F2=Refresh  
F6=Command  
F10=Exit

F3=Cancel  
F7=Edit  
Enter=Do

F4=List  
F8=Image

# Back up a file system by inode

Syntax:

```
backup [-u] [-level] [-f device] filesystem
```

- Levels provide incremental backups:
  - 0 Full file system back up
  - 1, -2, etc Backup changes since *level* -1
  - u Updates **/etc/dumpdates**  
( **/etc/dumpdates** contains a backup history)

```
# backup -u -1 -f /dev/rmt0 /home
```

# Incremental backup example

Sun	Mon	Tue	Wed	Thur	Fri	Sat
					1 <b>level 0</b>	2
3	4 <b>level 6</b>	5 <b>level 6</b>	6 <b>level 6</b>	7 <b>level 6</b>	8 <b>level 3</b>	9
10	11 <b>level 6</b>	12 <b>level 6</b>	13 <b>level 6</b>	14 <b>level 6</b>	15 <b>level 0</b>	16
17	18 <b>level 6</b>	19 <b>level 6</b>	20 <b>level 6</b>	21 <b>level 6</b>	22 <b>level 3</b>	23
24	25 <b>level 6</b>	26 <b>level 6</b>	27 <b>level 6</b>	28 <b>level 6</b>	29 <b>level 0</b>	30
31						

# Back up a file system by inode using SMIT

```
# smit backfilesys
```

## Backup a Filesystem

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

	[Entry Fields]	
This option will perform a backup by inode.		
* FILESYSTEM to backup	[ ]	+/
* Backup DEVICE	[/dev/fd0]	+/
Backup LEVEL (0 for a full backup)	[0]	#
RECORD backup in /etc/dumpdates?	no	+
* Backup extended attributes?	yes	+
* Backup EFS attributes?	yes	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# ~~restore command (1 of 2)~~

---

- List files on media (verify the backup):

```
restore -T [-q] [-v] [-f device]
```

```
# restore -Tvf /dev/rmt0
```

- Restore individual files:

```
restore -x [-q] [-v] [-f device] [file1 file2 ..]
```

```
# restore -xvf /dev/rmt0/home/mike/manual/chap1
```

- Restore complete file system:

```
restore -r [-q] [-v] [-f device]
```

Restore backups in order, that is, -0 then -1 and so forth

```
# restore -rqvf /dev/rmt0
```

# ~~restore command (2 of 2)~~

---

- Restores the file attributes without restoring the file contents:

```
restore -Pstring [-q] [-v] [-f device] [file1 file2 ...]
```

*string* can be:

- A** Restore all attributes
- a** Restore only the permissions of the file
- o** Restore only the ownership of the file
- t** Restore only the timestamp of the file
- c** Restore only the ACL attributes of the file

- To restore only the permissions of the file **/etc/passwd** from the archive:

```
# restore -Pa -vf /dev/rmt0 ./etc/passwd
```

- To display only the permissions of the file **/etc/passwd** on the archive:

```
# restore -Ta -vf /dev/rmt0 ./etc/passwd
```

# Restore a File or Directory

```
# smit restfile
```

## Restore a File or Directory

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

	[Entry Fields]	
* Restore DEVICE	[/dev/fd0]	+ /
* Target DIRECTORY	[.]	/
FILE or DIRECTORY to restore (Leave blank to restore entire archive.)	[ ]	
VERBOSE output?	no	+
Number of BLOCKS to read in a single input operation	[ ]	#
Restore Extended Attributes?	yes	+

F1=Help  
F5=Reset  
F9=Shell

F2=Refresh  
F6=Command  
F10=Exit

F3=Cancel  
F7=Edit  
Enter=Do

F4=List  
F8=Image



# Exercise 13: Using backup and restore

## (parts 2, 3 and 4)



- Part 2 - Prepare the file system for backup/restore
- Part 3 - Backup and restore by inode (file system)
- Part 4 - Backup and restore by name

# Other UNIX backup commands

---

- **tar** (tape archive)
  - Widely available
  - Good for transfer of data between platforms
- **cpio** (copy input to output)
  - Widely available
  - Difficulties can occur with many symbolic links
- **dd** (device to device)
  - Makes backup copies that are an exact image
  - Can also be used for conversions
    - For example: can convert ASCII to EBCDIC

# The tar command

---

- Generate a tar backup:

```
# tar -cvf /dev/rmt0.3 /home
```

- Restore a file from a tar image:

```
# tar -xvf /dev/rmt0 /home/team01/mydir
```

- List (verify) content of a tar file:

```
# tar -tvf /dev/rmt0
```

# The `cpio` command

---

- Generate a `cpio` backup:

```
# find /home | cpio -ov> /dev/rmt0
```

- Restore from a `cpio` image:

```
# cpio -idv </dev/rmt0
```

- List (verify) the contents of a `cpio` image:

```
# cpio -itv < /dev/rmt0
```

# The dd command

---

- The `dd` command converts and copies files
- To copy a file to diskette

```
# dd if=/etc/inittab of=/dev/rfd0
```

- To convert a file from ASCII to EBCDIC

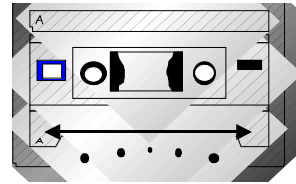
```
# dd if=text.ascii of=text.ebcdic conv=ebcdic
```

- To convert data to uppercase characters

```
# cat lcase.data | dd conv=ucase
```

# Controlling the tape

tctl	{	<b>rewind</b>	Rewinds a tape
		<b>fsf</b>	Fast forwards a tape
		<b>offline</b>	Ejects a tape
		<b>rewoffl</b>	Rewinds and ejects a tape



```
# tctl -f /dev/rmt0 rewind
# tctl -f /dev/rmt0.1 fsf 3
# tctl -f /dev/rmt0 rewoffl
```

**restore -s**

```
# restore -s 4 -xvf /dev/rmt0.1 ./etc/inittab
```

# Good practices

---

- Verify your backups
- Check the tape device
- Keep old backups
- Offsite secure storage
- Label tape
- Test recovery procedures before you have to!



# Checkpoint

1. What is the difference between the following two commands?
- a) `find /home/fred | backup -ivf /dev/rmt0`
  - b) `cd /home/fred; find . | backup -ivf /dev/rmt0`

---

---

---

- On a `mksysb` tape, if you entered `tctl rewind` and then `tctl -f/dev/rmt0.1 fsf 3`, which element on the tape could you look at?

---

---

- Which command could you use to restore these files?

---

6. True or False? `smit mksysb` backs up all file systems, provided they are mounted. \_\_\_\_\_

---



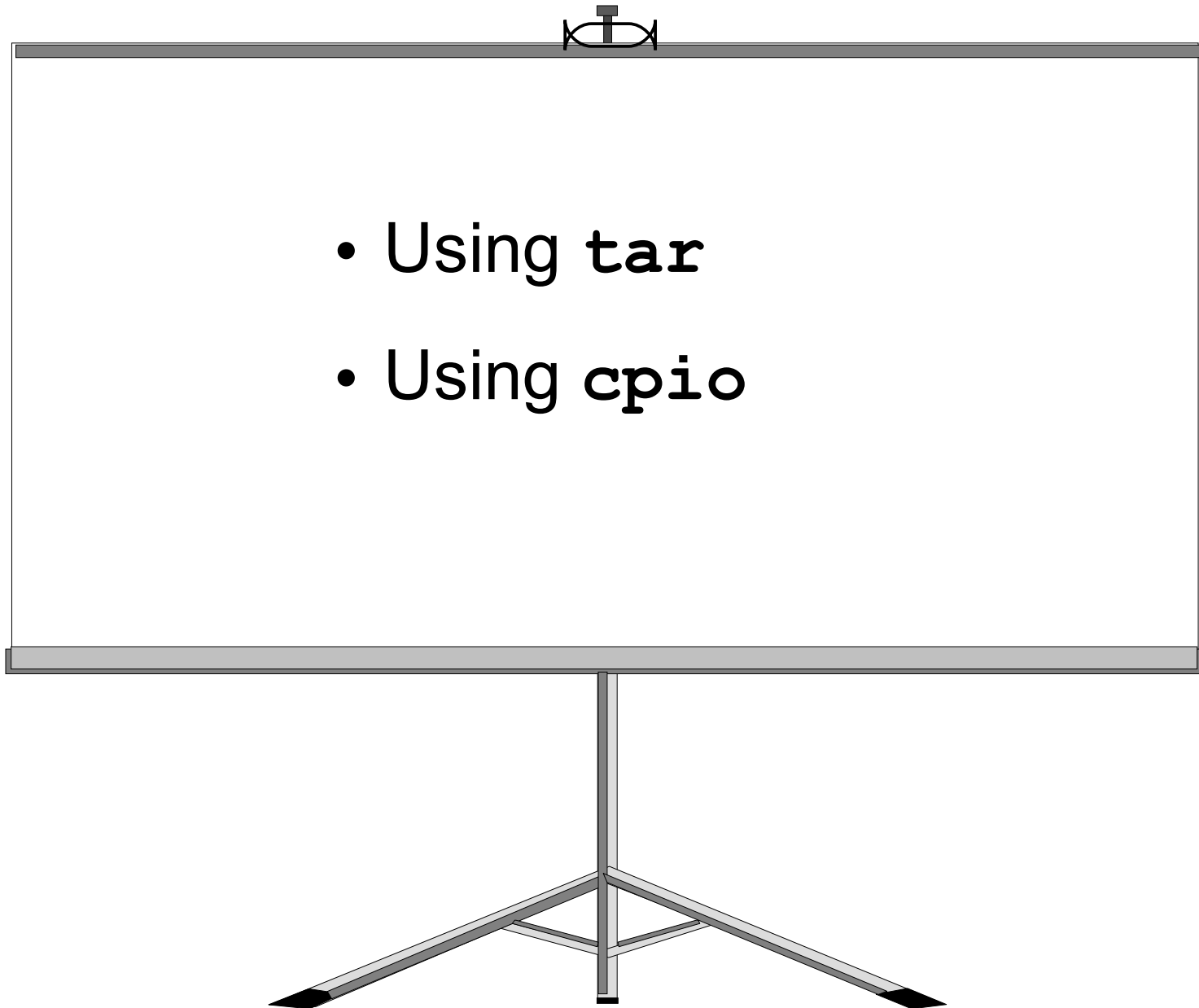
# Checkpoint solutions

1. What is the difference between the following two commands?
  - a) `find /home/fred | backup -ivf /dev/rmt0`
  - b) `cd /home/fred; find . | backup -ivf /dev/rmt0`

(a) backs up the files using the full path names, whereas (b) backs up the file names using the relative path names. So (b)'s files can be restored into any directory.
- On a `mksysb` tape, if you entered `tctl rewind` and then `tctl -f/dev/rmt0.1 fsf 3`, which element on the tape could you look at?

You would be at the start of the backed up images of the files, having skipped over the boot portion of the tape.
- Which command could you use to restore these files? The files were backed up using the `backup` command so you would have to use the `restore` command.
6. True or **False**? `smit mksysb` backs up all file systems, provided they are mounted. `mksysb` only backs up `rootvg` file systems. To back up other volume groups, you must use the `savevg` command.

# ~~Exercise 14: (optional) Using tar and cpio~~



# Unit summary



- In order to perform successful backups, consideration must be given to the frequency of the backup, the media to be used and the type of backup.
- Backups can be initiated on a single file, a file system or an entire volume group, all of which are supported through SMIT.
- By modifying the **bosinst.data** and the **image.data** files, a customized system image backup can be created.
- There are many other UNIX backup commands which can be used, however their limitations must be fully understood. The commands include: **tar**, **cpio** and **dd**.
- Other useful commands also exist to manipulate the data on the backup media such as **tctl**.



# Unit 14

## Security and user administration



# Unit objectives

---

After completing this unit, you should be able to:

- Define the concepts of users and groups, and explain how and when these should be allocated on the system
- Describe ways of controlling root access on the system
- Explain the uses of SUID, SGID, and SVTX permission bits
- Administer user accounts and groups
- Identify the data files associated with users and security

# User accounts

---

- Each user has a unique name, numeric ID, and password
- File ownership is determined by a numeric user ID
- The owner is usually the user who created the file, but ownership can be transferred by **root**
- Default users:
  - **root** Superuser
  - **adm, sys, bin, ...** IDs that own system files but cannot be used for login

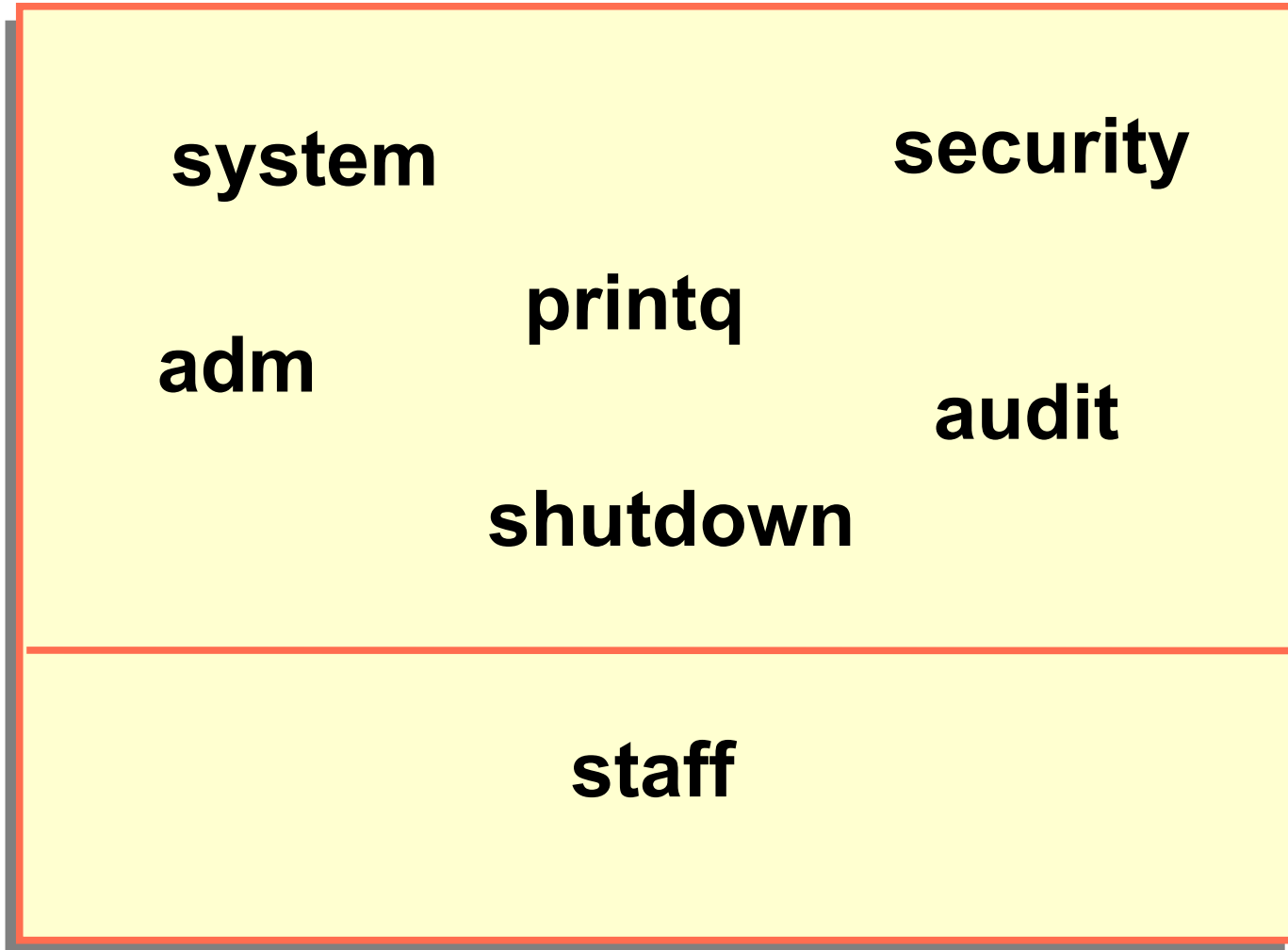
# Groups

---

- A group is a set of users, all of whom need access to a given set of files.
- Every user is a member of at least one group and can be a member of several groups.
- The user has access to a file if any group in the user's groupset provides access. To list the groupset, use the **groups** command.
- The user's real group ID is used for file ownership on creation. To change the real group ID, use the **newgrp** command.
- Default groups:
  - System administrators: **system**
  - Ordinary users: **staff**

# Group hierarchy

---



Rights to  
administrative  
functions

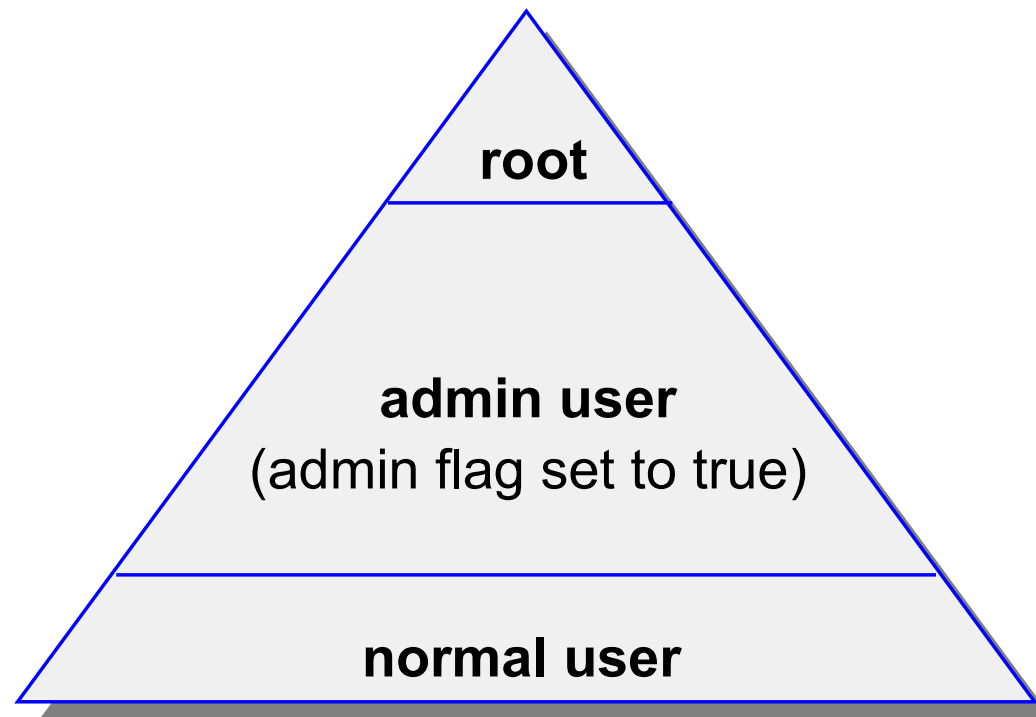
Ordinary  
user



# User hierarchy

---

- To protect important users and groups from members of the **security** group, AIX has **admin users** and **admin groups**
- Only **root** can add, remove, or change an **admin user** or **admin group**
- Any user on the system can be defined as an **admin user** regardless of the group they are in



# Controlling access to the root account

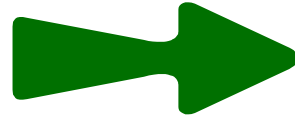
---

- Restrict access to privileged logins
- **root**'s passwords should be changed on an unannounced schedule by the system administrator
- Assign different **root** passwords to different machines
- System administrators should always login as themselves first and then **su** to **root** instead of logging in as **root**. This helps provide an audit trail for **root** usage
- Do not include unsecured directories in **root**'s **PATH**

# Security logs

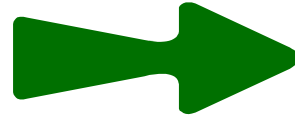
---

**`/var/adm/sulog`**



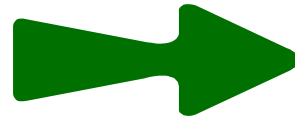
Audit trail of **su** activity

**`/var/adm/wtmp`**



Log of successful logins

**`/etc/utmp`**



List of users currently  
logged in

**`/etc/security/failedlogin`**

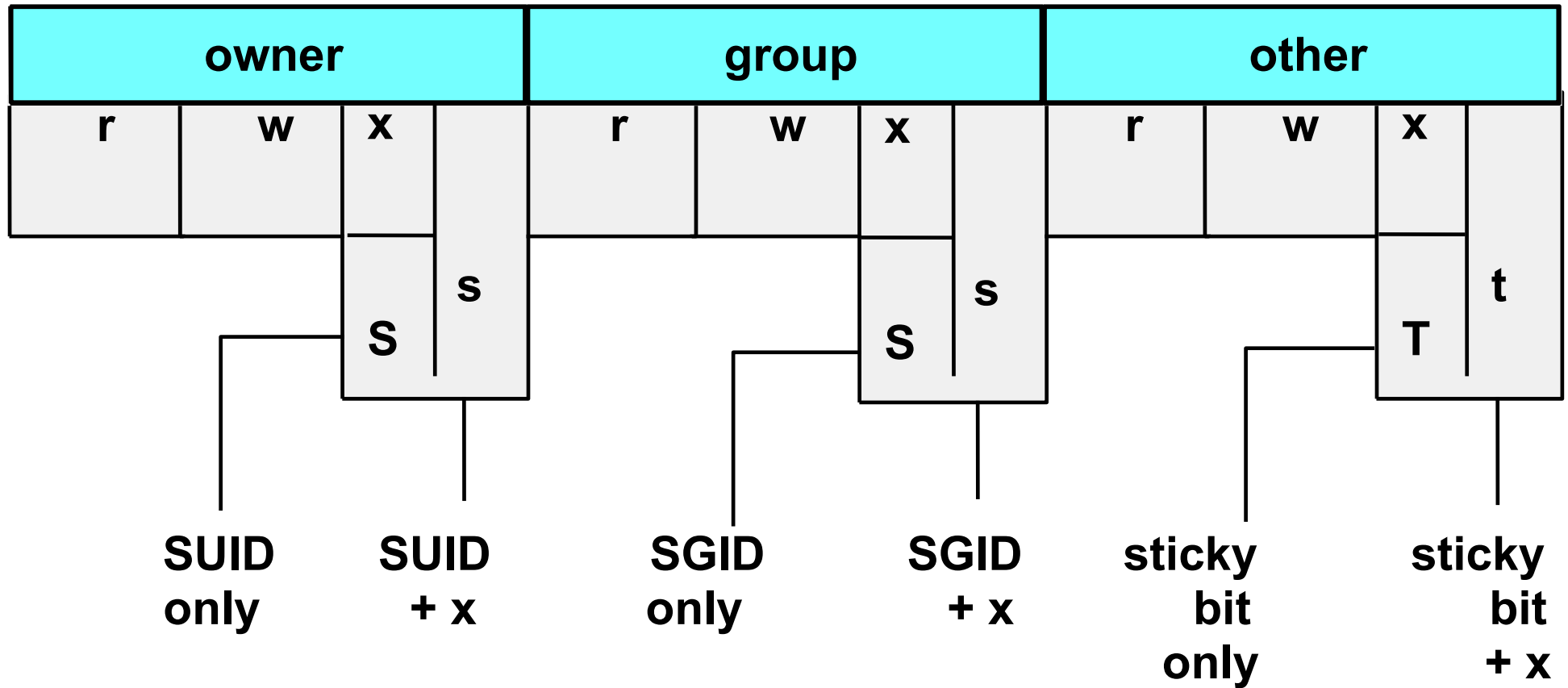


Information on fail  
login attempts

# File/Directory permissions

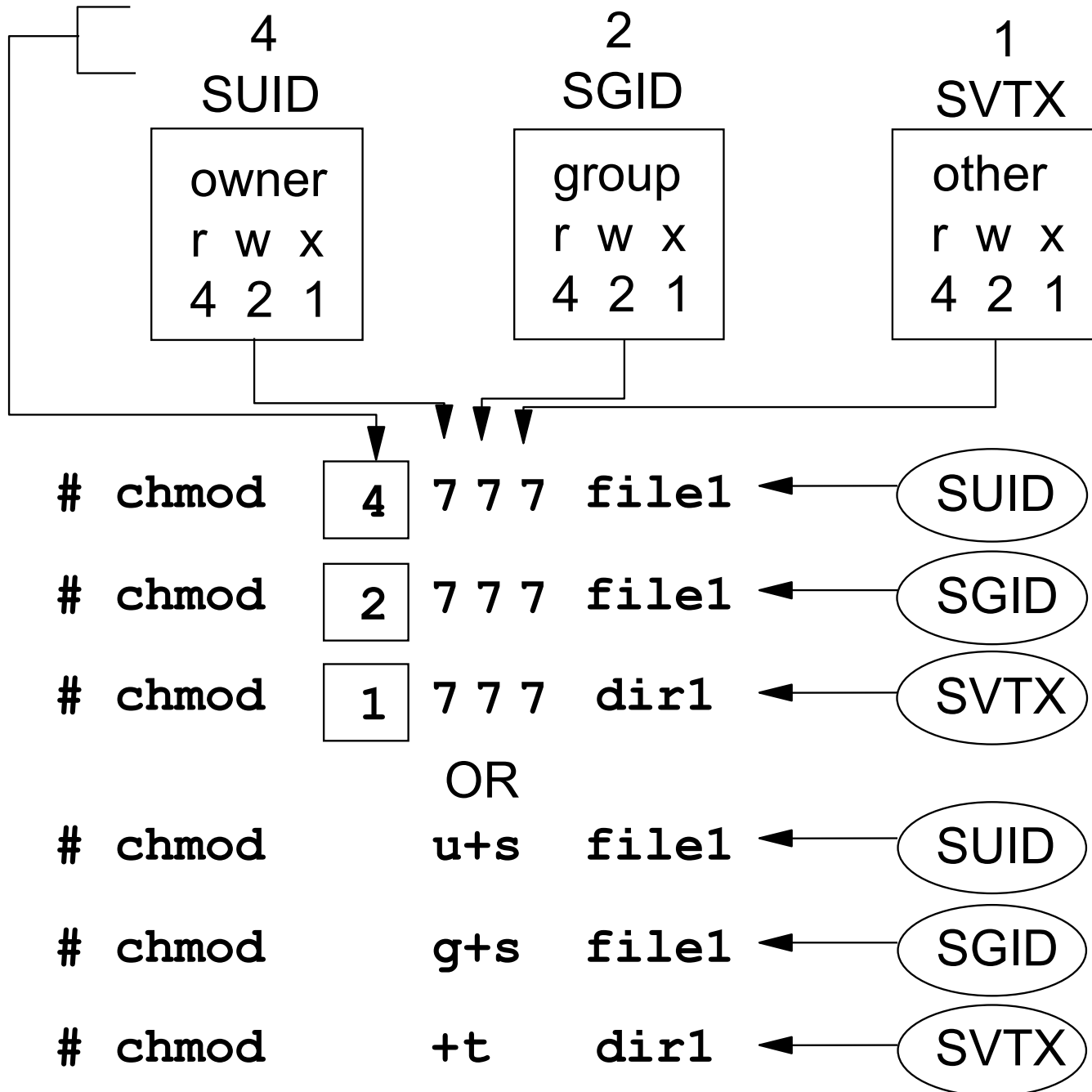
File	Perm. Bit	Directory
Read content of file	r	List content of directory
Modify content of file	w	Create and remove files in directory
Use file name to execute as a command	x	Give access to directory
Run program with effective UID of owner	SUID	-----
Run program with effective GID of group	SGID	Files created in directory inherit the same group as the directory
-----	SVTX	Must be owner of files to delete files from directory

# Reading permissions



```
# ls -ld /usr/bin/passwd /usr/bin/crontab /tmp
-r-sr-xr-x root security ... /usr/bin/passwd
-r-sr-sr-x root cron ... /usr/bin/crontab
drwxrwxrwt bin bin ... /tmp
```

# Changing permissions



# umask

---

- The **umask** governs permissions on new files and directories
- System default **umask** is 022
- A **umask** of 027 is recommended
- If the **umask** value is set to 022, then any ordinary files or directories created inherit the following permissions:
  - Ordinary file: `rw-r--r--`
  - Directory: `rwxr-xr-x`
- **/etc/security/user** specifies default and individual user **umask** values

# Changing ownership

---

The `chown` command:

```
# chown fred file1
```

The `chgrp` command:

```
# chgrp staff file1
```

Changing both user and group ownership:

```
# chown fred:staff file1  
# chown fred.staff file1
```



# Role based access control (RBAC)

---

- Fine grained delegation of authority
  - Roles assigned as an attribute of the user or group
- Legacy RBAC (AIX V4.2+):
  - User space implementation
  - Role assignment alone was insufficient
- Enhanced RBAC (AIX 6.1):
  - Covers user and kernel space
  - Effective role assignment without additional configuration
  - AIX 6.1 SP1 provides 10 predefined roles
- User can activate/inactivate roles as needed
  - Create subshell with role in effect:  
`$ swrole SysBoot`

# Predefined enhanced RBAC roles

---

- isso - Information System Security Officer
- sa - System Administrator
- so – System Operator
- AccountAdmin - User and Group Account Administration
- BackupRestore -Backup and Restore Administration
- DomainAdmin - Remote Domain Administration
- FSAdmin - File System Administration
- SecPolicy - Security Policy Administration
- SysBoot - System Boot Administration
- SysConfig - System Configuration

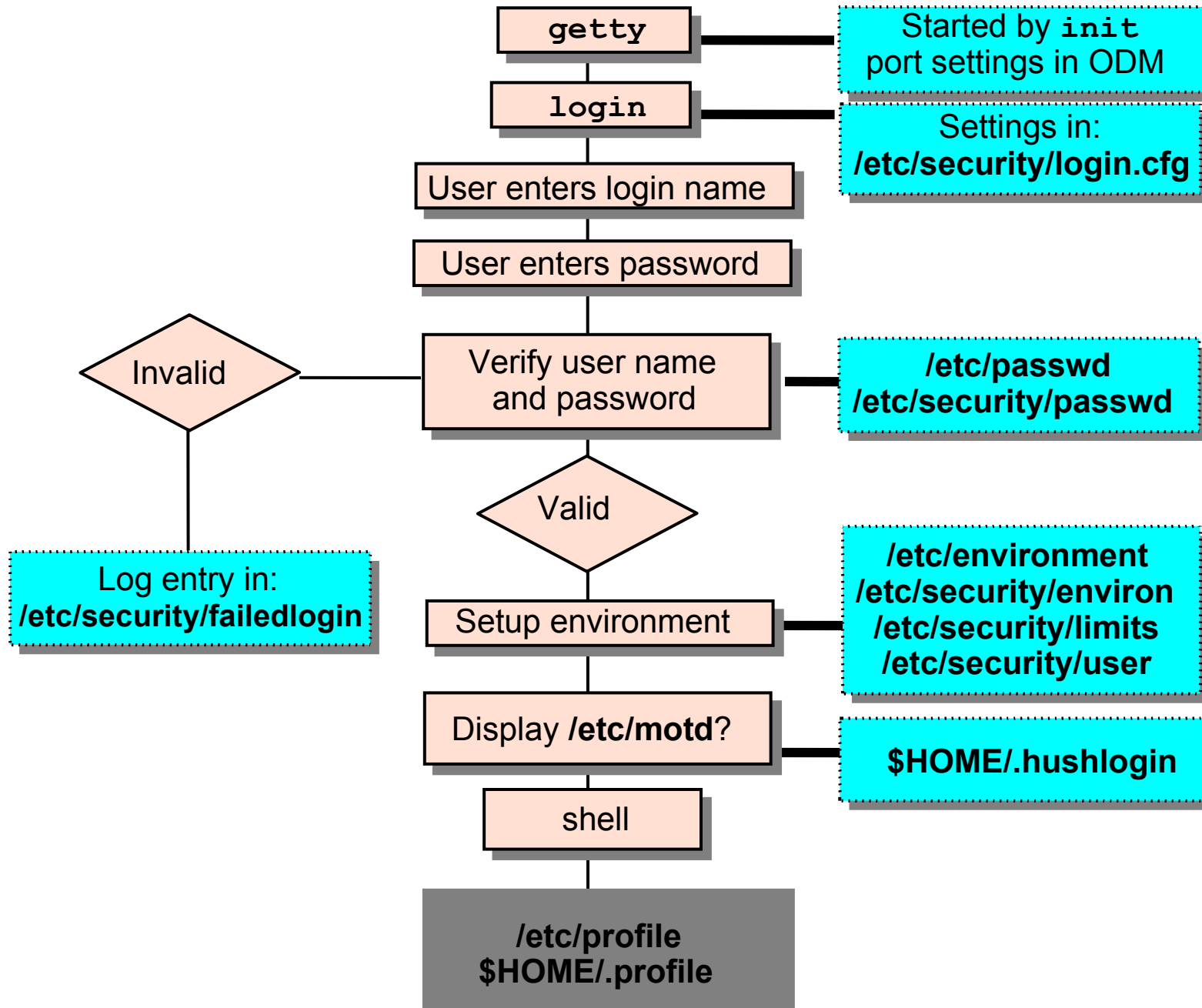
# Exercise 15: Security files

---



- Security control files
- SUID and sticky bit

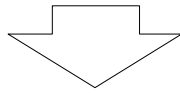
# Login sequence



# User initialization process

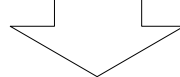
---

LOGIN



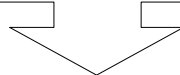
**/etc/environment**

Establishes base environment  
sets **PATH**, **TZ**, **LANG**, and  
**NLSPATH**



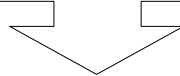
**/etc/profile**

Shell script run at all logins  
sets **TERM**, **MAILMSG**, and  
**MAIL**



**\$HOME/.profile**

User's personal file to  
customize their environment  
**PATH**, **ENV**, **PS1**



**\$HOME/.kshrc**

User's personal file to customize  
the Korn shell environment  
**set -o vi, alias**

# Security and users

---

```
# smit security
```

## Security & Users

Move cursor to desired item and press Enter.

Users

Groups

Passwords

Login Controls

Roles

PKI

LDAP

Role Based Access Control (RBAC)

Trusted Execution

F1=Help      F2=Refresh      F3=Cancel      F8=Image

F9=Shell      F10=Exit      Enter=Do

# SMIT users

---

```
# smit users
```

## Users

Move cursor to desired item and press Enter.

Add a User

Change a User's Password

Change / Show Characteristics of a User

Lock / Unlock a User's Account

Reset User's Failed Login Count

Remove a User

List All Users

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# List all users

---

The `lsuser` command:

```
lsuser [-c | -f] [-a attribute ...] {ALL | username ...}
```

Example:

```
# lsuser -a id home ALL
root id=0 home=/
daemon id=1 home=/etc
bin id=2 home=/bin
...
john id=200 home=/home/john
...
```



# Add a user to the system

```
# smit mkuser
```

## Add a User

```
...
```

```
[Entry Fields]
```

* User NAME	[ ]	
User ID	[ ]	#
ADMINISTRATIVE USER?	false	+
Primary GROUP	[ ]	+
Group SET	[ ]	+
ADMINISTRATIVE GROUPS	[ ]	+
ROLES	[ ]	+
Another user can SU TO USER?	true	+
SU GROUPS	[ALL]	+
HOME directory	[ ]	
Initial PROGRAM	[ ]	
User INFORMATION	[ ]	
EXPIRATION date (MMDDhhmmyy)	[0]	
Is this user ACCOUNT LOCKED?	false	+

```
[MORE ...37]
```

```
...
```

# Change / Show Characteristics of a User

```
# smit chuser
```

```
Change / Show Characteristics of a User
```

```
...
```

```
[Entry Fields]
```

```
* User NAME                george
User ID                    [206]                #
ADMINISTRATIVE USER?      false                +
Primary GROUP              [staff ]                +
Group SET                  [staff,security]    +
ADMINISTRATIVE GROUPS     [ ]                +
ROLES                      [ ]                +
Another user can SU TO USER? true                +
SU GROUPS                  [ALL]                +
HOME directory             [/home/george ]
Initial PROGRAM            [/usr/bin/ksh ]
User INFORMATION           [ ]
EXPIRATION date (MMDDhhmmyy) [0]
Is this user ACCOUNT LOCKED? false                +
[MORE ...37]
```

```
...
```

# Remove a user from the system

---

- The `rmuser` command or SMIT can be used to delete a user from the system.

```
# rmuser -p team01
```

- When you remove a user, that user's home directory is not deleted. Therefore, you must remember to manually *clean up* the directories of users you remove. (Remember to backup important files first!)

```
# rm -r /home/team01
```

# Passwords

---

- A new user ID cannot be used until a password is assigned
- There are two commands available for making password changes:

```
# passwd [username]
```

```
# pwdadm username
```

- SMIT invokes the **passwd** command
- An ordinary user can use the **passwd** command to change own password
- Only **root** or member of **security** group can change password of another user

# Regaining root's password

---

- Boot from CD-ROM, NIM, or a bootable tape
- Select option 3: **Start Maintenance Mode for System Recovery** from the **Installation and Maintenance** menu
- Follow the options to activate the **root** volume group and obtain a shell
- Once a shell is available, execute the `passwd` command to change **root's** password
- Enter the following command:  
`# sync ; sync`
- Reboot the system



# SMIT groups

---

# smit groups

## Groups

Move cursor to desired item and press Enter.

List All Groups

Add a Group

Change / Show Characteristics of a Group

Remove a Group

F1=Help

F2=Refresh

F3=Cancel

F8=Image

F9=Shell

F10=Exit

Enter=Do

# List all groups

---

The `lsgroup` command:

```
lsgroup [-c | -f] [-a attribute ...] {ALL | groupname ...}
```

Example:

```
# lsgroup ALL
system id=0 admin=true users=root,test2 registry=compat
staff id=1 admin=false users=ipsec,team01,team02,team03,
team04,team05,test1,daemon registry=compat
bin id=2 admin=true users=root,bin registry=compat
sys id=3 admin=true users=root,bin,sys registry=compat
adm id=4 admin=true users=bin,adm registry=compat
uucp id=5 admin=true users=uucp,nuucp registry=compat
...
ipsec id=200 admin=false users= registry=compat
```

# Add a Group

```
# smit mkgroup
```

## Add a Group

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

### [Entry Fields]

* Group NAME	[support]	
ADMINISTRATIVE group?	false	+
Group ID	[300]	#
USER list	[fred,barney]	+
ADMINISTRATOR list	[fred]	+
Projects	[ ]	+
Initial Keystore Mode	[ ]	+
Keystore Encryption Algorithm	[ ]	+
Keystore Access	[ ]	+

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



# Change / remove groups

## # smit chgroup

### Change Group Attributes

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

	[Entry Fields]	
Group NAME	[Support]	
Group ID	[300]	#
ADMINISTRATIVE group?	False	+
USER list	[fred, barney, wilma]	+
ADMINISTRATOR list	[fred]	+
Projects	[ ]	+
Initial Keystore Mode	[ ]	+
Keystore Encryption Algorithm	[ ]	+
Keystore Access	[ ]	+

F1=Help

F2=Refresh

F3=Cancel

F4=List

F5=Reset

F6=Command

F7=Edit

F8=Image

F9=Shell

F10=Exit

Enter=Do

# Message of the day

---

- The file **/etc/motd** contains text that is displayed every time a user logs in
- This file should only contain information necessary for the users to see
- If the **\$HOME/.hushlogin** file exists in a user's home directory, then the contents of the **/etc/motd** file are not displayed to that user



# Exercise 16: User administration (parts 1-5)

---



- Part 1 - User administration
- Part 2 - Group administration
- Part 3 - Customizing the default **.profile** file
- Part 4 - Removing users
- Part 5 - Communicating with users

# Security files

---

- Files used to contain user attributes and control access:
  - **/etc/passwd** Valid users (not passwords)
  - **/etc/group** Valid groups
  
  - **/etc/security** Directory not accessible to normal users
  
  - **/etc/security/passwd** User passwords
  - **/etc/security/user** User attributes, password restrictions
  
  - **/etc/security/group** Group attributes
  - **/etc/security/limits** User limits
  
  - **/etc/security/environ** User environment settings
  - **/etc/security/login.cfg** Login settings

# /etc/passwd file

---

```
# cat /etc/passwd
```

```
root!:0:0:::/usr/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::/
lp:*:11:11::/var/spool/lp:/bin/false
invscout:*:6:12::/var/adm/invscout:/usr/bin/ksh
snapp:*:200:13:snapp login user:/usr/sbin/snapp:/usr/sbin/snappd
nuucp:*:7:5:uucp login user:/var/spool/uucppublic:/usr/sbin/uucp/uucico
ipsec:*:201:1::/etc/ipsec:/usr/bin/ksh
esaadmin:*:811:0::/home/esaadmin:/usr/bin/ksh
john!:200:0:x7560 5th floor:/home/john:/usr/bin/ksh
bill:*:201:1::/home/bill:/usr/bin/ksh
```

# /etc/security/passwd file

---

```
# cat /etc/security/passwd
```

```
root:
```

```
    password = 92t.mzJBj1fbY  
    lastupdate = 885485990  
    flags =
```

```
daemon:
```

```
    password = *
```

```
bin:
```

```
    password = *
```

```
...
```

```
john:
```

```
    password = q/gD6q.ss21x.  
    lastupdate = 884801337  
    flags = ADMCHG,ADMIN,NOCHECK
```

# /etc/security/user file (1 of 2)

---

```
# cat /etc/security/user
```

```
default:
```

```
    admin = false  
    login = true  
    su = true  
    daemon = true  
    rlogin = true  
    sugroups = ALL  
    admgroups =  
    ttys = ALL  
    auth1 = SYSTEM  
    auth2 = NONE  
    tpath = nosak  
    umask = 022  
    expires = 0
```

```
...
```

# /etc/security/user file (2 of 2)

---

default

...

```
SYSTEM = "compat"  
logintimes =  
pwdwarntime = 0  
account_locked = false  
loginretries = 0  
histexpire = 0  
histsize = 0  
minage = 0  
maxage = 0  
maxexpired = -1  
minalpha = 0  
minother = 0  
minlen = 0  
mindiff = 0  
maxrepeats = 8  
dictionarylist =  
pwdchecks =
```



# Group files

---

```
# more /etc/group
```

```
system:!:0:root, john
staff:!:john
bin:!:2:root, bin
sys:!:3:root, bin, sys
...
usr:!:100:guest
accounts:!:200:john
...
```

```
# more /etc/security/group
```

```
system:
        admin=true
staff:
        admin=false
accounts:
        admin=false
        adms=john
        projects=system
```

# /etc/security/login.cfg file

---

```
default:  
  herald = "Authorized use only.\n\rlogin:"  
  logintimes =  
  logindisable = 0  
  logininterval = 0  
  loginreenable = 0  
  logindelay = 0  
  pwdprompt = "Password: "  
  usernameecho = false
```

# Validating the user environment

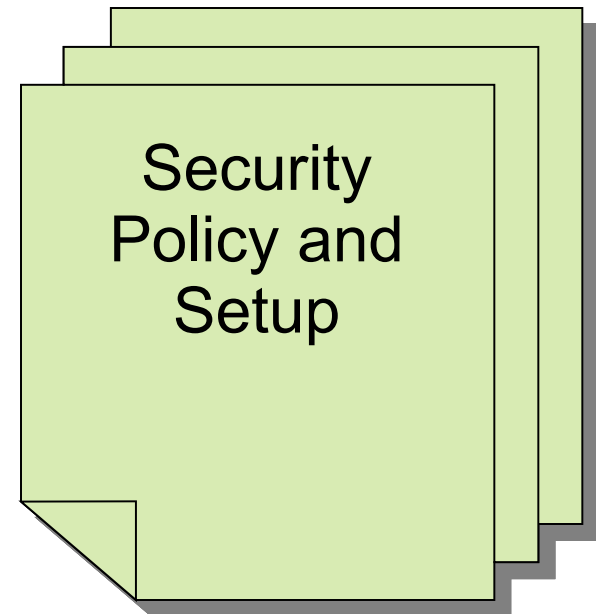
---

- **pwdck** verifies the validity of local authentication information:
  - **pwdck** `{-n|-p|-t|-y} {ALL | username}`
  - Verifies that `/etc/passwd` and `/etc/security/passwd` are consistent with each other and with `/etc/security/login.cfg` and `/etc/security/user`
- **usrck** verifies the validity of a user definition:
  - **usrck** `{-l|-b|-n|-p|-t|-y} {ALL | username}`
  - Checks each user name in `/etc/passwd`, `/etc/security/user`, `/etc/security/limits` and `/etc/security/passwd`
  - Checks are made to ensure that each has an entry in `/etc/group` and `/etc/security/group`
- **grpck** verifies the validity of a group:
  - **grpck** `{-n|-p|-t|-y} {ALL | groupname }`
  - Verifies that the files `/etc/passwd`, `/etc/security/user`, `/etc/group` and `/etc/security/group` are consistent

# Documenting security policy and setup

---

- Identify the different types of users and what data they will need to access
- Organize groups around the type of work that is to be done
- Organize ownership of data to fit with the group structure
- Set SVTX on shared directories
- Remember that UNIX/AIX has no concept of application ownership



# Checkpoint (1 of 2)

- What are the benefits of using the **su** command to switch user to **root** over logging in as **root**?

---

---

5. Why is a umask of 027 recommended?

---

---

- As a member of the **security** group, which password command would you use?

---

- Which password change command does SMIT use?

---

13. True or False? When you delete a user from the system, all the user's files and directories are also deleted.

# Checkpoint solutions (1 of 2)

- What are the benefits of using the **su** command to switch user to **root** over logging in as **root**?

A log (which can be monitored) of all users executing the **su** command is kept in the **su** **log**.

- Why is a **umask** of 027 recommended?

This value removes all permission bits for the “others” category, which enhances security.

- As a member of the **security** group, which password command would you use?

**pwdadm** (This command does not prompt for the **root** password or the old password of the user whose password is being changed.)

- Which password change command does SMIT use?

**passwd**

- True or False? When you delete a user from the system, all the user's files and directories are also deleted.

# Checkpoint (2 of 2)

1. If an ordinary user forgets their password, can the system administrator find out by querying the system as to what the user's password was set to? \_\_\_\_\_ Why? \_\_\_\_\_

---

2. Password restrictions are set in which of the following files?

- **/etc/passwd**
- **/etc/security/passwd**
- **/etc/security/restrictions**
- **/etc/security/user**

3. Which of the following statements are true?

- A user can only belong to one group
- A member of the **security** group can administer user accounts
- An admin user is a user whose account cannot be administered by any member of the **security** group (except **root**)
- The **chmod g+s** command sets the SUID permission of a file
- The **root** user, commonly known as the superuser has UID=0 and GID=0

# Checkpoint solutions (2 of 2)

- If an ordinary user forgets their password, can the system administrator find out by querying the system as to what the user's password was set to? No, because the passwords are held in encrypted format, so even the system administrator cannot tell what the password was set to.
2. Password restrictions are set in which of the following files?
- `/etc/passwd`
  - `/etc/security/passwd`
  - `/etc/security/restrictions`
  - `/etc/security/user`
3. Which of the following statements are true?
- A user can only belong to one group
  - A member of the **security** group can administer user accounts
  - An admin user is a user whose account cannot be administered by any member of the **security** group (except **root**)
  - The `chmod g+s` command sets the SUID permission of a file
  - The **root** user, commonly known as the superuser has UID=0 and GID=0



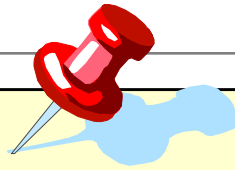
# Exercise 16: User administration (parts 6-7)

---



- Part 6 - Examine the security set up
- Part 7 - Customizing the login herald

# Unit summary



- User and groups can be added and deleted from the system by using **SMIT** or by using high level **commands**.
- Passwords must be set for all users using either **pwdadm** or **passwd**.
- Administrative users and groups can only be administered by **root**.
- Every **user** must be in at least one **group**.
- Certain groups give users additional **privileges**.
- Security files are located in ASCII text files in the **/etc** and **/etc/security** directories.



# Unit 15

## Scheduling



# Unit objectives

---

After completing this unit, you should be able to:

- Use **crontab** files to schedule jobs on a periodic basis
- Use the **at** command to schedule a job or series of jobs at some time in the future
- Use the **batch** command to schedule jobs in a queue to alleviate immediate system demand

# The cron daemon

---

- Responsible for running scheduled jobs
- Starts:
  - **crontab** command events  
(regularly scheduled jobs)
  - **at** command events  
(one time only execution at specified time)
  - **batch** command events  
(run when CPU load is low)



# crontab files

---

- Used to start regularly occurring jobs
- Schedule is defined in:  
**`/var/spool/cron/crontabs/$USER`**
- Files to control **crontab** privileges of users:
  - **`/var/adm/cron/cron.deny`** lists users who cannot use **crontab**
  - **`/var/adm/cron/cron.allow`** lists users who can use **crontab**
- An empty **cron.deny** exists by default

# Format of a crontab file

---

To view current **crontab**:

```
# crontab -l
```

```
...  
#0 3 * * * /usr/sbin/skulker  
#45 2 * * 0 /usr/lib/spell/compress  
...  
0 11 * * * /usr/bin/errclear -d S,0 30  
0 12 * * * /usr/bin/errclear -d H 90  
0 15 * * * /usr/lib/ras/dumpcheck >/dev/null 2>&1  
...
```

Format of entries:

```
minute hour date-of-month month day-of-week  
command
```

# Editing a crontab file

---

- One way to edit a **crontab** file:

```
# crontab -e
```

- A safer method:

```
# crontab -l > /tmp/crontmp  
# vi /tmp/crontmp  
# crontab /tmp/crontmp
```



# The at and batch commands

---

- The **at** command submits a uniquely occurring job to be run by **cron** at a specified time:

```
# at now +2 mins  
banner hello > /dev/pts/0  
<ctrl-d>  
job user.time.a will be run at date
```

- The **batch** command submits a job to be run when the processor load is sufficiently low:

```
# batch  
banner hello > /dev/pts/0  
<ctrl-d>
```

# Controlling at jobs

---

- To list at jobs:

```
at -l [user]
atq [user]
```

```
# at -l
root.1118077769.a      Mon Jun  6 10:09:29 2007
root.1118078393.a      Mon Jun  6 10:19:53 2007
test2.1118079063.a     Mon Jun  6 10:31:03 2007
```

- To cancel an at job:

```
at -r job
atrm [job | user]
```

```
# at -r test2.1118079063.a
at file: test2.1118079063.a deleted
```

- To cancel all your at jobs:

```
atrm -
```

# Documenting scheduling

---

- Have a copy of each user's **crontab** file
- Have a copy of the **/etc/inittab** file



**Scheduling Records**

<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input checked="" type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____

# Checkpoint

- True or False? The **at.allow** and **at.deny** files must be used to specify which users are allowed and denied use of the **at** command.
- Give a **crontab** entry that would specify that a job should run every Thursday at 10 past and 30 minutes past every hour.  

---
- How would you schedule a script named **myscript**, to run 10 minutes from now?  

---

---

---

---

# Checkpoint solutions

1. True or **False**? The **at.allow** and **at.deny** files must be used to specify which users are allowed and denied use of the **at** command.

False. Only one or the other of these files should be used.

- Give a **crontab** entry that would specify that a job should run every Thursday at 10 past and 30 minutes past every hour.

10,30 \* \* \* 4 <job>

- How would you schedule the script named **myscript**, to run 10 minutes from now?

```
# at now + 10 minutes
myscript
^d
#
```

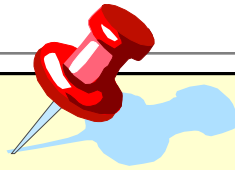
# Exercise 17: Scheduling

---



- Using **at**
- Using **batch**
- Using **crontab** files

# Unit summary



- The **cron daemon** is responsible for running scheduled jobs.
- The **crontab files** are used to schedule recurring jobs.
- The **at command** is used to schedule a command for one time only execution.
- The **batch command** is used to submit a job to be run when the processor load is sufficiently low.



# Unit 17

## Networking overview





# Unit objectives

---

After completing this unit, you should be able to:

- Define the basic TCP/IP terminology
- Configure TCP/IP for an Ethernet or Token-Ring connection
- Use some of the standard TCP/IP facilities to:
  - Log in to another system
  - Transfer files
  - Run commands

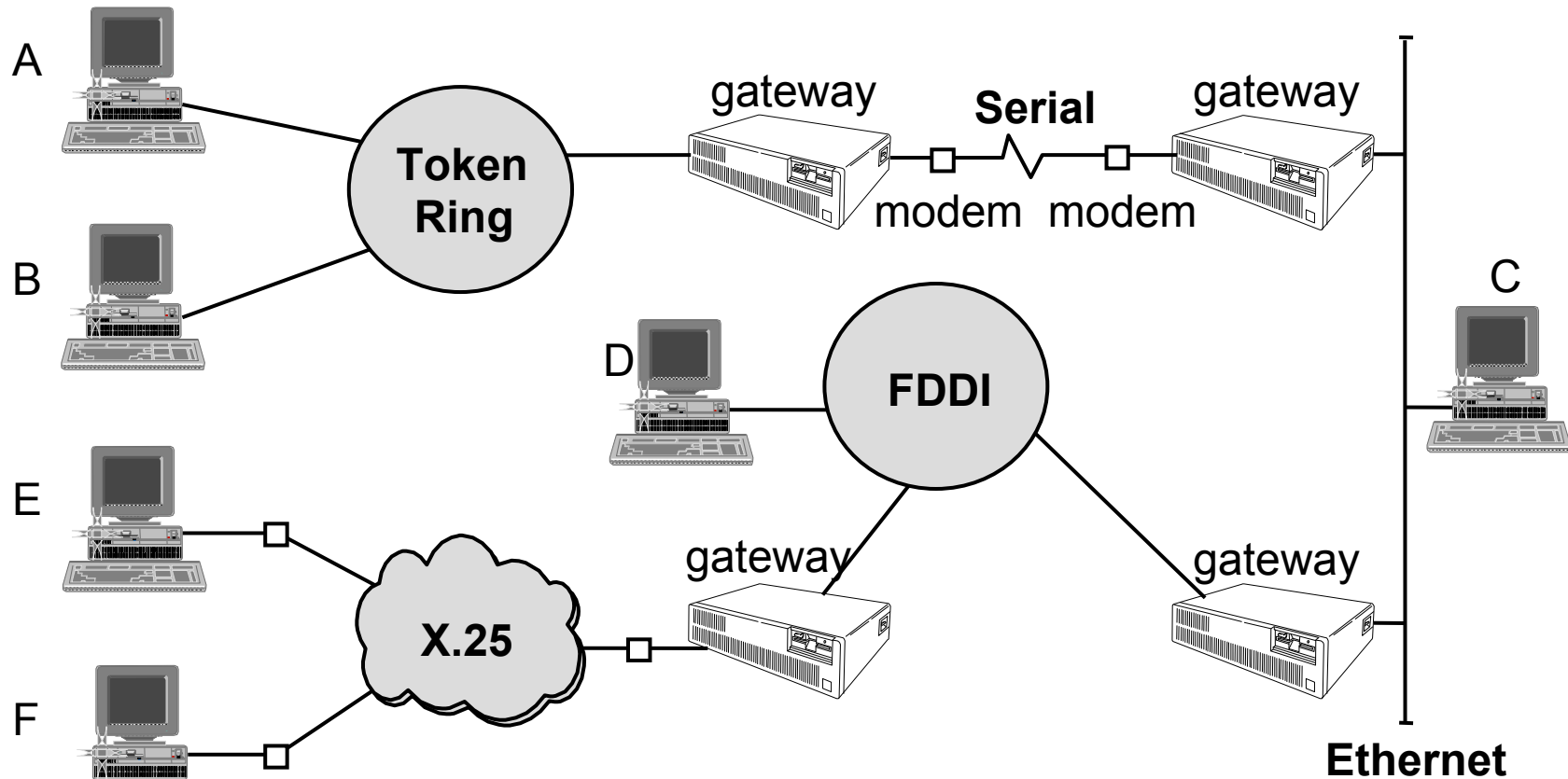
# What is TCP/IP?

---

- **T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol
- Software to enable different systems to exchange data over a variety of types of network
- The way in which systems are connected and how data is passed between them is transparent to the user
- TCP/IP is vendor-independent; development is overseen by the Internet Architecture Board

# An Internet

- A TCP/IP network is often called an *Internet*.



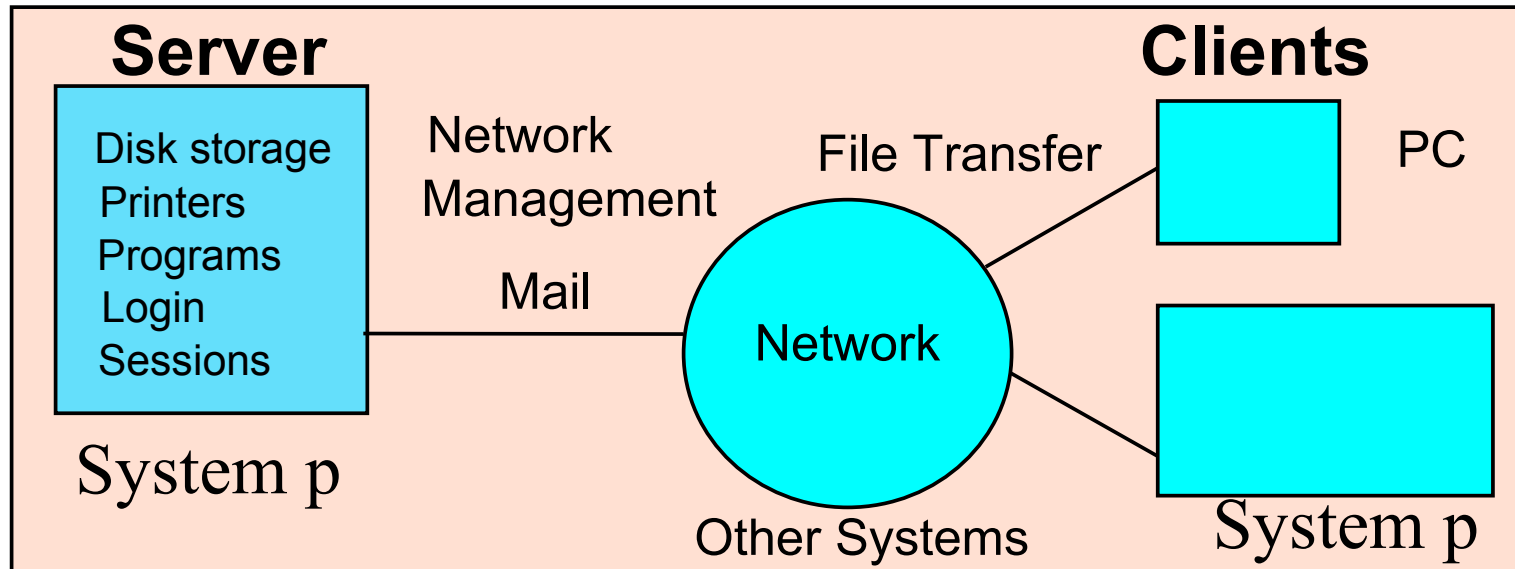
- Individual machines are called *hosts*
- Hosts may vary in size and functionality but have equal standing as far as TCP/IP is concerned
- Hosts which link two or more physical network segments to each other are called *gateways*

# Names and addresses

---

- Each system in a TCP/IP network is given a name:
  - For example: `sys3`
- When contacting another system you only need to know the name:
  - For example: `$ telnet sys3`
- When contacting another user you need to know the system and user name:
  - For example: `$ mail fred@sys3`
- Each system has one or more TCP/IP addresses:
  - For example: `10.0.0.3`
- If you know the address, but not the name, you can use some TCP/IP facilities with the address

# TCP/IP network facilities



- Standard TCP/IP facilities include: mail, file transfer, remote login, remote execution, and remote printing
- A number of AIX applications use TCP/IP:
  - Network File System (NFS)
  - Network Information Services (NIS)
  - Domain Name Service (DNS)
  - Dynamic Host Configuration Protocol (DHCP)
  - Network Computing System (NCS)
  - Distributed Computing Environment (DCE)
  - X Windows and AIXWindows
  - Tivoli Netview for AIX

# Information needed to configure TCP/IP

---

- Address:
  - Each adapter is given a unique TCP/IP address and often a subnet mask
  - These are usually assigned by your network administrator
- Name:
  - Each machine has a unique hostname
  - Each machine must have access to a table of name to address translations, which can be either:
    - **/etc/hosts** file
    - Domain Name Server - You must know:
      - Domain Name
      - Address of the Name Server
- Routes:
  - In order to communicate with systems in other networks, you may need to find the address of the default gateway

# Configuring TCP/IP

```
# smit mktcpip
```

## Minimum Configuration & Startup

To Delete existing configuration data, please use Further Configuration menus

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

	[Entry Fields]	
* HOSTNAME	[sys1]	
* Internet ADDRESS (dotted decimal)	[10.0.0.1]	
Network MASK (dotted decimal)	[255.255.255.0]	
* Network INTERFACE	en0	
NAMESERVER		
Internet ADDRESS (dotted decimal)	[ ]	
DOMAIN Name	[ ]	
Default Gateway		
Address (dotted decimal or symbolic name)	[10.0.0.192]	
Cost	[0]	#
Do Active Dead Gateway Detection?	no	+
Your CABLE Type	N/A	+
START TCP/IP daemons Now	no	+

F1=Help

Esc+5=Reset

Esc+9=Shell

F2=Refresh

Esc+6=Command

Esc+0=Exit

F3=Cancel

Esc+7=Edit

Enter=Do

F4=List

Esc+8=Image

# Flat name resolution

```
# more /etc/hosts
```

```
# The format of this file is:
```

```
# Internet Address      Hostname          # Comments
```

```
# Items are separated by any number of blanks and/or tabs. A '#'  
# indicates the beginning of a comment; characters up to the end  
# of the line are not interpreted by routines which search this  
# file. Blank lines are allowed.
```

#Internet Address	Hostname	#Comments
127.0.0.1	loopback	localhost
10.0.0.1	sys1	timeserver
10.0.0.2	sys2	
10.0.0.3	sys3	
10.0.0.4	sys4	



# Identifying the hostname

---

- **hostname** command:
  - Example:

```
# hostname  
sys3
```

- **host** command:
  - Examples:

```
# host sys3  
sys3 is 10.0.0.3, Aliases: sys3.washington.ibm.com  
  
# host 10.0.0.3  
sys3 is 10.0.0.3, Aliases: sys3.washington.ibm.com
```

# Basic TCP/IP user functions

---

- The following commands work with any TCP/IP system (not just UNIX/AIX):
  - Test connectivity: `ping`
  - Remote execution: `rexec`
  - File transfer: `ftp`
  - Remote login: `telnet`

# Checkpoint

1. What are the following commands used for?

• **ftp** \_\_\_\_\_

• **rexec** \_\_\_\_\_

• **telnet** \_\_\_\_\_

• What is the difference (if any) between a **host** and a **gateway**?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. True or false? Each machine in a TCP/IP network must have a unique hostname and TCP/IP address.

• Which file holds the name and the TCP/IP address of each host in a flat network? \_\_\_\_\_

# Checkpoint solutions

1. What are the following commands used for?
  - **ftp** transfers files from one machine to another
  - **rexec** executes a command on a remote system
  - **telnet** logs in to another system
- What is the difference (if any) between a **host** and a **gateway**?  
A host is an individual machine connected to a network, whereas a gateway is a special kind of host which links two or more physical networks together.
- **True** or false? Each machine in a TCP/IP network must have a unique hostname and TCP/IP address.
- Which file holds the name and the TCP/IP address of each host in a flat network? /etc/hosts

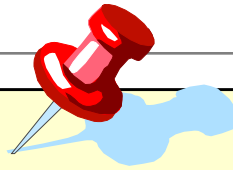
# Exercise 19: Networking

---



- Deconfigure TCP/IP
- Configure TCP/IP
- Testing the configuration
- Using `telnet`
- Using `ftp`

# Unit summary



- TCP/IP is a networking architecture which defines a set of rules. These rules describe how computers can communicate with one another over a network.
- A flat TCP/IP network can be configured through SMIT by supplying the following information: addresses, subnet mask and hostnames.
- There are many useful utilities which are provided by TCP/IP, such as **telnet** to login to another system, **ftp** to transfer files and **rexec** to execute a command on a remote system.
- Use the **ping** command to check for connectivity to remote hosts.



Welcome to:

# The Object Data Manager (ODM)



# Unit Objectives

---

After completing this unit, you should be able to:

- Describe the structure of the ODM
- Use the ODM command line interface
- Explain the role of the ODM in device configuration
- Describe the function of the most important ODM files

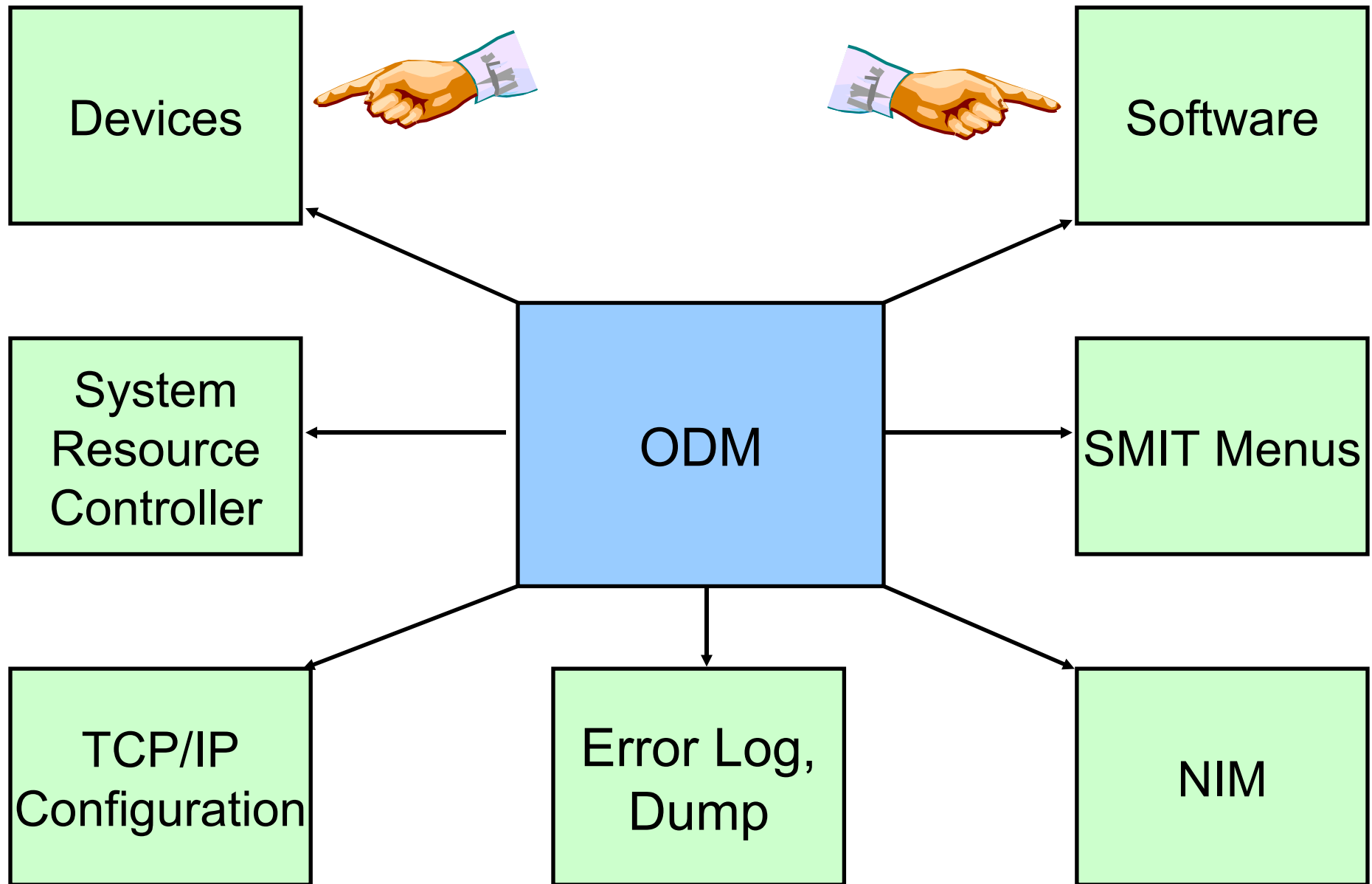


# What Is the ODM?

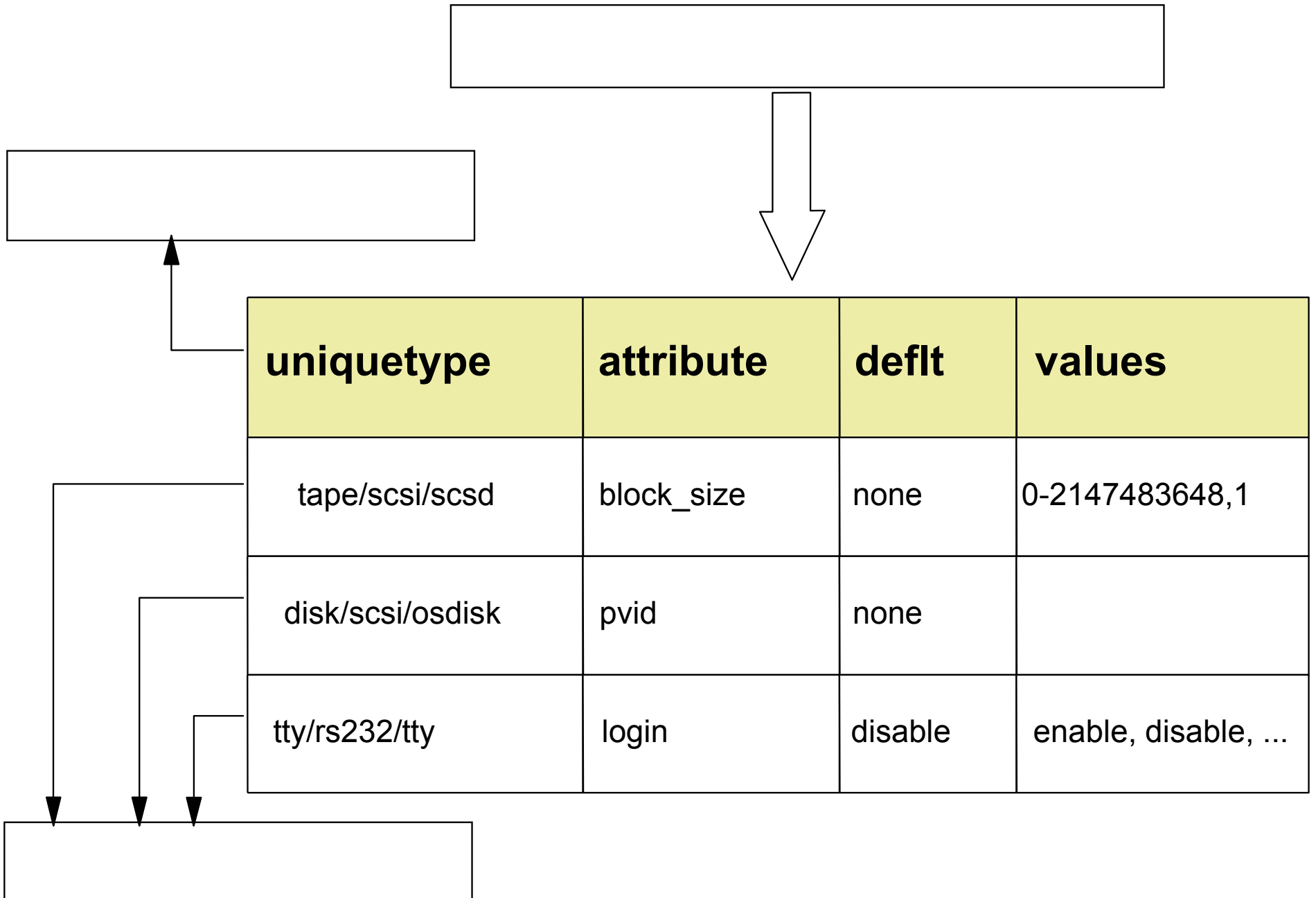
---

- The Object Data Manager (ODM) is a database intended for storing system information.
- Physical and logical device information is stored and maintained through use of objects with associated characteristics.

# Data Managed by the ODM



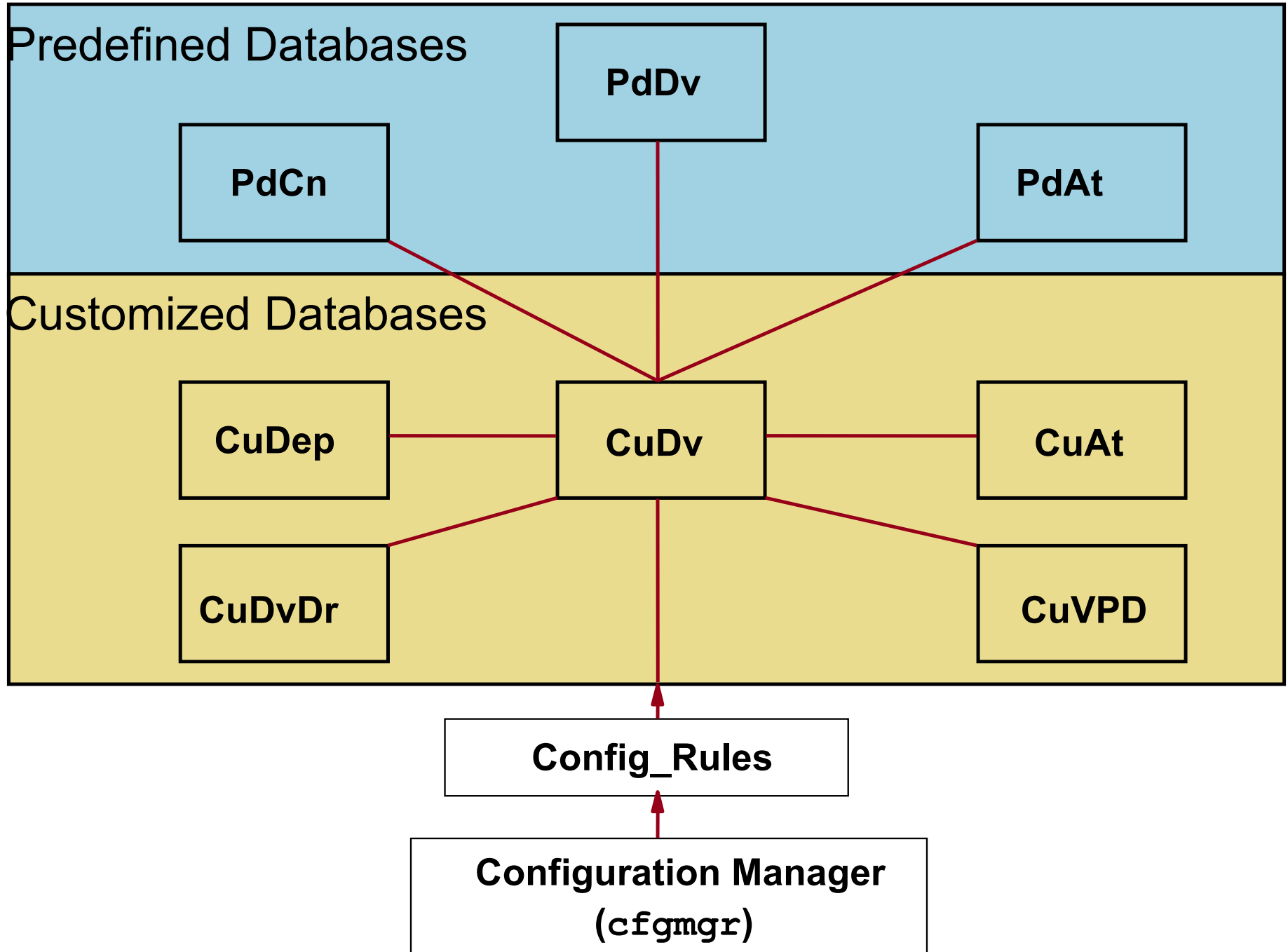
# ODM Components



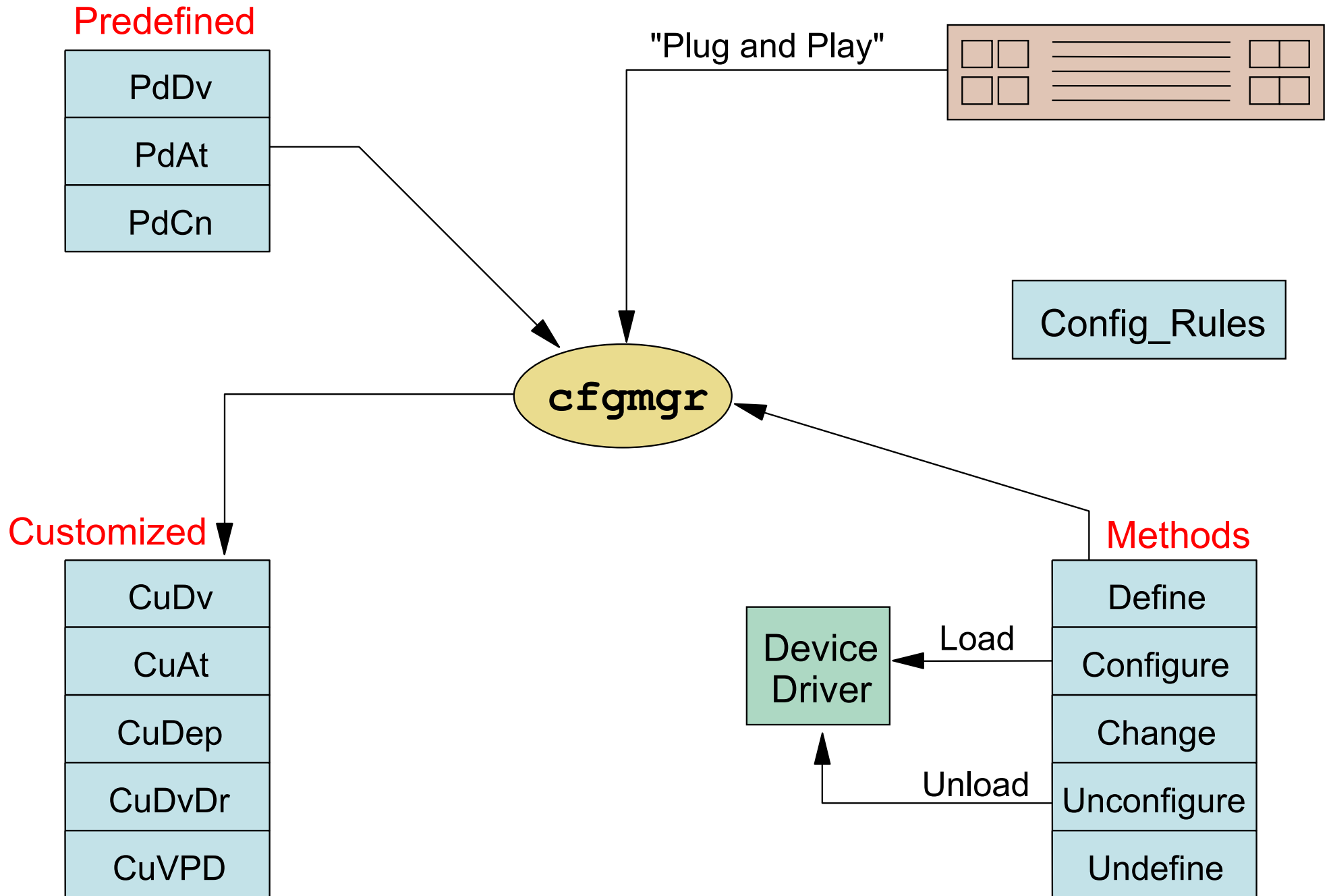
# ODM Database Files

<i>Predefined device information</i>	<i>PdDv, PdAt, PdCn</i>
<i>Customized device information</i>	<i>CuDv, CuAt, CuDep, CuDvDr, CuVPD, Config_Rules</i>
Software vital product data	history, inventory, lpp, product
SMIT menus	sm_menu_opt, sm_name_hdr, sm_cmd_hdr, sm_cmd_opt
Error log, alog, and dump information	SWservAt
System Resource Controller	SRCsubsys, SRCsubsvr, ...
Network Installation Manager (NIM)	nim_attr, nim_object, nim_pdatr

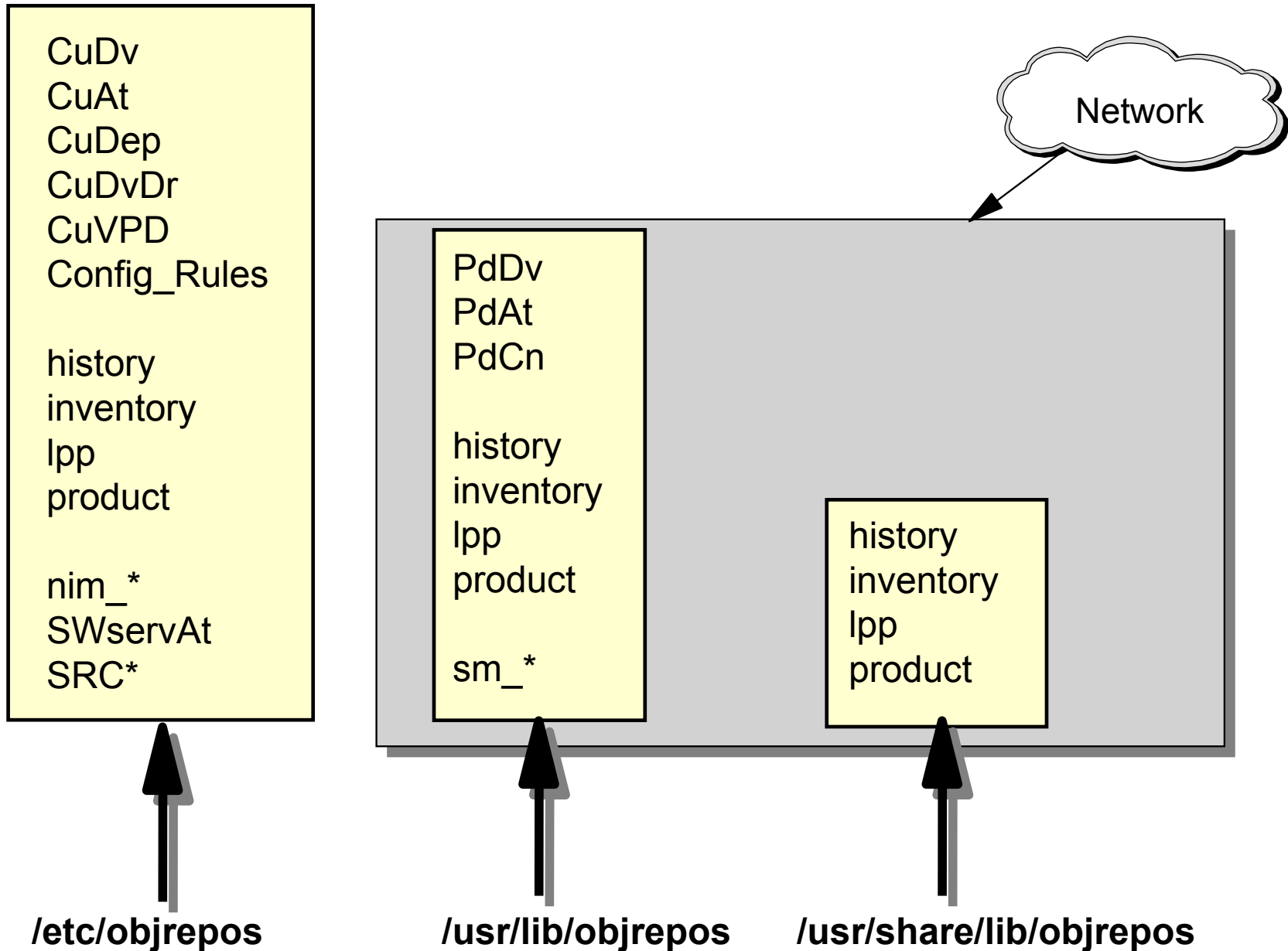
# Device Configuration Summary



# Configuration Manager



# Location and Contents of ODM Repositories



# How ODM Classes Act Together

```
PdDv:  
type = "14106902"  
class = "adapter"  
subclass = "pci"  
prefix = "ent"  
  
DvDr = "pci/goentdd"  
Define = /usr/lib/methods/define_rspc"  
Configure = /usr/lib/methods/cfggoent"  
  
uniquetype = "adapter/pci/14106902"
```

cfgmgr →

```
CuDv:  
name = "ent1"  
status = 1  
chgstatus = 2  
ddins = "pci/goentdd"  
location = "02-08"  
parent = "pci2"  
connwhere = "8"  
  
PdDvLn = "adapter/pci/14106902"
```

```
PdAt:  
uniquetype =  
"adapter/pci/14106902"  
attribute = "jumbo_frames"  
deflt = "no"  
values = "yes,no"
```

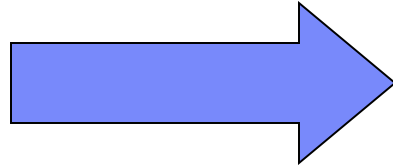
chdev -l ent1 \  
-a jumbo\_frames=yes  
→

```
CuAt:  
name = "ent1"  
attribute = "jumbo_frames"  
value = "yes"  
type = "R"
```



# ~~Data Not Managed by the ODM~~

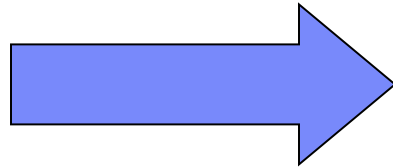
Filesystem  
information



?



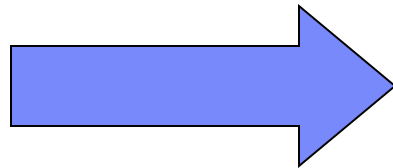
User/Security  
information



?



Queues and  
Queue devices

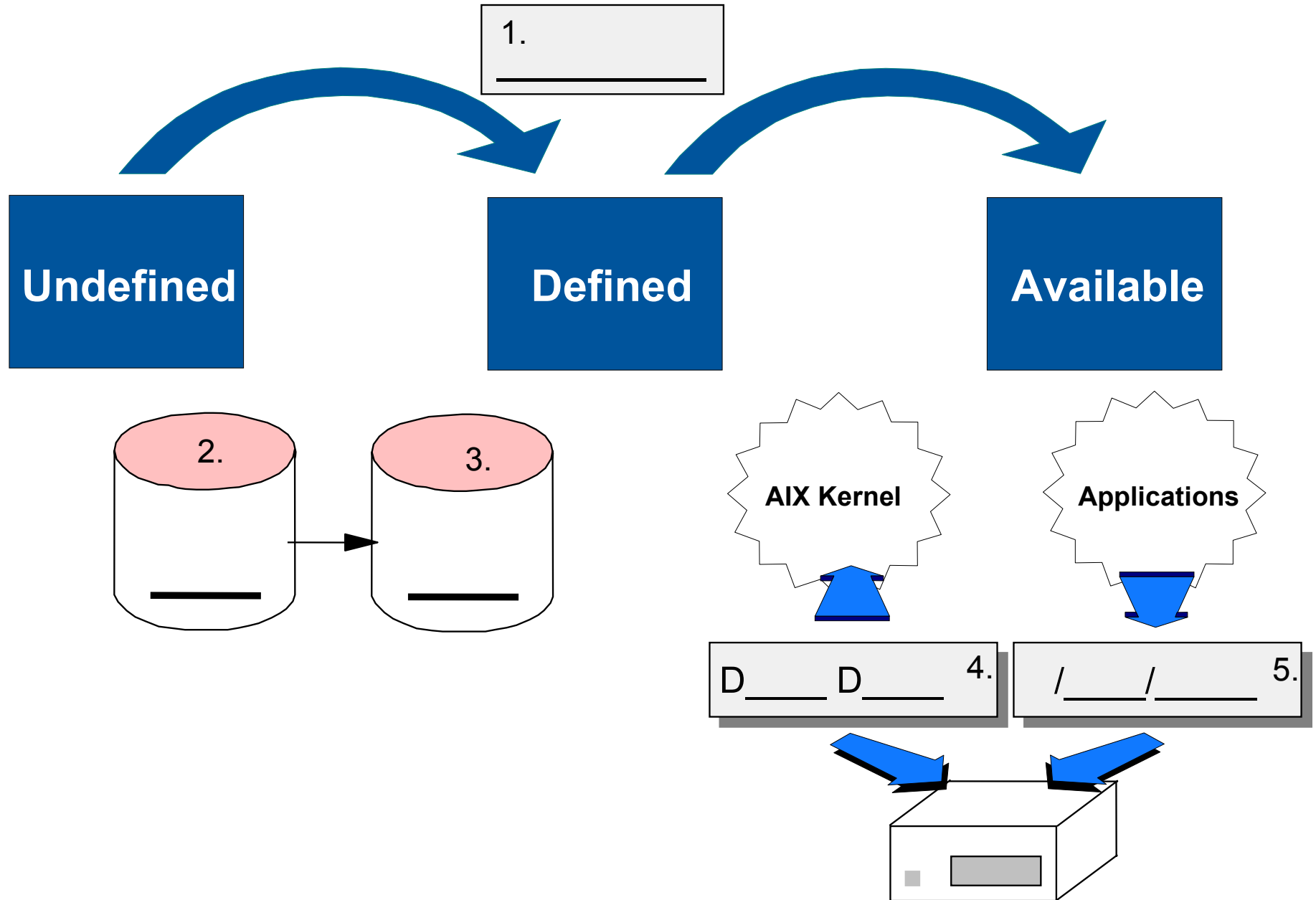


?



# Let's Review:

## Device Configuration and the ODM



# ODM Commands

Object class: `odmcreate`, `odmdrop`

Descriptors: `odmshow`

<b>uniquetype</b>	<b>attribute</b>	<b>deflt</b>	<b>values</b>
tape/scsi/scsd	block_size	none	0-2147483648,1
disk/scsi/osdisk	pvid	none	
tty/rs232/tty	login	disable	enable, disable, ...

Objects: `odmadd`, `odmchange`, `odmdelete`, `odmget`

# Changing Attribute Values

```
# odmget -q"uniquetype=tape/scsi/scsd and attribute=block_size" PdAt > file
```

```
# vi file
```

**PdAt:**

```
uniquetype = "tape/scsi/scsd"  
attribute = "block_size"  
deflt = "512"  
values = "0-2147483648,1"  
width = ""  
type = "R"  
generic = "DU"  
rep = "nr"  
nls_index = 6
```

**Modify deflt to 512**



```
# odmdelete -o PdAt -q"uniquetype=tape/scsi/scsd and attribute=block_size"
```

```
# odmadd file
```

# Using odmchange to Change Attribute Values

```
# odmget -q"uniquetype=tape/scsi/scsd and attribute=block_size" PdAt > file
```

```
# vi file
```

**PdAt:**

```
uniquetype = "tape/scsi/scsd"  
attribute = "block_size"  
deflt = "512"  
values = "0-2147483648,1"  
width = ""  
type = "R"  
generic = "DU"  
rep = "nr"  
nls_index = 6
```

**Modify deflt to 512**



```
# odmchange -o PdAt -q"uniquetype=tape/scsi/scsd and attribute=block_size" file
```

# Software Vital Product Data

```
lpp:  
  name = "bos.rte.printers"  
  size = 0  
  state = 5  
  ver = 6  
  rel = 1  
  mod = 0  
  fix = 0  
  description = "Front End Printer  
  Support"  
  lpp_id = 38
```

```
product:  
  lpp_name = "bos.rte.printers"  
  comp_id = "5765-C3403"  
  state = 5  
  ver = 6  
  rel = 1  
  mod = 0  
  fix = 0  
  ptf = ""  
  prereq = "*coreq bos.rte 5.1.0.0"  
  description = ""  
  supersedes = ""
```

```
inventory:  
  lpp_id = 38  
  private = 0  
  file_type = 0  
  format = 1  
  loc0 = "/etc/qconfig"  
  loc1 = ""  
  loc2 = ""  
  size = 0  
  checksum = 0
```

```
history:  
  lpp_id = 38  
  ver = 6  
  rel = 1  
  mod = 0  
  fix = 0  
  ptf = ""  
  state = 1  
  time = 1187714064  
  comment = ""
```

# Software States You Should Know About

<b>Applied</b>	<ul style="list-style-type: none"><li>• Only possible for PTFs or Updates</li><li>• Previous version stored in <code>/usr/lpp/Package_Name</code></li><li>• <i>Rejecting</i> update recovers to saved version</li><li>• <i>Committing</i> update deletes previous version</li></ul>
<b>Committed</b>	<ul style="list-style-type: none"><li>• Removing committed software is possible</li><li>• No return to previous version</li></ul>
<b>Applying, Committing, Rejecting, Deinstalling</b>	<p>If installation was not successful:</p> <ul style="list-style-type: none"><li>• <code>installp -C</code></li><li>• <code>smit maintain_software</code></li></ul>
<b>Broken</b>	<ul style="list-style-type: none"><li>• Cleanup failed</li><li>• Remove software and reinstall</li></ul>

# Predefined Devices (PdDv)

PdDv:

```
type = "scsd"
class = "tape"
subclass = "scsi"
prefix = "rmt"
...
base = 0
...
detectable = 1
...
led = 2418

setno = 54
msgno = 0
catalog = "devices.cat"

DvDr = "tape"

Define = "/etc/methods/define"
Configure = "/etc/methods/cfgstape"
Change = "/etc/methods/chggen"
Unconfigure = "/etc/methods/ucfgdevice"
Undefine = "etc/methods/undefine"
Start = ""
Stop = ""
...
uniquetype = "tape/scsi/scsd"
```



# Predefined Attributes (PdAt)

PdAt:

```
uniquetype = "tape/scsi/scsd"  
attribute = "block_size"  
deflt = ""  
values = "0-2147483648,1"  
...
```

PdAt:

```
uniquetype = "disk/scsi/osdisk"  
attribute = "pvid"  
deflt = "none"  
values = ""  
...
```

PdAt:

```
uniquetype = "tty/rs232/tty"  
attribute = "term"  
deflt = "dumb"  
values = ""  
...
```

# Customized Devices (CuDv)

## CuDv:

```
name = "ent1"  
status = 1  
chgstatus = 2  
ddins = "pci/goentdd"  
location = "02-08"  
parent = "pci2"  
connwhere = "8"  
PdDvLn = "adapter/pci/14106902"
```

## CuDv:

```
name = "hdisk2"  
status = 1  
chgstatus = 2  
ddins = "scdisk"  
location = "01-08-01-8,0"  
parent = "scsi1"  
connwhere = "8,0"  
PdDvLn = "disk/scsi/scsd"
```

# Customized Attributes (CuAt)

**CuAt:**

```
name = "ent1"
```

```
attribute = "jumbo_frames"
```

```
value = "yes"
```

```
...
```

**CuAt:**

```
name = "hdisk2"
```

```
attribute = "pvid"
```

```
value = "00c35ba0816eafe50000000000000000"
```

```
...
```

# Additional Device Object Classes

```
PdCn:  
  uniquetype =  
  "adapter/pci/sym875"  
  connkey = "scsi"  
  connwhere = "1,0"
```

```
PdCn:  
  uniquetype =  
  "adapter/pci/sym875"  
  connkey = "scsi"  
  connwhere = "2,0"
```

```
CuDep:  
  name = "rootvg"  
  dependency = "hd6"
```

```
CuDep:  
  name = "datavg"  
  dependency = "lv01"
```

```
CuDvDr:  
  resource = "devno"  
  value1 = "36"  
  value2 = "0"  
  value3 = "hdisk3"
```

```
CuDvDr:  
  resource = "devno"  
  value1 = "36"  
  value2 = "1"  
  value3 = "hdisk2"
```

```
CuVPD:  
  name = "hdisk2"  
  vpd_type = 0  
  vpd = "*MFIBM          *TM\n\  
        HUS151473VL3800 *F03N5280  
  
*RL53343341*SN009DAFDF*ECH17  
923D      *P26K5531      *Z0\n\  
000004029F00013A*ZVMPSS43A  
*Z20068*Z307220"
```

# Checkpoint

1. In which ODM class do you find the physical volume IDs of your disks?

---

2. What is the difference between state defined and available?

---

---

---

---

---

# Checkpoint Solutions

1. In which ODM class do you find the physical volume IDs of your disks?

CuAt

2. What is the difference between state defined and available?

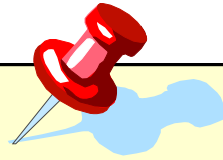
When a device is defined, there is an entry in ODM class **CuDv**. When a device is available, the device driver has been loaded. The device driver can be accessed by the entries in the **/dev** directory.

# Exercise 2: The Object Data Manager (ODM)



- Review of device configuration ODM classes
- Role of ODM during device configuration
- Creating self-defined ODM classes (Optional)

# Unit Summary



- The ODM is made from object **classes**, which are broken into individual **objects** and **descriptors**
- AIX offers a **command line interface** to work with the ODM files
- The **device information** is held in the **customized** and the **predefined** databases (Cu\*, Pd\*)





# System Initialization Part 1



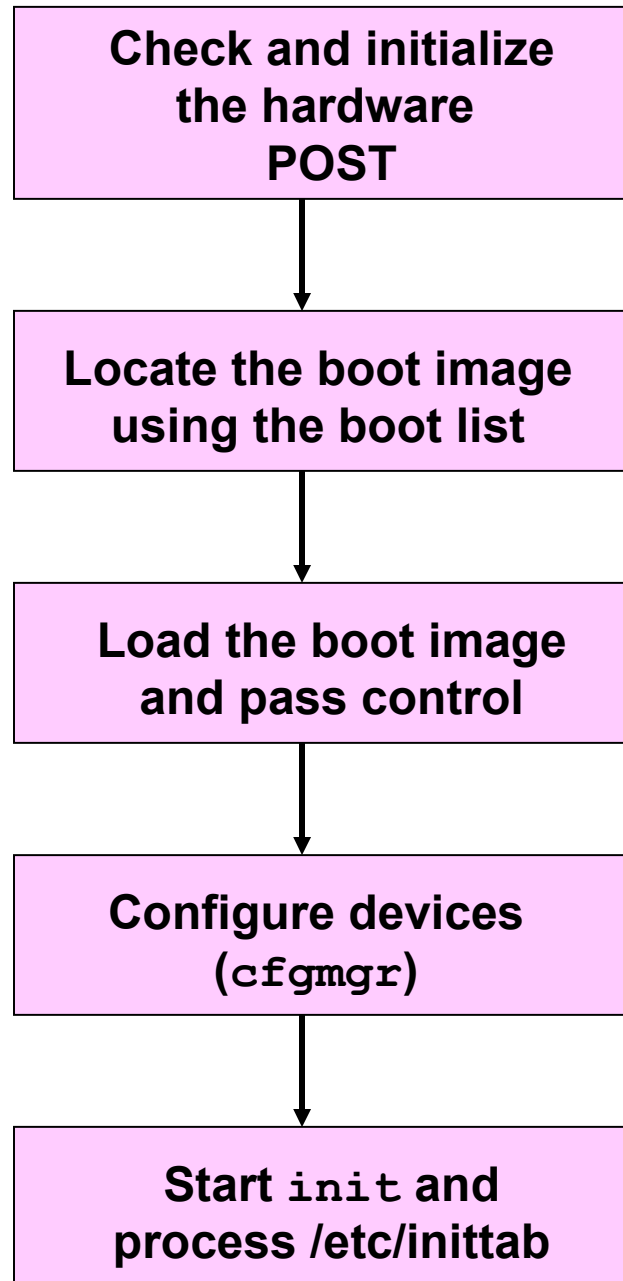
# Unit Objectives

After completing this unit, you should be able to:

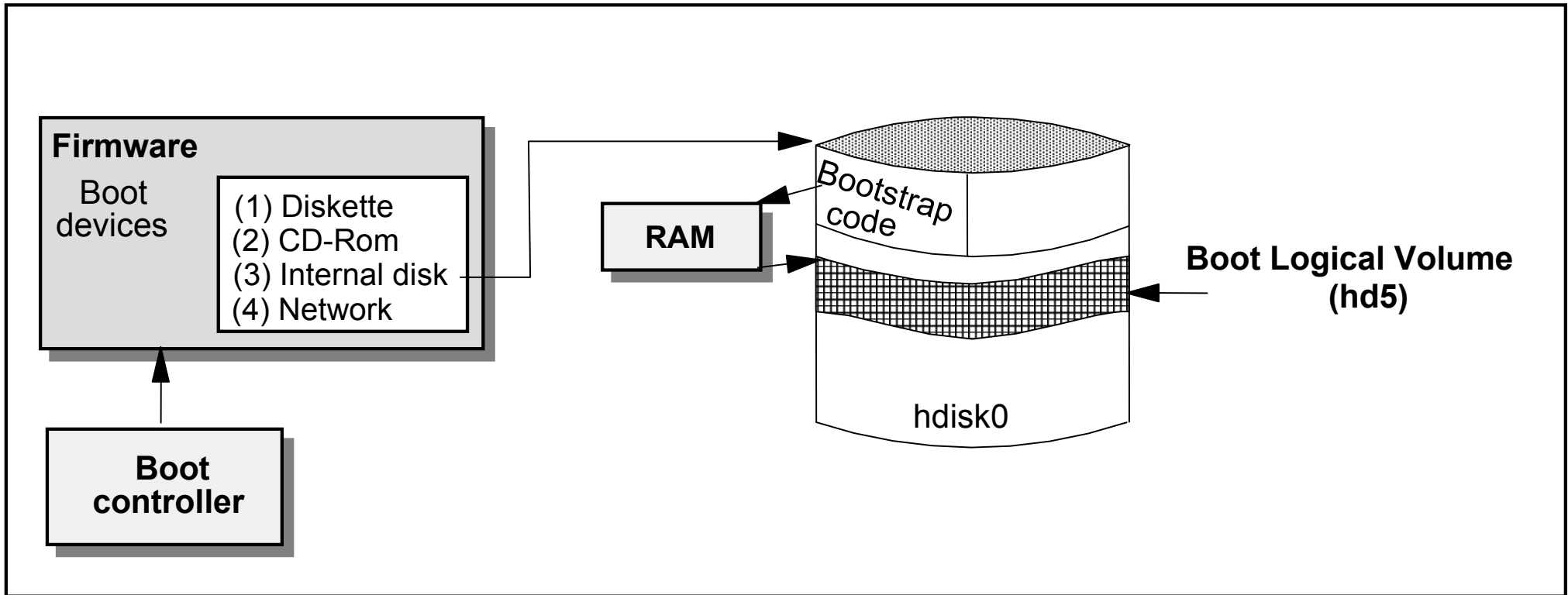
- Describe the boot process through to the loading the boot logical volume
- Describe the contents of the boot logical volume
- Interpret LED codes displayed during boot and at system halt
- Re-create the boot logical volume on a system which is failing to boot
- Describe the features of a service processor

# How Does An AIX System Boot?

---

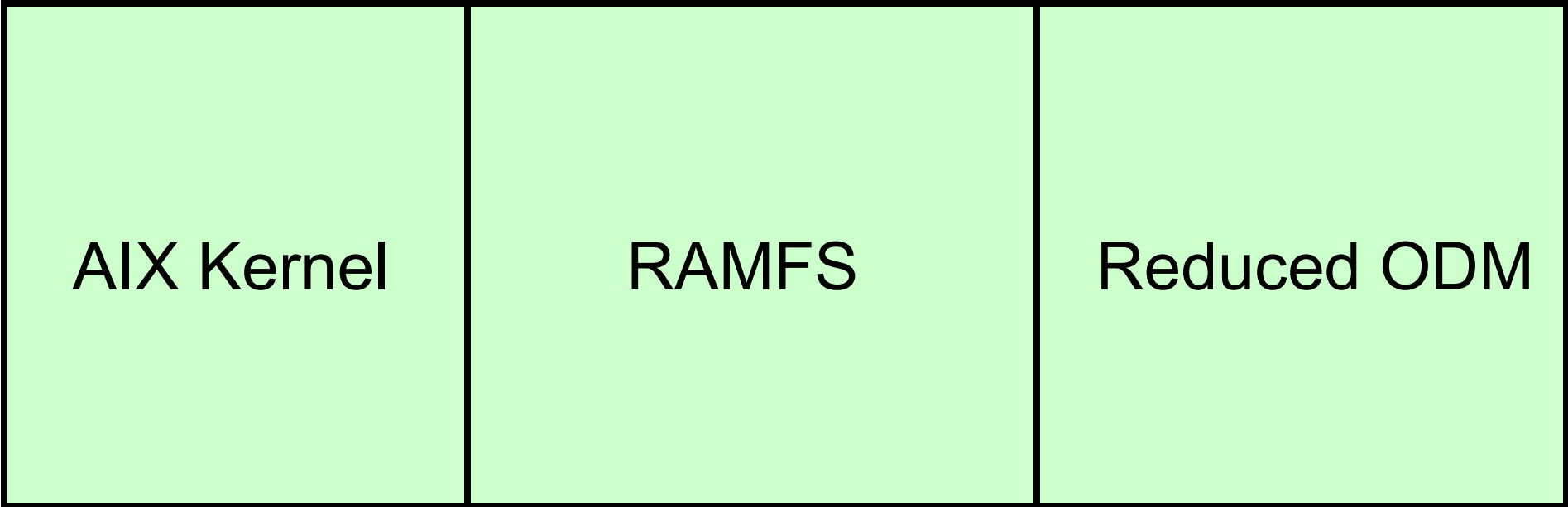


# Loading of a Boot Image



# Contents of the Boot Logical Volume (hd5)

---



# Boot Device Alternatives

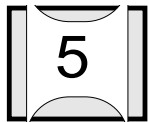
---

- Boot device is first one found with a boot image in bootlist
- If boot device is removable media (CD, DVD, Tape) – boots to the Install and Maintenance m7enu
- If the boot device is a network adapter – boot result depends on NIM configuration for client machine:
  - `nim -o bos_inst` : Install and Maintenance menu
  - `nim -o maint_boot` : Maintenance menu
  - `nim -o diag` : Diagnostic menu
- *If boot device is a disk – boot depends on “service key” usage*
  - Normal mode boot – boot to multi-user
  - Service mode boot – Diagnostic menu
  - Two types of service mode boots:
    - Requesting default service bootlist (key 5 or F5)
    - Requesting customized service bootlist (key 6 or F6)
    - HMC advanced boot options support both of the above options

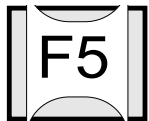
# How to Fix a Corrupted BLV

Boot from bootable  
media:  
CD, tape or NIM

Select volume group  
that contains **hd5**



or



or

HMC boot option  
Diagnostic with  
default bootlist  
or

(**F1** or **#1**  
to set SMS  
options)



Maintenance

1 Access a Root Volume Group

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

```
# shutdown -Fr
```

# Working with Bootlists

---

- Normal Mode:

```
# bootlist -m normal hdisk0 hdisk1
# bootlist -m normal -o
hdisk0 blv=hd5
hdisk1 blv=hd5
```

- Service Mode:

```
# bootlist -m service -o
cd0
hdisk0 blv=hd5
ent0
```

# diag

## TASK SELECTION LIST

```
Display Service Hints
Display Software Product Data
Display or Change Bootlist
Gather System Information
```





# Starting System Management Services

- Reboot or power on the system
- Press **F1** or numeric **1** or specify SMS on HMC activate

```

IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM IBM
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```

```

1 = SMS Menu
8 = Open Firmware Prompt

```

```

5 = Default Boot List
6 = Stored Boot List

```

```

Memory Keyboard Network SCSI

```

```

...

```

# Working with Bootlists in SMS (1 of 2)

2. Tape  
System Management Services  
Main Menu

3. CD/DVD

3. Select Language

4. Setup Remote IPL  
(Initial Program Load)

5. Change SCSI Settings

6. Select Console

7. Select Boot Options

Multiboot

1. Select Install/Boot Device

2. Configure Boot Device Order

3. Multiboot Startup <OFF>

Configure Boot Device Order

1. Select 1st Boot Device

2. Select 2nd Boot Device

3. Select 3rd Boot Device

4. Select 4th Boot Device

5. Select 5th Boot Device

6. Display Current Setting

7. Restore Default Setting

6. Network

7. None

8. List All Devices

====> 8

# Working with Bootlists in SMS (2 of 2)

Select Device

Device Current Device

Number Position Name

1. - IBM 10/100/1000 Base-TX PCI-X Adapter

( loc=U789D.001.DQDWAYT-P1-C5-T1 )  
Select Task

2. -

SAS 73407 MB Harddisk, part=2 (AIX 6.1.0)

3. 1

( loc=U789D.001.DQDWAYT-P3-D1 )  
Current Boot Sequence

4. None

1. SAS 73407 MB Harddisk, part=2 (AIX 6.1.0)

====> 2

1. Inform

( loc=U789D.001.DQDWAYT-P3-D1 )

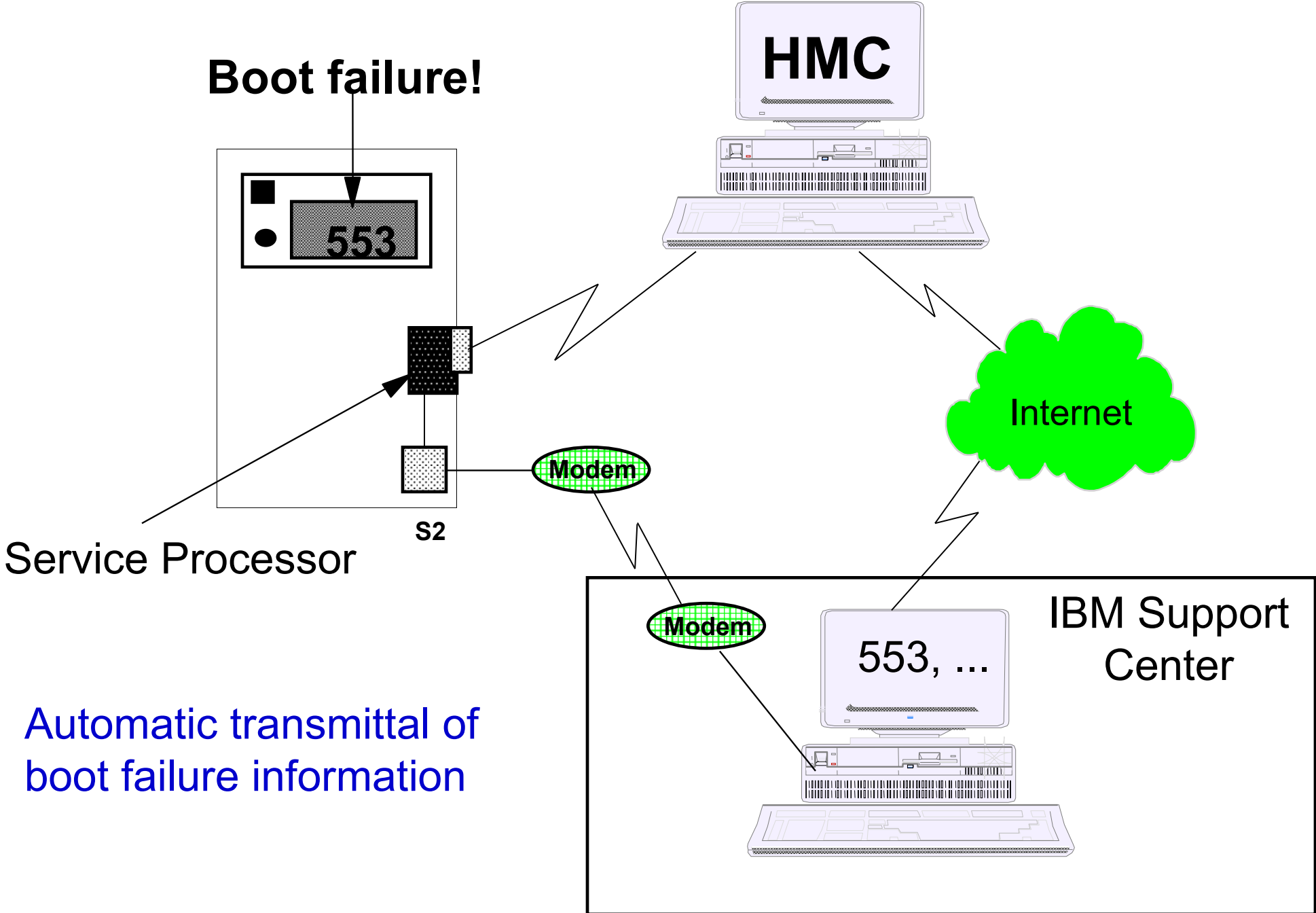
2. Set Bo

2. None

3. None

====> 2

# Service Processors and Boot Failures



Automatic transmittal of boot failure information

# Let's Review

- True or False? You must have AIX loaded on your system to use the System Management Services programs.
- Your AIX system is currently powered off. AIX is installed on **hdisk1** but the bootlist is set to boot from **hdisk0**. How can you fix the problem and make the machine boot from **hdisk1**?

---

---

3. Your machine is booted and at the # prompt.
- What is the command that will display the bootlist?  
\_\_\_\_\_
  - b) How could you change the bootlist?  
\_\_\_\_\_

4. What command is used to build a new boot image and write it to the boot logical volume?

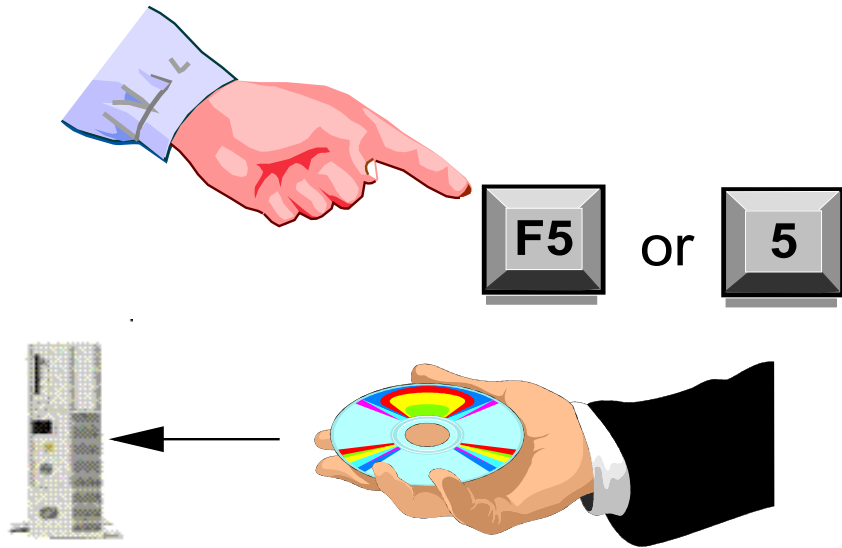
---

5. What script controls the boot sequence? \_\_\_\_\_

# Let's Review Solutions

- True or False? You must have AIX loaded on your system to use the System Management Services programs. False. SMS is part of the built-in firmware.
- 2. Your AIX system is currently powered off. AIX is installed on **hdisk1** but the bootlist is set to boot from **hdisk0**. How can you fix the problem and make the machine boot from **hdisk1**? You need to boot the SMS programs. Press **F1** or **1** when the logos appear at boot time and set the new boot list to include **hdisk1**.
- 3. Your machine is booted and at the **#** prompt.
  - What is the command that will display the bootlist? **bootlist -om normal.**
  - How could you change the bootlist? **bootlist -m normal device1 device2**
- What command is used to build a new boot image and write it to the boot logical volume? **bosboot -ad /dev/hdiskx**
- What script controls the boot sequence? **rc.boot**

# Accessing a System That Will Not Boot



**Boot the system from  
the BOS CD-ROM, tape  
or  
network device (NIM)**

**Select maintenance mode**

## **Maintenance**

- **Access a Root Volume Group**
- Copy a System Dump to Media
- Access Advanced Maintenance
- **Install from a System Backup**

**Perform corrective actions**

**Recover data**

# Booting in Maintenance Mode

## Define the System Console

Type the number of your choice and press Enter.

>>> 1 Access a Root Volume Group



Maintenance

2 Copy a System Dump to Removable Media

3 Access Advanced Maintenance Functions

4 Erase Disks

5 Configure Network Disks (iSCSI) Choice [1]: 3

6 Install from a System Backup

Choice [1]: 1

Welcome to Base Operating System  
Installation and Maintenance

Type the number of your choice and press Enter.  
Choice is indicated by >>>.

>>> 1 Start Install Now with Default Settings

2 Change/Show Installation Settings and Install

**3 Start Maintenance Mode for System Recovery**

4 Configure Network Disks (iSCSI)



# Working in Maintenance Mode

## Access a Root Volume Group

Type the number for a volume group to display the logical volume information and press Enter.

- 1) Volume Group 00c35ba000004c00000001153ce1c4b0 contains these disks:

hdisk1 70006 02-08-00      hdisk0 70006 02-08-00

Choice: 1

## Volume Group Information

Volume Group ID 00c35ba000004c00000001153ce1c4b0 includes the following logical volumes:

hd5      hd6      hd8      hd4      hd2      hd9var  
hd3      hd1      hd10opt

Type the number of your choice and press Enter.

- 1) Access this Volume Group and start a shell
- 2) Access this Volume Group and start a shell before mounting filesystems

99) Previous Menu

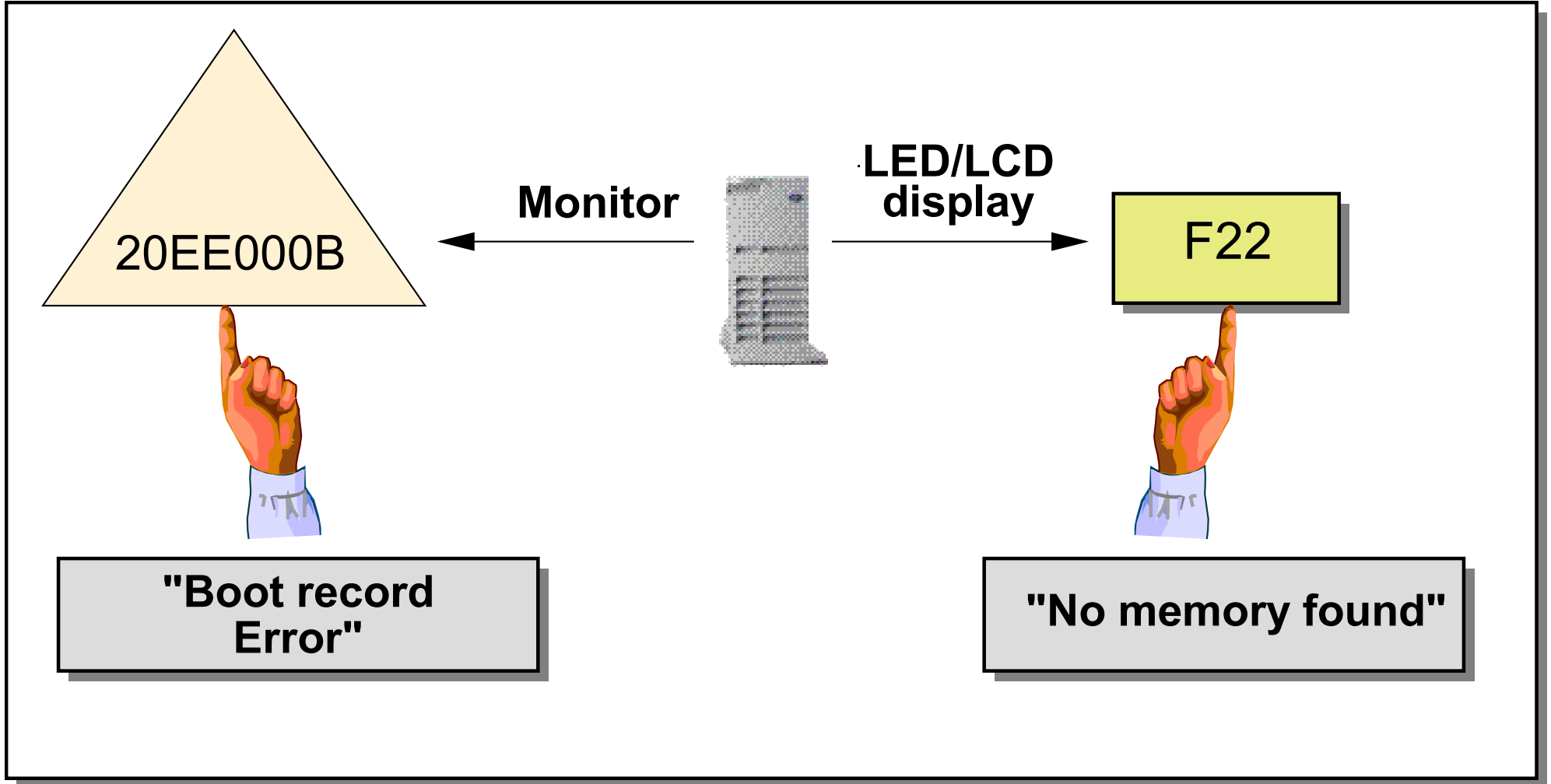
Choice [99]: 1

# Progress and Reference Codes

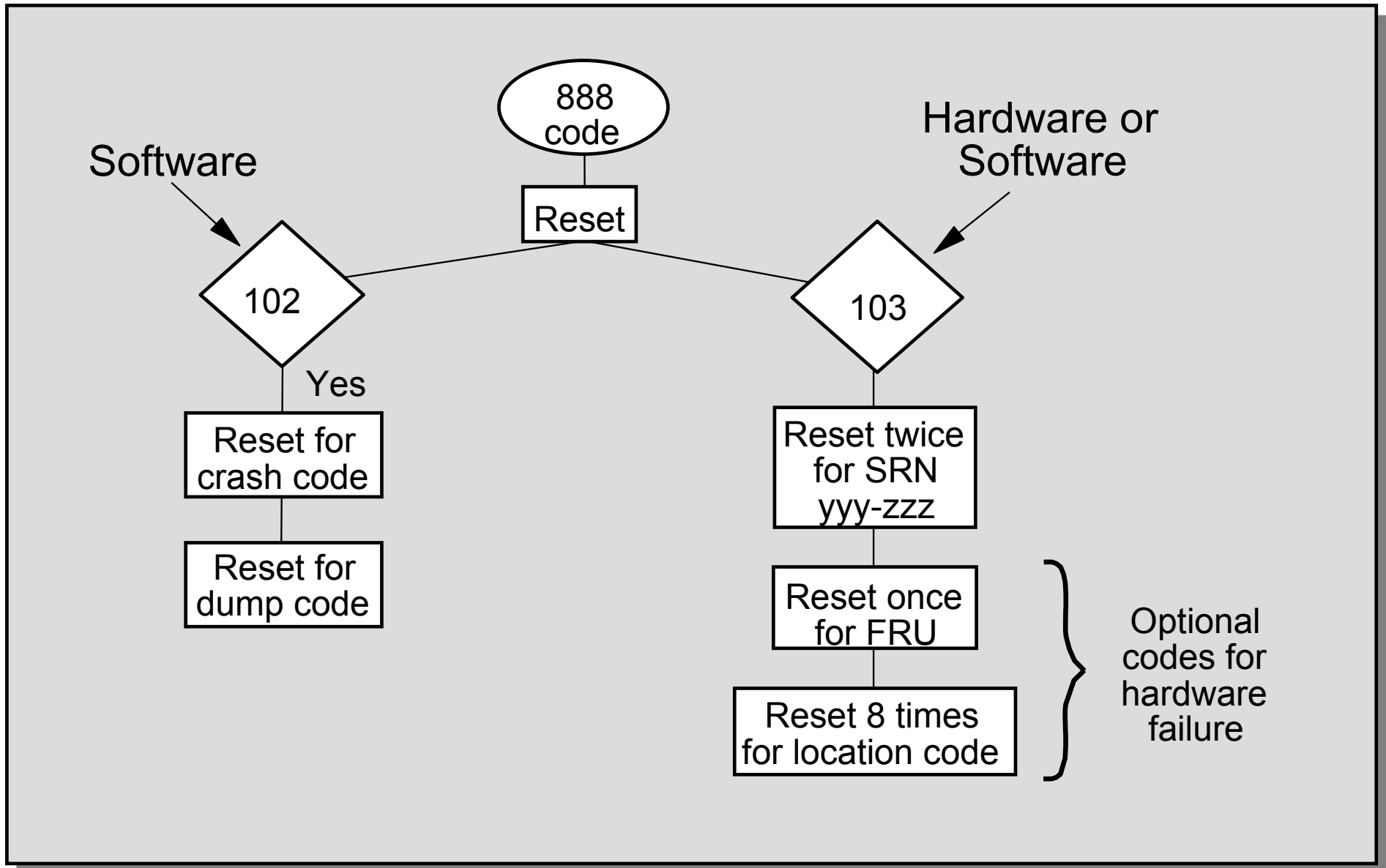
---

- Progress Codes
- System Reference Codes (SRCs)
- Service Request Numbers (SRNs)
- Obtained from:
  - Front panel of system enclosure
  - HMC or IVM (for logically partitioned systems)
  - Operator console message or diagnostics (diag utility)
- Online hardware and AIX documentation available at:  
*<http://publib.boulder.ibm.com/infocenter/systems>*
  - Search for: “**service support troubleshooting**”
    - Customer Service, Support, and Troubleshooting manual
    - Covers procedures and lists of reference codes
  - For AIX progress codes, search for “**AIX Progress Codes**”
  - For AIX message codes, click on **Message Center**
- *RS/6000 Eserver pSeries Diagnostic Information for Multiple Bus Systems (SA38-0509)*

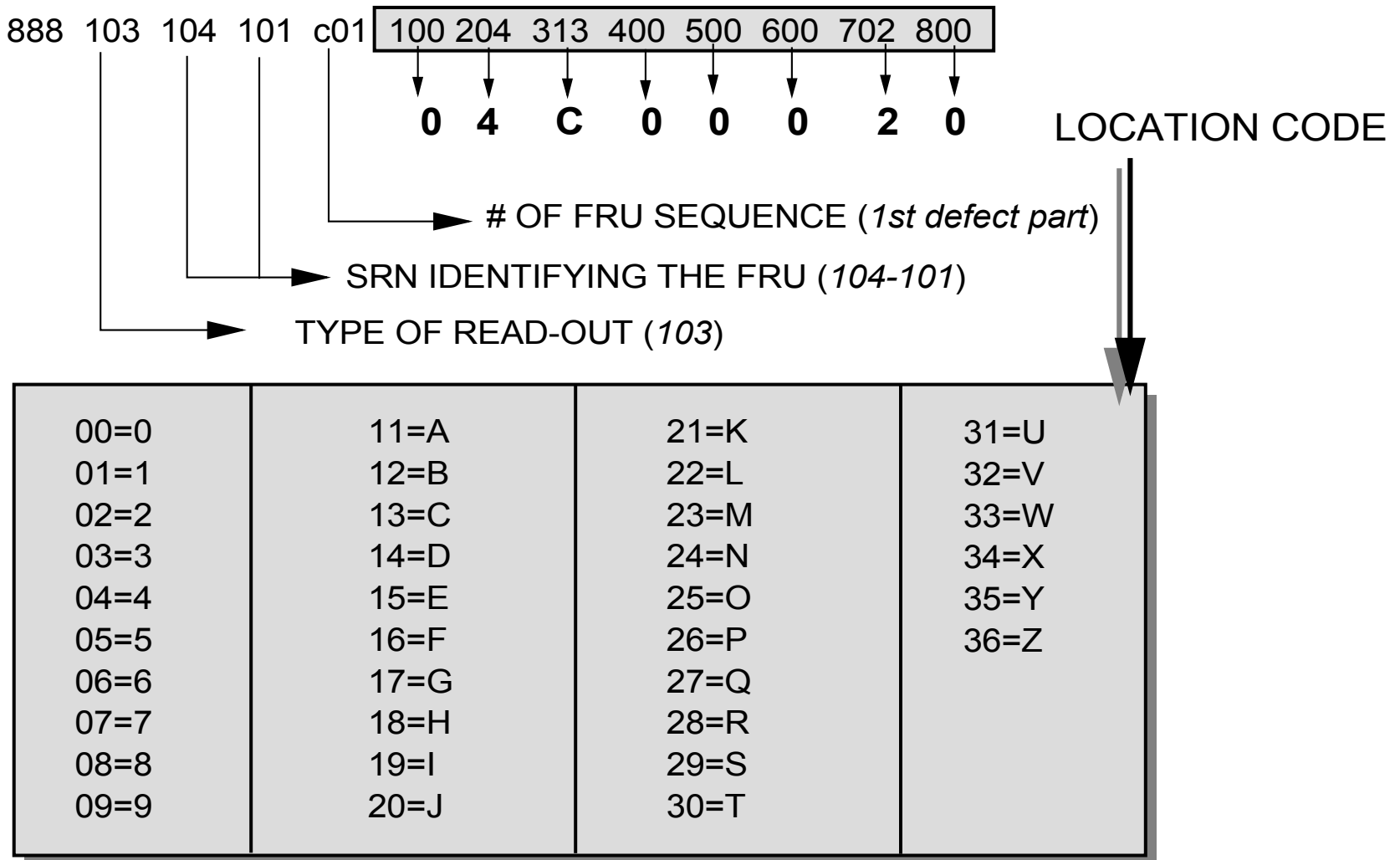
# Firmware Checkpoints and Error Codes



# LED 888 Code



# Understanding the 103 Message



**FRU** = Field Replaceable Unit

**SRN** = Service Request Number

# Problem Reporting Form (1 of 2)

- Search for “Problem Reporting Form” at information center
- Items to fill in:
  - Your name, Mailing address, Telephone number, Fax number
  - IBM customer number, if available
  - Date and time that the problem occurred
  - Description of the problem
  - Machine type, Model, Serial number
  - Logical partition state, Logical partition ID
  - Logical partition operating system, version, and release
  - IPL type, IPL mode
  - Message ID, Message text
  - From/send program, Instruction number
  - To/receive program, Instruction number
  - Service request number (SRN) SRN:
  - In what mode were AIX hardware diagnostics run?  
Online? Stand-alone? Service mode? Concurrent mode?
  - Go to the HMC or control panel and indicate whether the following lights are on: Power On. System Attention

(continued on next page)

# Problem Reporting Form (2 of 2)

- Using the HMC (reference code history) or control panel (using increment button), find and record the values for functions 11 through 19.

(See *Collecting reference codes and system information* for step-by-step instructions on finding reference codes. )

- Use the grid to record the characters shown on the HMC.

11    \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_

12    \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_

...

19    \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_

20 (if you use the control panel – use increment button) \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_

\_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_ \_\_\_  
20 (if you use the HMC) Machine type: Model: Processor feature code: IPL  
type:

Note: For item 20:

if HMCv7: Use Serviceability ... Control Panel Functions

if pre HMCv7: Use Service Focal Point ... Service Utilities... Operator Panel  
Service Functions

# Firmware Fixes

---

- The following types of firmware (Licensed Internal Code) fixes are available:
  - Server firmware
  - Power subsystem firmware
  - I/O adapter and device firmware
- Types of firmware maintenance:
  - Disruptive (always for upgrades to new version/release)
  - Concurrent (only if using HMC interface for service pack)
- Firmware maintenance can be done:
  - Using the HMC
  - Through the operating system (service partition)
- Systems with an HMC should normally use the HMC
- Firmware maintenance through the operating system is always disruptive



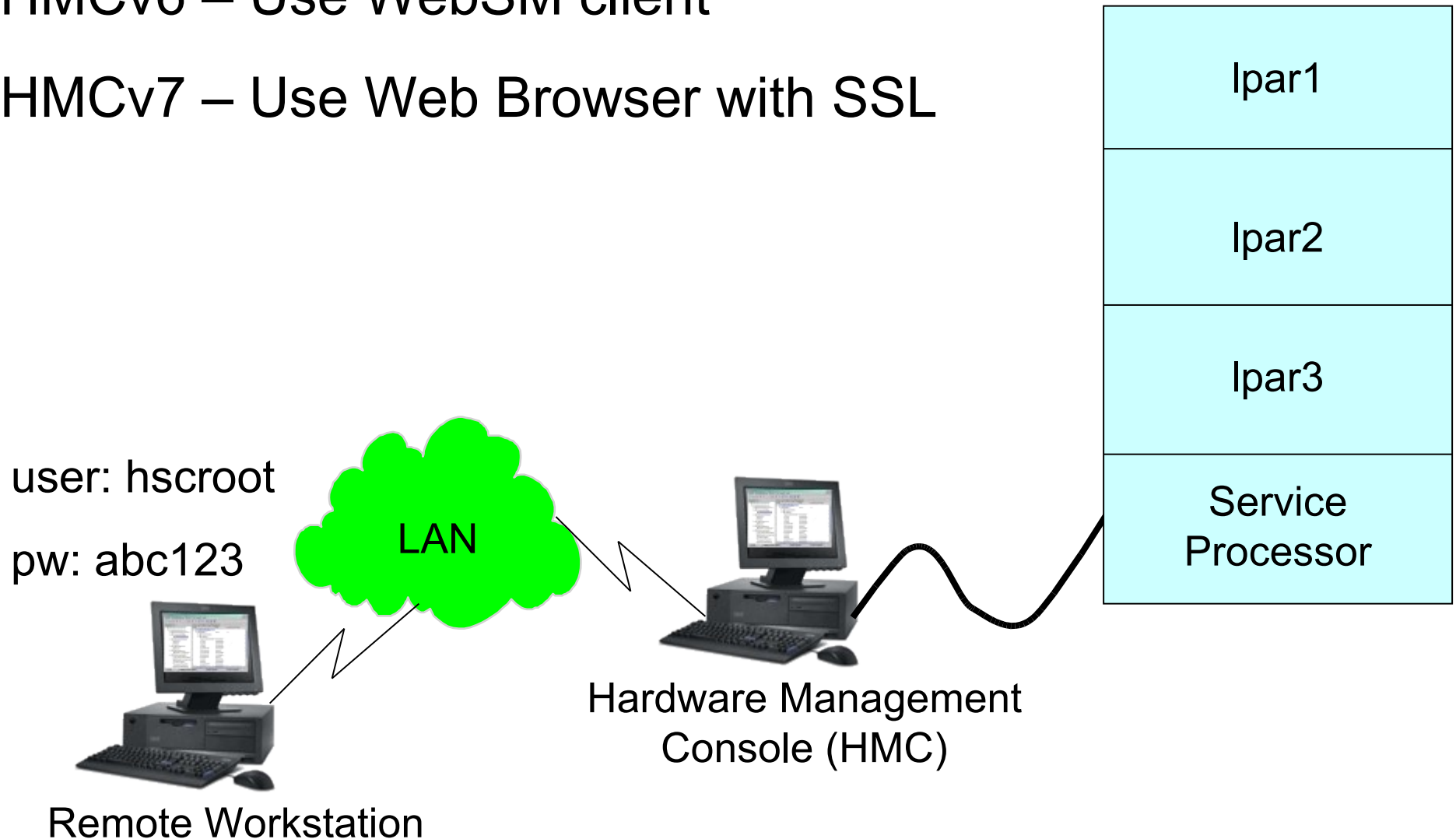
# Getting Firmware Updates from the Internet

---

- Get firmware updates from IBM at:  
*<http://techsupport.services.ibm.com/server/mdownload>*
- Update firmware through:
  - [Hardware Management Console](#)
- For more information, go to the online *Performing Licensed Internal Code Maintenance* course:
  - <http://www-1.ibm.com/servers/resourcelink>
  - **Select Education**
  - **Select eServer i5 and eServer p5  
or System p POWER6 hardware**
  - **Select Performing Licensed Internal Code Maintenance**

# HMC Remote Access

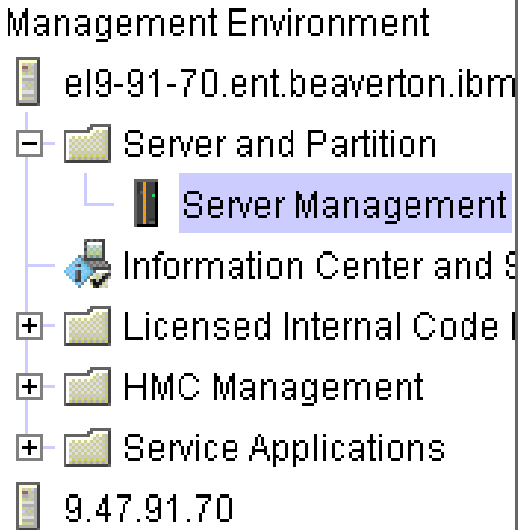
- HMCv6 – Use WebSM client
- HMCv7 – Use Web Browser with SSL



# HMCv6: Server Management

Web-based System Manager - /home/hscroot/WebSM.pref: /Management Environment/el9-91-70.er

Console Server Management Selected View Window Help



**Navigation Area**

- Management Environment
  - el9-91-70.ent.beaverton.ibm
  - Server and Partition
    - Server Management**
    - Information Center and S
  - Licensed Internal Code I
  - HMC Management
  - Service Applications
- 9.47.91.70

**Server and Partition: Server Management**

Name	State	Operator Panel Value
[-] Server-9111-520-SN10F19...	Operating	
[-] Partitions		
[+] el9-91-73	Running	
[+] LPAR2_el9-91-68	Not Activated	00000000
[+] WaynesWorld	Open Firmware	AA00E1A9
[-] System Profiles		
[-] Server-9111-520-SN10F19...	Operating	
[-] Partitions		
[+] el9-91-68	Running	
[+] el9-91-71	Not Activated	00000000
[+] VIOserver1	Running	
[+] vlp1	Not Activated	00000000
[-] System Profiles		

# HMCv6: Activate a Partition

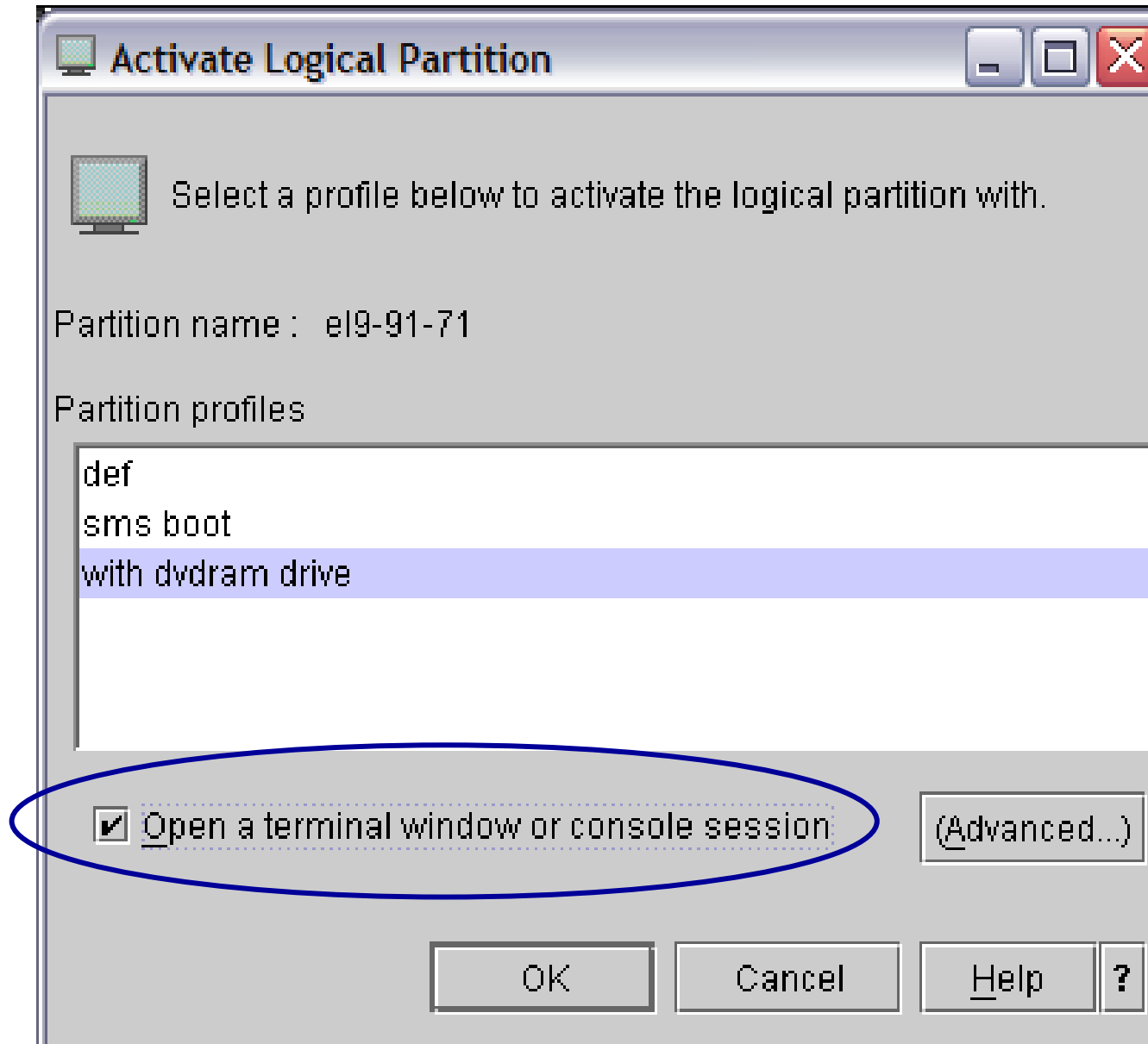
- Partition must be in the *Not Activated* state
- Select the partition profile name and right-click Activate

The screenshot displays the 'Server and Partition: Server Management' interface. It features a tree view on the left and a table on the right. The tree view shows a server with two 'Partitions' folders. The second server's 'Partitions' folder is expanded, showing several partitions: 'el9-91-68' (Running), 'el9-91-71' (Not Activated), 'def' (checked), 'sms boot', and 'with dvdram drive' (highlighted). A context menu is open over the 'with dvdram drive' partition, listing options: Properties, Delete, Copy, Activate (highlighted), and Add Managed System(s). The table on the right shows the state of these partitions.

Name	State	Operator Panel Value
Server-9111-520-SN10F19... Operating		
+ Partitions		
System Profiles		
Server-9111-520-SN10F19... Operating		
- Partitions		
+ el9-91-68	Running	
- el9-91-71	Not Activated	
+ def		
+ sms boot		
+ with dvdram drive		
+ VIOserver1	Running	
+ vlpar1	Not Activated	00000000
System Profiles		

# HMCv6: Activating Partition with Console

- Select the profile and check the terminal window check box



# HMCv7: Server Management

The screenshot displays the Hardware Management Console (HMC) interface within a Microsoft Internet Explorer browser window. The browser's address bar shows the URL: `https://10.31.198.151 - rt1s3hmc: Hardware Management Console Workplace (V7R310.0) - Microsoft Internet E...`. The page title is "Hardware Management Console".

The interface is divided into a left navigation pane and a main content area. The navigation pane includes the following items:

- Welcome
- Systems Management
  - Servers
    - rt1s3fsp** (highlighted with a blue circle)
  - Custom Groups
- System Plans
- HMC Management
- Service Management
- Updates

The main content area displays a "Welcome" message and a list of management tasks with their descriptions:

- Systems Management**: Manage servers, logical partitions, managed systems, and frames; set up, configure, view current status, troubleshoot, and apply solutions.
- System Plans**: Import, deploy, and manage system plans on the HMC.
- HMC Management**: Perform management tasks to set up, configure, and customize operations associated with this HMC.
- Service Management**: Perform service tasks to create, customize and manage services associated with this HMC.
- Updates**: Perform and manage updates on your system.
- Status Bar**: View details of status and messages.
- Additional Resources**
  - Guided Setup Wizard**: Provides a step-by-step process to configure your HMC.

At the bottom of the navigation pane, there is a "Status: Open Serviceable Events" section with four icons: a list, a close button, a warning triangle, and a wrench.

The browser's status bar at the bottom shows the message: "Applet com.ibm.hwmca.fw.servlet.taskcontroller.applet.TaskControllerApplet started".

# HMCv7: Activate Partition Operation

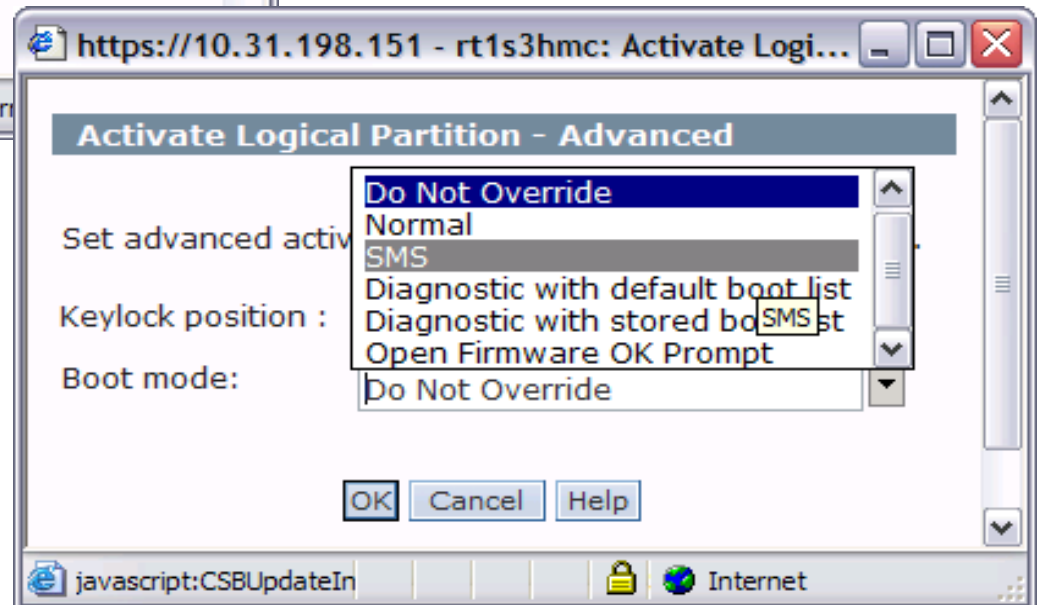
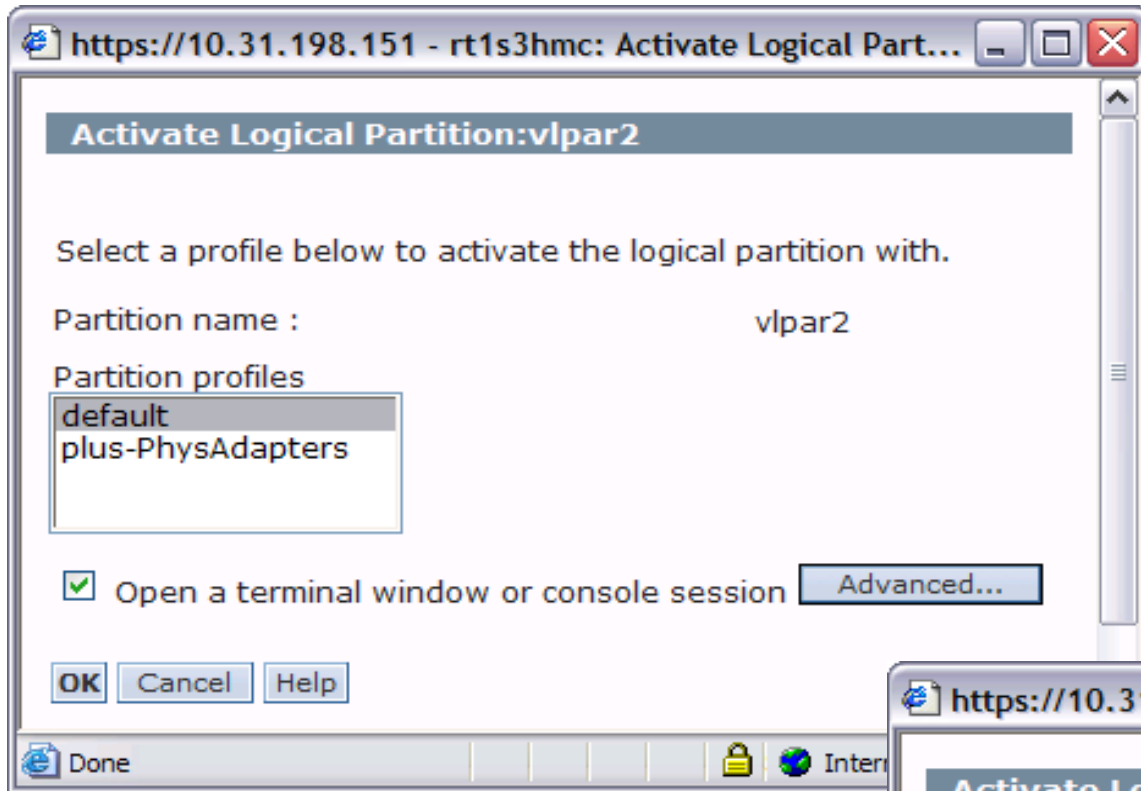
The screenshot displays the Hardware Management Console (HMC) interface in a Microsoft Internet Explorer browser window. The address bar shows the URL: `https://10.31.198.151 - rt1s3hmc: Hardware Management Console Workplace (V7R310.0) - Microsoft Internet Ex...`. The main title is "Hardware Management Console".

The interface is divided into several sections:

- Left Navigation Panel:** Contains "Welcome", "Systems Management" (with sub-items "Servers" and "rt1s3fsp"), "Custom Groups", "System Plans", "HMC Management", "Service Management", and "Updates".
- Table:** Titled "Contents of: rt1s3fsp". It contains a table with columns: "Sel...", "Name", "Status", "Proces... Units", "Mem... (GB)", "Act... Pro...", "Environm...", and "Referenc... Code". The table lists several partitions, with "v1par2" selected (checkbox checked).
- Context Menu:** A menu is open over the "v1par2" row, showing options: "Properties", "Change Default Profile", "Operations" (highlighted), "Configuration", "Hardware Information", "Console Window", and "Serviceability". The "Operations" sub-menu is also open, showing "Activate", "Manage Attention LED", "Schedule Operations", and "Delete".
- Bottom Panel:** Titled "Tasks: v1par2 [ Expand All | Collapse All ]". It lists tasks: "Properties", "Change Default Profile", "Operations" (expanded), "Configuration", "Hardware Information", and "Console Window".
- Status Bar:** Shows "Status: Open Serviceable Ev..." and a message: "Applet com.ibm.hwmca.fw.servlet.taskcontroller.applet.TaskControllerApplet started".

Sel...	Name	Status	Proces... Units	Mem... (GB)	Act... Pro...	Environm...	Referenc... Code
<input type="checkbox"/>	atlnim02			2	2	Default	ADX or Linux
<input type="checkbox"/>	rt1s3vio				1	default	Virtual I/O Se...
<input type="checkbox"/>	Teds_pla			.75	default	ADX or Linux	
<input checked="" type="checkbox"/>	v1par2			1	default	ADX or Linux	00000000

# HMCv7: Activate Partition Options





# Checkpoint

- True or False? During the AIX boot process, the AIX kernel is loaded from the **root** file system.
- True or False? A service processor allows actions to occur even when the regular processors are down.

5. How do you boot an AIX machine in maintenance mode?

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6. Your machine keeps rebooting and repeating the POST. What can be the reason for this?

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# Checkpoint Solutions

- True or **False**? During the AIX boot process, the AIX kernel is loaded from the **root** file system.

False. The AIX kernel is loaded from **hd5**.

- **True** or False? A service processor allows actions to occur even when the regular processors are down.

- How do you boot an AIX machine in maintenance mode?

You need to boot from an AIX CD, **mksysb**, or NIM server.

6. Your machine keeps rebooting and repeating the POST. What can be the reason for this?

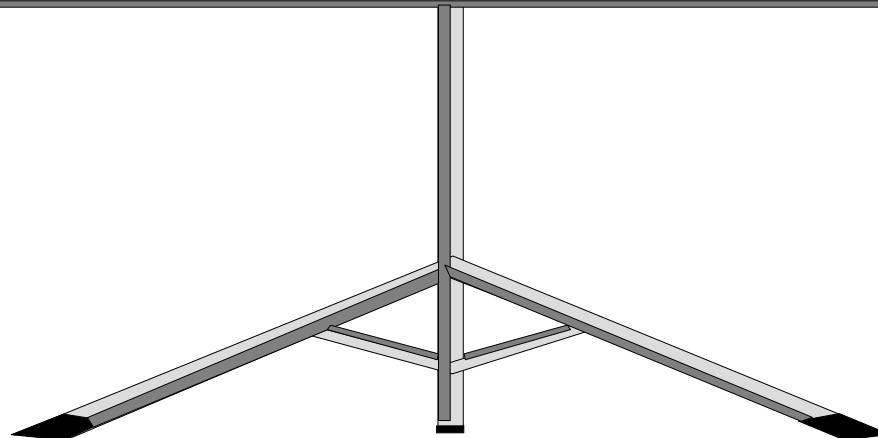
Invalid boot list, corrupted boot logical volume, or hardware failures of boot device.

# Exercise 3: System Initialization Part I

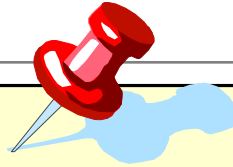
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- Work with bootlists and identify information on your system
- Identify LVM information from your system
- Repair a corrupted boot logical volume



# Unit Summary



- During the boot process, the kernel from the boot image is loaded into memory.
- Boot devices and sequences can be updated using the `bootlist` command, the `diag` command, and SMS.
- The boot logical volume contains an AIX kernel, an ODM, and a RAM file system (that contains the boot script `rc.boot` that controls the AIX boot process).
- The boot logical volume can be re-created using the `bosboot` command.
- LED codes produced during the boot process can be used to diagnose boot problems.



Welcome to:

# System Initialization Part 2



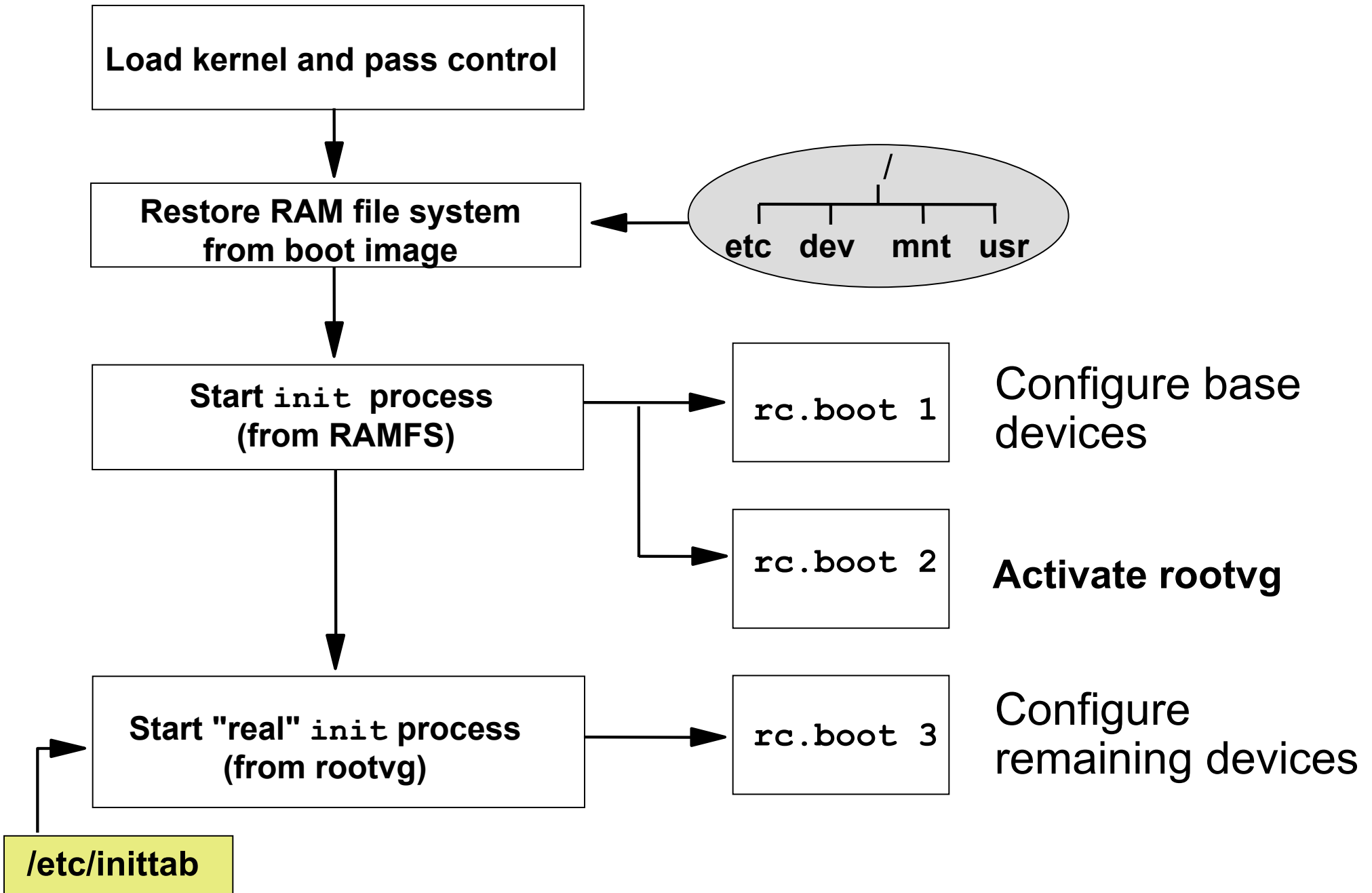
# Unit Objectives

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After completing this unit, you should be able to:

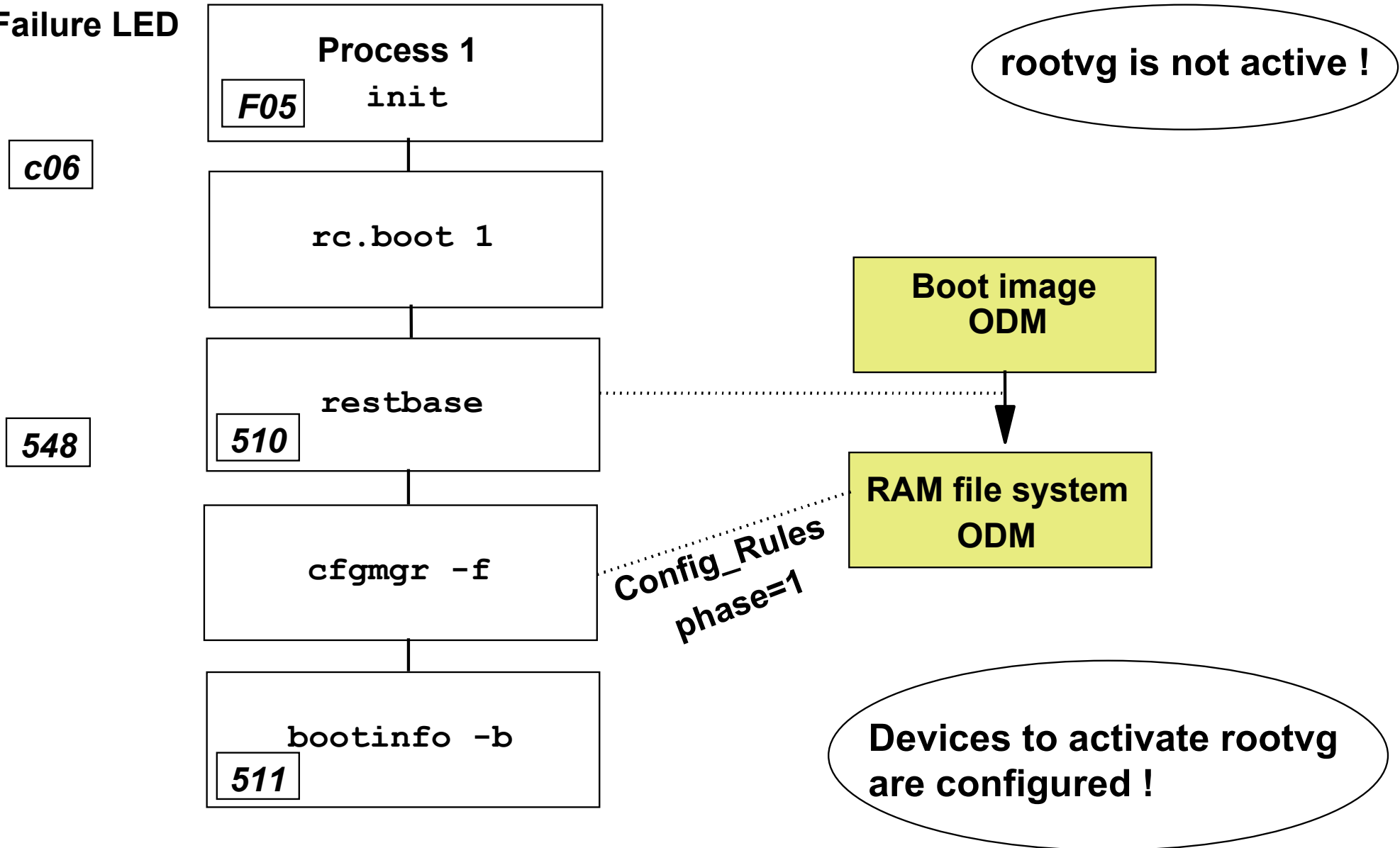
- Identify the steps in system initialization from loading the boot image to boot completion
- Identify how devices are configured during the boot process
- Analyze and solve boot problems

# System Software Initialization Overview



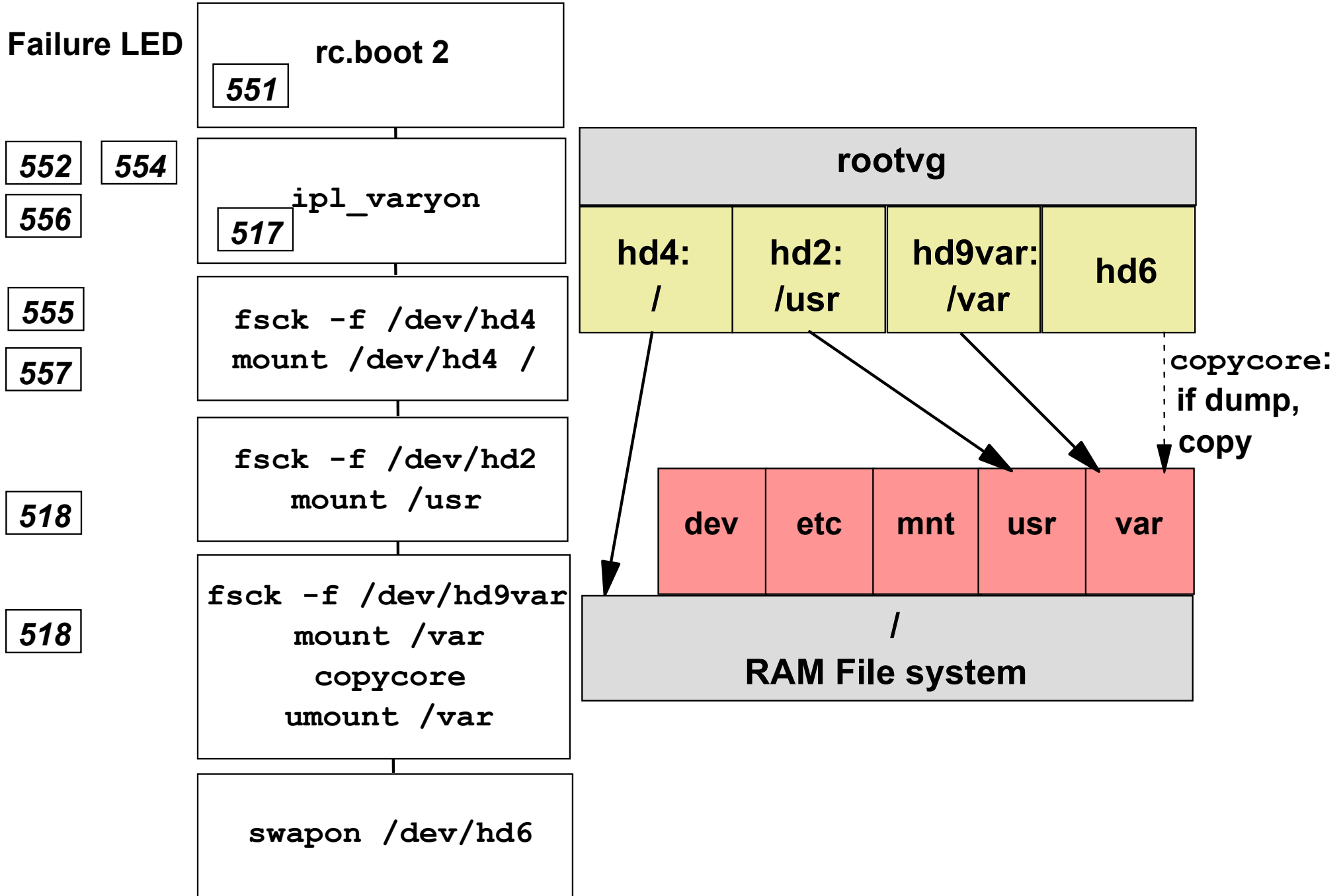
# rc.boot 1

Failure LED

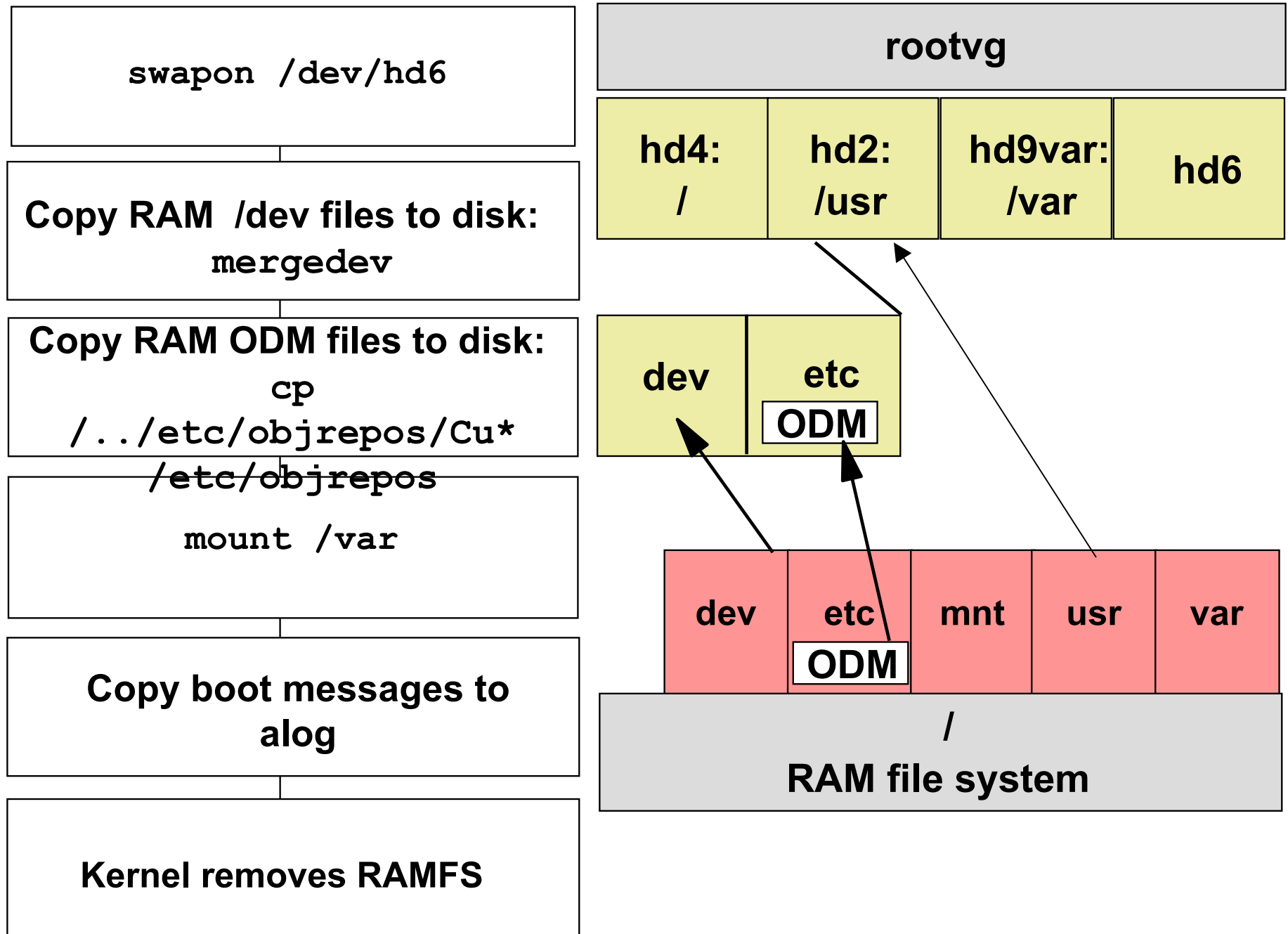




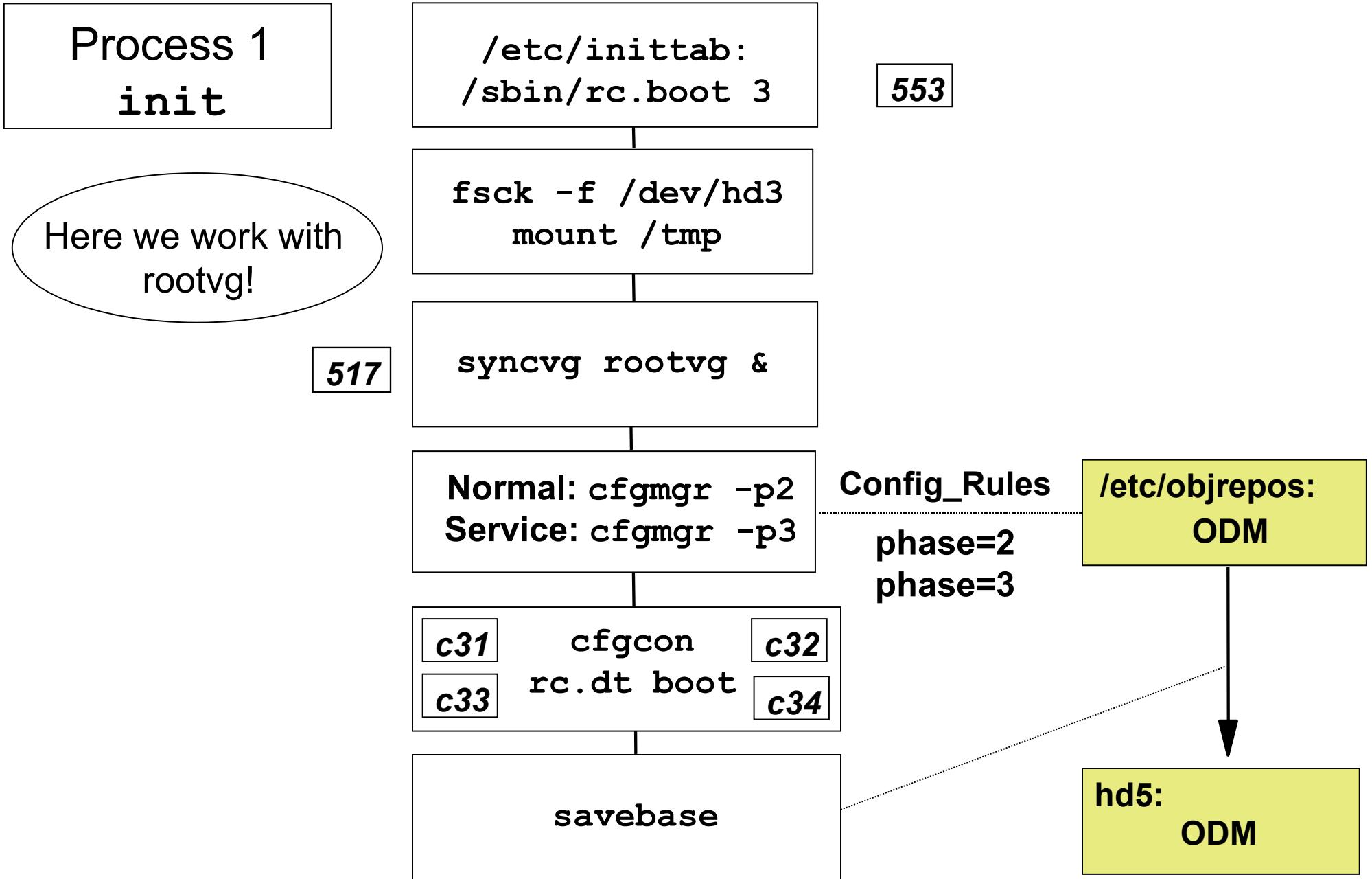
# rc.boot 2 (Part 1)



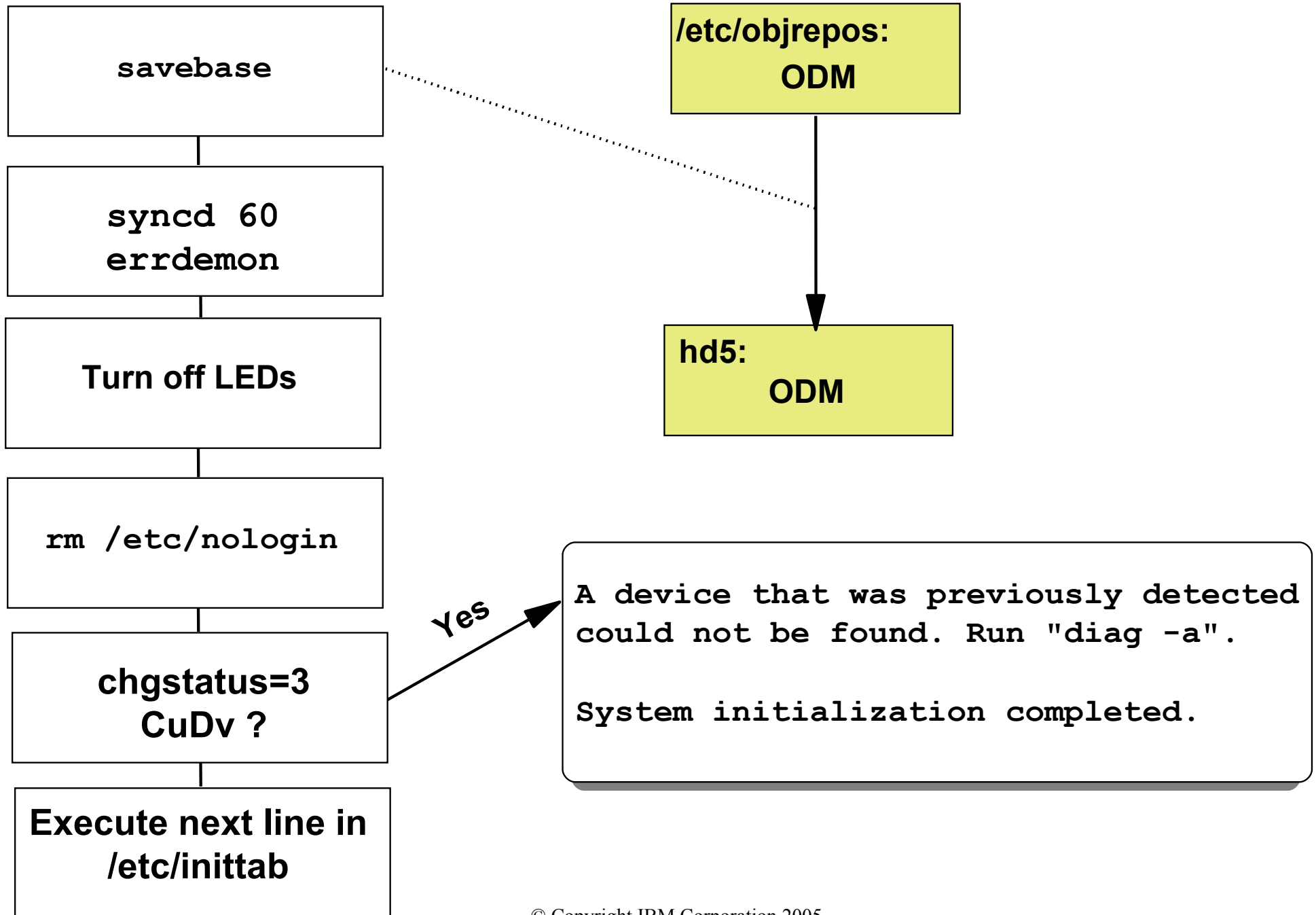
# rc.boot 2 (Part 2)



# rc.boot 3 (Part 1)



# rc.boot 3 (Part 2)

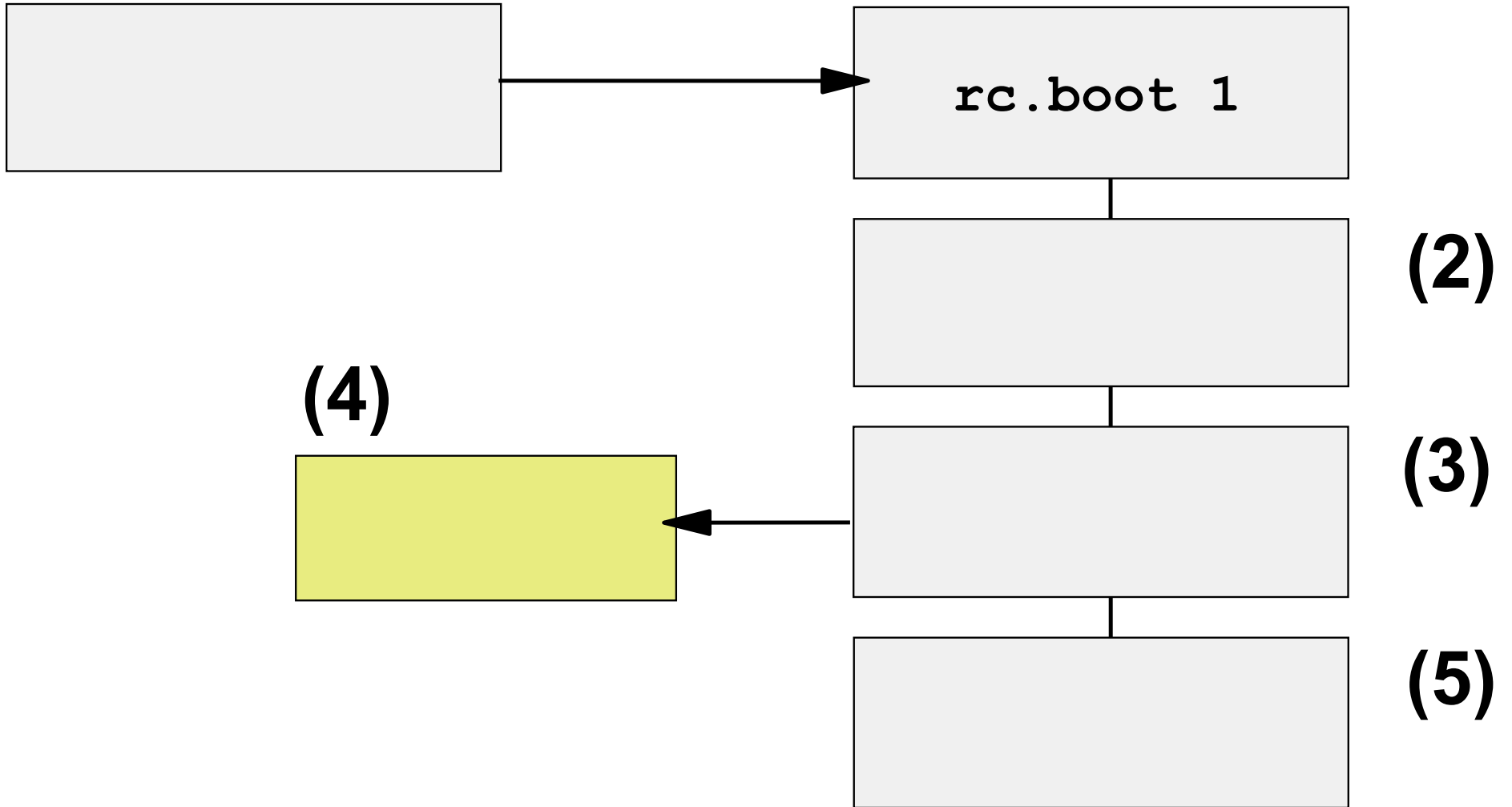


# ~~rc.boot~~ Summary

	Where From	Action	Phase Config_Rules
rc.boot 1	/dev/ram0	restbase cfgmgr -f	1
rc.boot 2	/dev/ram0	ipl_varyon rootvg Merge /dev Copy ODM	
rc.boot 3	rootvg	cfgmgr -p2 cfgmgr -p3 savebase	2-normal 3-service

# Let's Review: rc.boot 1

(1)



# ~~Let's Review Solution: rc.boot 1~~

(1)

`/etc/init` from RAMFS  
in the boot image



`rc.boot 1`



`restbase`

(2)



`cfgmgr -f`

(3)

(4)

ODM files  
in RAM file  
system



`bootinfo -b`

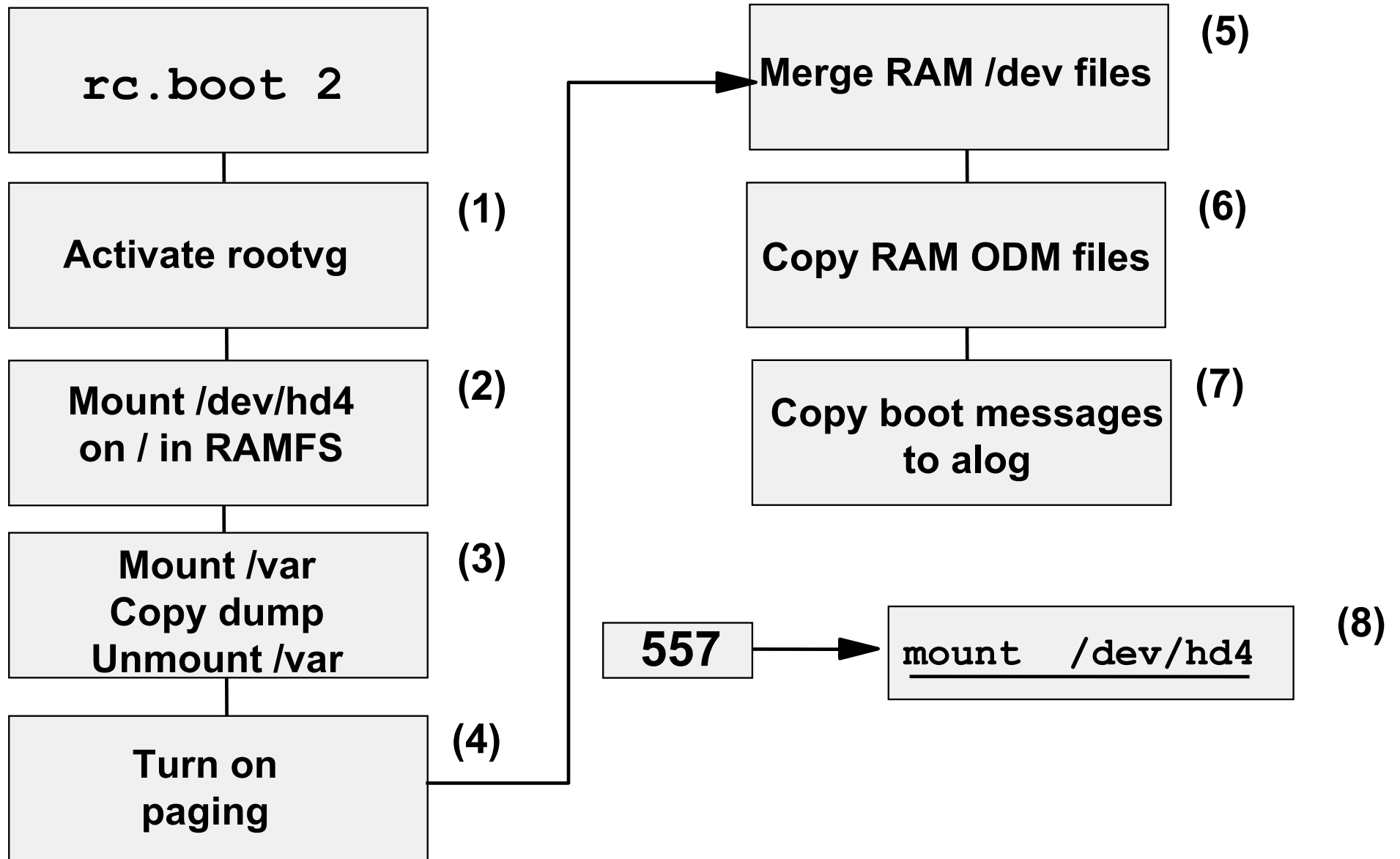
(5)

# Let's Review: rc.boot 2

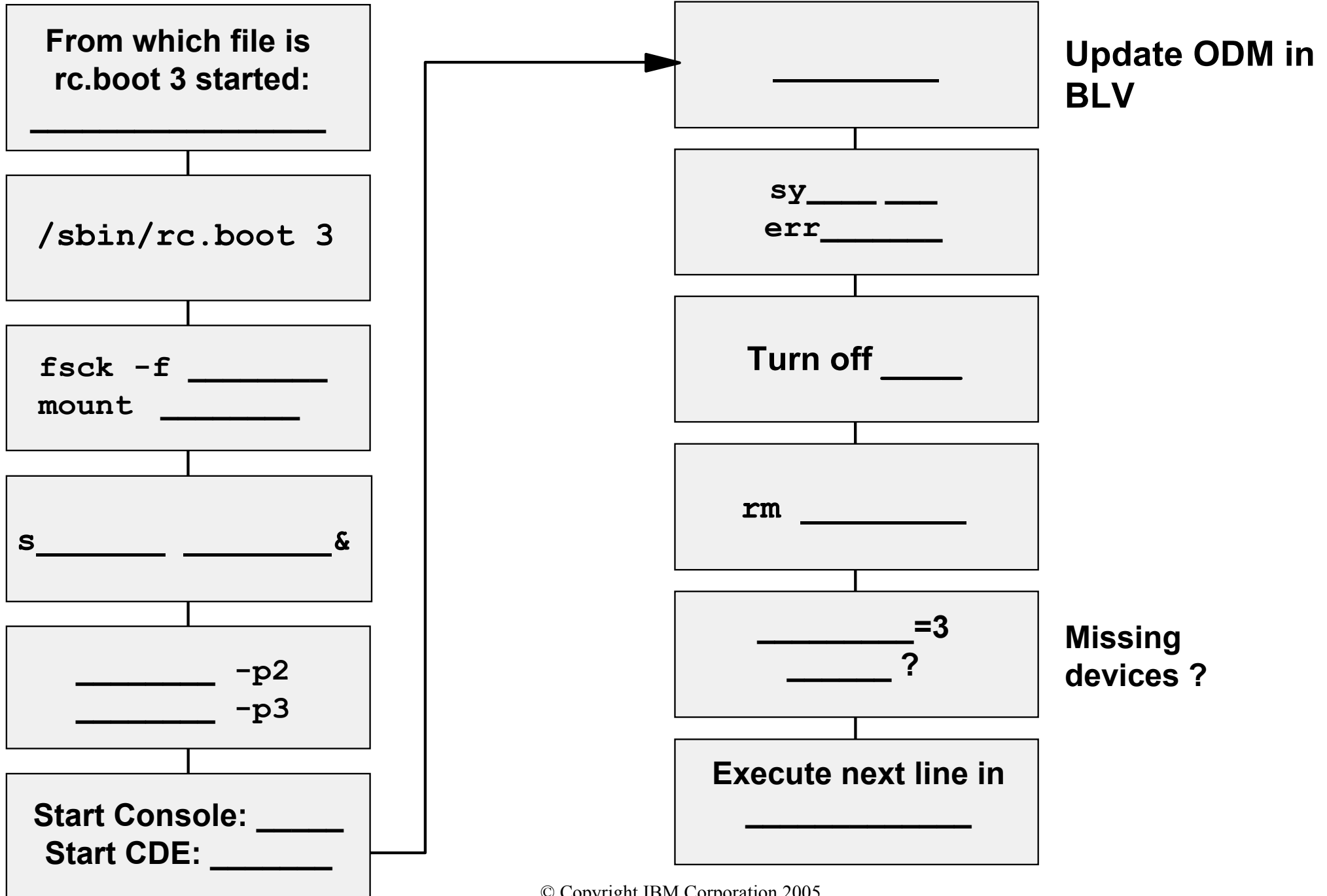




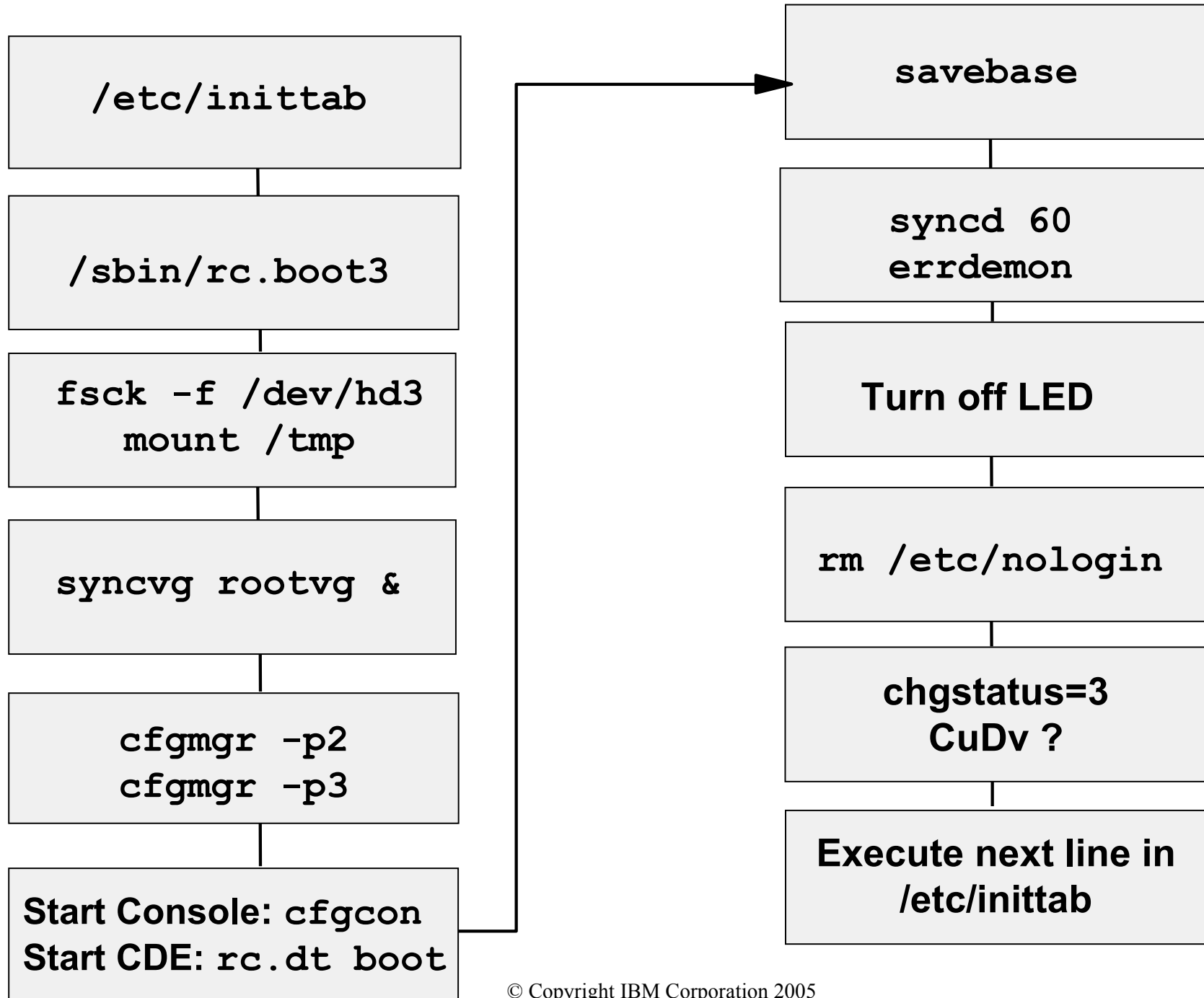
# Let's Review Solution: rc.boot 2



# Let's Review: rc.boot 3

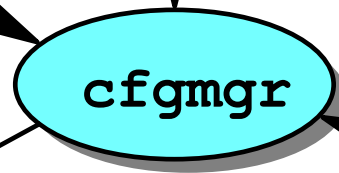
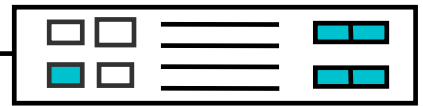
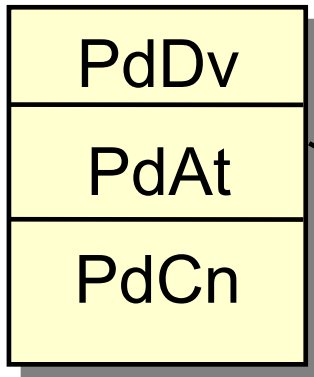


# Let's Review Solution: rc.boot 3

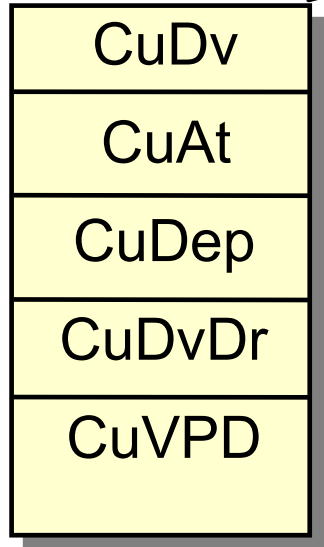


# Configuration Manager

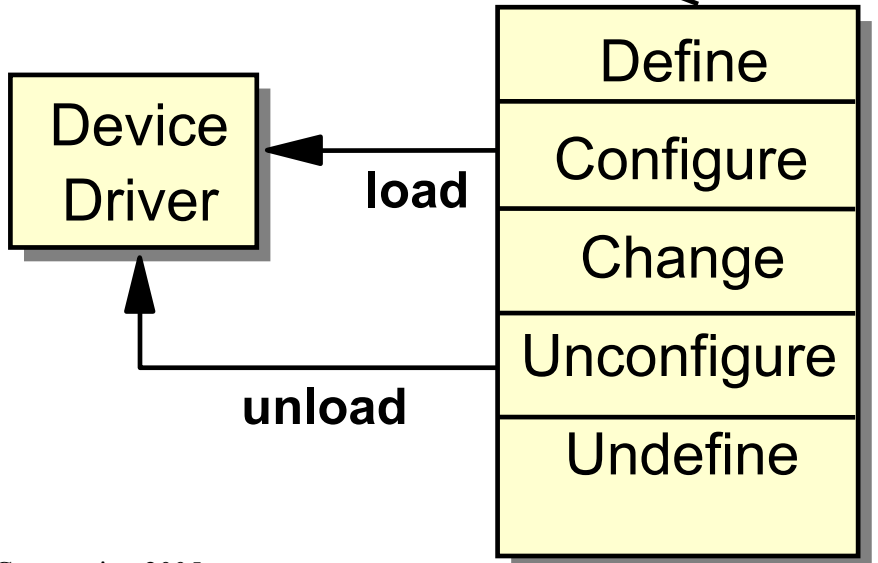
Predefined



Customized



Methods



# Config\_Rules Object Class

Phase	seq	boot	rule	
1	10	0	/etc/methods/defsys	← <b>cfgmgr -f</b>
1	12	0	/usr/lib/methods/deflvm	
2	10	0	/etc/methods/defsys	
2	12	0	/usr/lib/methods/deflvm	← <b>cfgmgr -p2</b>
2	19	0	/etc/methods/ptynode	(Normal boot)
2	20	0	/etc/methods/startlft	
3	10	0	/etc/methods/defsys	
3	12	0	/usr/lib/methods/deflvm	← <b>cfgmgr -p3</b>
3	19	0	/etc/methods/ptynode	(Service boot)
3	20	0	/etc/methods/startlft	
3	25	0	/etc/methods/starttty	

# ~~cfgmgr Output in the Boot Log Using alog~~

```
# alog -t boot -o
-----
attempting to configure device 'sys0'
invoking /usr/lib/methods/cfgsys_rspc -l sys0
return code = 0
***** stdout *****
bus0
***** no stderr *****
-----
attempting to configure device 'bus0'
invoking /usr/lib/methods/cfgbus_pci bus0
return code = 0
***** stdout *****
bus1, scsi0
***** no stderr *****
-----
attempting to configure device 'bus1'
invoking /usr/lib/methods/cfgbus_isa bus1
return code = 0
***** stdout *****
fda0, ppa0, sa0, sioka0, kbd0
***** no stderr *****
```

# /etc/inittab File

```
init:2:initdefault:
brc::sysinit:/sbin/rc.boot 3 >/dev/console 2>&1 # Phase 3 of system boot
powerfail::powerfail:/etc/rc.powerfail 2>&1 | alog -tboot > /dev/console #
mkatmpvc:2:once:/usr/sbin/mkatmpvc >/dev/console 2>&1
atmsvcd:2:once:/usr/sbin/atmsvcd >/dev/console 2>&1
tunables:23456789:wait:/usr/sbin/tunrestore -R > /dev/console 2>&1 # Set tunab
securityboot:2:bootwait:/etc/rc.security.boot > /dev/console 2>&1
rc:23456789:wait:/etc/rc 2>&1 | alog -tboot > /dev/console # Multi-User checks
rcemgr:23456789:once:/usr/sbin/emgr -B > /dev/null 2>&1
fbcheck:23456789:wait:/usr/sbin/fbcheck 2>&1 | alog -tboot > /dev/console # ru

srcmstr:23456789:respawn:/usr/sbin/srcmstr # System Resource Controller
rctcpip:23456789:wait:/etc/rc.tcpip > /dev/console 2>&1 # Start TCP/IP daemons
mkcifs_fs:2:wait:/etc/mkcifs_fs > /dev/console 2>&1
sniinst:2:wait:/var/adm/sni/sniprei > /dev/console 2>&1
rcnfs:23456789:wait:/etc/rc.nfs > /dev/console 2>&1 # Start NFS Daemons
cron:23456789:respawn:/usr/sbin/cron
piobe:2:wait:/usr/lib/lpd/pioint_cp >/dev/null 2>&1 # pb cleanup
cons:0123456789:respawn:/usr/sbin/getty /dev/console
qdaemon:23456789:wait:/usr/bin/startsrc -sqdaemon
writesrv:23456789:wait:/usr/bin/startsrc -swritesrv
uprintfd:23456789:respawn:/usr/sbin/uprintfd
shdaemon:2:off:/usr/sbin/shdaemon >/dev/console 2>&1 # High availability
```

**Do not use an editor to change /etc/inittab.  
Use mkitab, chitab, rmitab instead !**

# System Hang Detection

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- System hangs:
  - High priority process
  - Other
- What does `shdaemon` do?
  - Monitors system's ability to run processes
  - Takes specified action if threshold is crossed
- Actions:
  - Log error in the Error Log
  - Display a warning message on the console
  - Launch recovery login on a console
  - Launch a command
  - Automatically REBOOT system



# Configuring shdaemon

```
# shconf -E -l prio
sh_pp      disable      Enable Process Priority Problem

pp_errlog  disable      Log Error in the Error Logging
pp_eto     2           Detection Time-out
pp_eprio   60          Process Priority

pp_warning enable      Display a warning message on a console
pp_wto     2           Detection Time-out
pp_wprio   60          Process Priority
pp_wterm   /dev/console Terminal Device

pp_login   enable      Launch a recovering login on a console
pp_lto     2           Detection Time-out
pp_lprio   100        Process Priority
pp_lterm   /dev/console Terminal Device

pp_cmd     disable      Launch a command
pp_cto     2           Detection Time-out
pp_cprio   60          Process Priority
pp_cpath   /home/unhang      Script

pp_reboot  disable      Automatically REBOOT system
pp_rto     5           Detection Time-out
pp_rprio   39          Process Priority
```

# Resource Monitoring and Control (RMC)

- Based on two concepts:
  - Conditions
  - Responses
- Associates predefined responses with predefined conditions for monitoring system resources
- Example: Broadcast a message to the system administrator when the **/tmp** file system becomes 90% full

# RMC Conditions Property Screen: General Tab

Condition /tmp space used Properties @ aix

General Monitored Resources

**Name:** /tmp space used

Management scope: Local Machine

**Monitored:** No

**Resource class:** File System

**Monitored property:** PercentTotUsed

**Event expression:** PercentTotUsed > 90

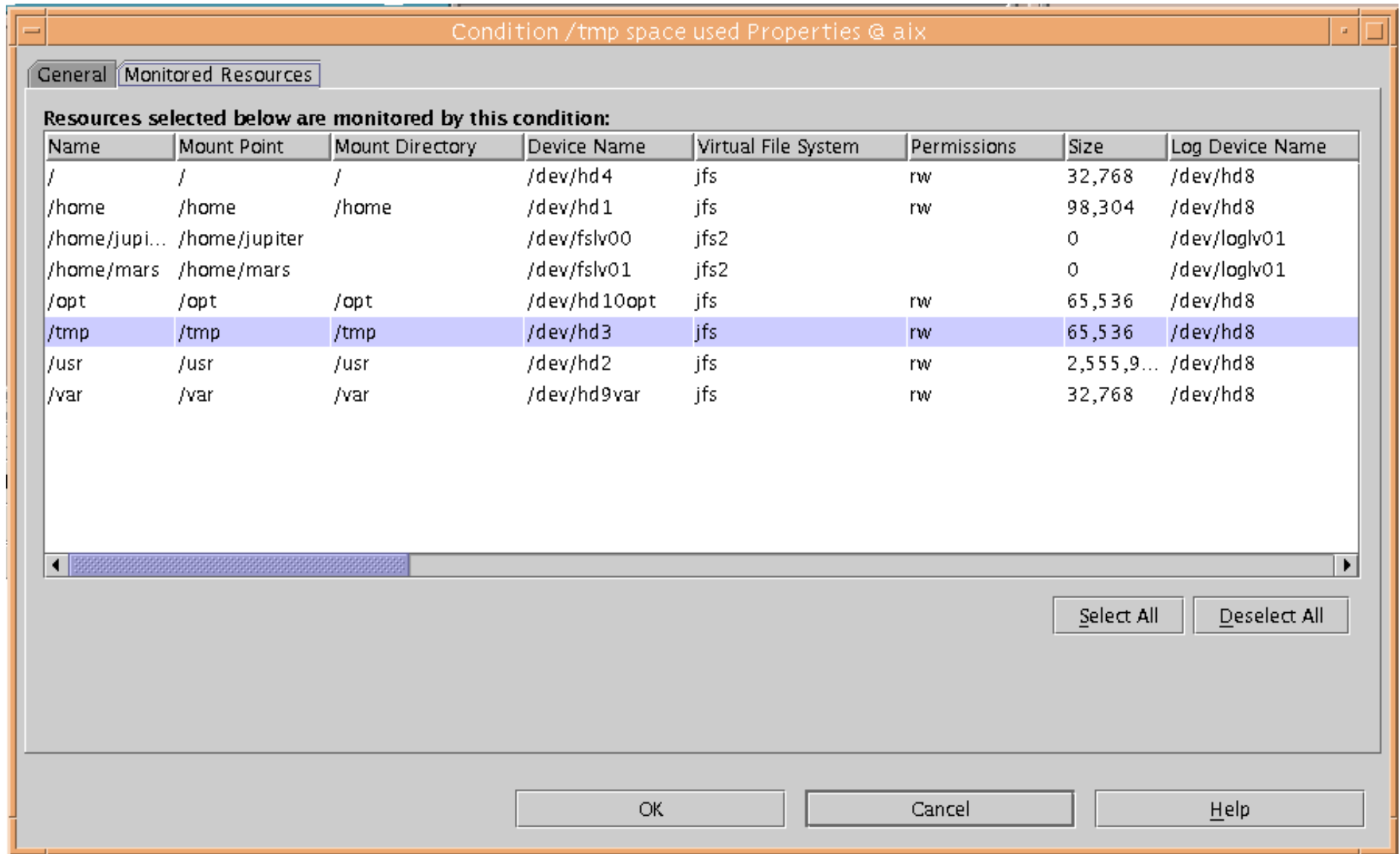
Event description: An event will be generated when more than 90 percent of the total space in the /tmp directory is in use.

**Rearm expression:** PercentTotUsed < 75

Rearm description: The event will be rearmd when the percent of the space used in the /tmp directory falls below 75 percent.

**Severity:** Informational

# RMC Conditions Property Screen: Monitored Resources Tab



# RMC Actions Property Screen: General Tab

The screenshot shows a dialog box titled "Modify Action E-mail root" with three tabs: "General", "When in Effect", and "Environment". The "General" tab is active. The "Action name" field contains "E-mail root". Below it, the "Command to run:" section has a dropdown menu set to "Run program" and an "Enter program name:" field. A context menu is open over the dropdown, listing "Send mail", "Log file", "Broadcast message", "SNMP trap", and "Run program" (which is highlighted). Below the dropdown, there are three checkboxes: "Redirect command's standard output to audit log" (unchecked), "Run command when rearm event occurs" (checked), and "Check command return code" (unchecked). At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".

Modify Action E-mail root

General When in Effect Environment

Action name: E-mail root

Command to run:

Run program Enter program name:

Send mail  
Log file  
Broadcast message  
SNMP trap  
Run program

Redirect command's standard output to audit log

Run command when rearm event occurs

Check command return code

OK Cancel Help

# RMC Actions Property Screen: When in Effect Tab

The screenshot shows a dialog box titled "Modify Action E-mail root" with three tabs: "General", "When in Effect", and "Environment". The "When in Effect" tab is active. It contains two main sections: "Periods when the action should be taken:" and "Specify when the action should be taken:". The first section has a table with two columns: "Time" and "Date". The table contains two rows: "All day" and "17:00-23:00". The "Date" column contains "Everyday" and "Monday, Tuesday, Wednesday, Thursd...". To the right of the table are three buttons: "Add", "Remove", and "Modify". The second section, "Specify when the action should be taken:", has two sub-sections: "Time of Day" and "Day of Week". Under "Time of Day", there are two radio buttons: "All day" (selected) and "Time period". Below "Time period" are "From" and "To" labels, each followed by two spinners showing "00". Under "Day of Week", there are seven checkboxes: "Everyday" (checked), "Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Saturday", and "Sunday". At the bottom of this section are "Set" and "Undo" buttons. At the bottom of the dialog box are "OK", "Cancel", and "Help" buttons.

Modify Action E-mail root

General When in Effect Environment

Periods when the action should be taken:

Time	Date
All day	Everyday
17:00-23:00	Monday, Tuesday, Wednesday, Thursd...

Add  
Remove  
Modify

Specify when the action should be taken:

Time of Day

All day  
 Time period

From 00 00  
To 00 00

Set Undo

Day of Week

Everyday  
 Monday  Tuesday  
 Wednesday  Thursday  
 Friday  Saturday  
 Sunday

OK Cancel Help

# Boot Problem Management

Check	LED	User Action
Bootlist wrong?	LED codes cycle	Power on, press <b>F1</b> , select Multi-Boot, select the correct boot device.
<b>/etc/inittab</b> corrupt? <b>/etc/environment</b> corrupt?	553	Access the <b>rootvg</b> . Check <b>/etc/inittab</b> (empty, missing or corrupt?). Check <b>/etc/environment</b> .
Boot logical volume or boot record corrupt?	20EE000B	Access the <b>rootvg</b> . Re-create the BLV: <code># bosboot -ad /dev/hdiskx</code>
JFS/JFS2 log corrupt?	551, 552, 554, 555, 556, 557	Access <b>rootvg</b> before mounting the <b>rootvg</b> file systems. Re-create the JFS/JFS2 log: <code># logform -v jfs /dev/hd8</code> or <code># logform -v jfs2 /dev/hd8</code> Run <b>fsck</b> afterwards.
Superblock corrupt?	552, 554, 556	Run <b>fsck</b> against all <b>rootvg</b> file systems. If <b>fsck</b> indicates errors (not an AIX file system), repair the superblock as described in the notes.
<b>rootvg</b> locked?	551	Access <b>rootvg</b> and unlock the <b>rootvg</b> : <code># chvg -u rootvg</code>
ODM files missing?	523 - 534	ODM files are missing or inaccessible. Restore the missing files from a system backup.
Mount of <b>/usr</b> or <b>/var</b> failed?	518	Check <b>/etc/filesystem</b> . Check network (remote mount), file systems ( <b>fsck</b> ) and hardware.

# Let's Review: /etc/inittab File

<code>init:2:initdefault:</code>	
<code>brc::sysinit:/sbin/rc.boot 3</code>	
<code>rc:2:wait:/etc/rc</code>	
<code>fbcheck:2:wait:/usr/sbin/fbcheck</code>	
<code>srcmstr:2:respawn:/usr/sbin/srcmstr</code>	
<code>cron:2:respawn:/usr/sbin/cron</code>	
<code>rctcpip:2:wait:/etc/rc.tcpip</code> <code>rcnfs:2:wait::/etc/rc.nfs</code>	
<code>qdaemon:2:wait:/usr/bin/startsrc -sqdaemon</code>	
<code>dt:2:wait:/etc/rc.dt</code>	
<code>tty0:2:off:/usr/sbin/getty /dev/tty1</code>	
<code>myid:2:once:/usr/local/bin/errlog.check</code>	



# Let's Review Solution: /etc/inittab File

<code>init:2:initdefault:</code>	Determine initial run-level
<code>brc::sysinit:/sbin/rc.boot 3</code>	Startup last boot phase
<code>rc:2:wait:/etc/rc</code>	Multiuser initialization
<code>fbcheck:2:wait:/usr/sbin/fbcheck</code>	Execute <b>/etc/firstboot</b> , if it exists
<code>srcmstr:2:respawn:/usr/sbin/srcmstr</code>	Start the System Resource Controller
<code>cron:2:respawn:/usr/sbin/cron</code>	Start the <code>cron</code> daemon
<code>rctcpip:2:wait:/etc/rc.tcpip</code> <code>rcnfs:2:wait::/etc/rc.nfs</code>	Startup communication daemon processes ( <code>nfsd</code> , <code>biod</code> , <code>ypserv</code> , and so forth)
<code>qdaemon:2:wait:/usr/bin/startsrc -sqdaemon</code>	Startup spooling subsystem
<code>dt:2:wait:/etc/rc.dt</code>	Startup CDE desktop
<code>tty0:2:off:/usr/sbin/getty /dev/tty1</code>	Line ignored by <code>init</code>
<code>myid:2:once:/usr/local/bin/errlog.check</code>	Process started only one time

# Checkpoint

1. From where is `rc.boot 3` run?

---

3. Your system stops booting with LED 557:

- In which `rc.boot` phase does the system stop?

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- What are some reasons for this problem?

- 

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- 

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- 

---

4. Which ODM file is used by the `cfgmgr` during boot to configure the devices in the correct sequence?

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- What does the line `init:2:initdefault:` in `/etc/inittab` mean?

# Checkpoint Solutions

1. From where is `rc.boot 3` run?

From the `/etc/inittab` file in `rootvg`

3. Your system stops booting with LED 557:

- In which `rc.boot` phase does the system stop? `rc.boot 2`
- What are some reasons for this problem?
  - Corrupted BLV
  - Corrupted JFS log
  - Damaged file system
- Which ODM file is used by the `cfgmgr` during boot to configure the devices in the correct sequence? `Config_Rules`
- What does the line `init:2:initdefault:` in `/etc/inittab` mean?

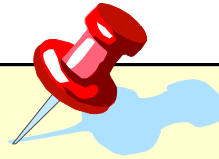
This line is used by the `init` process, to determine the initial run level (2=multiuser).

# Exercise 4: System Initialization Part 2



- Repair a corrupted log logical volume
- Analyze and fix a boot failure

# Unit Summary



- After the boot image is loaded into RAM, the `rc.boot` script is executed three times to configure the system
- During `rc.boot 1`, devices to varyon the `rootvg` are configured
- During `rc.boot 2`, the `rootvg` is varied on
- In `rc.boot 3`, the remaining devices are configured
- Processes defined in `/etc/inittab` file are initiated by the `init` process



# Disk Management Theory



# Unit Objectives

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After completing this unit, you should be able to:

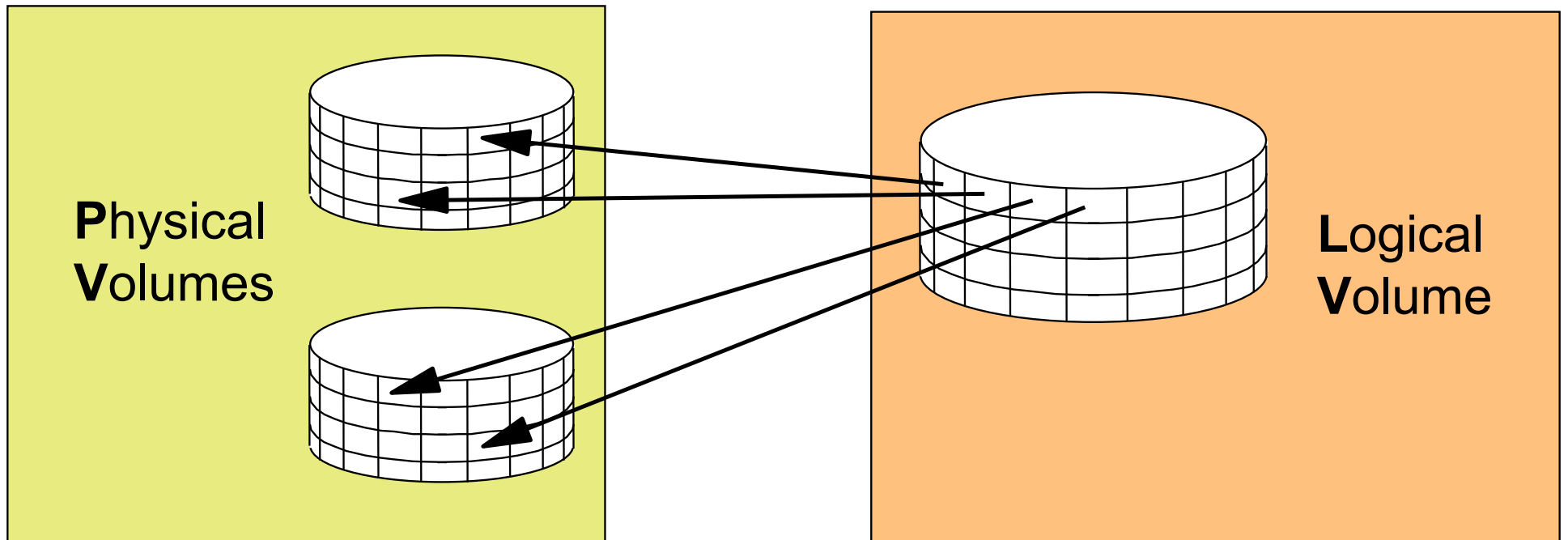
- Explain where LVM information is stored
- Solve ODM-related LVM problems
- Set up mirroring appropriate to your needs
- Describe the quorum mechanism
- Explain the physical volume states used by the LVM

# LVM Terms

---

**Physical  
Partitions**

**Logical  
Partitions**



**Physical  
Volumes**

**Logical  
Volume**

**Volume  
Group**



# Volume Group Limits

- Normal Volume Groups (**mkvg**)

Number of disks:	Max. number of partitions/disk:
1	32512
2	16256
4	8128
8	4064
16	2032
<b>32</b>	<b>1016</b>

- Big Volume Groups (**mkvg -B** or **chvg -B**)

Number of disks:	Max. number of partitions/disk:
1	130048
2	65024
4	32512
8	16256
16	8128
32	4064
64	2032
<b>128</b>	<b>1016</b>

**mkvg -t**  
**chvg -t**

# Scalable Volume Groups

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- Introduced in AIX 5L V5.3
- Support 1024 disks per volume group.
- Support 4096 logical volumes per volume group.
- Maximum number of PPs is VG instead of PV dependent.
- LV control information is kept in the VGDA.
- No need to set the maximum values at creation time; the initial settings can always be increased at a later date.

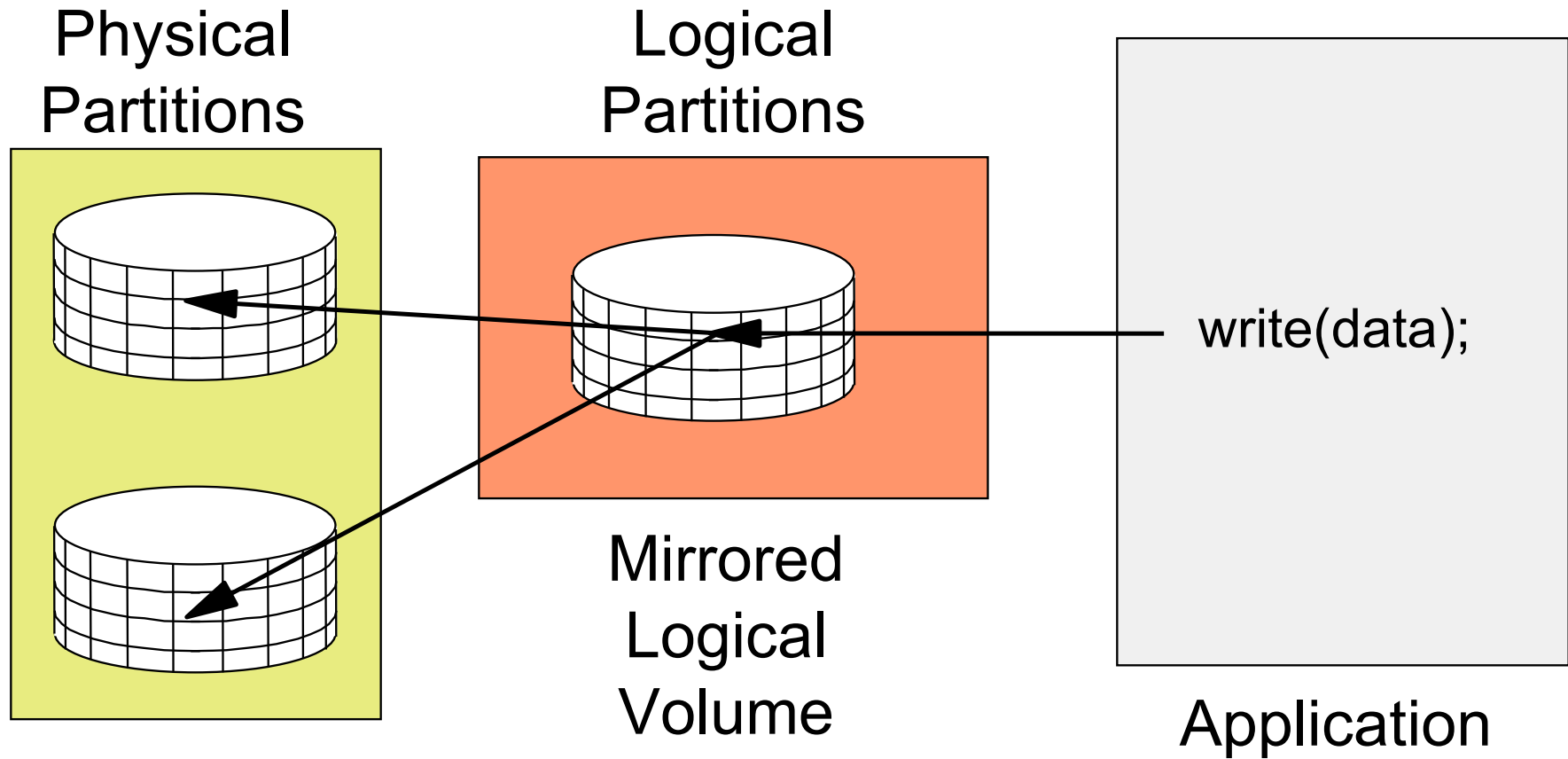
# Configuration Limits for Volume Groups

---

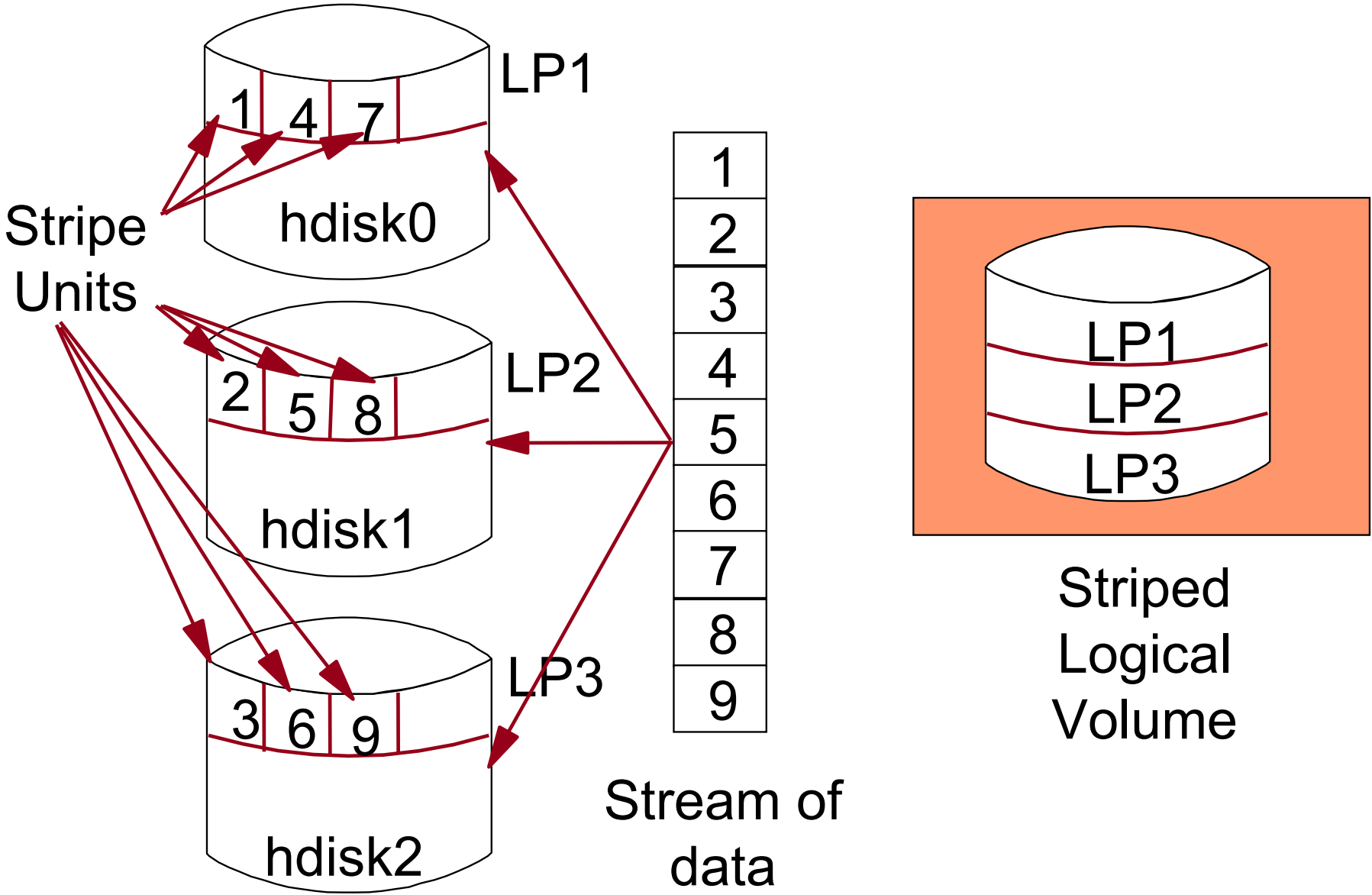
<b>VG Type</b>	<b>Maximum PVs</b>	<b>Maximum LVs</b>	<b>Maximum PPs per VG</b>	<b>Maximum PP size</b>
Normal VG	32	256	32512 (1016*32)	1 GB
Big VG	128	512	130048 (1016*128)	1 GB
Scalable VG	1024	4096	2097152	128 GB

# Mirroring

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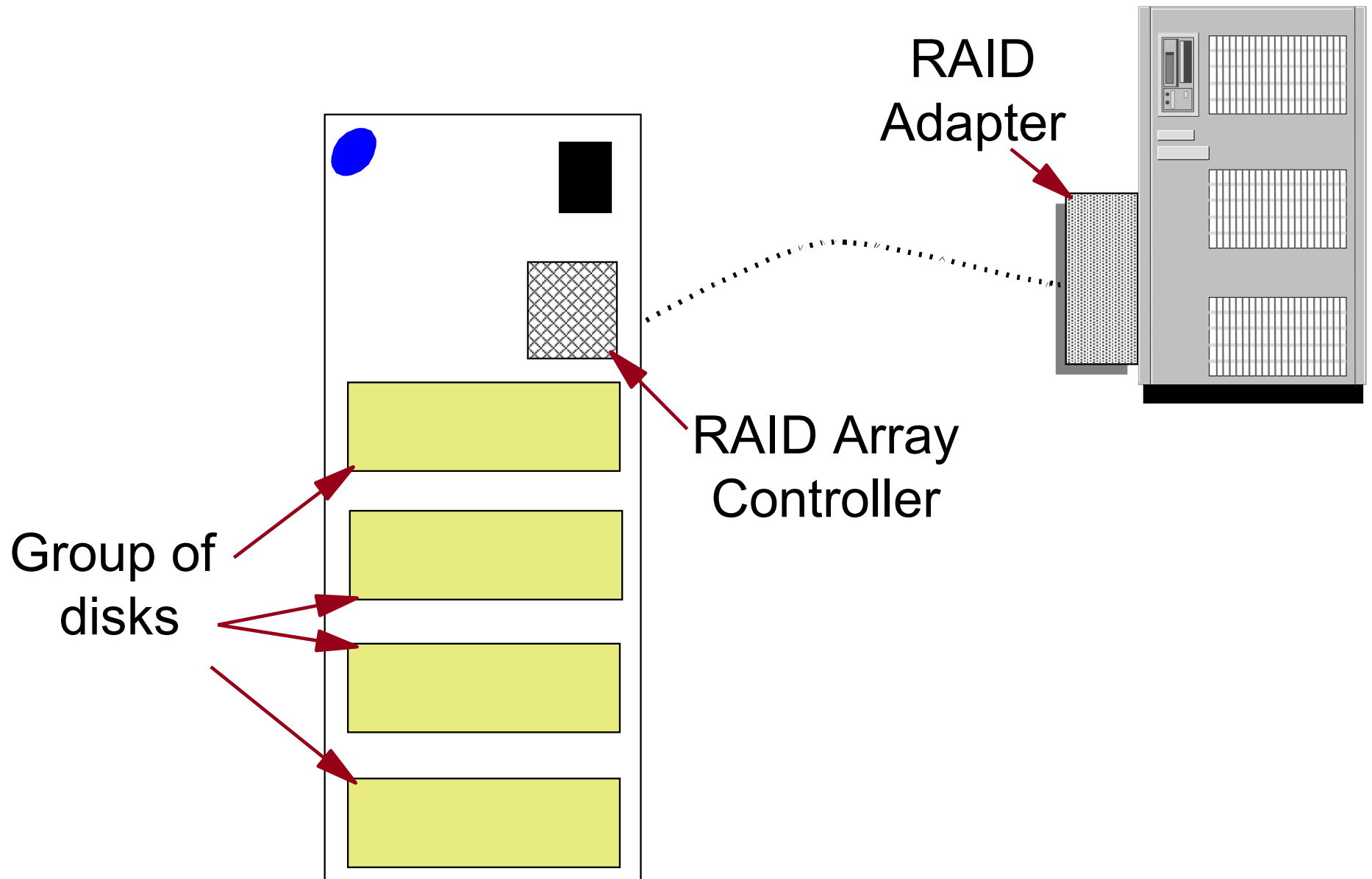


# Striping



# Mirroring and Striping with RAID

RAID = **R**edundant **A**rray of **I**ndependent **D**isks



# RAID Levels You Should Know About

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RAID Level	Implementation	Explanation
0	Striping	Data is split into blocks. These blocks are written to or read from a series of disks in parallel. No data redundancy.
1	Mirroring	Data is split into blocks and duplicate copies are kept on separate disks. If any disk in the array fails, the mirrored data can be used.
5	Striping with parity drives	Data is split into blocks that are striped across the disks. For each block, parity information is written that allows the reconstruction in case of a disk failure.

# Exercise 5: LVM Tasks and Problems (Part 1)

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- Part 1: Basic LVM Tasks



# LVM Identifiers

Goal: Unique worldwide identifiers for

- Volume groups
- Hard disks
- Logical volumes

```
# lsvg rootvg
... VG IDENTIFIER: 00c35ba000004c00000001157f54bf78

# lspv
hdisk0    00c35ba07b2e24f0    rootvg    active
...
# lslv hd4
LOGICAL VOLUME:      hd4    VOLUME GROUP: rootvg
LV IDENTIFIER: 00c35ba000004c00000001157f54bf78.4 ...
...

# uname -m
00C35BA04C00
```

32 bytes long

32 bytes long  
(16 are shown)

VGID.minor number

# LVM Data on Disk Control Blocks

---

## Volume Group Descriptor Area (VGDA)

- Most important data structure of LVM
- Global to the volume group (same on each disk)
- One or two copies per disk

## Volume Group Status Area (VGSA)

- Tracks the state of mirrored copies
- One or two copies per disk

## Logical Volume Control Block (LVCB)

- Has historically occupied first 512 bytes of each logical volume
- Contains LV attributes (policies, number of copies)
- Should not be overwritten by applications using raw devices!

# LVM Data in the Operating System

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## Object Data Manager (ODM)

- Physical volumes, volume groups, and logical volumes are represented as devices (customized devices)
- **CuDv, CuAt, CuDvDr, CuDep**

## AIX Files

- **/etc/vg/vgVGID** Handle to the VGDA copy in memory
- **/dev/hdiskX** Special file for a disk
- **/dev/VGname** Special file for administrative access to a VG
- **/dev/LVname** Special file for a logical volume
- **/etc/filesystems** Used by the **mount** command to associate LV name, file system log, and mount point

# Contents of the VGDA

---

<b>Header Time Stamp</b>	<ul style="list-style-type: none"><li>• Updated when VG is changed</li></ul>
<b>Physical Volume List</b>	<ul style="list-style-type: none"><li>• PVIDs only (no PV names)</li><li>• VGDA count and PV state</li></ul>
<b>Logical Volume List</b>	<ul style="list-style-type: none"><li>• LVIDs and LV names</li><li>• Number of copies</li></ul>
<b>Physical Partition Map</b>	<ul style="list-style-type: none"><li>• Maps LPs to PPs</li></ul>
<b>Trailer Time Stamp</b>	<ul style="list-style-type: none"><li>• Must contain same value as header time stamp</li></ul>

# VGDA Example

```
# lqueryvg -p hdisk1 -At
```

```
Max LVs:                256
PP Size:                20  → 1: _____

Free PPs:              12216
LV count:              3   → 2: _____
PV count:              1   → 3: _____

Total VGDA:            2   → 4: _____

MAX PPs per PV:        32768
MAX PVs:                1024
```

```
Logical:                5: _____
00c35ba000004c00000001157fcf6bdf.1      lv00      1
      00c35ba000004c00000001157fcf6bdf.2      lv01      1
      00c35ba000004c00000001157fcf6bdf.3      lv02      1
```

```
Physical:                00c35ba07fcf6b93      2      0
```

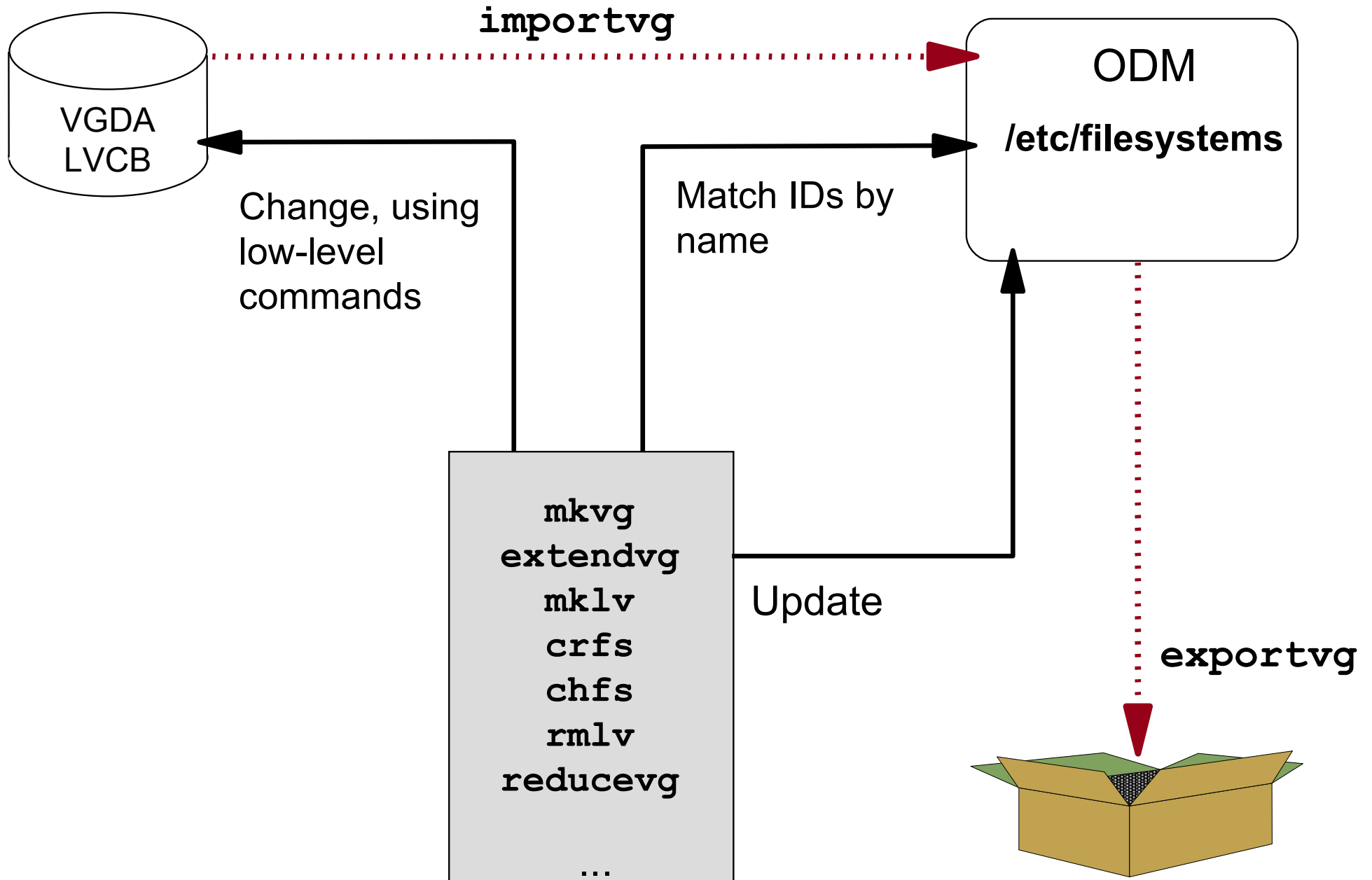
6: \_\_\_\_\_

7: \_\_\_\_\_

# The Logical Volume Control Block (LVCB)

```
# getlvcb -AT hd2
  AIX LVCB
  intrapolicy = c
  copies = 1
  interpolicy = m
  lvid = 00c35ba000004c00000001157f54bf78.5
  lvname = hd2
  label = /usr
  machine id = 35BA04C00
  number lps = 102
  relocatable = y
  strict = y
  stripe width = 0
  stripe size in exponent = 0
  type = jfs2
  upperbound = 32
  fs =
  time created   = Mon Oct  8 11:16:49 2007
  time modified  = Mon Oct  8 07:00:09 2007
```

# How LVM Interacts with ODM and VGDA



# ODM Entries for Physical Volumes (1 of 3)

```
# odmget -q "name like hdisk[02]" CuDv
```

CuDv:

```
name = "hdisk0"  
status = 1  
chgstatus = 2  
ddins = "scsidisk"  
location = ""  
parent = "vscsi0"  
connwhere = "8100000000000"  
PdDvLn = "disk/vscsi/vdisk"
```

CuDv:

```
name = "hdisk2"  
status = 1  
chgstatus = 0  
ddins = "scdisk"  
location = "01-08-01-8,0"  
parent = "scsi1"  
connwhere = "8,0"  
PdDvLn = "disk/scsi/scsd"
```



# ODM Entries for Physical Volumes (2 of 3)

---

```
# odmget -q "name=hdisk0 and attribute=pvid" CuAt
CuAt:
    name = "hdisk0"
    attribute = "pvid"
    value = "00c35ba07b2e24f000000000000000000000"
    type = "R"
    generic = "D"
    rep = "s"
    nls_index = 11
```

# ODM Entries for Physical Volumes (3 of 3)

```
# odmget -q "value3 like hdisk[03]" CuDvDr
```

```
CuDvDr:
```

```
    resource = "devno"  
    value1 = "17"  
    value2 = "0"  
    value3 = "hdisk0"
```

```
CuDvDr:
```

```
    resource = "devno"  
    value1 = "36"  
    value2 = "0"  
    value3 = "hdisk3"
```

```
# ls -l /dev/hdisk[03]
```

```
brw----- 1 root system 17, 0 Oct 08 06:17 /dev/hdisk0  
brw----- 1 root system 36, 0 Oct 08 09:19 /dev/hdisk3
```

# ODM Entries for Volume Groups (1 of 2)

```
# odmget -q "name=rootvg" CuDv
```

```
CuDv:
```

```
    name = "rootvg"
```

```
    status = 0
```

```
    chgstatus = 1
```

```
    ddins = ""
```

```
    location = ""
```

```
    parent = ""
```

```
    connwhere = ""
```

```
    PdDvLn = "logical_volume/vgsubclass/vgtype"
```

```
# odmget -q "name=rootvg" CuAt
```

```
CuAt:
```

```
    name = "rootvg"
```

```
    attribute = "vgserial_id"
```

```
    value = "00c35ba000004c000000001157f54bf78"
```

```
    type = "R"
```

```
    generic = "D"
```

```
    rep = "n"
```

```
    nls_index = 637
```

(output continues on next page)

# ODM Entries for Volume Groups (2 of 2)

```
# odmget -q "name=rootvg" CuAt
```

```
...
```

```
CuAt:
```

```
name = "rootvg"  
attribute = "timestamp"  
value = "470a1bc9243ed693"  
type = "R"  
generic = "DU"  
rep = "s"  
nls_index = 0
```

```
CuAt:
```

```
name = "rootvg"  
attribute = "pv"  
value = "00c35ba07b2e24f000000000000000000000"  
type = "R"  
generic = ""  
rep = "sl"  
nls_index = 0
```

# ODM Entries for Logical Volumes (1 of 2)

```
# odmget -q "name=hd2" CuDv
```

```
CuDv:
```

```
name = "hd2"
```

```
status = 0
```

```
chgstatus = 1
```

```
ddins = ""
```

```
location = ""
```

```
parent = "rootvg"
```

```
connwhere = ""
```

```
PdDvLn = "logical_volume/lvsubclass/lvtype"
```

```
# odmget -q "name=hd2" CuAt
```

```
CuAt:
```

```
name = "hd2"
```

```
attribute = "lvserial_id"
```

```
value = "00c35ba000004c000000001157f54bf78.5"
```

```
type = "R"
```

```
generic = "D"
```

```
rep = "n"
```

```
nls_index = 648
```

Other attributes include `intra`,  
`stripe_width`, `type`, etc.

# ODM Entries for Logical Volumes (2 of 2)

```
# odmget -q "value3=hd2" CuDvDr
```

```
CuDvDr:
```

```
    resource = "devno"
```

```
    value1 = "10"
```

```
    value2 = "5"
```

```
    value3 = "hd2"
```

```
# ls -l /dev/hd2
```

```
brw----- 1 root system 10,5 08 Jan 06:56 /dev/hd2
```

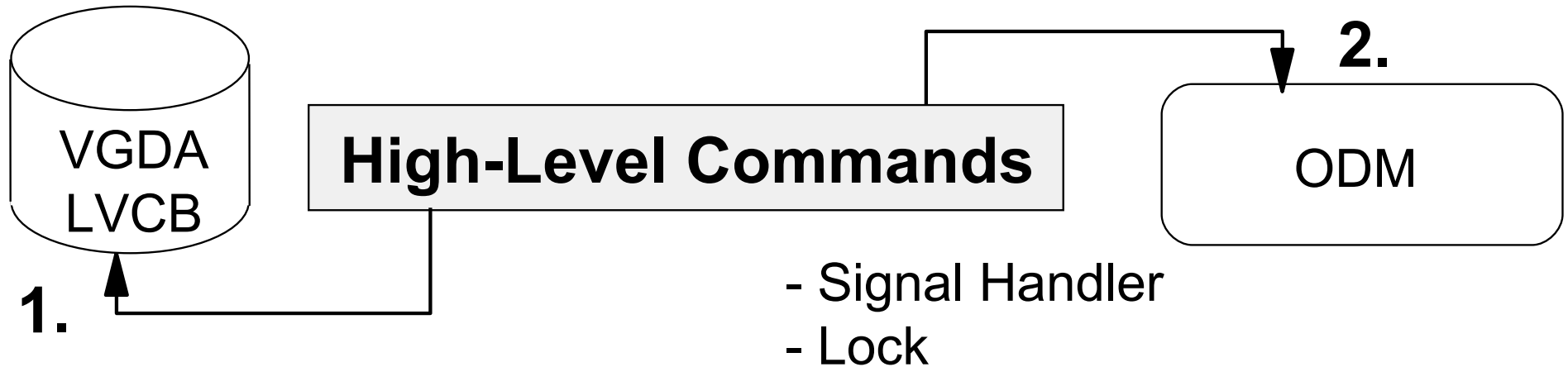
```
# odmget -q "dependency=hd2" CuDep
```

```
CuDep:
```

```
    name = "rootvg"
```

```
    dependency = "hd2"
```

# ODM-Related LVM Problems



## What can cause problems ?

- `kill -9`, shutdown, system crash
- Improper use of low-level commands
- Hardware changes without or with wrong software actions
- Full root file system

# Fixing ODM Problems (1 of 2)

---

If the ODM problem is *not in the rootvg*, for example in volume group **homevg**, do the following:

```
# varyoffvg homevg  
  
# exportvg homevg  
  
# importvg -y homevg hdiskX
```

← Remove complete volume group from the ODM

↑ Import volume group and create new ODM objects



# Fixing ODM Problems (2 of 2)

---

If the ODM problem is in the `rootvg`, try using `rvGRECOVER`:

```
PV=hdisk0
VG=rootvg
cp /etc/objrepos/CuAt /etc/objrepos/CuAt.$$
cp /etc/objrepos/CuDep /etc/objrepos/CuDep.$$
cp /etc/objrepos/CuDv /etc/objrepos/CuDv.$$
cp /etc/objrepos/CuDvDr /etc/objrepos/CuDvDr.$$
lqueryvg -Lp $PV | awk '{print $2}' | while read LVname;
do
    odmdelete -q "name=$LVname" -o CuAt
    odmdelete -q "name=$LVname" -o CuDv
    odmdelete -q "value3=$LVname" -o CuDvDr
done
odmdelete -q "name=$VG" -o CuAt
odmdelete -q "parent=$VG" -o CuDv
odmdelete -q "name=$VG" -o CuDv
odmdelete -q "name=$VG" -o CuDep
odmdelete -q "dependency=$VG" -o CuDep
odmdelete -q "value1=10" -o CuDvDr
odmdelete -q "value3=$VG" -o CuDvDr
importvg -y $VG $PV # ignore lvaryoffvg errors
varyonvg $VG
```

- Uses `odmdelete` to “export” `rootvg`
- Uses `importvg` to import `rootvg`

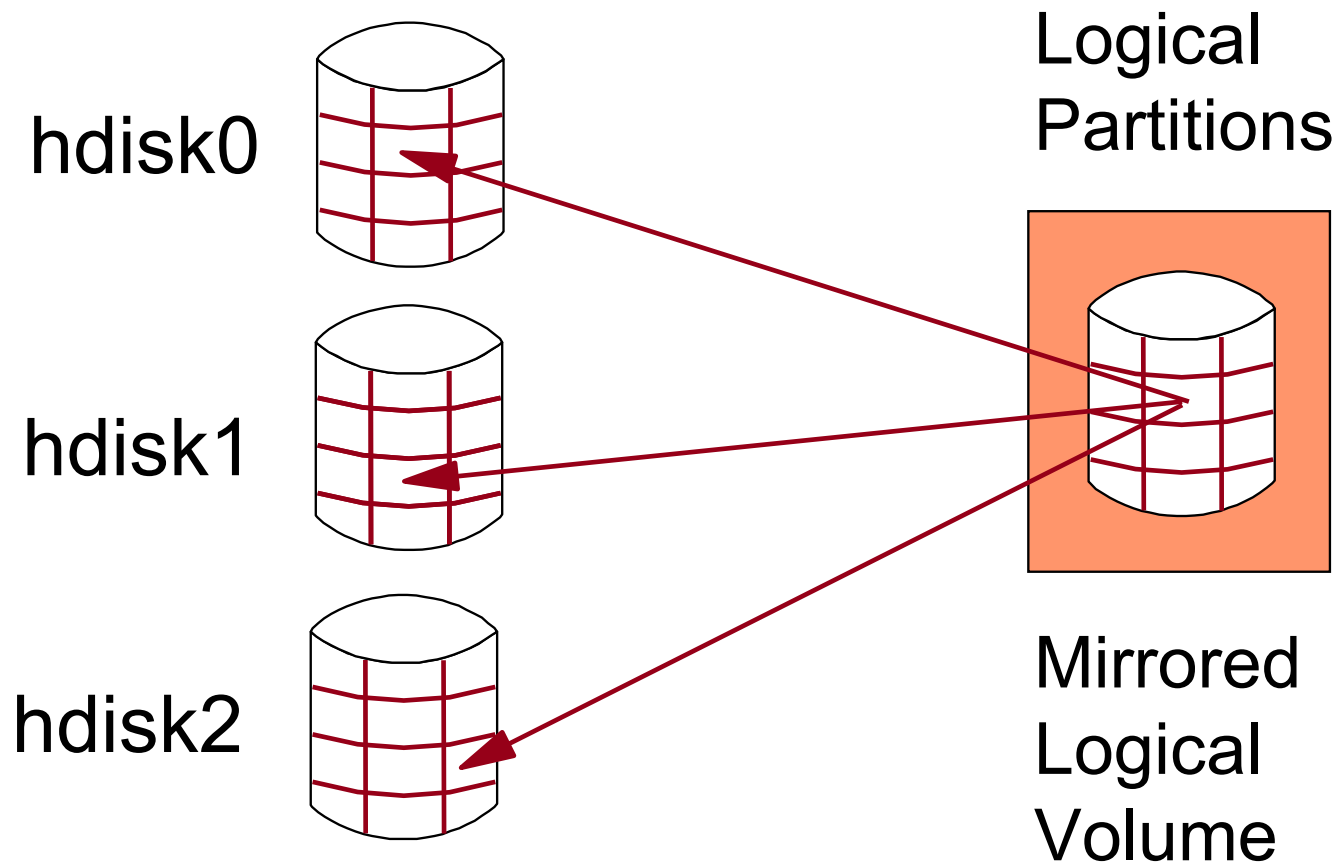
# Exercise 5: LVM Tasks and Problems (Part 2)

---



- Part 2: Analyze and Fix an LVM-related ODM Problem
- Part 2: Analyze and Fix an LVM-related ODM Problem Using **rvgrecover**

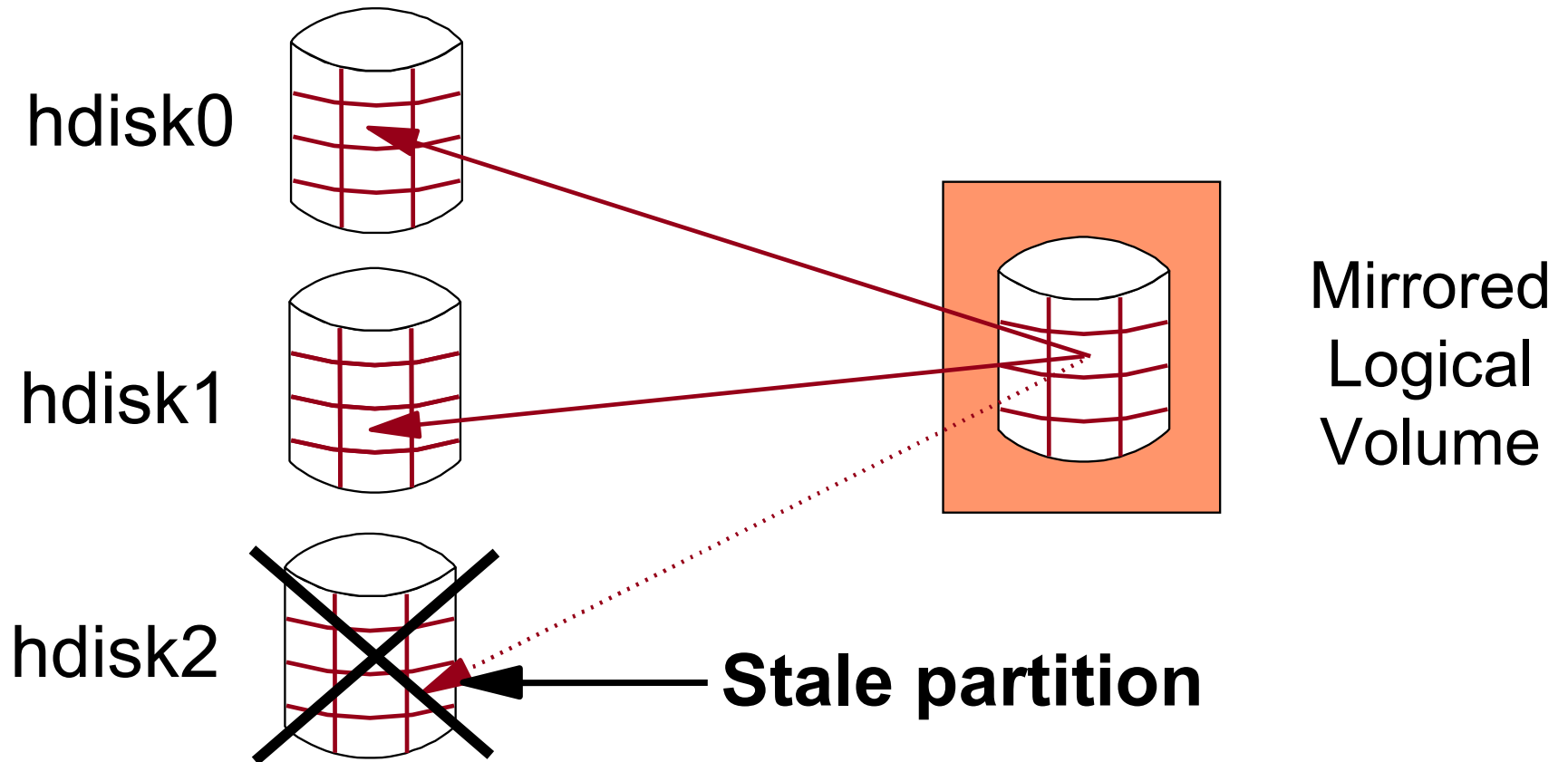
# Mirroring



**VGSA** →

<b>LP:</b>	<b>PP1:</b>	<b>PP2:</b>	<b>PP3:</b>
5	hdisk0, 5	hdisk1, 8	hdisk2, 9

# Stale Partitions



After repair of **hdisk2**:

- **varyonvg VGName** (calls **syncvg -v VGName**)
- Only stale partitions are updated

# Creating Mirrored LVs (smit mk1v)

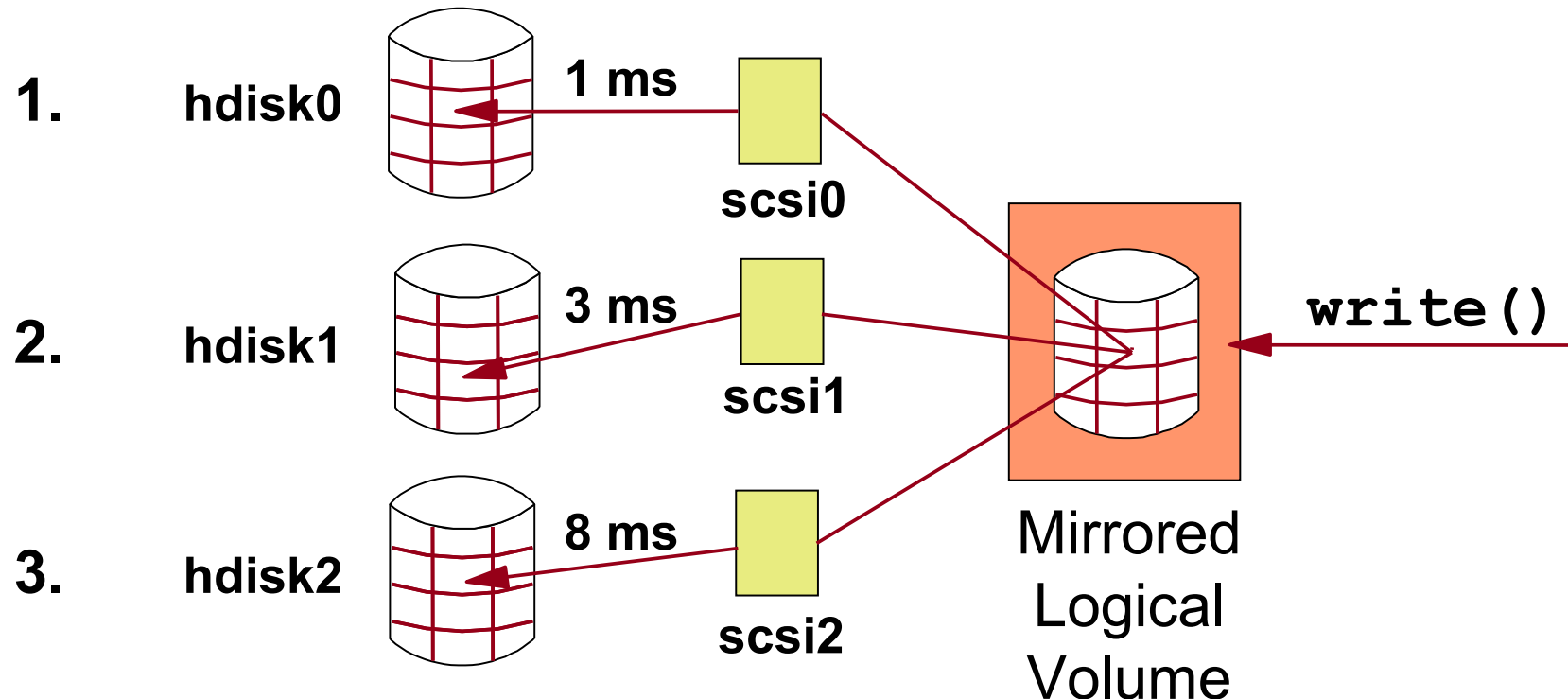
## Add a Logical Volume

Type or select values in entry fields.

Press Enter AFTER making all desired changes.

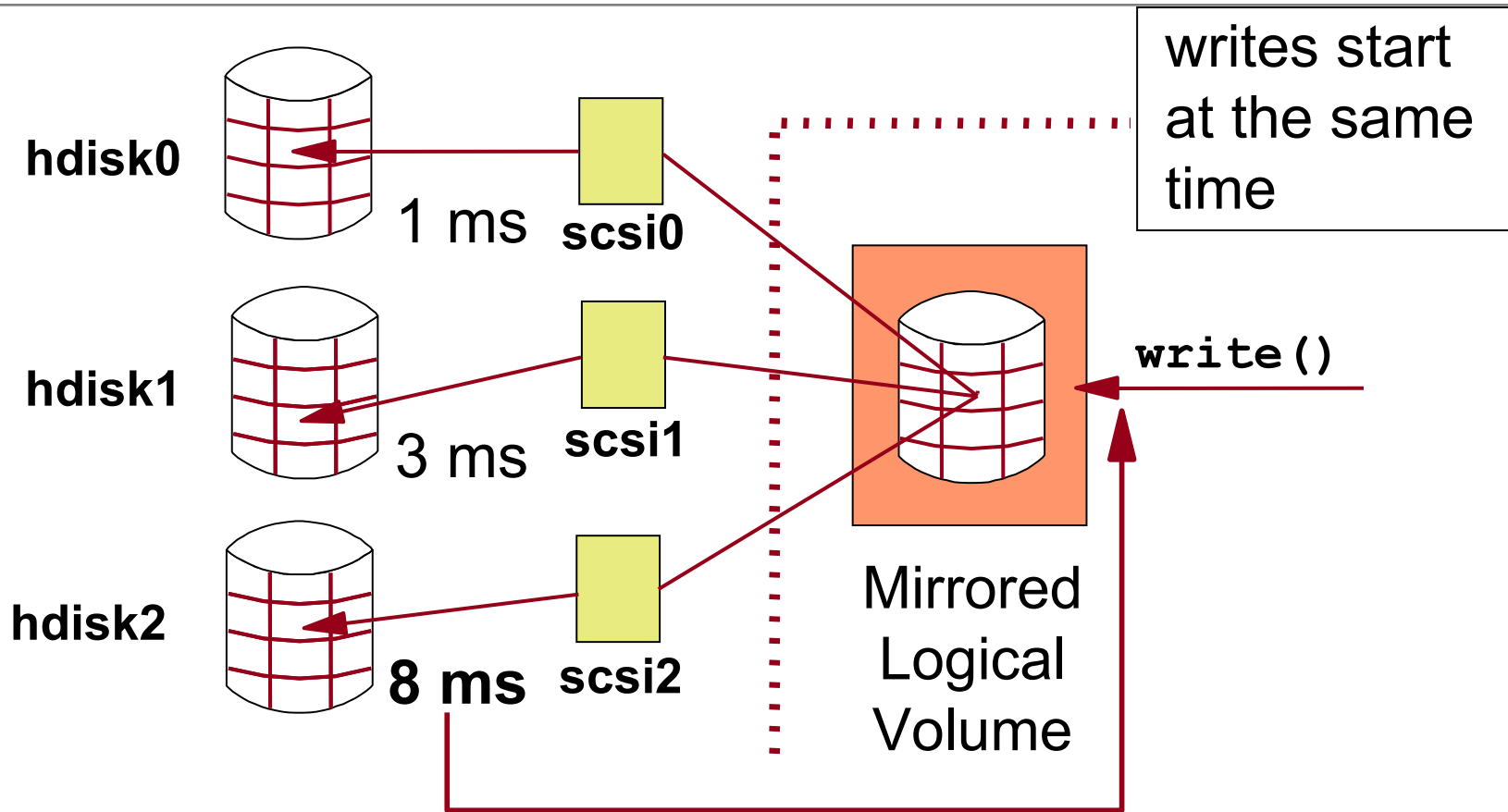
[TOP]	[Entry Fields]
Logical volume NAME	[lv01]
VOLUME GROUP name	rootvg
Number of LOGICAL PARTITIONS	[50]
PHYSICAL VOLUME names	[hdisk2 hdisk4]
Logical Volume TYPE	[]
POSITION on physical volume	edge
RANGE of physical volumes	minimum
MAXIMUM NUMBER of PHYSICAL VOLUMES to use for allocation	[]
Number of COPIES of each logical partition	[2]
Mirror Write Consistency?	active
Allocate each logical partition copy on a SEPARATE physical volume?	yes
...	
SCHEDULING POLICY for reading/writing logical partition copies	parallel

# Scheduling Policies: Sequential



- Second physical write operation is not started unless the first has completed successfully
- In case of a total disk failure, there is always a "good copy"
- Increases availability, but decreases performance
- In this example, the write operation takes 12 ms (1 + 3 + 8)

# Scheduling Policies: Parallel



- Write operations for physical partitions start at the same time: When the longest write (8 ms) finishes, the write operation is complete
- Improves performance (especially READ performance)

# Mirror Write Consistency (MWC)

---

## Problem:

- Parallel scheduling policy and ...
- ... system crashes *before the writes to all mirrors* have been completed
- Mirrors of the logical volume are in an *inconsistent* state

## Solution: Mirror Write Consistency (MWC)

- MWC information used to make logical partitions consistent again after reboot
- *Active* MWC uses separate area of each disk (outer edge area)
- Try to place logical volumes that use active MWC in the outer edge area



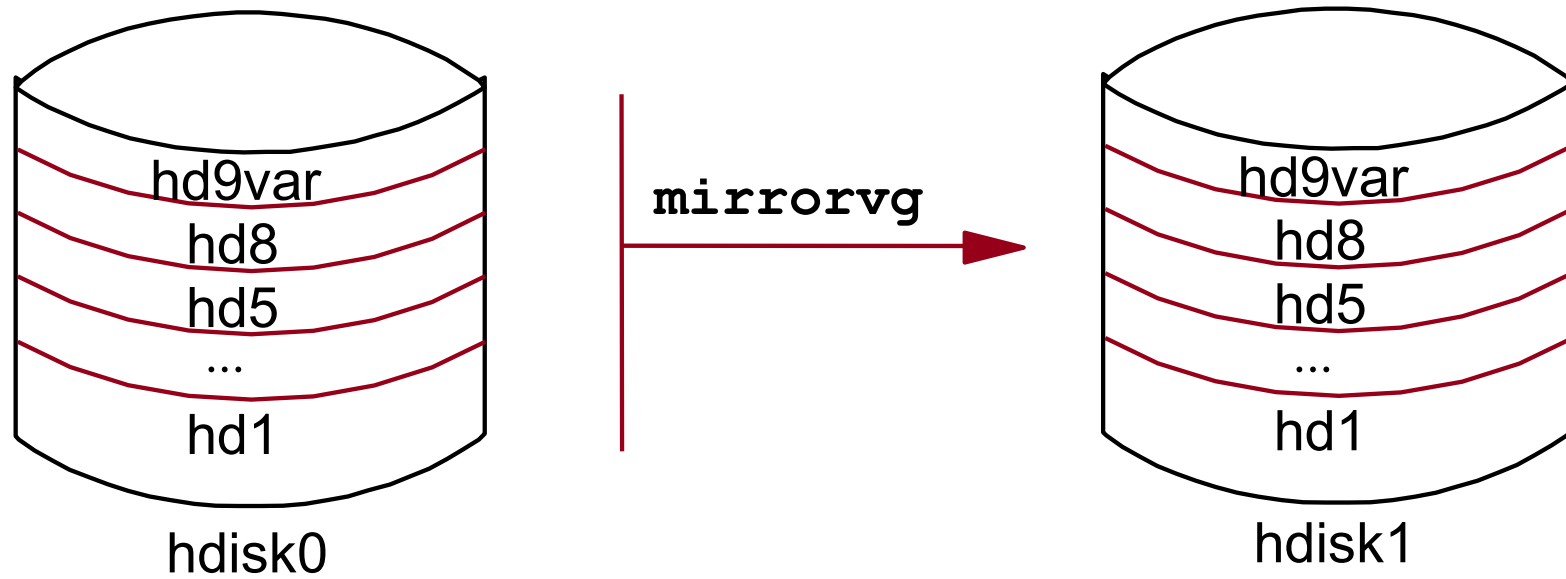
# Adding Mirrors to Existing LVs (mk1vcopy)

## Add Copies to a Logical Volume

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

	[Entry Fields]
Logical volume NAME	[hd2]
NEW TOTAL number of logical partition copies	2
PHYSICAL VOLUME names	[hdisk1]
POSITION on physical volume	outer edge
RANGE of physical volumes	minimum
MAXIMUM NUMBER of PHYSICAL VOLUMES to use for allocation	[32]
Allocate each logical partition copy on a SEPARATE physical volume?	yes
File containing ALLOCATION MAP	[]
SYNCHRONIZE the data in the new logical partition copies?	no

# Mirroring rootvg



1. `extendvg`
2. `chvg -Qn`
3. `mirrorvg -s`
4. `syncvg -v`

5. `bosboot -a`
6. `bootlist`
7. `shutdown -Fr`
8. `bootinfo -b`

- Make a copy of all **rootvg** LVs using **mirrorvg** and place copies on the second disk
- Execute **bosboot** and change your **bootlist**

# Mirroring Volume Groups (`mirrorvg`)

## Mirror a Volume Group

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

	[Entry Fields]
VOLUME GROUP name	rootvg
Mirror sync mode	[Foreground]
PHYSICAL VOLUME names	[hdisk1]
Number of COPIES of each logical partition	2
Keep Quorum Checking On?	no
Create Exact LV Mapping?	no

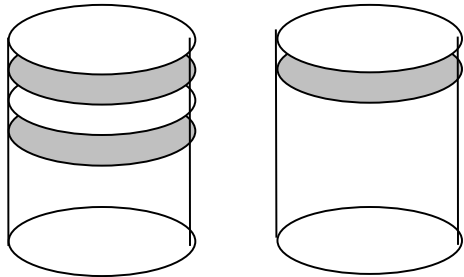
For `rootvg`, you need to execute:

- `bosboot`
- `bootlist -m normal ...`

# VGDA Count

---

## Two-disk Volume Group



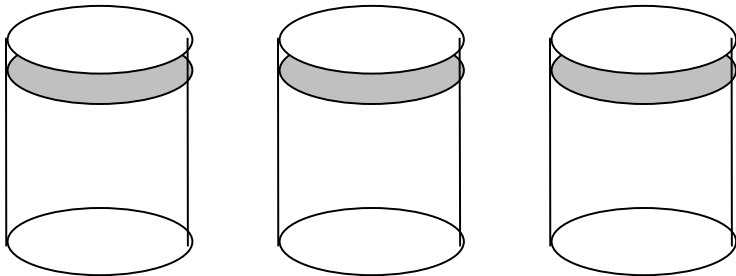
PV1

PV2

Loss of PV1: Only 33% VGDA's available  
**(No quorum)**

Loss of PV2: 66% of VGDA's available  
**(Quorum)**

## Three-disk Volume Group



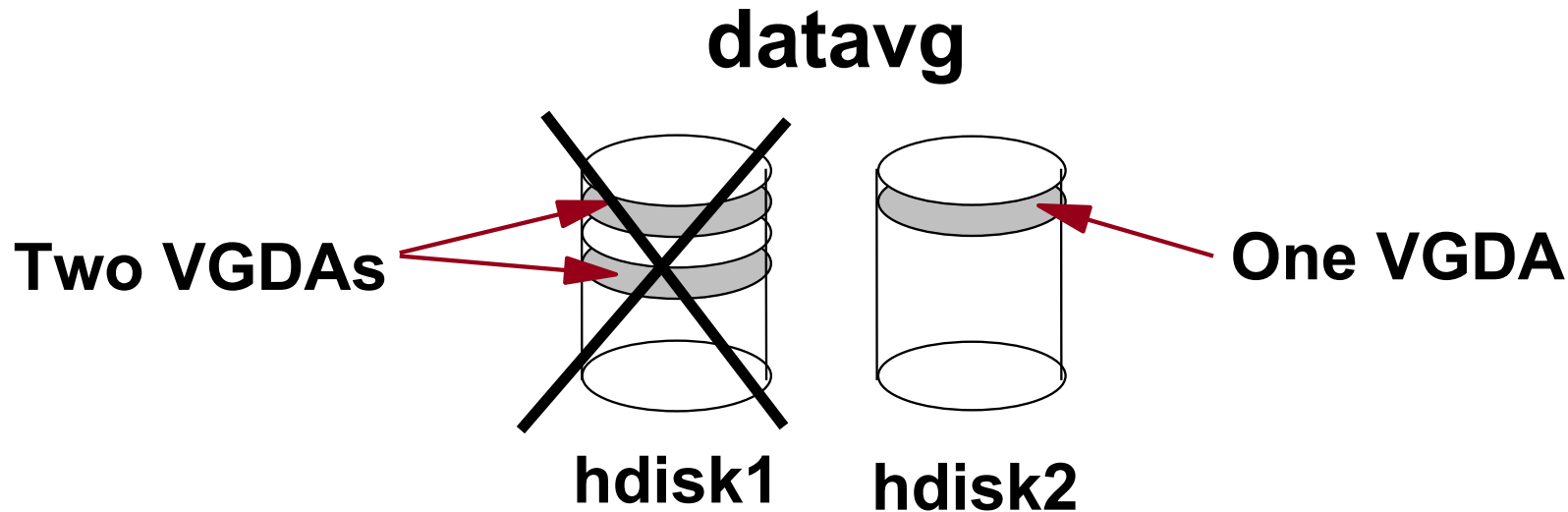
PV1

PV2

PV3

Loss of 1 PV: 66% of VGDA's still available  
**(Quorum)**

# Quorum Not Available



**If hdisk1 fails, datavg has no quorum !**

VG not active

VG active

# varyonvg datavg

**FAILS !!!**

**Closed during operation:**

- No more access to LVs
- `LVM_SA_QUORCLOSE` in error log

# Nonquorum Volume Groups

---

With single mirroring, always disable the quorum:

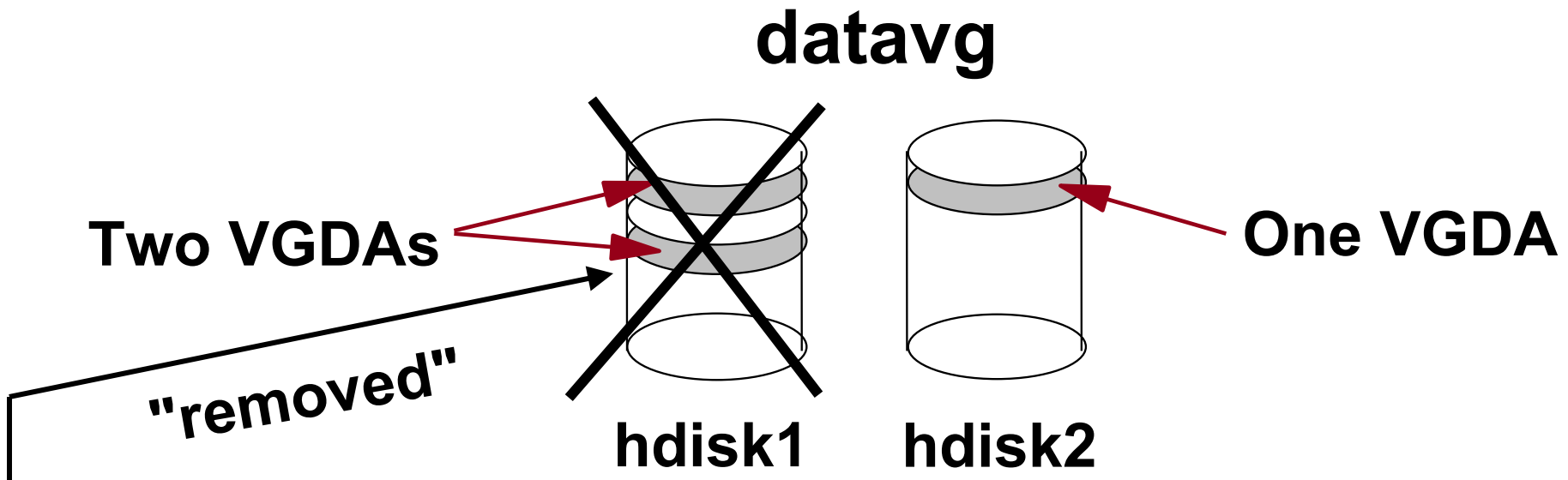
- `chvg -Qn datavg`
- `varyoffvg datavg`
- `varyonvg datavg`

Additional considerations for **rootvg**:

- `chvg -Qn rootvg`
- `bosboot -ad /dev/hdiskX`
- Reboot

- Turning off the quorum checking does not allow a normal `varyonvg` without a quorum
- It does prevents closing of the volume group when quorum is lost

# Forced Varyon (`varyonvg -f`)



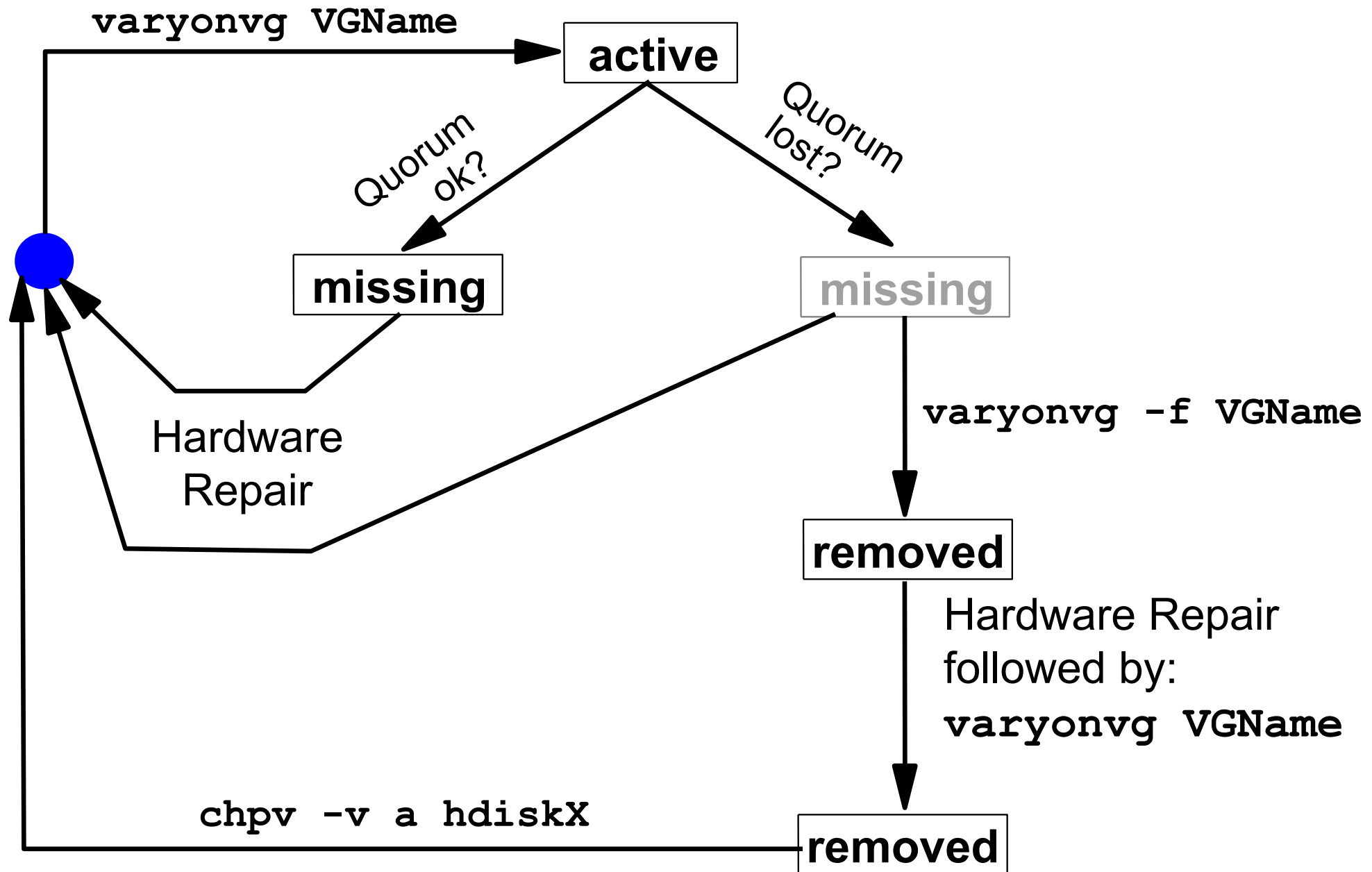
```
# varyonvg datavg FAILS !!! (even when quorum disabled)
```

Check the reason for the failure (cable, adapter, power),  
before doing the following ...

```
# varyonvg -f datavg
```

Failure accessing **hdisk1**. Set PV STATE to removed.  
Volume group **datavg** is varied on.

# Physical Volume States





# Checkpoint

---

1. (True or False) All LVM information is stored in the ODM.
2. (True or False) You detect that a physical volume **hdisk1** that is contained in your **rootvg** is missing in the ODM. This problem can be fixed by exporting and importing the **rootvg**.
3. (True or False) The LVM supports RAID-5 without separate hardware.

# Checkpoint Solutions

- (True or **False**) All LVM information is stored in the ODM. False. Information is also stored in other AIX files and in disk control blocks (like the VGDA and LVCB).
- (True or **False**) You detect that a physical volume **hdisk1** that is contained in your **rootvg** is missing in the ODM. This problem can be fixed by exporting and importing the **rootvg**. False. Use the **rvgrecover** script instead. This script creates a complete set of new rootvg ODM entries.
- (True or **False**) The LVM supports RAID-5 without separate hardware. False. LVM supports RAID-0, RAID-1, and RAID-10 without additional hardware.

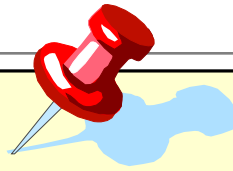
# Exercise 6: Mirroring rootvg

---



- Mirror and Unmirror the Complete **rootvg**

# Unit Summary



- The LVM information is held in a number of different places on the disk, including the ODM and the VGDA
- ODM related problems can be solved by:
  - `exportvg/importvg` (non-rootvg VGs)
  - `rvgrecover` (rootvg)
- Mirroring improves the availability of a system or a logical volume
- Striping improves the performance of a logical volume
- Quorum means that more than 50% of VGDA's must be available



Welcome to:

# Disk Management Procedures



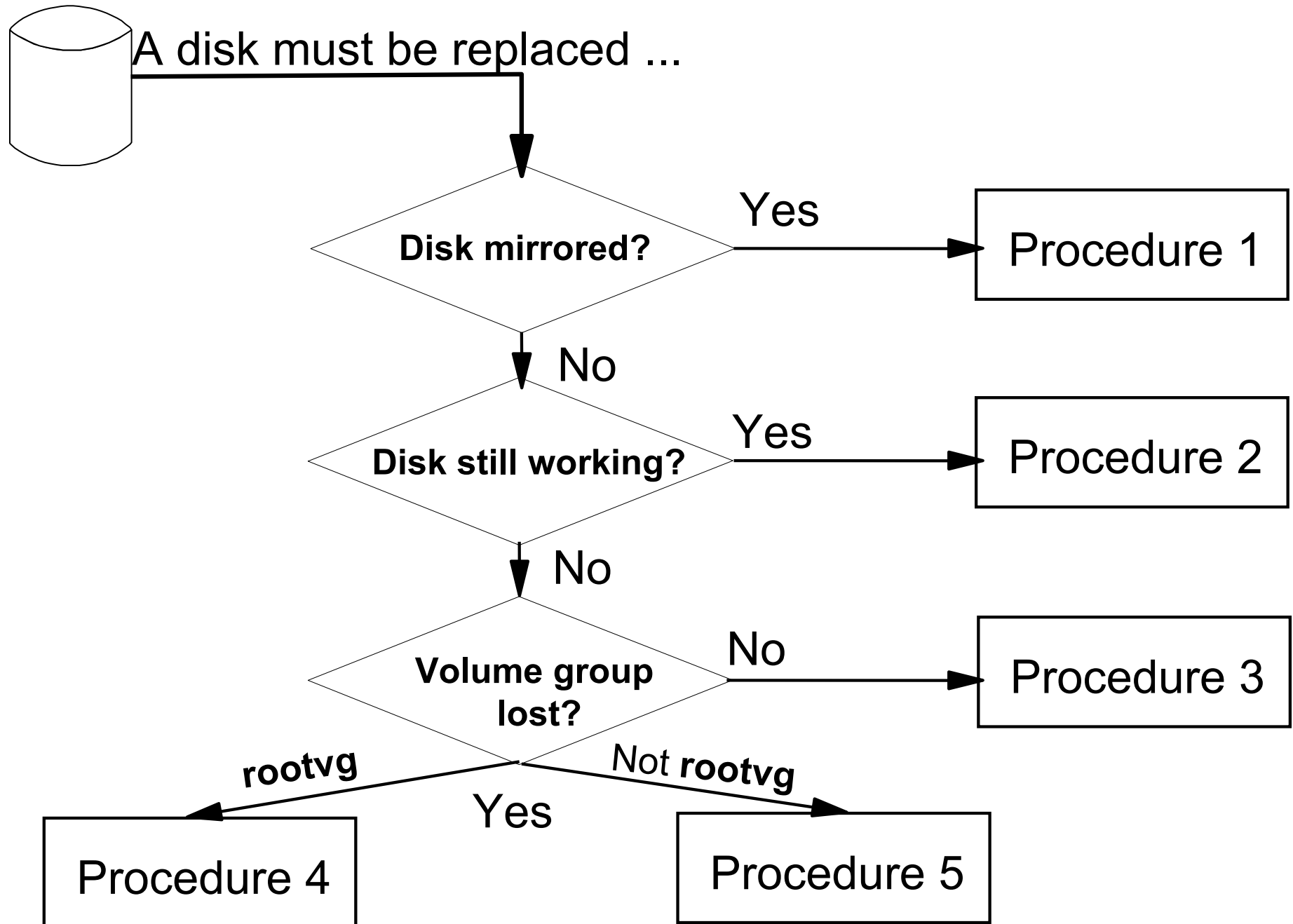
# Unit Objectives

---

After completing this unit, you should be able to:

- Replace a disk under different circumstances
- Recover from a total volume group failure
- Rectify problems caused by incorrect actions that have been taken to change disks
- Export and import volume groups

# Disk Replacement: Starting Point



# Procedure 1: Disk Mirrored

1. Remove all copies from disk:

```
# unmirrorvg vg_name hdiskX
```

4. Remove disk from volume group:

```
# reducevg vg_name hdiskX
```

7. Remove disk from ODM:

```
# rmdev -l hdiskX -d
```

10. Connect new disk to system

May have to shut down if not hot-pluggable

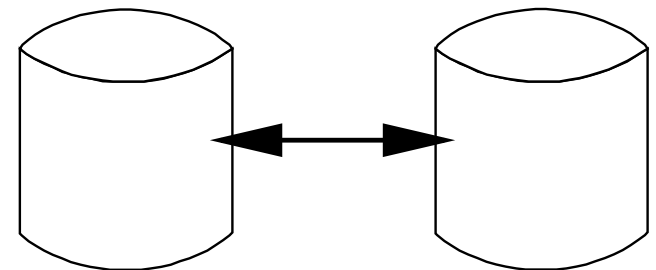
13. Add new disk to volume group:

```
# extendvg vg_name hdiskY
```

16. Create new copies:

```
# mirrorvg vg_name hdiskY
```

```
# syncvg vg_name
```

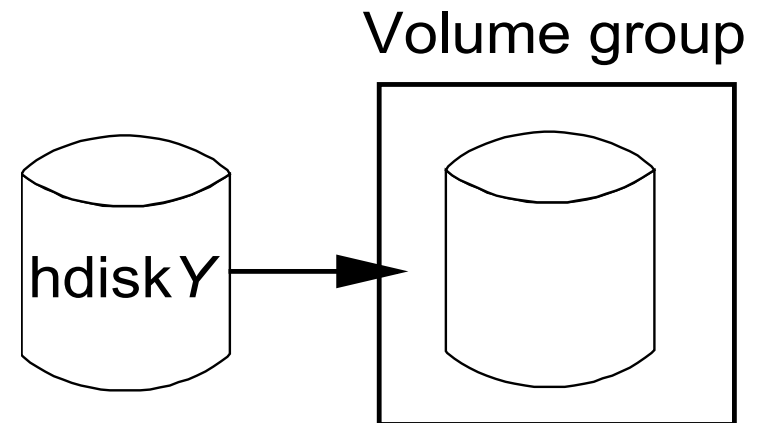


Mirrored



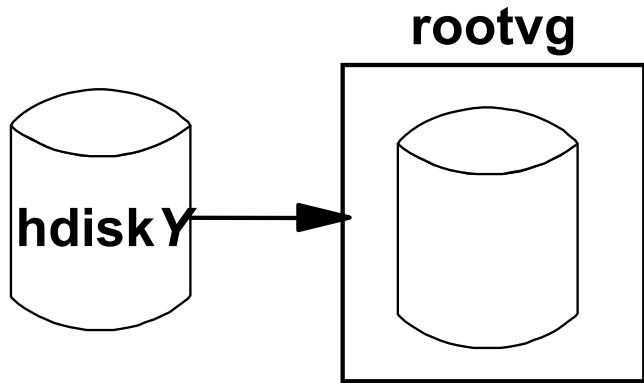
# Procedure 2: Disk Still Working

1. Connect new disk to system.
3. Add new disk to volume group:  
`# extendvg vg_name hdiskY`
6. Migrate old disk to new disk: (\*)  
`# migratepv hdiskX hdiskY`
9. Remove old disk from volume group:  
`# reducevg vg_name hdiskX`
12. Remove old disk from ODM:  
`# rmdev -l hdiskX -d`




(\*) : Is the disk in **rootvg**?  
See next visual for further considerations!

# Procedure 2: Special Steps for rootvg



1. Connect new disk to system

3. Add new disk to volume group

5.  →

7. Remove old disk from volume group

9. Remove old disk from ODM

1...

2...

- Disk contains **hd5**?  
# `migratepv -l hd5 hdiskX hdiskY`  
# `bosboot -ad /dev/hdiskY`  
# `chpv -c hdiskX`  
# `bootlist -m normal hdiskY`

Migrate old disk to new disk:

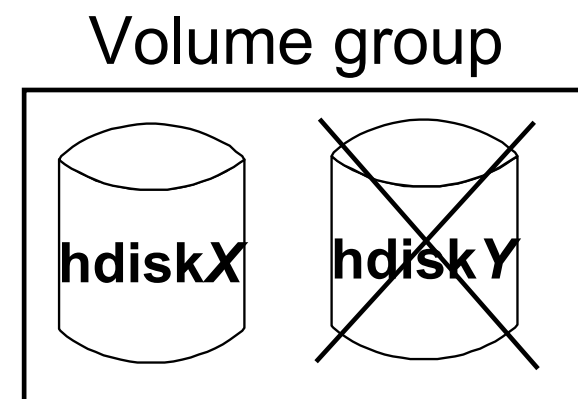
```
# migratepv hdiskX hdiskY
```

4...

5...

## Procedure 3: Disk in Missing or Removed State

1. Identify all LVs and file systems on failing disk:  
`# lspv -l hdiskY`
4. Unmount all file systems on failing disk:  
`# umount /dev/lv_name`
7. Remove all file systems and LVs from failing disk:  
`# smit rmfs                   # rmlv lv_name`
10. Remove disk from volume group:  
`# reducevg vg_name hdiskY`
13. Remove disk from system:  
`# rmdev -l hdiskY -d`
16. Add new disk to volume group:  
`# extendvg vg_name hdiskZ`
19. Re-create all LVs and file systems on new disk:  
`# mklv -y lv_name               # smit crfs`
22. Restore file systems from backup:  
`# restore -rvqf /dev/rmt0`



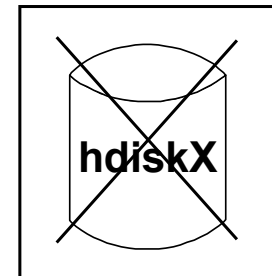
```
# lspv hdiskY
...
PV STATE: removed

# lspv hdiskY
...
PV STATE: missing
```

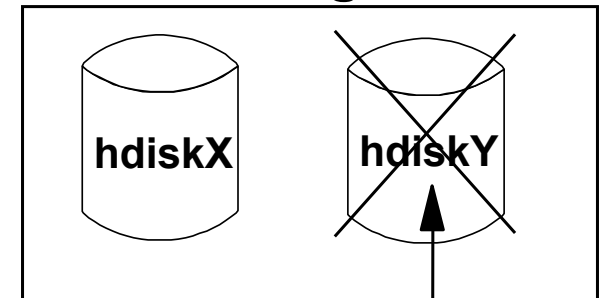
# Procedure 4: Total rootvg Failure

2. Replace bad disk
4. Boot in maintenance mode
6. Restore from a `mksysb` tape
8. Import each volume group into the new ODM (`importvg`) if needed

rootvg

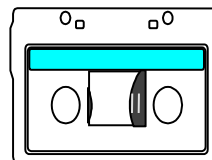
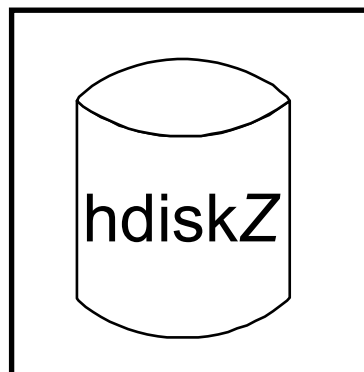


rootvg



Contains OS  
logical  
volumes

datavg

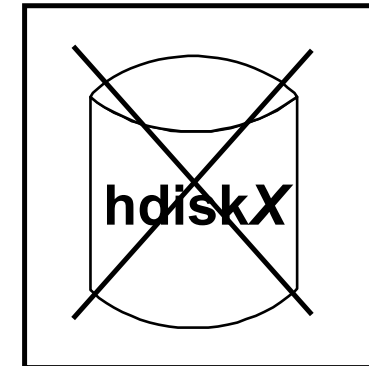


`mksysb`

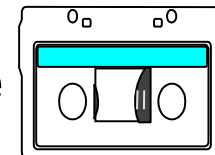
# Procedure 5: Total non-rootvg Failure

1. Export the volume group from the system:  
`# exportvg vg_name`
    - Check `/etc/filesystems`.
    - Remove bad disk from ODM and the system:  
`# rmdev -l hdiskX -d`
  9. Connect new disk.
  11. If volume group backup is available (`savevg`):  
`# restvg -f /dev/rmt0 hdiskY`
    - If **no** volume group backup is available: Re-create ...
      - Volume group (`mkvg`)
      - Logical volumes and file systems (`mklv, crfs`)
- Restore data from a backup:  
`# restore -rqvf /dev/rmt0`

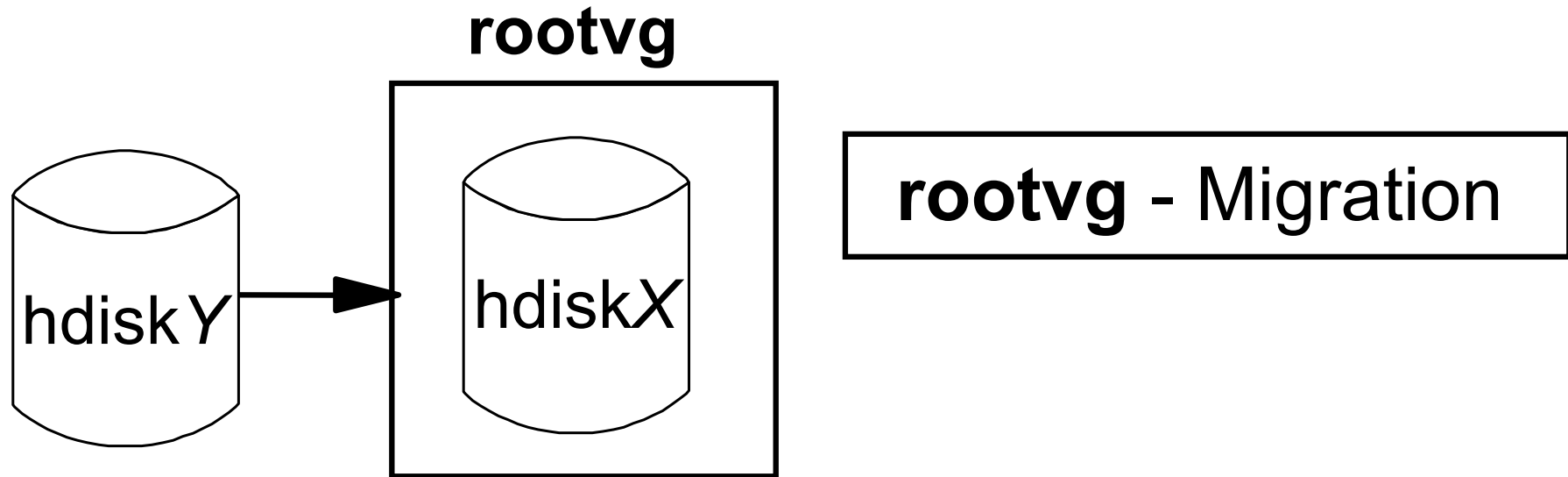
datavg



Tape



# ~~Frequent Disk Replacement Errors (1 of 4)~~



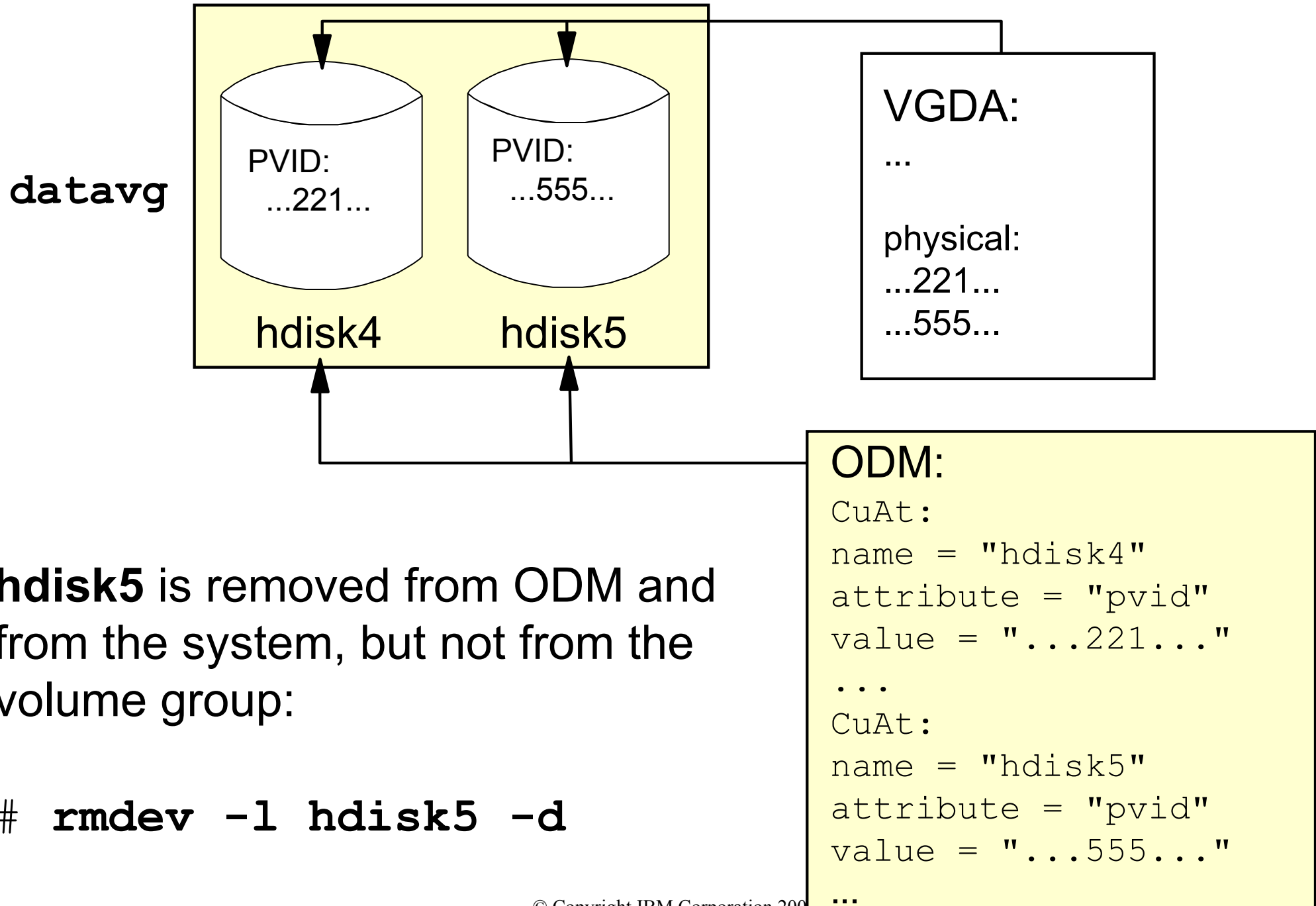
## Boot problems after migration:

- Firmware LED codes cycle or boots to SMS multiboot menu

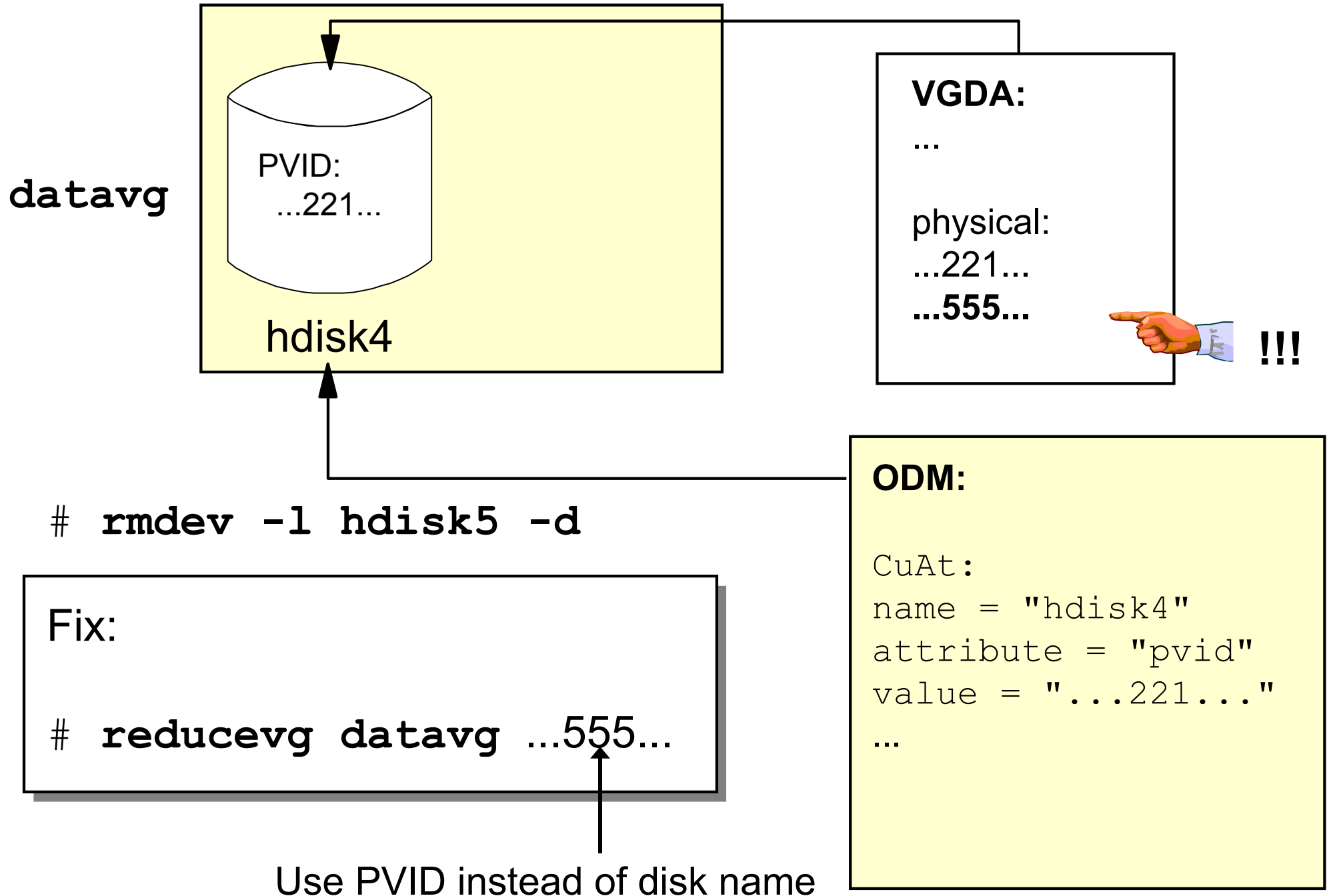
## Fix:

- Check bootlist (SMS menu)
- Check bootlist (bootlist)
- Re-create boot logical volume (**bosboot**)

# Frequent Disk Replacement Errors (2 of 4)

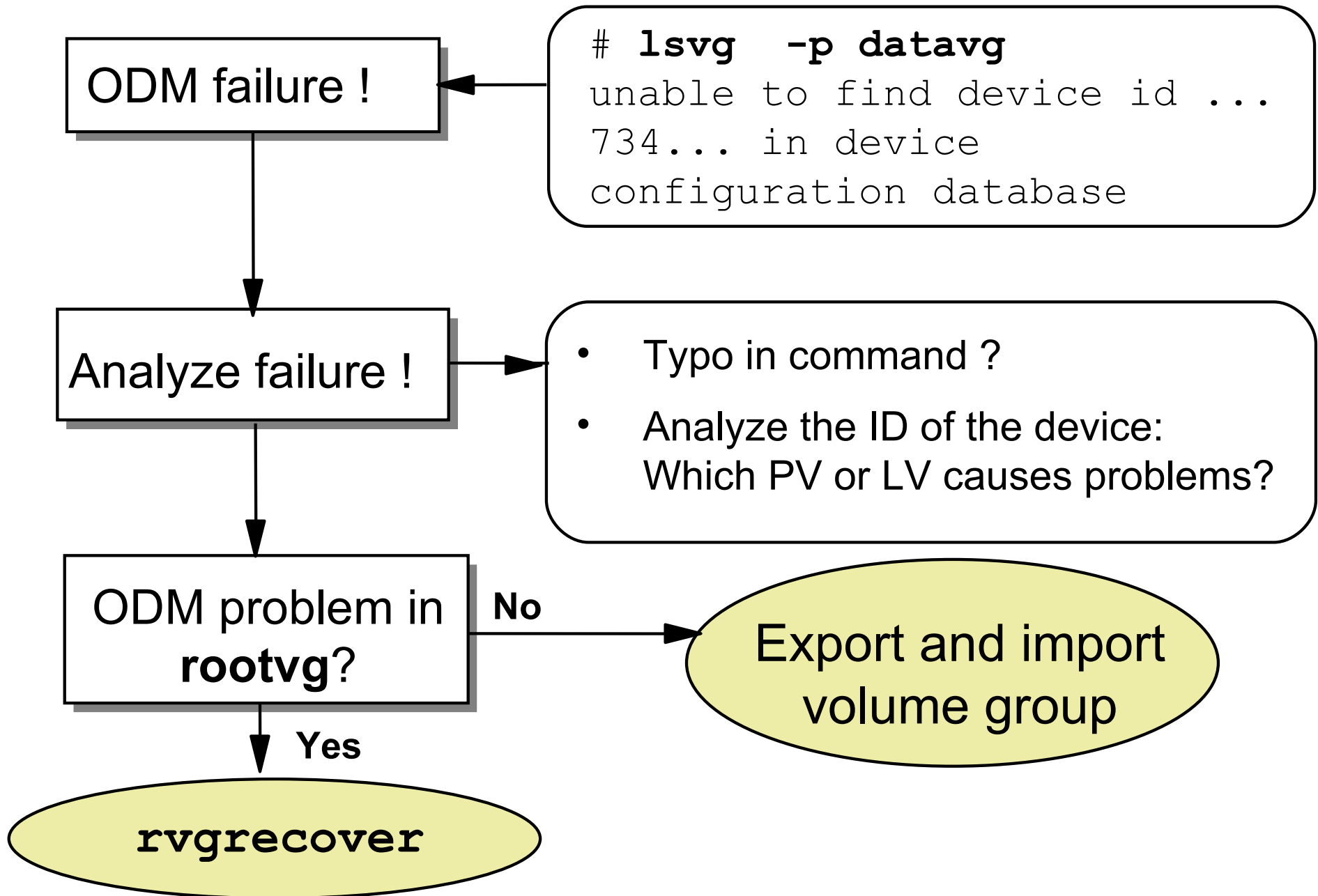


# Frequent Disk Replacement Errors (3 of 4)



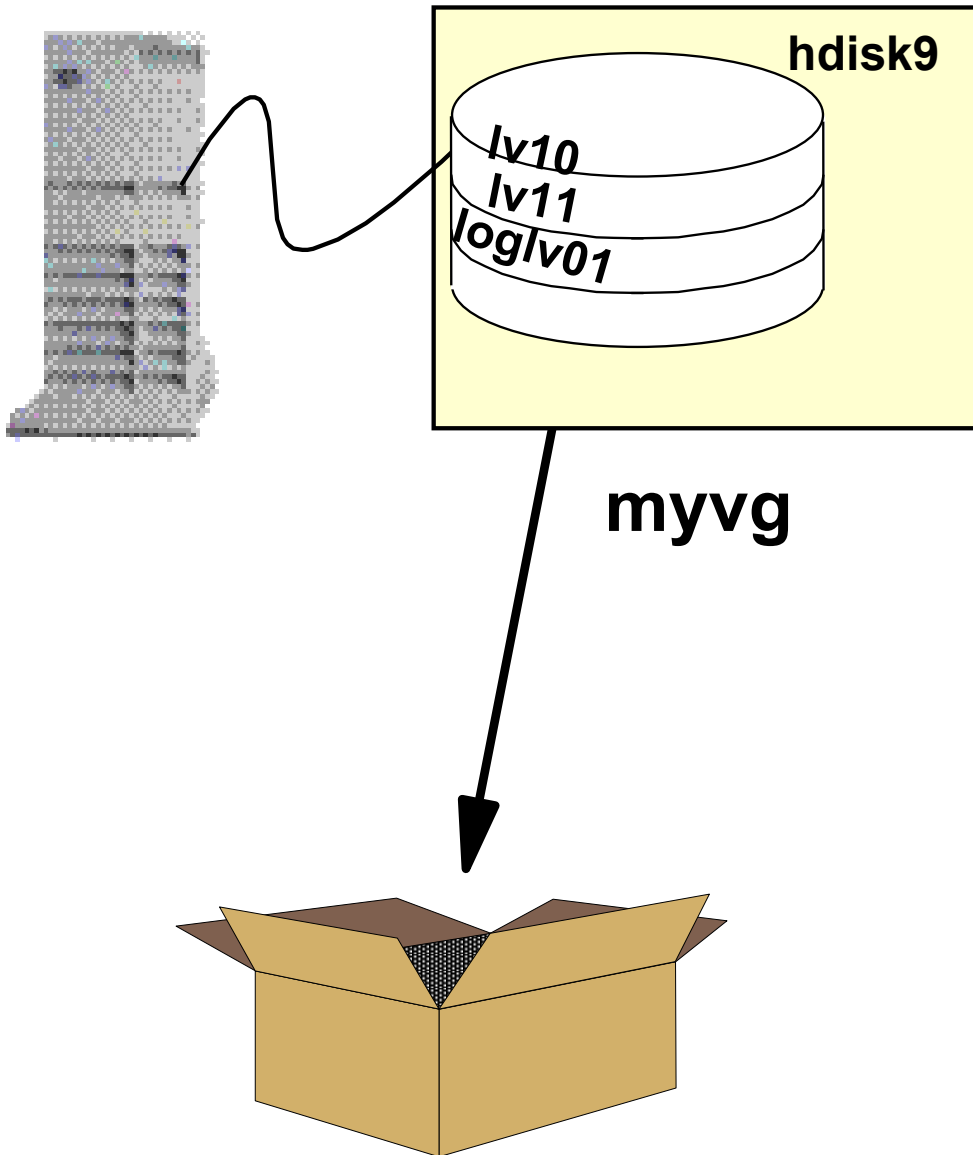


# Frequent Disk Replacement Errors (4 of 4)



# Exporting a Volume Group

moon



To export a volume group:

3. Unmount all file systems from the volume group:

```
# umount /dev/lv10
```

```
# umount /dev/lv11
```

7. Vary off the volume group:

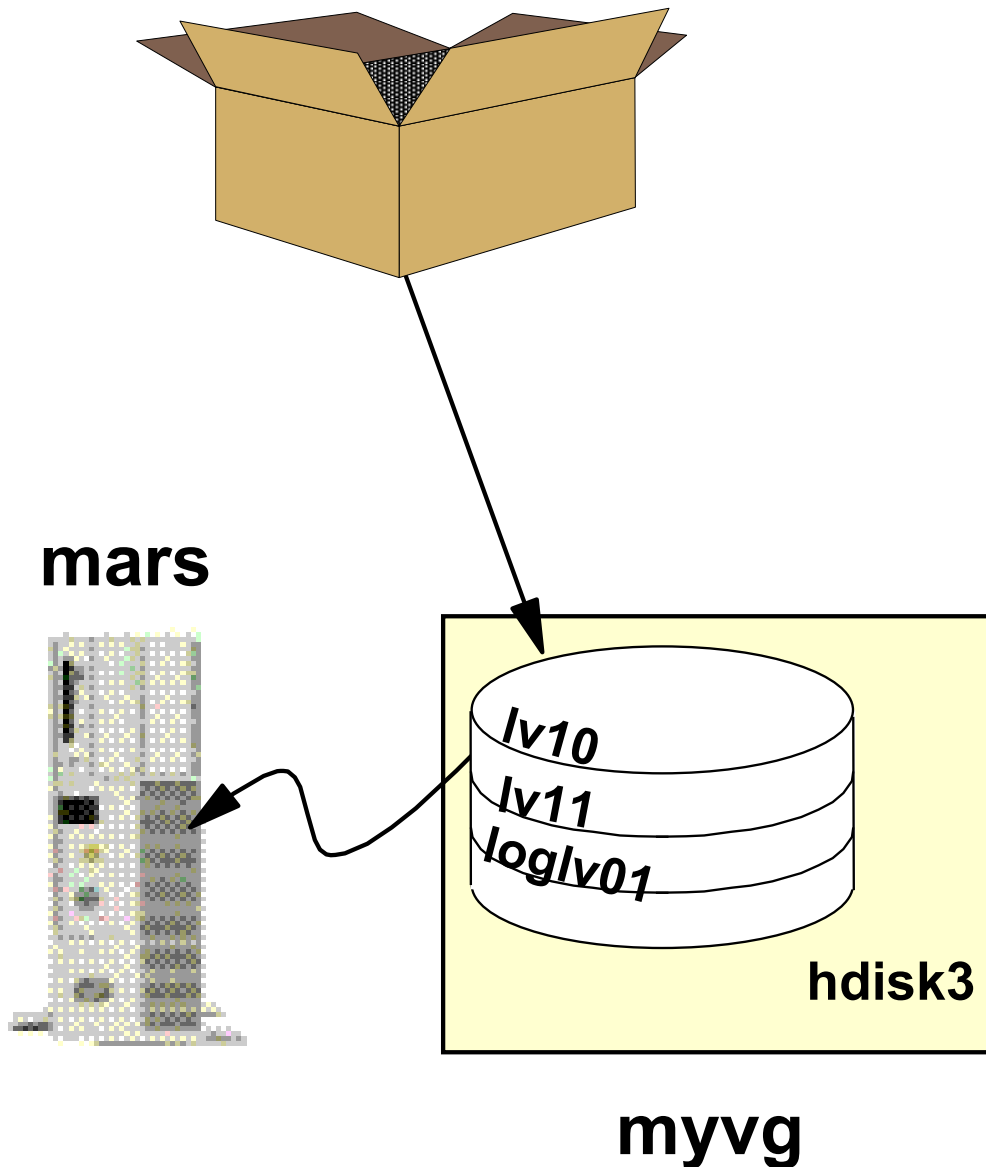
```
# varyoffvg myvg
```

10. Export volume group:

```
# exportvg myvg
```

The complete volume group is removed from the ODM.

# Importing a Volume Group



To import a volume group:

3. Configure the disk(s).

5. Import the volume group:

```
# importvg -y myvg hdisk3
```

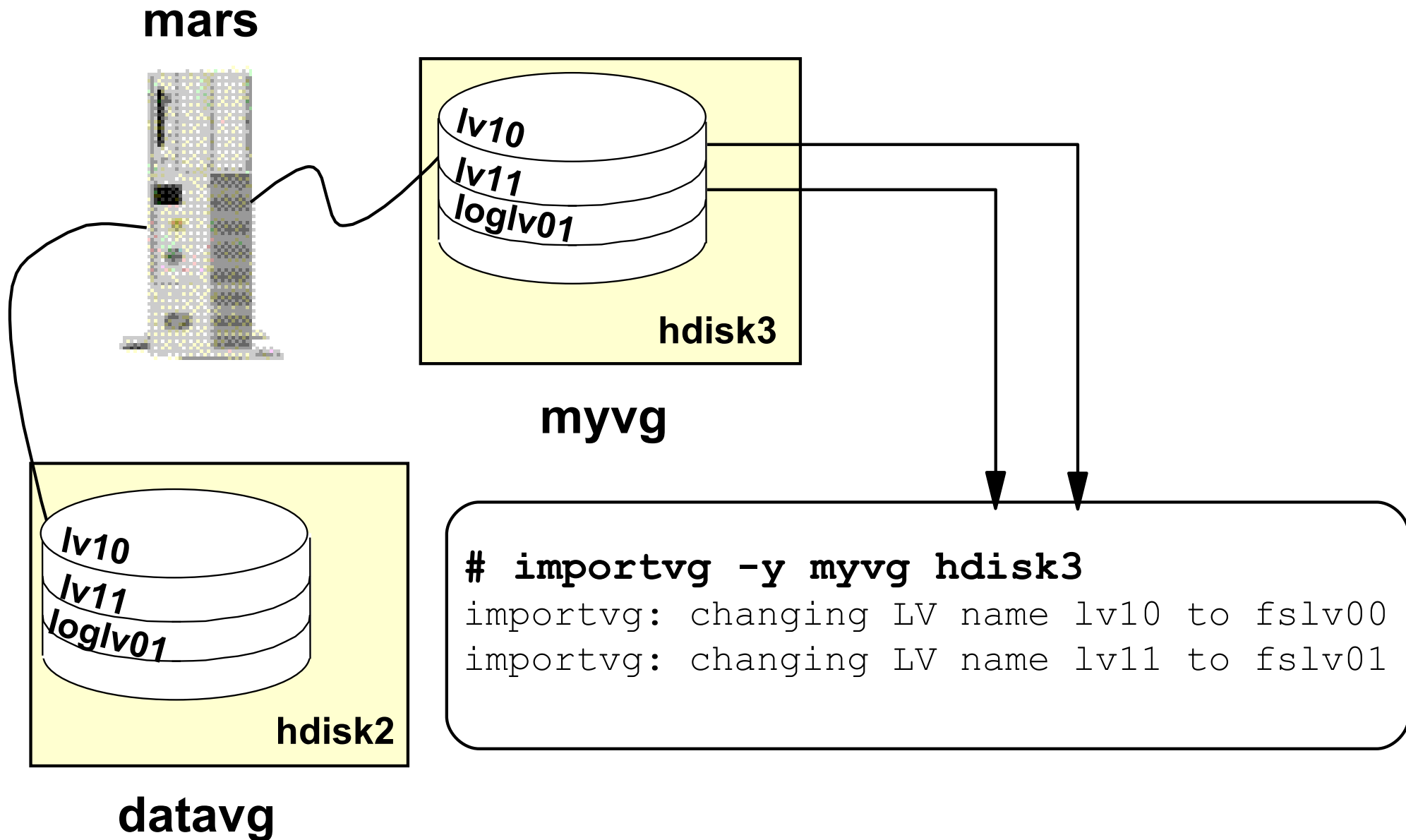
8. Mount the file systems:

```
# mount /dev/lv10
```

```
# mount /dev/lv11
```

The complete volume group is added to the ODM.

# ~~importvg~~ and Existing Logical Volumes



**importvg** can also accept the PVID in place of the hdisk name

# ~~importvg and Existing File Systems (1 of 2)~~

<code>/dev/lv10:</code>	<code>/home/sarah</code>
<code>/dev/lv11:</code>	<code>/home/michael</code>
<code>/dev/loglv00:</code>	log device

<code>/dev/lv23:</code>	<code>/home/peter</code>
<code>/dev/lv24:</code>	<code>/home/michael</code>
<code>/dev/loglv01:</code>	log device

```
# importvg -y myvg hdisk3
```

```
Warning: mount point /home/michael already  
exists in /etc/filesystems
```

```
# umount /home/michael
```

```
# mount -o log=/dev/loglv01 /dev/lv24 /home/michael
```

# ~~importvg and Existing File Systems (2 of 2)~~

```
# vi /etc/filesystems
```

```
/home/michael:
```

```
dev      = /dev/lv11
vfs      = jfs
log      = /dev/loglv00
mount    = false
options  = rw
account  = false
```

```
/home/michael_moon:
```

```
dev      = /dev/lv24
vfs      = jfs
log      = /dev/loglv01
mount    = false
options  = rw
account  = false
```

```
/dev/lv10:    /home/sarah
/dev/lv11:    /home/michael
```

```
/dev/loglv00: log device
```

```
datavg
```

```
/dev/lv23:    /home/peter
/dev/lv24:    /home/michael
```

```
/dev/loglv01: log device
```

```
hdisk3 (myvg)
```

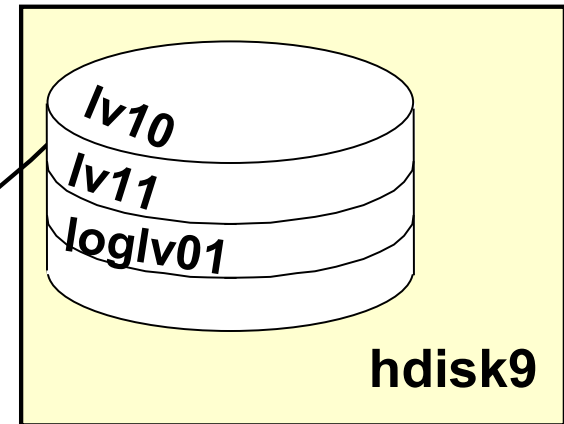
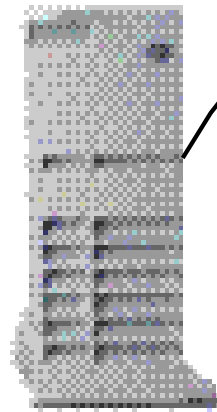
```
# mount /home/michael
```

```
# mount /home/michael_moon → Mount point must exist!
```

# ~~importvg -L (1 of 2)~~

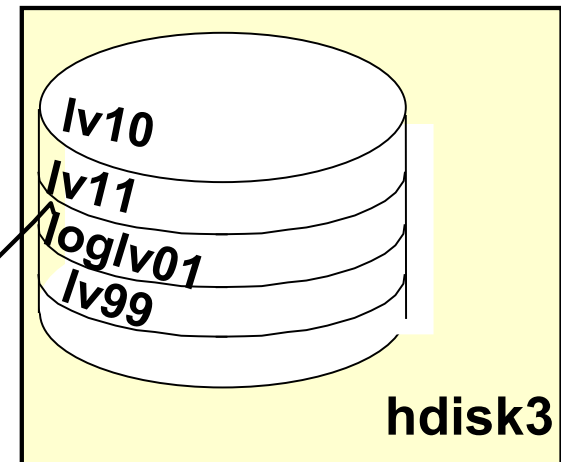
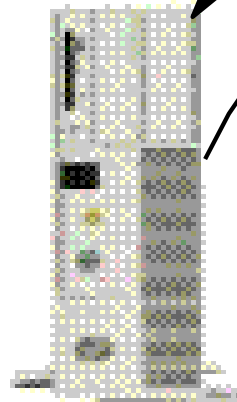
No exportvg !!!

moon



myvg

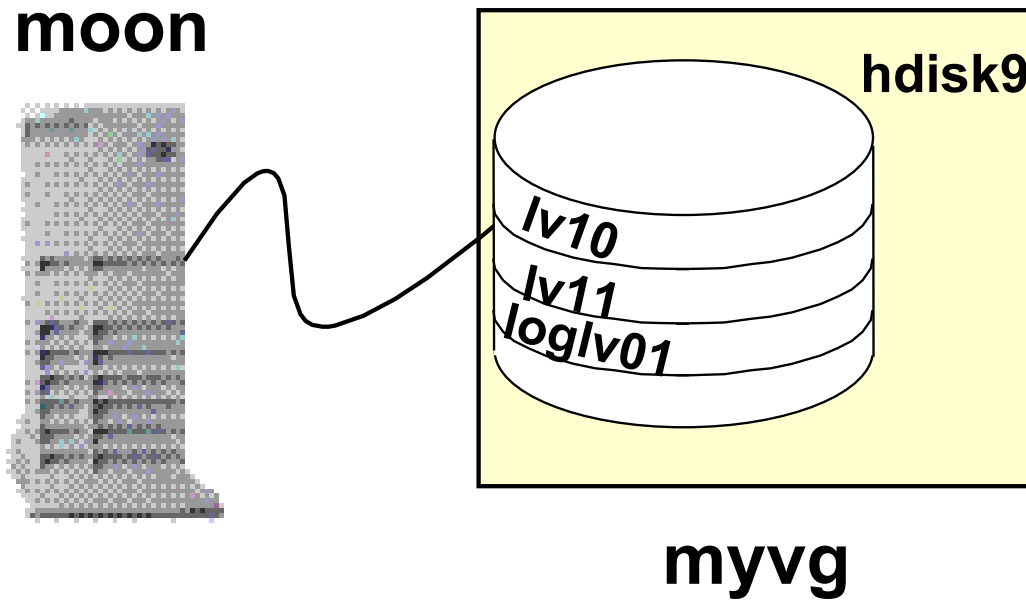
mars



myvg

```
# importvg -y myvg hdisk3  
# mklv lv99 myvg
```

# ~~importvg -L (2 of 2)~~



*"Learn about possible changes!"*

```
# importvg -L myvg hdisk9  
# varyonvg myvg
```

```
==> importvg -L fails if a name clash is detected
```



# Checkpoint

1. Although everything seems to be working fine, you detect error log entries for disk **hdisk0** in your **rootvg**. The disk is not mirrored to another disk. You decide to replace this disk. Which procedure would you use to migrate this disk?

---

---

5. You detect an unrecoverable disk failure in volume group **datavg**. This volume group consists of two disks that are completely mirrored. Because of the disk failure you are not able to vary on **datavg**. How do you recover from this situation?

---

---

8. After disk replacement you recognize that a disk has been removed from the system but not from the volume group. How do you fix this problem?

---

---

# Checkpoint Solutions

1. Although everything seems to be working fine, you detect error log entries for disk **hdisk0** in your **rootvg**. The disk is not mirrored to another disk. You decide to replace this disk. Which procedure would you use to migrate this disk?

Procedure 2: Disk still working. There are some additional steps necessary for **hd5** and the primary dump device **hd6**.

3. You detect an unrecoverable disk failure in volume group **datavg**. This volume group consists of two disks that are completely mirrored. Because of the disk failure you are not able to vary on **datavg**. How do you recover from this situation?

Forced varyon: **varyonvg -f datavg**.  
Use Procedure 1 for mirrored disks.

4. After disk replacement you recognize that a disk has been removed from the system but not from the volume group. How do you fix this problem?

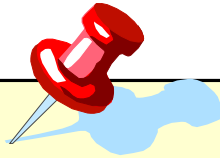
Use PVID instead of disk name: **reducevg vg\_name PVID**

# Exercise 7:

## Exporting and Importing Volume Groups

- 
- Export and import a volume group
  - Analyze import messages (Optional)

# Unit Summary



- Different procedures are available that can be used to fix disk problems under any circumstance:
  - Procedure 1: Mirrored disk
  - Procedure 2: Disk still working (**rootvg** specials)
  - Procedure 3: Total disk failure
  - Procedure 4: Total **rootvg** failure
  - Procedure 5: Total non-**rootvg** failure
- **exportvg** and **importvg** can be used to easily transfer volume groups between systems



Welcome to:

# Performance and Workload Management



# Unit Objectives

---

After completing this unit, you should be able to:

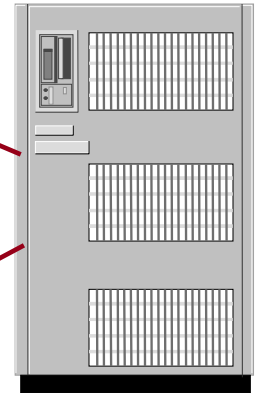
- Provide basic performance concepts
- Provide basic performance analysis
- Manage the workload on a system
- Use the Performance Diagnostic Tool (PDT)

# Performance Problems

What a fast machine!

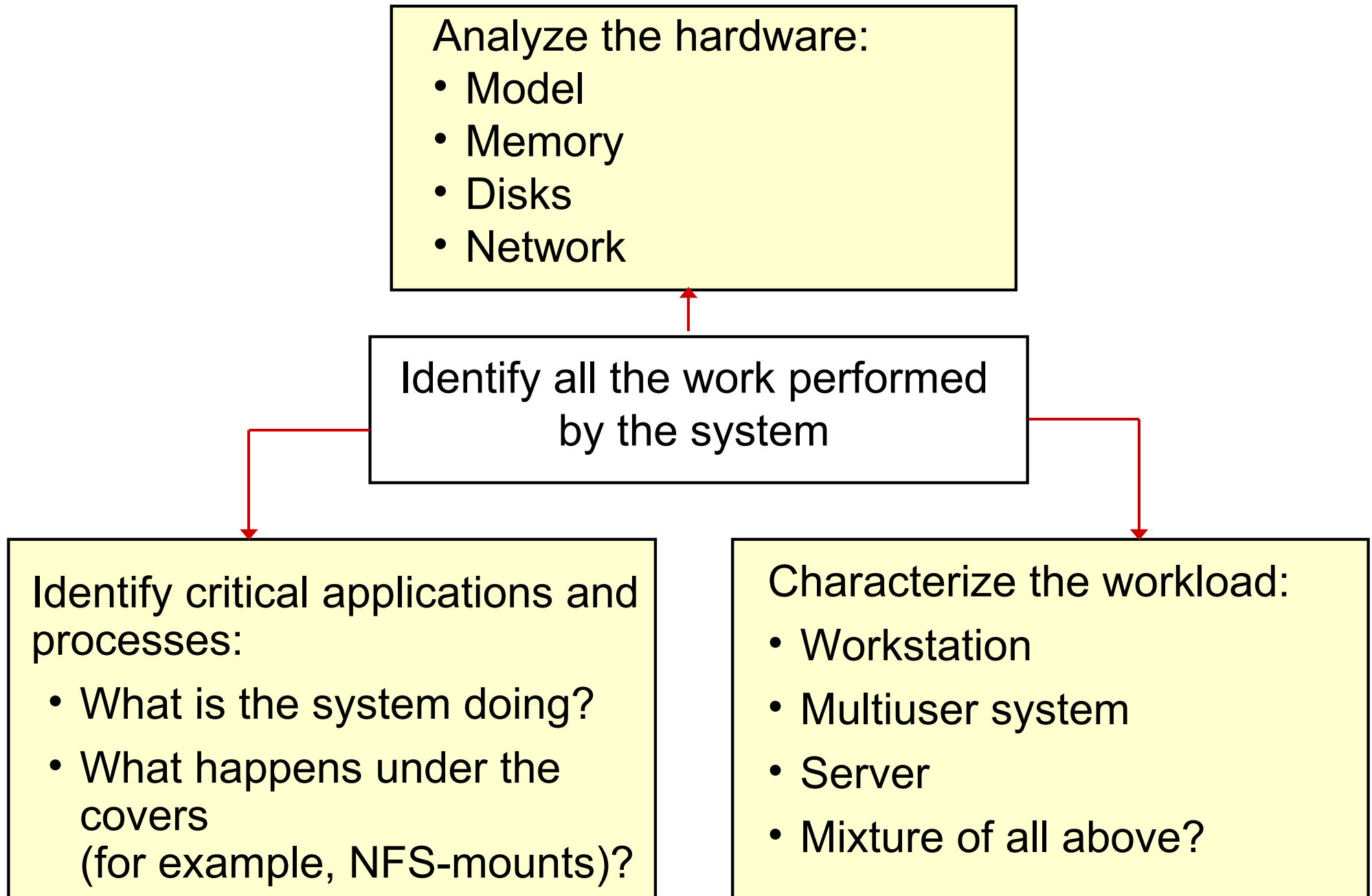


The system is so slow today!



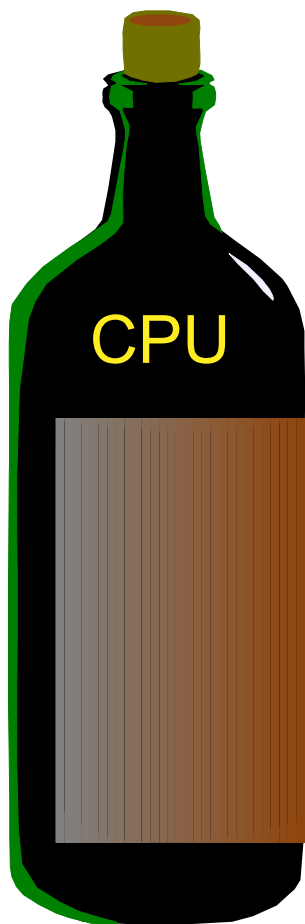
Performance is very often not objective!

# Understand the Workload

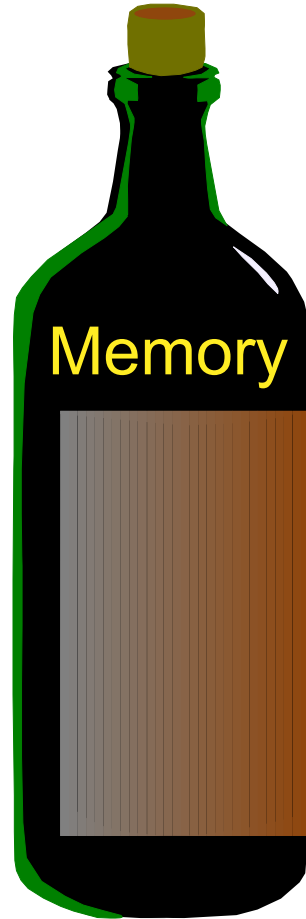




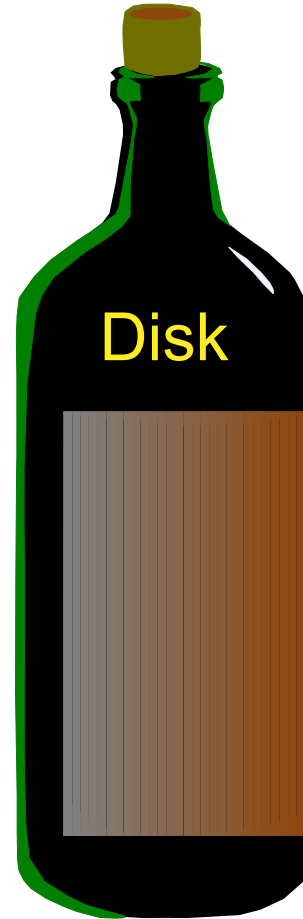
# Critical Resources: The Four Bottlenecks



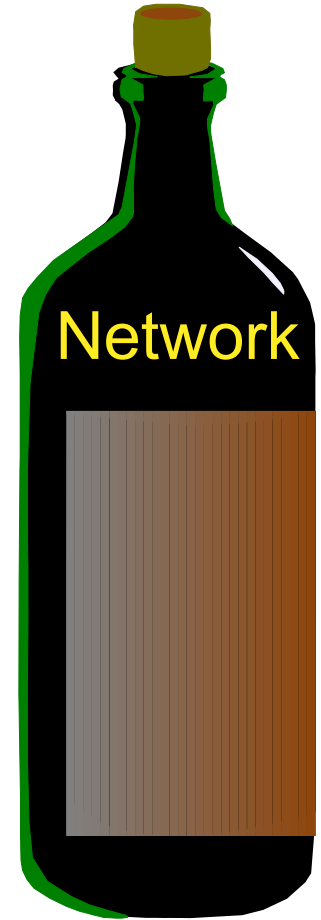
- Number of processes
- Process priorities



- Real memory
- Paging
- Memory leaks

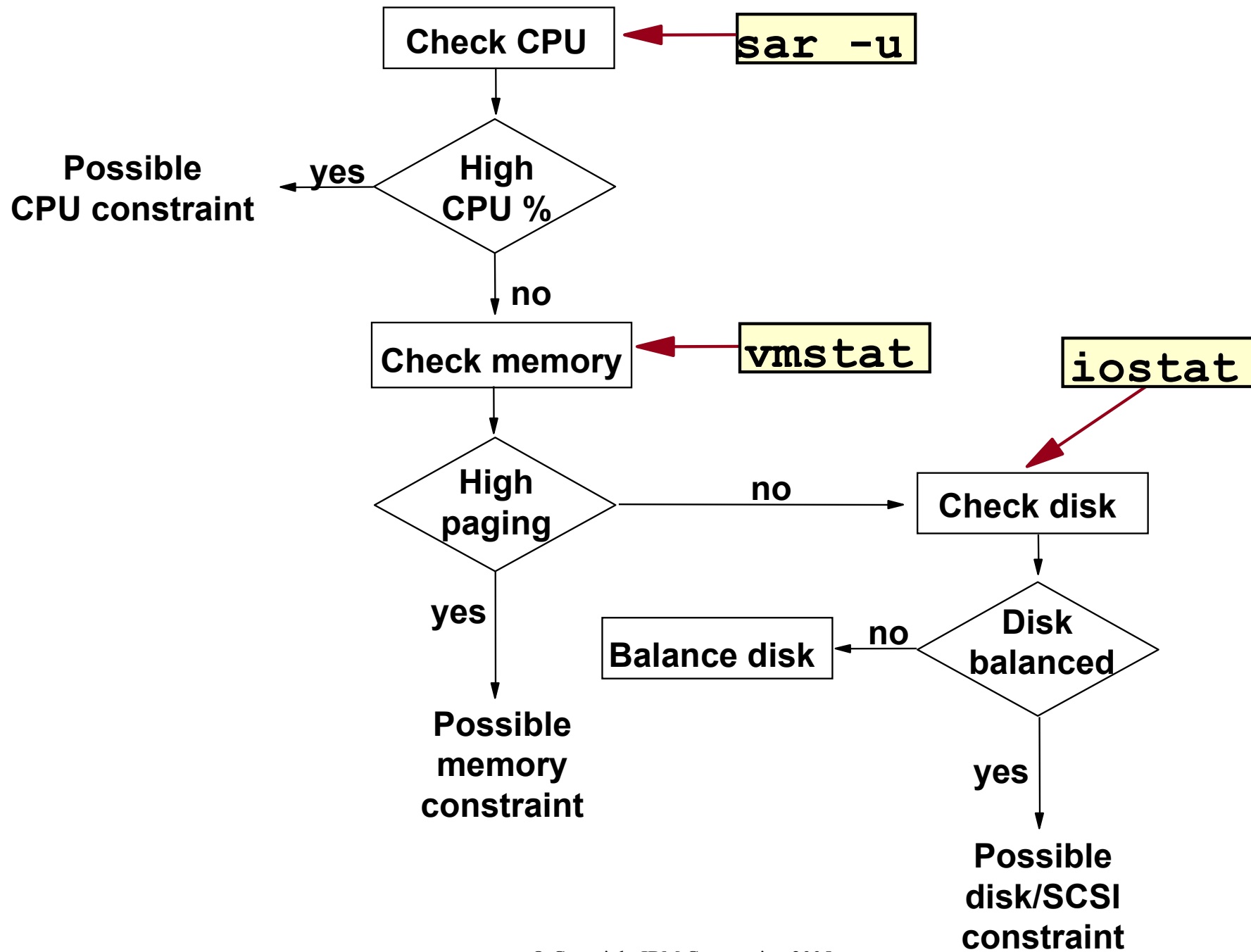


- Disk balancing
- Types of disks
- LVM policies



- NFS used to load applications
- Network type
- Network traffic

# Basic Performance Analysis



# AIX Performance Tools

Identify causes of bottlenecks:

CPU Bottlenecks  
Processes using CPU time

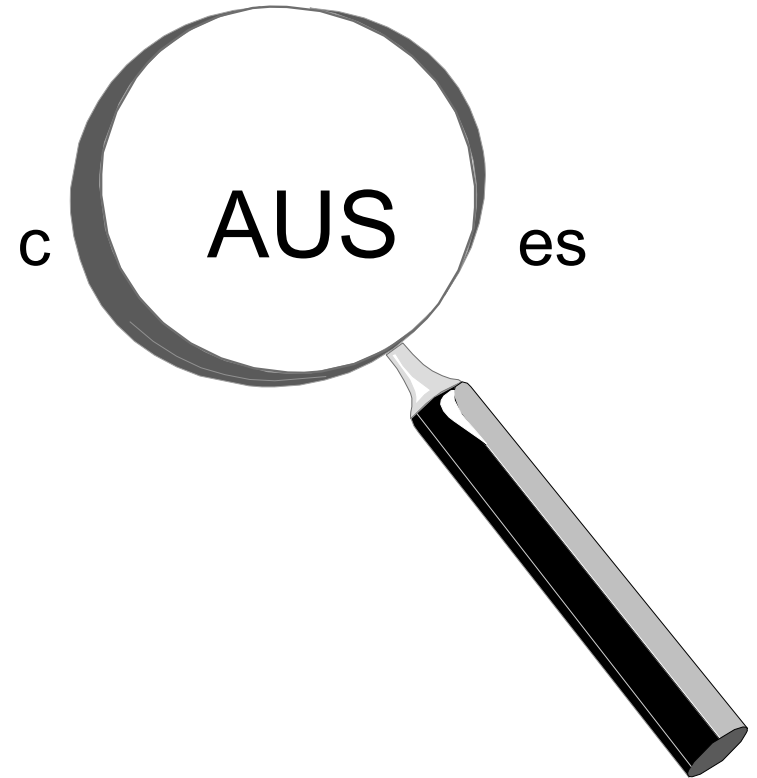
`tprof`

Memory Bottlenecks  
Processes using memory

`svmon`

I/O Bottlenecks  
File systems, LVs, and files  
causing disk activity

`filemon`



# Identify CPU-Intensive Programs: ps aux

```
# ps aux
```

USER	PID	%CPU	%MEM	...	STIME	TIME	COMMAND
root	516	98.2	0.0	...	13:00:00	1329:38	wait
johnp	7570	1.2	1.0	...	17:48:32	0:01	-ksh
root	1032	0.8	0.0	...	15:13:47	78:37	kproc
root	1	0.1	1.0	...	15:13:50	13:59	/etc/init

Percentage of time  
the process has  
used the CPU

Percentage of real  
memory

Total Execution  
Time

# Identify High Priority Processes: ~~ps -elf~~

```
# ps -elf
```

	F	S	UID	PID	PPID	C	PRI	NI	...	TIME	CMD
200003	A	root	1	0	0	0	60	20	...	0:04	/etc/init
240001	A	root	69718	1	0	0	60	20	...	1:16	/usr/sbin/syncd 60
200001	A	root	323586	188424	24	72	20	...	0:00	ps -elf	

Priority of  
the process

Nice value

- The smaller the PRI value, the higher the priority of the process. The average process runs a priority around 60.
- The NI value is used to adjust the process priority. The higher the nice value is, the lower the priority of the process.

# Monitoring CPU Usage: sar -u

Interval

Number

```
# sar -u 60 30
```

```
AIX www 3 5 000400B24C00 08/09/05
```

```
System configuration: lcpu=2
```

08:24:10	%usr	%sys	%wio	%idle
08:25:10	48	52	0	0
08:26:10	63	37	0	0
08:27:10	59	41	0	0
...				
Average	<b>57</b>	<b>43</b>	0	0

A system may be CPU bound, if:  
 $\%usr + \%sys > 80\%$

# AIX Tools: tprof

```
# tprof -x sleep 60
# more sleep.prof
```

Process	Freq	Total	Kernel	User	Shared	Other
=====	=====	=====	=====	=====	=====	=====
./cpuprog	5	99.56	92.86	3.05	3.64	0.00
/usr/bin/tprof	2	0.41	0.01	0.01	0.39	0.00
/usr/sbin/syncd	4	0.02	0.02	0.00	0.00	0.00
gil	2	0.01	0.01	0.00	0.00	0.00
/usr/bin/sh	1	0.00	0.00	0.00	0.00	0.00
/usr/bin/trcstop	1	0.00	0.00	0.00	0.00	0.00
=====	=====	=====	=====	=====	=====	=====
Total	15	100.00	92.91	3.06	4.03	0.00

Process	PID	TID	Total	Kernel	User	Shared	Other
=====	=====	=====	=====	=====	=====	=====	=====
./cpuprog	184562	594051	20.00	18.72	0.63	0.66	0.00
./cpuprog	262220	606411	19.96	18.64	0.58	0.74	0.00
./cpuprog	168034	463079	19.89	18.57	0.61	0.71	0.00
./cpuprog	254176	598123	19.87	18.51	0.61	0.74	0.00
./cpuprog	282830	618611	19.83	18.43	0.61	0.79	0.00
/usr/bin/tprof	270508	602195	0.40	0.01	0.01	0.39	0.00
/usr/sbin/syncd	73808	163995	0.01	0.01	0.00	0.00	0.00
/usr/bin/trcstop	196712	638993	0.00	0.00	0.00	0.00	0.00
/usr/bin/sh	196710	638991	0.00	0.00	0.00	0.00	0.00
gil	49176	61471	0.00	0.00	0.00	0.00	0.00
...							
=====	=====	=====	=====	=====	=====	=====	=====
Total			100.00	92.91	3.06	4.03	0.00

Total Samples = 24316

Total Elapsed Time = 121.59s

# Monitoring Memory Usage: vmstat

Summary report every 5 seconds

```
# vmstat 5
```

```
System Configuration: lcpu=2 mem=512MB
```

kthr		memory			page		...			cpu				
r	b	avm	fre	re	pi	po	fr	sr	cy	...	us	sy	id	wa
0	0	8793	81	0	0	0	1	7	0		1	2	95	2
0	0	9192	66	0	0	16	81	167	0		1	6	77	16
0	0	9693	69	0	0	53	95	216	0		1	4	63	33
0	0	10194	64	0	21	0	0	0	0		20	5	42	33
0	0	4794	5821	0	24	0	0	0	0		5	8	41	46

pi, po:

- Paging space page ins and outs
- If any paging space I/O is taking place, the workload is approaching the system's memory limit

wa:

- I/O wait percentage of CPU
- If non-zero, a significant amount of time is being spent waiting on file I/O



# AIX Tools: svmon

Global report

# **svmon -G**

	size	inuse	free	pin	virtual
memory	32744	20478	12266	2760	11841
pg space	65536	294			
	work	pers	clnt	lpage	
pin	2768	0	0	0	
in use	13724	6754	0	0	

Sizes are in # of  
4K frames

Top 3 users of  
memory

# **svmon -Pt 3**

Pid	Command	Inuse	Pin	Pgsp	Virtual	64-bit	Mthrd	Lpage
14624	java	6739	1147	425	4288	N	Y	N
...								
9292	httpd	6307	1154	205	3585	N	Y	N
...								
3596	X	6035	1147	1069	4252	N	N	N
...								

\* output has been modified

# Monitoring Disk I/O: iostat

```
# iostat 10 2
```

```
System configuration: lcpu=2 drives=3 ent=0.30 paths=4 vdisks=1
```

```
tty:      tin  tout  avg-cpu:  %user  %sys  %idle  %iowait  physc  %entc
          0.1  110.7          7.0   59.4   0.0    33.7    0.0    1.4
```

```
Disks:    %tm_act  Kbps      tps      Kb_read  Kb_wrtn
```

```
hdisk0    77.9  115.7    28.7      456      8
hdisk1     0.0    0.0      0.0        0        0
cd0        0.0    0.0      0.0        0        0
```

```
tty:      tin  tout  avg-cpu:  %user  %sys  %idle  %iowait  physc  %entc
          0.1   96.3          6.5   58.0   0.0    35.5    0.0    1.3
```

```
Disks:    %tm_act  Kbps      tps      Kb_read  Kb_wrtn
```

```
hdisk0    79.8  120.1    28.7      485      9
hdisk1     0.0    0.0      0.0        0        0
cd0        0.0    0.0      0.0        0        0
```

# AIX Tools: filemon

```
# filemon -o fmout
```

Starts monitoring disk activity

```
# trcstop
```

```
# more fmout
```

Stops monitoring and creates report

## Most Active Logical Volumes

util	#rblk	#wblk	KB/s	volume	description
0.03	3368	888	26.5	/dev/hd2	/usr
0.02	0	1584	9.9	/dev/hd8	jfs2log
0.02	56	928	6.1	/dev/hd4	/

## Most Active Physical Volumes

util	#rblk	#wblk	KB/s	volume	description
0.10	24611	12506	231.4	/dev/hdisk0	Virtual SCSI Disk Drive
0.02	56	8418	52.8	/dev/hdisk1	N/A

# topas

# topas

```

Topas Monitor for host:      kca81          EVENTS/QUEUES      FILE/TTY
Mon Aug  9 11:48:35 2005   Interval:  2      Cswitch           370  Readch           11800
                                                                    Syscall           461  Writech           95
                                                                    Reads             18  Rawin             0
                                                                    Writes            0  Ttyout            0
                                                                    Forks             0  Igets             0
                                                                    Execs             0  Namei             1
                                                                    Runqueue          0.0  Dirblk            0
                                                                    Waitqueue         0.0

Kernel    0.1  |          |
User      0.0  |          |
Wait      0.0  |          |
Idle     99.8  |#####|
Physc =   0.00          %Entc=  1.5

Network  KBPS  I-Pack  O-Pack  KB-In  KB-Out
en0      0.1    0.4    0.4    0.0    0.1
lo0      0.0    0.0    0.0    0.0    0.0

Disk      Busy%   KBPS    TPS  KB-Read  KB-Writ
hdisk0    0.0    0.0    0.0    0.0    0.0
hdisk1    0.0    0.0    0.0    0.0    0.0

Name          PID  CPU%  PgSp  Owner
topas         18694  0.1  1.4  root
rmcd          10594  0.0  2.0  root
nfsd          15238  0.0  0.0  root
syncd         3482  0.0  1.3  root
gil           2580  0.0  0.0  root

EVENTS/QUEUES      FILE/TTY
PAGING             MEMORY
Faults             1  Real,MB           4095
Steals             0  % Comp            15.4
PgspIn            0  % Noncomp          9.3
PgspOut           0  % Client            1.8
PageIn            0
PageOut           0  PAGING SPACE
Sios              0  Size,MB            3744
                  % Used              0.6
                  % Free              99.3

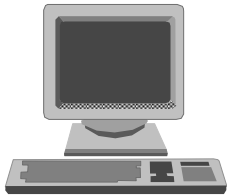
NFS (calls/sec)
ClientV2          0  WPAR Activ        0
ServerV2          0  WPAR Total        0
ClientV2          0
ServerV3          0  "h" for help
ClientV3          0  "q" for quit
    
```

CPU  
info

iostat  
info

vmstat  
info

# ~~There Is Always a Next Bottleneck!~~



```
# iostat 10 60
```

Our system is I/O bound.  
Let's buy faster disks!



```
# vmstat 5
```

Our system is now  
memory bound! Let's buy  
more memory!!!



```
# sar -u 60 60
```

Oh no! The CPU is  
completely overloaded!

# Workload Management Techniques (1 of 3)

Run programs at a specific time

```
# echo "/usr/local/bin/report" | at 0300  
# echo "/usr/bin/cleanup" | at 1100 friday
```

```
# crontab -e
```

```
0 3 * * 1-5 /usr/local/bin/report
```

minute hour day\_of\_month month weekday command

# Workload Management Techniques (2 of 3)

## Sequential execution of programs

```
# vi /etc/qconfig
```

```
ksh:
```

```
    device = kshdev
```

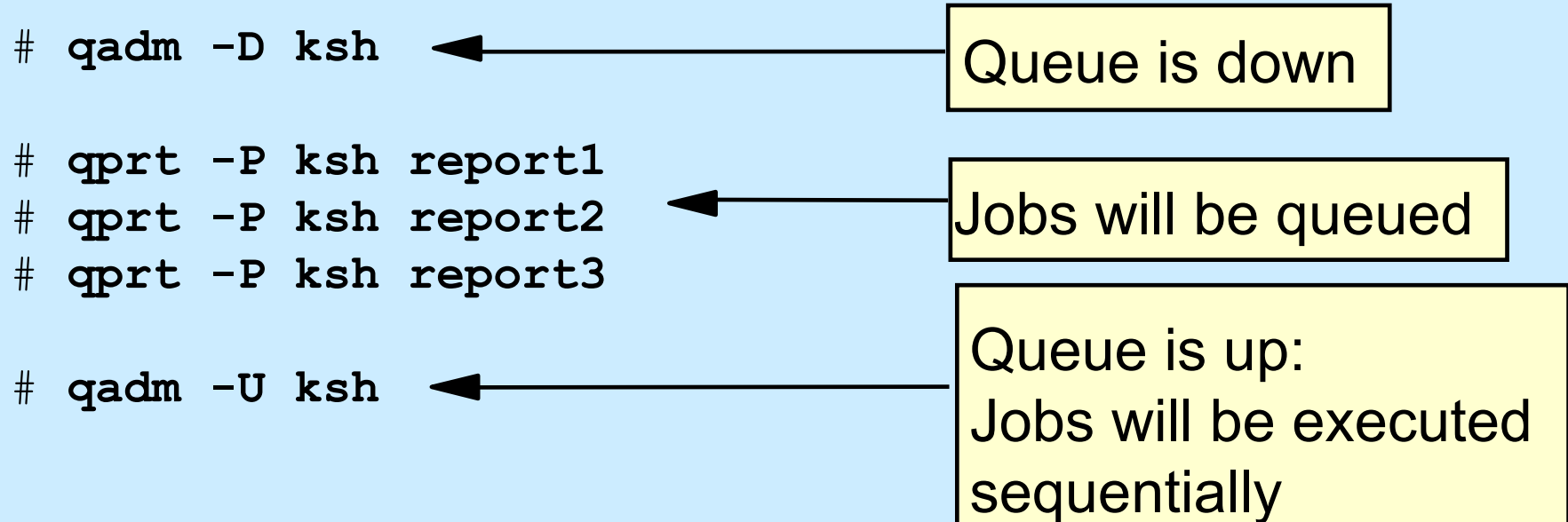
```
    discipline = fcfs
```

```
kshdev:
```

```
    backend = /usr/bin/ksh
```

```
# qadm -D ksh
```

Queue is down



```
# qprt -P ksh report1
```

```
# qprt -P ksh report2
```

```
# qprt -P ksh report3
```

Jobs will be queued

```
# qadm -U ksh
```

Queue is up:  
Jobs will be executed  
sequentially

# Workload Management Techniques (3 of 3)

Run programs at a reduced priority

```
# nice -n 15 backup_all &
# ps -el
  F      S   UID   PID  PPID   C  PRI  NI   ...   TIME   CMD
240001  A      0  3860  2820  30  90  35   ...   0:01   backup_all
```

Very low  
priority

Nice value:  
20+15

```
# renice -n -10 3860
# ps -el
  F      S   UID   PID  PPID   C  PRI  NI   ...   TIME   CMD
240001  A      0  3860  2820  26  78  25   ...   0:02   backup_all
```



# Simultaneous Multi-Threading (SMT)

---

- Each chip appears as a two-way SMP to software:
  - Appear as 2 logical CPUs
  - Performance tools may show number of logical CPUs
- Processor resources optimized for enhanced SMT performance:
  - May result in a 25-40% boost and even more
- Benefits vary based on workload
- To enable:

```
smtctl [ -m off | on [ -w boot | now ] ]
```

# ~~Tool Enhancements for Micro-Partitioning~~

- Added two new values to the default `topas` screen
  - `Phyisc` and `%Entc`
- The `vmstat` command has two new metrics:
  - `pc` and `ec`
- The `iostat` command has two new metrics:
  - `%phyisc` and `%entc`
- The `sar` command has two new metrics:
  - `phyisc`
  - `%entc`

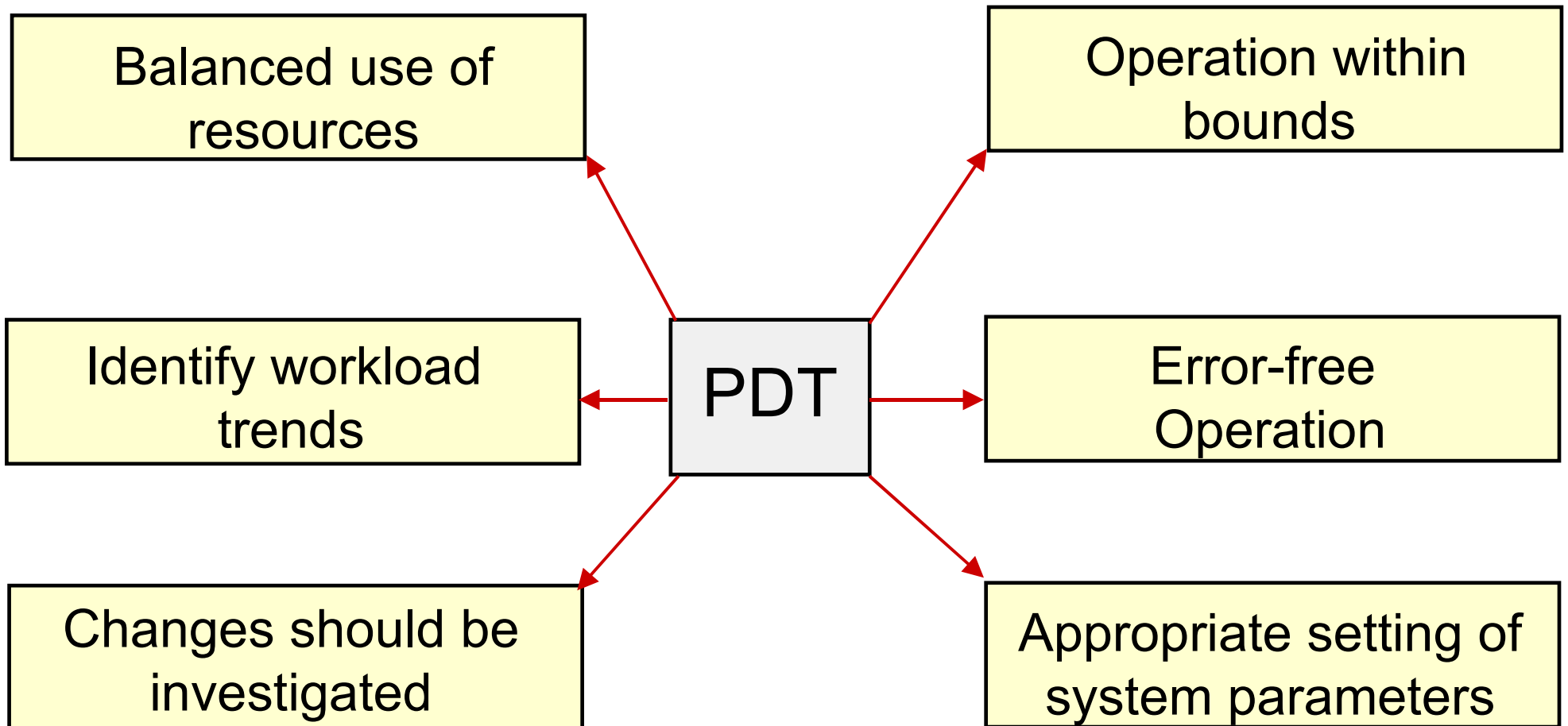
# ~~Exercise 12: Basic Performance Commands~~



- Working with `ps`, `nice`, and `renice`
- Basic performance analysis
- Working with a Korn shell job queue

# Performance Diagnostic Tool (PDT)

PDT assesses the current state of a system and tracks changes in workload and performance.



# Enabling PDT

```
# /usr/sbin/perf/diag_tool/pdt_config
```

```
-----PDT customization menu-----
```

- show current PDT report recipient and severity level
- modify/enable PDT reporting
- disable PDT reporting
- **modify/enable PDT collection**
- disable PDT collection
- de-install PDT
- exit pdt\_config

```
Please enter a number: 4
```

# ~~cron~~ Control of PDT Components

```
# cat /var/spool/cron/crontabs/adm
```

```
0 9 * * 1-5 /usr/sbin/perf/diag_tool/Driver_daily
```

Collect system data, each workday at 9:00 A.M.

```
0 10 * * 1-5 /usr/sbin/perf/diag_tool/Driver_daily2
```

Create a report, each workday at 10:00 A.M.

```
0 21 * * 6 /usr/sbin/perf/diag_tool/Driver_offweekly
```

Clean up old data, each Saturday at 9:00 P.M.

# PDT Files

## Collection

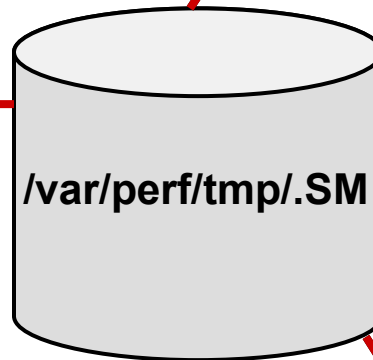
Driver\_daily  
/var/perf/cfg/diag\_tool/.collection.control

## Retention

Driver\_offweekly  
/var/perf/cfg/diag\_tool/.retention.control

## Reporting

Driver\_daily2  
/var/perf/cfg/diag\_tool/.reporting.control



→ /var/perf/tmp/.SM.last

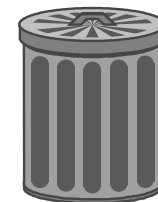
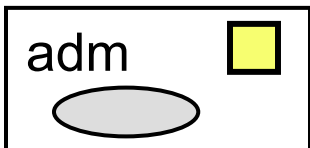
→ /var/perf/tmp/PDT\_REPORT

35 days  
.retention.list

→ /var/perf/tmp/.SM.discards

Next Day

→ /var/perf/tmp/PDT\_REPORT.last



# Customizing PDT: Changing Thresholds

```
# vi /var/perf/cfg/diag_tool/.thresholds

DISK_STORAGE_BALANCE 800
PAGING_SPACE_BALANCE 4
NUMBER_OF_BALANCE 1
MIN_UTIL 3
FS_UTIL_LIMIT 90
MEMORY_FACTOR .9
TREND_THRESHOLD .01
EVENT_HORIZON 30
```



# Customizing PDT: Specific Monitors

```
# vi /var/perf/cfg/diag_tool/.files
```

```
/var/adm/wtmp
```

```
/var/spool/qdaemon/
```

```
/var/adm/ras/
```

```
/tmp/
```

Files and  
directories  
to monitor

```
# vi /var/perf/cfg/diag_tool/.nodes
```

```
pluto
```

```
neptun
```

```
mars
```

Systems  
to monitor

# ~~PDT Report Example (Part 1)~~

## **Performance Diagnostic Facility 1.0**

Report printed: Sun Aug 21 20:53:01 2005

Host name: master

Range of analysis included measurements  
from: Hour 20 on Sunday, August 21st, 2005  
to: Hour 20 on Sunday, August 21st, 2005

## **Alerts**

### **I/O CONFIGURATION**

- Note: volume hdisk2 has 480 MB available for allocation while volume hdisk1 has 0 MB available

### **PAGING CONFIGURATION**

- Physical Volume hdisk1 (type:SCSI) has no paging space defined

### **I/O BALANCE**

- Physical volume hdisk0 is significantly busier than others  
volume hdisk0, mean util. = 11.75  
volume hdisk1, mean util. = 0.00

### **NETWORK**

- Host sys1 appears to be unreachable

# PDT Report Example (Part 2)

## Upward Trends

### FILES

- File (or directory) /var/adm/ras/ SIZE is increasing now, 364 KB and increasing an avg. of 5282 bytes/day

### FILE SYSTEMS

- File system lv01(/fs3) is growing now, 29.00% full, and growing an avg. of 0.30%/day  
At this rate lv01 will be full in about 45 days

### ERRORS

- Hardware ERRORS; time to next error is 0.982 days

## System Health

### SYSTEM HEALTH

- Current process state breakdown:
  - 2.10 [0.5%]: waiting for the CPU
  - 89.30 [22.4%]: sleeping
  - 306.60 [77.0%]: zombie
  - 398.00 = TOTAL

## Summary

This is a severity level 1 report

No further details available at severity level >1

# Checkpoint

1. What commands can be executed to identify CPU-intensive programs?
  - 
  -
- What command can be executed to start processes with a lower priority? \_\_\_\_\_
5. What command can you use to check paging I/O? \_\_\_\_\_
7. True or False? The higher the PRI value, the higher the priority of a process.

# Checkpoint Solutions

1. What commands can be executed to identify CPU-intensive programs?
    - `ps aux`
    - `tprof`
  3. What command can be executed to start processes with a lower priority? `nice`
  5. What command can you use to check paging I/O? `vmstat`
- True or False? The higher the PRI value, the higher the priority of a process.

# Exercise 13: Performance Diagnostic Tool



- Use the Performance Diagnostic Tool to:
  - Capture data
  - Create reports

# Unit Summary



- The following commands can be used to identify potential bottlenecks in the system:
  - `ps`
  - `sar`
  - `vmstat`
  - `iostat`
- If you cannot fix a performance problem, manage your workload through other means (`at`, `crontab`, `nice`, `renice`).
- Use the Performance Diagnostic tool (PDT) to assess and control your systems performance.



Welcome to:

# Security





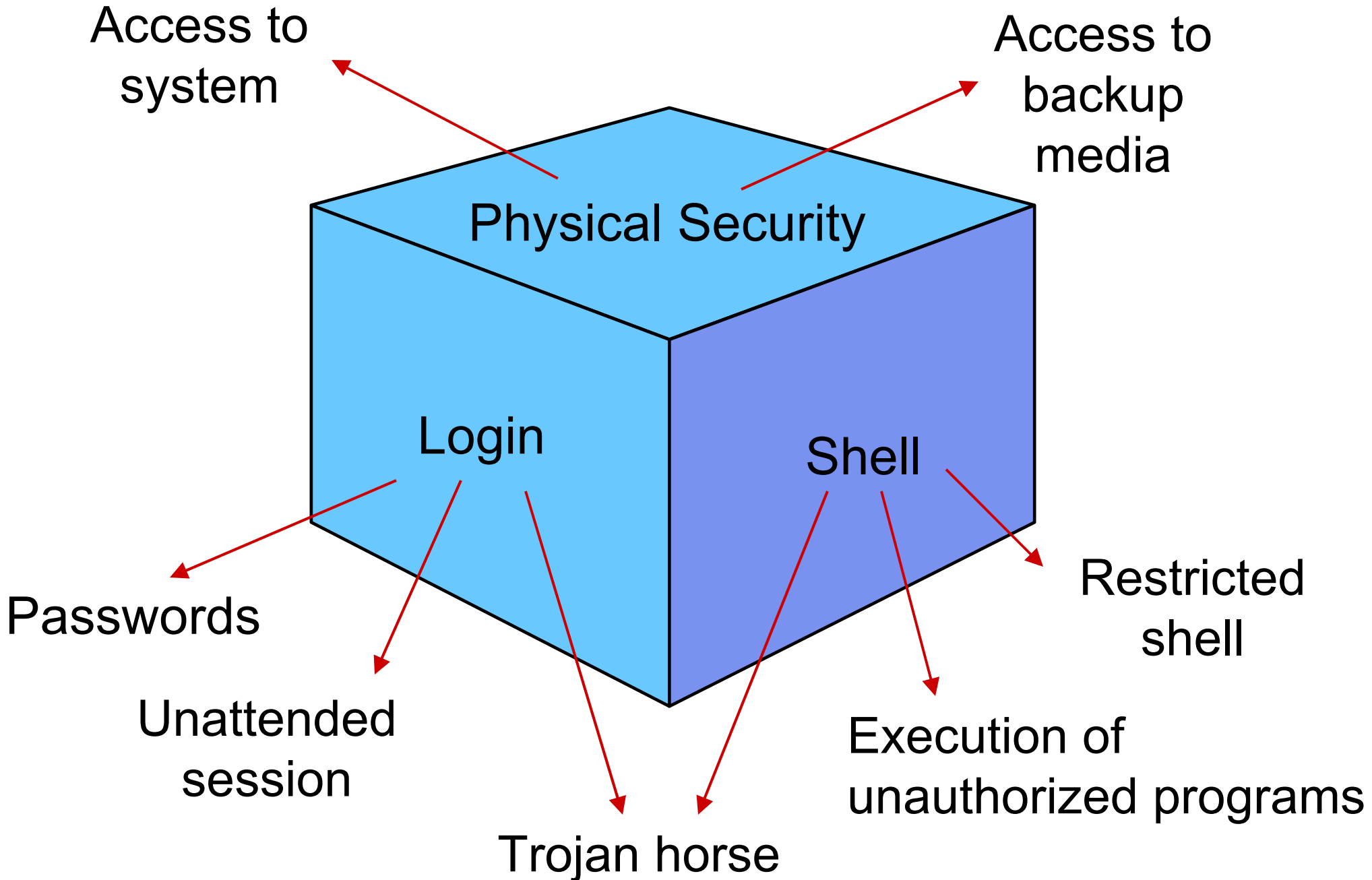
# Unit Objectives

---

After completing this unit, you should be able to:

- Provide authentication procedures
- Specify extended file permissions
- Configure the Trusted Computing Base (TCB)
- Compare AIX 6.1 Trusted Environment to TCB

# Protecting Your System



# ~~How Do You Set Up Your PATH?~~

```
PATH=/usr/bin:/etc:/usr/sbin:/sbin:.
```

- or -

```
PATH=./usr/bin:/etc:/usr/sbin:/sbin
```

???

# Trojan Horse: An Easy Example (1 of 3)

```
$ cd /home/hacker
```

```
$ vi ls
```

```
#!/usr/bin/ksh
```

```
cp /usr/bin/ksh /tmp/.hacker
```

```
chown root /tmp/.hacker
```

```
chmod u+s /tmp/.hacker
```

```
rm -f $0
```

```
/usr/bin/ls $*
```

SUID Bit: Runs  
under **root** authority



```
$ chmod a+x ls
```

# Trojan Horse: An Easy Example (2 of 3)

```
$ cd /home/hacker  
$ cat > -i  
blablabla<CTRL-D>
```

Hello SysAdmin,  
I have a file "-i" and cannot  
remove it. Please help me ...



```
PATH=.: /usr/bin: /etc: /usr/sbin: /sbin
```

```
# cd /home/hacker  
# ls  
-i
```

# Trojan Horse: An Easy Example (3 of 3)

```
$ cd /tmp  
$ .hacker  
# passwd root
```

Effective **root** authority

Don't worry, be happy ...



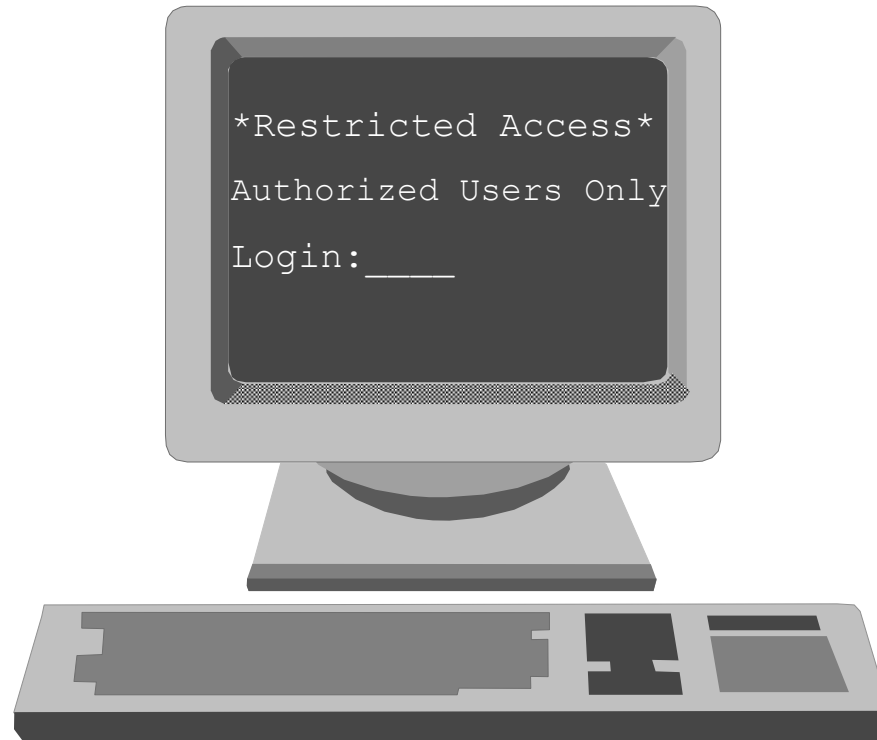
```
PATH=.: /usr/bin:/etc:/usr/sbin:/sb  
in
```

When using as **root** user, *never* specify the working directory in the *PATH* variable!

# login.cfg: login prompts

```
# vi /etc/security/login.cfg
```

```
default:  
    sak_enabled = false  
    logintimes =  
    .  
    .  
    .  
    herald = "\n*Restricted Access*\n\rAuthorized Users Only\  
n\rLogin: "
```



# login.cfg: Restricted Shell

```
# vi
/etc/security/login.cfg
```

```
* Other security attributes
```

```
usw:
```

```
shells = /bin/sh, /bin/bsh, /usr/bin/ksh, ..., /usr/bin/Rsh
```

```
# chuser shell=/usr/bin/Rsh michael
```

**michael** cannot:

- Change the current directory
- Change the `PATH` variable
- Use command names containing slashes
- Redirect standard output (`>`, `>>`)



# Customized Authentication

```
# vi /etc/security/login.cfg
```

```
* Authentication Methods
```

```
secondPassword:
```

```
program = /usr/local/bin/getSecondPassword
```

```
# vi /etc/security/user
```

```
michael:
```

```
auth1 = SYSTEM,secondPassword
```

# Authentication Methods (1 of 2)

```
# vi /usr/local/bin/getSecondPassword
```

```
print "Please enter the second Password: "  
  
stty -echo                # No input visible  
read PASSWORD  
stty echo  
  
if [[ $PASSWORD = "d1f2g3" ]]; then  
    exit 0  
else  
    exit 255  
fi
```

Valid Login



Invalid Login



# Authentication Methods (2 of 2)

```
# vi /usr/local/bin/limitLogins
```

```
#!/usr/bin/ksh

# Limit login to one session per user

USER=$1      # User name is first argument

              # How often is the user logged in?
COUNT=$(who | grep "^$USER" | wc -l)

              # User already logged in?
if [[ $COUNT -ge 1 ]]; then
    errlogger "$1 tried more than 1 login"
    print "Only one login is allowed"
    exit 128
fi

exit 0      # Return 0 for correct authentication
```

# Two-Key Authentication

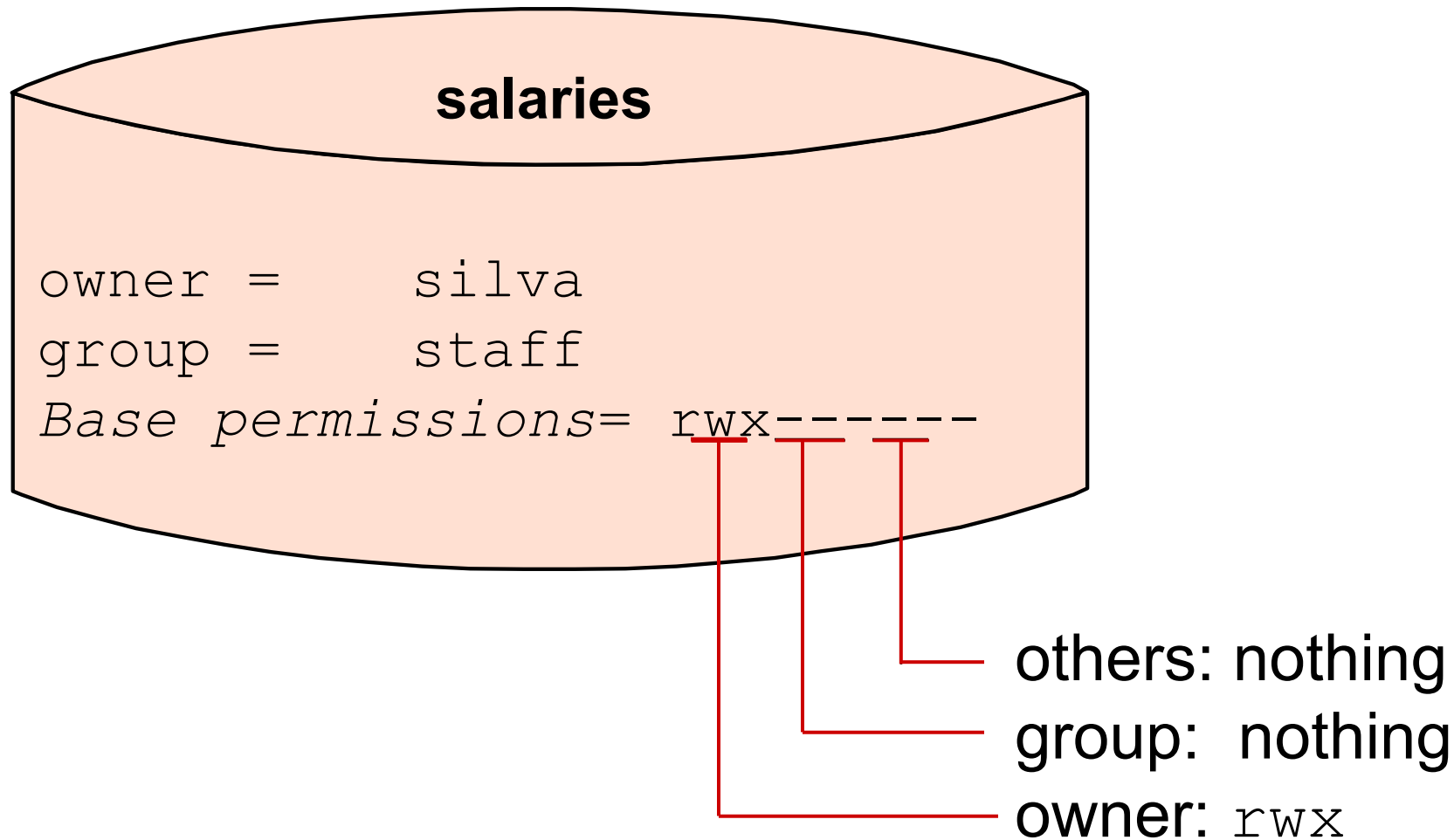
```
# vi  
/etc/security/user
```

```
boss:  
auth1 = SYSTEM; deputy1, SYSTEM; deputy2
```



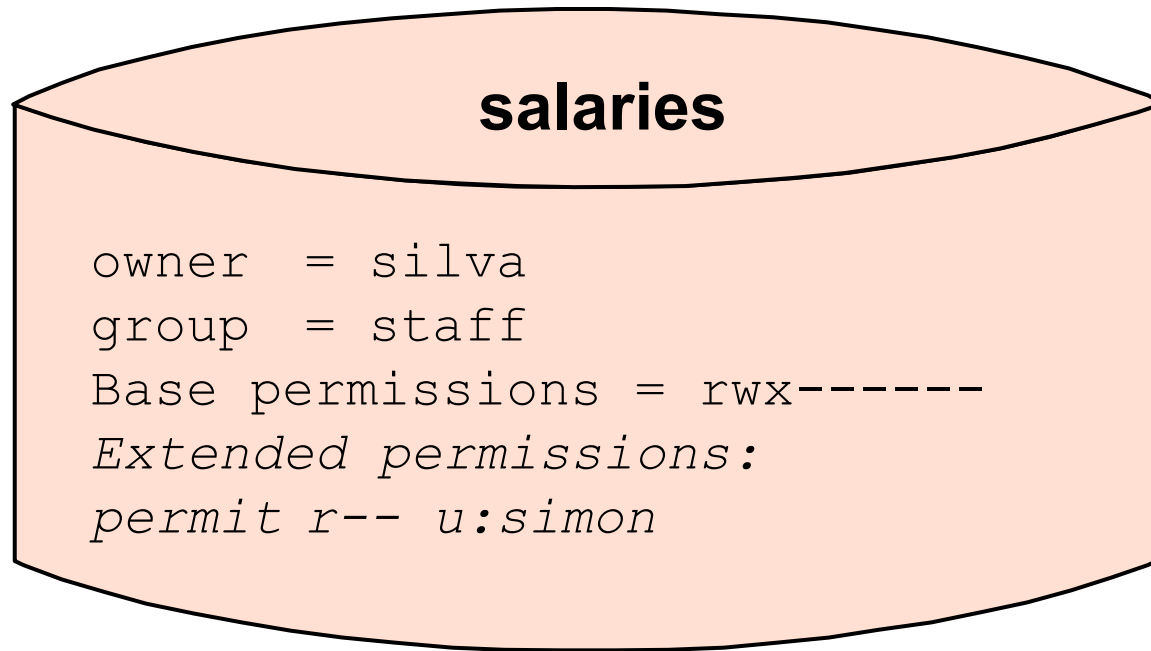
```
login: boss  
deputy1's Password:  
deputy2's Password:
```

# Base Permissions



How can **silva** easily give **simon** read access to the file **salaries**?

# Extended Permissions: Access Control Lists



```
# acledit salaries
```



**EDITOR**

```
base permissions
...
extended permissions
enabled
permit r- u:simon
```

# ACL Commands

# `aclget file1` ← Display base/extended permissions

↓ Copy an access control list

# `aclget status99 | aclput report99`

# `acledit salaries2` ← To specify extended permissions

- `chmod` in the octal format *disables* ACLs
- Only the `backup` command by default saves ACLs
- `tar` and `cpio` will back up ACLs if the flag `-U` is used
- `acledit` requires the `EDITOR` variable (full pathname of an AIX editor)

# ~~AIXC ACL Keywords: permit and specify~~

```
# acledit status99
```

```
attributes:  
  base permissions  
    owner(fred): rwx  
    group(finance): rw-  
    others: ---  
  extended permissions  
  enabled  
  permit    --x    u:michael  
  specify  r--    u:anne,g:account  
  specify  r--    u:nadine
```

- **michael** (member of group **finance**) gets *read*, *write* (base) and *execute* (extended) permission
- If **anne** is in group **account**, she gets *read* permission on file **status99**
- **nadine** (member of group **finance**) gets only *read* access



# ~~AIXC ACL Keywords: deny~~

```
# acledit report99
```

```
attributes:
```

```
base permissions
```

```
owner (sarah): rwx
```

```
group (mail): r--
```

```
others: r--
```

```
extended permissions
```

```
enabled
```

```
deny          r--    u:paul g:mail
```

```
deny          r--    g:gateway
```

- **deny**: Restricts the user or group from using the specified access to the file
- **deny overrules** permit **and** specify

# ~~JFS2 Extended Attributes Version 2~~

- Extension of normal attributes
- Name and value pairs
- **setea** - to associate name/value pairs
- **getea** - to view
- **acledit** works with EAv2 ACLs

```
# acledit /fs2
*
* ACL_type NFS4
**
* Owner: root
* Group: system
*
s:(OWNER@): d wpDd
s:(OWNER@): a rRWxaAcCo
s:(GROUP@): a rx
```

# Exercise 14: Authentication and ACLs



- Setting a new login herald
- Adding a primary authentication method
- Access control lists

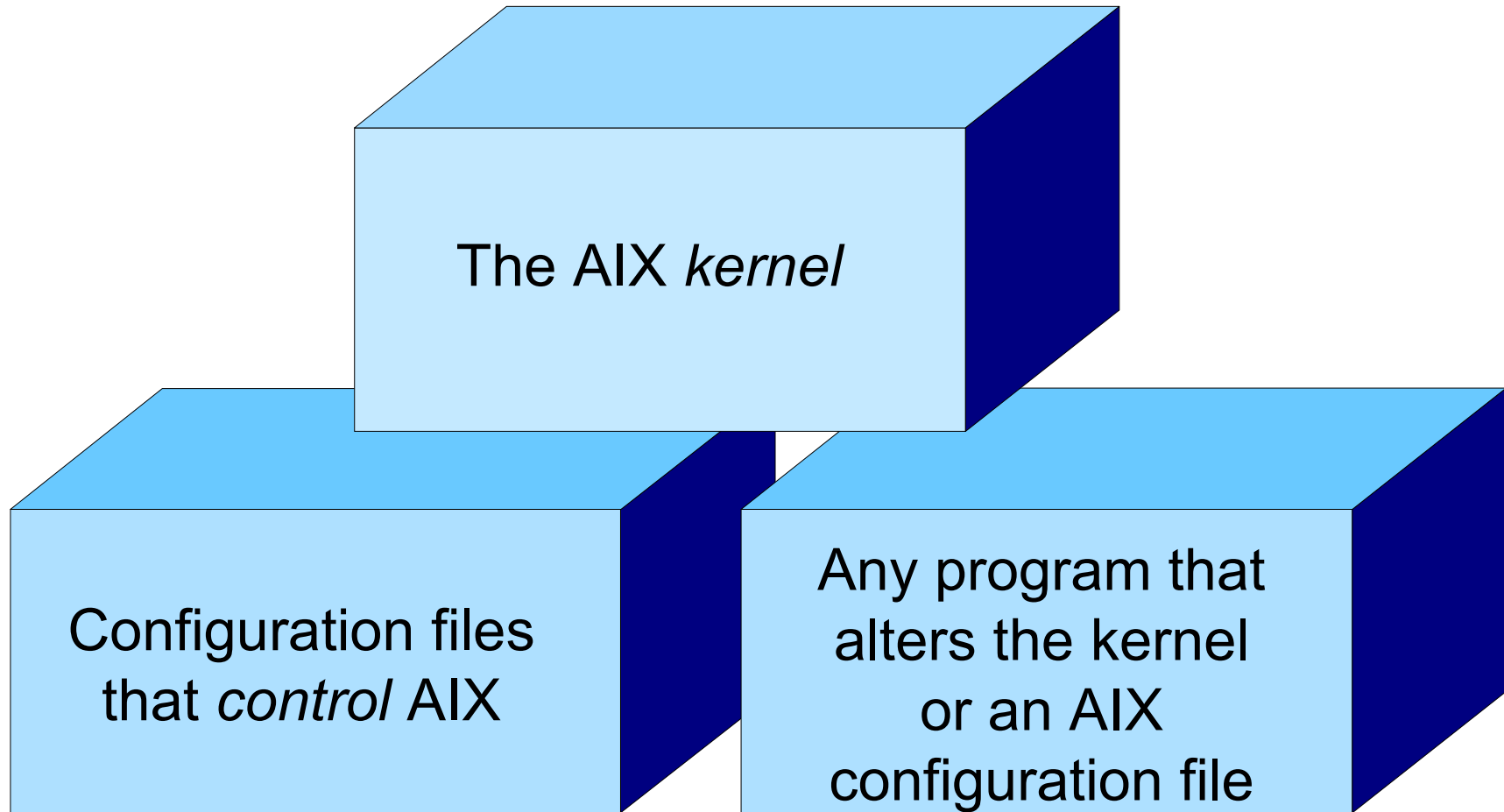
# The Trusted Computing Base (TCB)

The *TCB* is the part of the system that is responsible for *enforcing the security policies* of the system.

```
# ls -l /etc/passwd
-rw-r--rw-  1  root  security  ...      /etc/passwd

# ls -l /usr/bin/be_happy
-r-sr-xr-x  1  root  system  ...      /usr/bin/be_happy
```

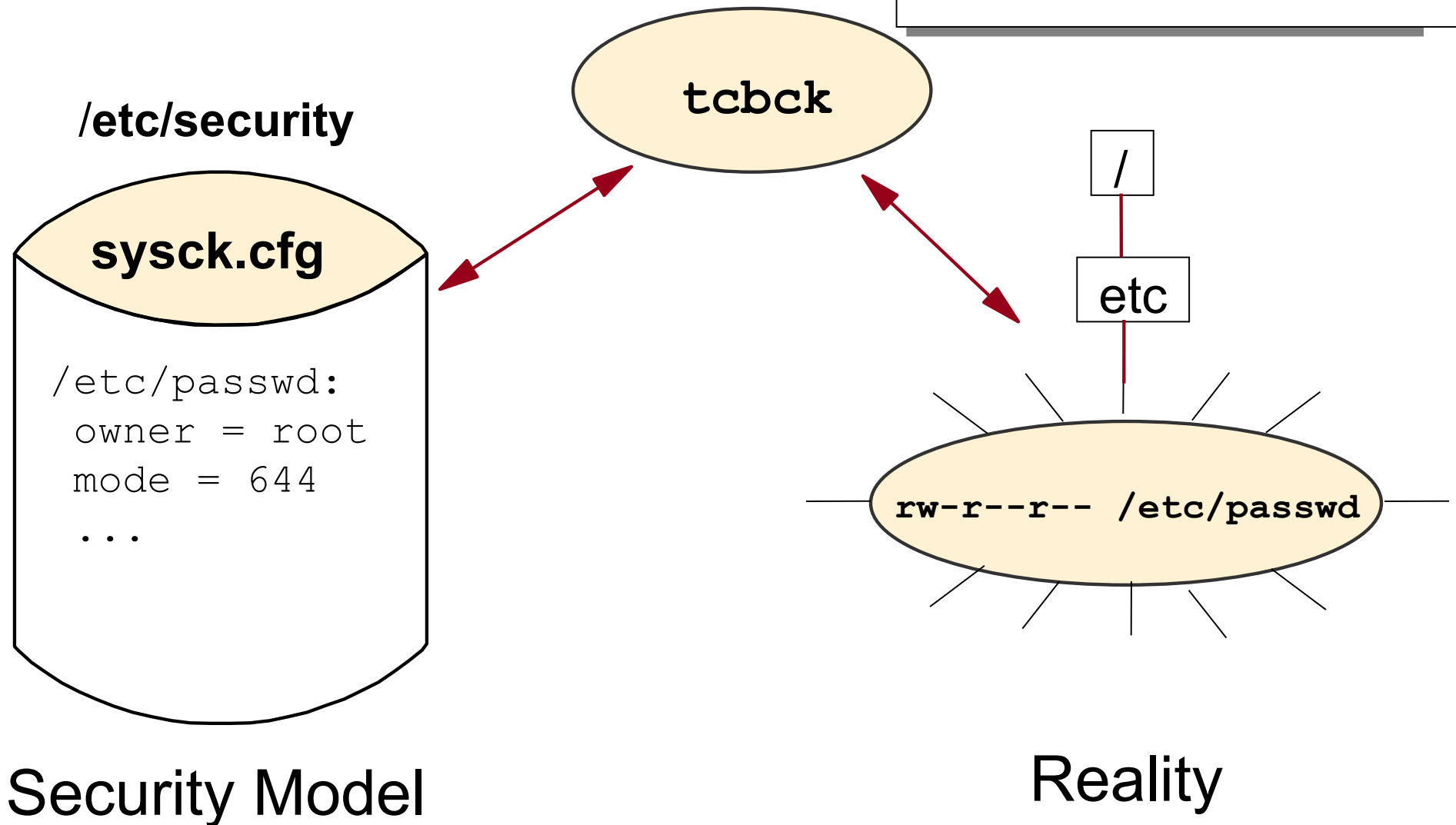
# TCB Components



The TCB can only be enabled at installation time!

# Checking the Trusted Computing Base

- Reports differences
- Implements fixes



# The ~~sysck.cfg~~ File

```
# vi /etc/security/sysck.cfg
```

```
...
```

```
/etc/passwd:
```

```
owner = root
```

```
group = security
```

```
mode = TCB, 644
```

```
type = FILE
```

```
class = apply, inventory,
```

```
bos.rte.security
```

```
checksum = VOLATILE
```

```
size = VOLATILE
```

```
...
```

```
# tcbck -t /etc/passwd
```

# ~~tcbck: Checking Mode Examples~~

```
# chmod 777 /etc/passwd
# ls -l /etc/passwd
-rwxrwxrwx    1      root  security ... /etc/passwd
```

```
# tcbck -t /etc/passwd
```

```
The file /etc/passwd has the wrong file mode
Change mode for /etc/passwd ?
(yes, no ) yes
```

```
# ls -l /etc/passwd
-rw-r--r--    1      root  security      ... /etc/passwd
```

---

```
# ls -l /tmp/.4711
-rwsr-xr-x    1      root  system ... /tmp/.4711
```

```
# tcbck -t tree
```

```
The file /tmp/.4711 is an unregistered set-UID program.
Clear the illegal mode for /tmp/.4711 (yes, no) yes
```

```
# ls -l /tmp/.4711
-rwxr-xr-x    1      root  system ... /tmp/.4711
```



# ~~tcbck: Checking Mode Options~~

Command:	Report:	Fix:
<code>tcbck -n &lt;what&gt;</code>	yes	no
<code>tcbck -p &lt;what&gt;</code>	no	yes
<code>tcbck -t &lt;what&gt;</code>	yes	prompt
<code>tcbck -y &lt;what&gt;</code>	yes	yes

`<what>` can be:

- a *filename* (for example `/etc/passwd`)
- a *classname*: A logical group of files defined by `class = name` entries in **sysck.cfg**
- **tree**: Check all files in the filesystem tree
- **ALL**: Check all files listed in **sysck.cfg**

# ~~tcbck: Update Mode Examples~~

```
# tcbck -a /salary/salary.dat class=salary
```

Add **salary.dat**  
to  
**sysck.cfg**

Additional  
class information

```
# tcbck -t salary
```

} Test all files  
belonging  
to class `salary`

```
# tcbck -d /etc/cvid
```

} Delete file **/etc/cvid**  
from **sysck.cfg**

# ~~chtcb: Marking Files As Trusted~~

```
# ls -le /salary/salary.dat
-rw-rw----- root salary ...
salary.dat
```



No "+" indicates not trusted

```
# tcbck -n salary
```

```
The file /salary/salary.dat has the wrong
TCB attribute value
```



**tcbck indicates a problem!**

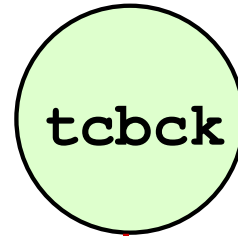
```
# chtcb on /salary/salary.dat
```

```
# ls -le /salary/salary.dat
-rw-rw-----+ root salary ...
salary.dat
```



Now its trusted!

# tcbck: Effective Usage



Normal  
Use (-n)

Non-interactive  
through **inittab**  
or **cron**

Interactive  
Use (-t)

Useful for  
checking  
individual files or  
classes

Paranoid  
Use

Store the  
**sysck.cfg** file  
offline and  
restore it  
periodically to  
check out the  
system

# Trusted Communication Path

The *Trusted Communication Path* allows for secure communication between users and the Trusted Computing Base.

What do you think when you see this screen on a terminal ?



```
AIX Version 5  
(C) Copyrights by IBM and by others 1982,  
2004  
login:
```

# ~~Trusted Communication Path: Trojan Horse~~

```
#!/usr/bin/ksh
print "AIX Version 6"
print "(C) Copyrights by IBM and by others
1982, 2007"
print -n "login: "
read NAME
print -n "$NAME's Password: "
stty -echo
read PASSWORD
stty echo
print $PASSWORD > /tmp/.4711
```

Victim's password can be retrieved by the intruder!

```
$ cat /tmp/.4711
darth22
```

# Trusted Communication Path Elements

The **Trusted Communication Path** is based on:

- A *trusted shell* (**ts<sub>h</sub>**) that only executes commands that are marked as being trusted
- A *trusted terminal*
- A *reserved key sequence*, called the *secure attention key* (SAK), which allows the user to request a trusted communication path

# Using the Secure Attention Key (SAK)

- *Before logging in at the trusted terminal:*

```
AIX Version 6  
(C) Copyrights by IBM and by others 1982, 2007  
login: <CTRL-x><CTRL-r>  
  
tsh>
```

Previous login prompt was from a Trojan horse.

- *To establish a secure environment:*

```
# <CTRL-x><CTRL-r>  
tsh>
```

Ensures that no untrusted programs will be run with **root** authority.



# Configuring the Secure Attention Key

- Configure a trusted terminal:

```
# vi /etc/security/login.cfg  
  
/dev/tty0:  
    sak_enabled = true
```

- Enable a user to use the trusted shell:

```
# vi /etc/security/user  
  
root:  
    tpath = on
```

# ~~chtcb: Changing the TCB Attribute~~

```
# chtcb query /usr/bin/ls  
/usr/bin/ls is not in the TCB
```

```
tsh>ls *.c
```

```
ls: Command must be trusted to run in the  
tsh
```

```
# chtcb on /usr/bin/ls
```

```
tsh>ls *.c
```

```
a.c  b.c  d.c
```

# Trusted Execution (TE) Environment

---

- AIX 6.1 Feature
- Alternative to TCB; similar functions plus enhancements
- Not recommended to run TCB at the same time
- Uses hash values based on keys and certificates
- AIX filesets install with IBM signed hashes
- Supports run-time checking of executables
- Can monitor loads of kernel extensions and shared libraries
- Can lock the database, even against root

# Comparing TCB to TE

Trusted Computing Base	Trusted Execution Environment
Configure at BOS installation	Install/configure anytime: <code>clib.rte.*</code> filesets <code># /usr/lib/methods/loadkclib</code>
Trusted Computing Base Database: <code>/etc/security/sysck.cfg</code>	Trusted Signature Database: <code>/etc/security/tsd/tsd.dat</code> certified hashes database can be locked
Uses <code>tcbchk</code> to manage: add/delete entries audit with reports and/or fixes	Uses <code>trustchk</code> to manage: add/delete entries audit with reports and fixes can enable run-time checking
Trusted Communications Path: Trusted Shell and SAK	Trusted Execution Path: Trusted Shell and SAK supported also has trusted directories  Trusted Library Path: dynamic links can be restricted to trusted libraries

# Checkpoint (1 of 2)

- (True or False) Any programs specified as `auth1` must return a zero in order for the user to log in.
- Using AIXC ACLs, how would you specify that all members of the **security** group had `rx` access to a particular file except for **john**?

---

---

---

---

4. Which file would you edit to modify the ASCII login prompt?

---

6. Name the two modes that `tcchk` supports.

---

# Checkpoint Solutions (1 of 2)

- (True or False) Any programs specified as `auth1` must return a zero in order for the user to log in.
- Using AIXC ACLs, how would you specify that all members of the **security** group had `rxw` access to a particular file except for **john**?

extended permissions

enabled

permit rxw g:security

deny rxw u:john

4. Which file would you edit to modify the ASCII login prompt?

/etc/security/login.cfg

6. Name the two modes that `tcck` supports.

check mode and update mode

# Checkpoint (2 of 2)

1. When you execute `<ctrl-x ctrl-r>` at a login prompt and you obtain the `tsh` prompt, what does that indicate?

---

---

- (True or False) The system administrator must manually mark commands as trusted, which will automatically add the command to the **sysck.cfg** file.
7. (True or False) When the `tcbck -p tree` command is executed, all errors are reported and you get a prompt asking if the error should be fixed.

# Checkpoint Solutions (2 of 2)

1. When you execute `<ctrl-x ctrl-r>` at a login prompt and you obtain the `tsh` prompt, what does that indicate?

It indicates that someone is running a fake `getty` program (a Trojan horse) on that terminal.

- (True or **False**) The system administrator must manually mark commands as trusted, which will automatically add the command to the `sysck.cfg` file.

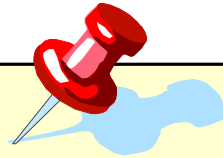
False. The system administrator must add the commands to `sysck.cfg` using the `tcbck -a` command.

- (True or **False**) When the `tcbck -p tree` command is executed, all errors are reported and you get a prompt asking if the error should be fixed.

False. The `-p` option specifies fixing and no reporting. (This is a very dangerous option.)



# Unit Summary



- The authentication process in AIX can be customized by authentication methods.
- Access control lists (ACLs) allow a more granular definition of file access modes.
- The Trusted Computing Base (TCB) is responsible for enforcing the security policies on a system.

# Exercise: Challenge Activity (Optional)

