HP-UX System Administrator's Guide: Routine Management Tasks

HP-UX 11i Version 3

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Preface

Publication History

The manual publication date and part number indicate its current edition. The publication date will change when a new edition is released.

To ensure that you receive the new editions, you should subscribe to the appropriate product support service. See your HP sales representative for details.

First Edition	February 2007, 5991-6483, HP-UX 11i version 3 (B.11.31) Printed, DVD (Instant Information), and Web (**HP-UX Core Docs**)
Second Edition	September 2007, 5992-0633, HP-UX 11i version 3 (B.11.31 September 2007 Update) Printed, DVD (Instant Information), and Web (**HP-UX Core Docs**)
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Fifth Edition	September 2010, B3921-90023, HP-UX 11i version 3 (B.11.31 September 2010 Update) Printed, DVD (Instant Information), and Web (**HP-UX Core Docs**)

NOTE: The volumes in the *HP-UX System Administrator's Guide* may be updated independently. Therefore, the latest versions of the volumes in the set may vary with time and with respect to each other. The latest versions of each volume are available at **HP-UX Core Docs**.

Conventions

We use the following typographical conventions.

audit(5)	An HP-UX manpage. *audit* is the name and *5* is the section in the *HP-UX Reference*. On the web and on the Instant Information DVD,

	it may be a hot link to the manpage itself. From the HP-UX command line, you can enter "`man audit`" or "`man 5 audit`" to view the manpage. See *man*(1).
Book Title	The title of a book. On the web and on the Instant Information DVD, it may be a hot link to the book itself.
KeyCap	The name of a keyboard key. Note that **Return** and **Enter** both refer to the same key.
Emphasis	Text that is emphasized.
Emphasis	Text that is strongly emphasized.
Term	The defined use of an important word or phrase.
`ComputerOut`	Text displayed by the computer.
`UserInput`	Commands and other text that you type.
`Command`	A command name or qualified command phrase.
`Variable`	The name of a variable that you may replace in a command or function or information in a display that represents several possible values.
[ ]	The contents are optional in formats and command descriptions.
{ }	The contents are required in formats and command descriptions. If the contents are a list separated by `|`, you must choose one of the items
. . .	The preceding element may be repeated an arbitrary number of times.
|	Separates items in a list of choices.

Intended Audience

The *HP-UX System Administrator's Guide* is written for administrators of HP-UX systems of all skill levels needing to administer HP-UX systems beginning with Release HP-UX 11i version 3.

While many topics in this set apply to previous releases, much has changed in HP-UX 11i as of version 3; therefore, for information about prior releases please see the manual *Managing Systems and Workgroups, a Guide for System Administrators*.

About this Document Set

The *HP-UX System Administrator's Guide* documents the core set of tasks (and associated concepts) necessary to administer HP-UX 11i based systems as of Release HP-UX 11i version 3.

The *HP-UX System Administrator's Guide* is a set of manuals, comprised of the following volumes:

HP-UX System Administrator's Guide (volume list)

Overview	Provides a high-level view of HP-UX 11i, its components, and how they relate to each other.
Configuration Management	There are many sub-systems and system settings you can configure to customize the behavior of HP-UX to your needs. *Configuration Management* describes many of the customization tasks you need to perform. For example: □ Adding Peripherals □ Setting and adjusting the system clock and time zone □ Kernel Configuration □ Configuring Users and Groups □ Network (Initial configuration)
Logical Volume Management	Documents how to configure physical volumes, volume groups, and logical volumes using the HP Logical Volume Manager (LVM).
Security Management	Documents the data and system security features of HP-UX 11i.
Routine Management Tasks	Documents many of the ongoing tasks you need to perform to keep your system running smoothly. For example: □ Managing printers and the print spooler □ Managing software (installing and removing applications using HP's Software Distributor) □ Starting and shutting down systems □ Installing software patches □ Monitoring system performance

About this Volume: *Routine Management Tasks*

This document supports HP-UX 11i version 3 (B.11.31).

It includes the following major topics:

- Chapter 1: "Introduction" (page 21)
- Chapter 2: "Booting and Shutdown" (page 35)
- Chapter 3: "Managing Systems" (page 93)
- Chapter 4: "Managing Printers" (page 161)
- Chapter 5: "Managing Software" (page 177)

- Chapter 6: “Managing System Performance” (page 189)
- Appendix A: “Using High Availability Strategies” (page 201)

HP-UX 11i Release Names and Release Identifiers

With HP-UX 11i, HP delivers a highly available, secure, and manageable operating system that meets the demands of end-to-end Internet-critical computing. HP-UX 11i supports enterprise, mission-critical, and technical computing environments. HP-UX 11i is available on both PA-RISC systems and Intel® Itanium®-based systems.

Each HP-UX 11i release has an associated release name and release identifier. The `uname` command with the `-r` option returns the release identifier. Table 1 shows the releases available for HP-UX 11i.

Table 1 HP-UX 11i Releases

OS Version Identifier	Release Name	Supported Processor Architecture
B.11.11	HP-UX 11i Version 1	PA-RISC
B.11.23	HP-UX 11i Version 2	Itanium-based
B.11.23	HP-UX 11i Version 2 September 2004	PA-RISC and Itanium-based
B.11.31	HP-UX 11i Version 3, February 2007	PA-RISC and Itanium-based
B.11.31	HP-UX 11i Version 3, September 2007	PA-RISC and Itanium-based
B.11.31	HP-UX 11i Version 3, March 2008	PA-RISC and Itanium-based
B.11.31	HP-UX 11i Version 3, September 2010	PA-RISC and Itanium-based

For information about supported systems and processor architecture for different versions of HP-UX, see the HP-UX system release notes specific to your version of HP-UX (for example, the *HP-UX 11.0 Release Notes* or the *HP-UX 11i Version 3 Release Notes*).

HP Encourages Your Comments

HP encourages your comments concerning this document. We are truly committed to providing documentation that meets your needs.

Please submit comments to:

http://www.hp.com/bizsupport/feedback/ww/webfeedback.html

Please include the document title, manufacturing part number, and any comment, error found, or suggestion for improvement you have concerning this document.

Finding HP-UX Information

The following table outlines where to find basic system administration information for HP-UX. This table does not include information for specific products.

Table 2 Finding HP-UX Information and Documents

If you need to. . .	Go to . . .	Located at . . .
find out what has changed in HP-UX releases, content of the Operating Environments, firmware requirements, and supported systems	the HP-UX system release notes specific to your version of HP-UX, for example, you may want to see the *HP-UX 11.0 Release Notes* or the *HP-UX 11i Version 3 Release Notes*.	• HP Instant Information DVD • **`HP-UX Core Docs`** • `/usr/share/doc/` directory The `/usr/share/doc` directory contains only the original release note for your version of HP-UX. For revised release notes, see the Instant Information DVD and **`HP-UX Core Docs`**.
install or update HP-UX	• *Read Before Installing or Updating to HP-UX* • *HP-UX 11i Installation and Update Guide* • *Software Distributor Administration Guide* (Note: See the manuals specific for your version of HP-UX.)	• Media Kit (supplied with the OE) • HP Instant Information DVD • **`HP-UX Core Docs`**
administer an HP-UX system	• *HP-UX System Administrator's Guide* • *nPartition Administrator's Guide* • "Planning Superdome Configurations" (white paper)	• HP Instant Information DVD • **`HP-UX Core Docs`** • "Planning Superdome Configurations" is available at **`Planning Superdome Configurations`**

1 Introduction

This chapter provides an introduction to the management tools used to perform routine system tasks.

Configuration Tools

There are three ways (at least) to configure your HP-UX system:

- Via the web using the HP Systems Insight Manager (HP SIM). [*Multi-system Management*]
- Directly on the system with the text-based HP-UX System Management Homepage (HP SMH) or via the web using the web-based HP SMH.
- Directly with HP-UX commands.

HP Systems Insight Manager

The HP Systems Insight Manager (HP SIM) provides web-based multiple system management. You can use it to configure and manage not only HP-UX systems, but also HP Linux systems and HP Windows® systems, as well as non-HP Linux and Windows systems. HP SIM makes use of the HP SMH interface and other tools. It is fully described in *HP Systems Insight Manager 6.0 Installation and Configuration Guide for HP-UX* and other the other HP SIM documents on HP Systems Insight Manager 6.0 Installation and Configuration Guide for HP-UX.

You can also use HP Insight Dynamics — Virtual Server Environment (HP Insight Dynamics — VSE) together with HP SIM to manage server resources. HP Insight Dynamics — VSE is an integrated set of multi-platform products and technologies that provides the visualization, configuration, workload policy, application management, and capacity planning tools to optimize your system resources.

The HP Insight Dynamics — VSE management software includes the following products and technologies:

- HP Virtualization Manager
- HP Global Workload Manager (gWLM)
- HP Capacity Advisor
- HP Integrity Virtual Machines Manager
- HP Application Discovery
- HP Instant Capacity Manager
- Process Resource Manager (PRM) graphical user interface
- Web-Based Enterprise Management (WBEM) providers and other VSE agents

One of the advantages of using HP SIM with HP Insight Dynamics — VSE is the ability of launching HP Virtualization Manager from HP SIM. With the appropriate set up,

you can launch Virtualization Manager from HP SIM to display and manage your VSE resources.

For information about HP Insight Dynamics — VSE, see HP Insight Dynamics Software

HP-UX System Management Homepage (Web-Based)

NOTE: Not all management functions can be performed using HP SMH. See volume one of the *HP-UX System Administrator's Guide: Overview* for additional information.

The HP-UX System Management Homepage (HP SMH) is a web-based interface for managing one HP-UX system at a time. It completes the transfer of the System Administration Manager (SAM) functions into web-based processes. In HP-UX 11i Version 2, the management of kernel configuration, peripheral devices, and partition management became web-based, using `kcweb`, `pdweb`, and `parmgr`, respectively. In HP-UX 11i Version 3, most management functions can be accessed using the web-based HP SMH interface.

HP SMH is tightly integrated with HP SIM. You can easily navigate to HP SMH from the **System Lists** and **System Pages** in HP SIM.

For HP Superdome 2 systems, the Onboard Administrator (OA) manages partitions, both nPartitions and vPars. OA is an extension of and a replacement of the Management Processor (MP) on Superdome and other cellular-based systems.

PropPlus (SysMgmtPlus) displays HP SIM compatible overall system status on HP SMH. PropPlus has been enhanced to support the following new and updated property pages in HP SMH:

- Blade
- Cell Blade
- Memory

For more information about PropPlus properties, see *hpsmh*(1M).

The following chapters provide examples using HP SMH. See "System Management Homepage (Web-Based)" (page 23). HP SMH is also described in the *System Management Homepage* manual and the *smh*(1M).

HP-UX System Management Homepage (Text-Based)

The text-based HP-UX System Management Homepage (HP SMH) replaces the System Administration Manager (SAM). It operates as a logged-in management tool. It uses simple terminal-based screens. In some cases, the earlier screen-based and X-Window-based displays have been retained. See "System Management Homepage (Text-Based)" (page 27).

HP-UX Commands

HP-UX commands provide you with the finest granularity of access to system configuration, but you must be careful to complete all the steps correctly. In some cases, such as root home directory reconfiguration (see "Create the Root Home Directory" in the *HP-UX System Administrator's Guide: Configuration Management*), they may be the only way to do it. In other cases, such as tweaking non-password data in the password file, it is just easier to run a command such as `vipw`. The following chapters describe the use of HP-UX commands where they are necessary or convenient.

Generally, HP recommends that less-experienced system administrators use HP SMH or HP SIM to manage systems wherever possible and convenient, because they are designed to ensure that all the files and databases are updated and all the commands are issued correctly.

Using HP SIM and HP SMH versus HP-UX Commands

HP SIM and HP SMH reduce the complexity of most administration tasks. They minimize or eliminate the need for detailed knowledge of many administration commands, thus saving valuable time. Use these utilities whenever possible, especially when first mastering a task. Some tasks described in this manual cannot be done by these utilities, in which case you need to use the HP-UX commands. However, these utilities are the tools of choice for much administration work.

TIP: Most tasks in HP SMH allow you to display the HP-UX commands that it uses to perform the task at hand. Previewing these commands can help you learn how to perform HP-UX administration tasks at the command line.

System Management Homepage (Web-Based)

The System Management Homepage (HP SMH) helps you with detailed system administration. When you log in via the web (see "Starting an HP SMH Web Client" (page 26)), you see a **Home** page that gives you access to a wide range of system information and some principal areas of system configuration.

The **Tools** page, selectable from the menu bar, displays the full range of configuration tools available through HP SMH. Depending on which Operating Environment you have installed, your, installation choices, and added optional software, your **Tools** page may be different.

- Accounts for Users and Groups

  Configure Groups
  Configure Local Users *or* Configure NIS Users
  Configure User Templates

  See "Configuring Users and Groups in the *HP-UX System Administrator's Guide: Configuration Management*.

(Also accessible with `/usr/sbin/ugweb`.)

- Audit Configuration

  Audit Events
  Audit System Calls
  Audit Users

  See "Audit Administration" in *HP-UX System Administrator's Guide: Security Management*.

- Authenticated Commands (PAM)

  Configure Account Authentication
  Configure Password Authentication
  Configure Session Authentication
  Configure User Authentication

  See "Authenticating Users with PAM" in *HP-UX System Administrator's Guide: Security Management*.

- Disks and File Systems

  Disks
  File Systems
  Logical Volumes
  Paging Space
  Volume Groups

  See *HP-UX System Administrator's Guide: Overview*, *HP-UX System Administrator's Guide: Logical Volume Management*, and *VERITAS File System 3.5 (HP OnlineJFS/JFS 3.5) Administrator's Guide* manuals, and the*The Next Generation Mass Storage Stack* white paper.

  (Also accessible with `/usr/sbin/fsweb`)

- Distributed Systems Administration Utilities (DSAU)

  Configure Configuration Synchronization
  Configure Consolidated Logging
  View System Logs

  See the *Distributed Systems Administration Utilities User's Guide*.

- Error Management Technology

  Query or Customize Error Data

- Evweb

  Subscription Administration

  (Also accessible with `/opt/sfm/bin/evweb`)

- IPMI Event Viewer

Event Viewer

- Kernel Configuration

  Alarms
  Modules
  Tunables

  See "Configuring the Kernel in the *HP-UX System Administrator's Guide: Configuration Management*.

  (Also accessible with `/usr/sbin/kcweb`)

- Network Interfaces Configuration

  Network Interface Cards
  Remote Direct Memory Access

- Network Services Configuration

  Bootable Devices
  DHCPv6
  DNS
  Hosts
  Network Services
  NIS
  Route
  Networked File Systems
  System Access
  Time

- nPartition Management

  View and Manage Complex
  View and Manage Remote Complex

- Peripheral Devices

  Manage Peripheral Devices
  - OLRAD Cards
  - I/O Tree

  See "Configuring Peripherals" in the *HP-UX System Administrator's Guide: Configuration Management*.

  (Also accessible with `/usr/sbin/pdweb`)

- Printer Management

  Configure Printers or Plotters
  Manage Print Requests
  Save or Restore Print Spooler Configuration

See “Configuring Printers” in the *HP-UX System Administrator’s Guide: Configuration Management*.

- Resource Management

  Event Monitoring Service

  See “Configuring Printers” in the *HP-UX System Administrator’s Guide: Configuration Management*.

- Resource Monitors

  Monitor Configuration
  X Server Configuration

- Security Attributes Configuration

  Local Users *or* NIS Users
  System Defaults

  See “Configuring Peripherals” in the *HP-UX System Administrator’s Guide: Configuration Management*.

  (Also accessible with `/usr/sbin/secweb`)

- Serviceguard Cluster

  Serviceguard Manager

  See the *Managing Serviceguard* manual.

- Software Management

  Copy Depot Software
  Install Software
  List Depot Software
  List Installed Software
  Remove Depot Software
  Remove Installed Software

  Over time with new OEs the tools available in HP SMH may increase allowing you to perform more system administration tasks via HP SMH

Starting an HP SMH Web Client

You should have an X Window System client running on the local system. See *HP-UX System Administrator’s Guide: Configuration Management* for details.

In a browser window, enter one of the following URLs, where *`targetsystem`* is the host domain name or IP address of the system being managed:

`http://targetsystem:2301/` You will see a webpage with the message:

```
Please Wait... You will be
redirected to the System Management
Homepage
```

If the `hpsmh` daemon has not been started on the target system, it is automatically started.

After a brief wait, you will see the login webpage for HP SMH. Enter a valid HP SMH login name (for example, `root`) and the password.

`https://targetsystem:2381/`	• If the `hpsmh` daemon is running on the target system, you will see the login webpage for HP SMH. Enter a valid HP SMH login name (for example, `root`) and the password. • If the `hpsmh` daemon has not been started on the target system, you will see a browser-dependent message, such as: `The page cannot be displayed` (Internet Explorer) `Unable to connect` (Firefox) `The document contains no data` (Mozilla) Try using the URL for port 2301 (above).

Starting the HP SMH Daemon on the Target System

To start the HP SMH daemon on the target system, enter the command:

```
# /opt/hpsmh/bin/hpsmh autostart
```

The HP SMH daemon is also started if a browser attempts to access port 2301 on the target system, as with the URL: `http://targetsystem:2301/`

System Management Homepage (Text-Based)

The HP-UX System Management Homepage (HP SMH) helps you with the administration of your system.

HP SMH administrative areas:

- a - Auditing and Security
  - Audited Events
  - Audited System Calls
  - Audited Users
  - System Security Policies
  - Authenticated Commands

See the *HP-UX System Administrator's Guide: Security Management*.

- c - Security Attributes Configuration

  Topics include password aging and default umask.

  — s - System Defaults

  Configure system-wide values of security attributes.

  See *security*(4).

  — l - Local Users

  Configure per-user values of security attributes of local users (if NIS is *not* configured).

  See *userdb*(4).

  — n - NIS USers

  Configure per-user values of security attributes of NIS users (if NIS is configured).

  See *userdb*(4).

  See "Configuring System and User Security" in the *HP-UX System Administrator's Guide: Configuration Management*.

  (Also accessible with `/usr/sbin/secweb -t`)

- d - Peripheral Devices

  — o - OLRAD Cards

  View all OLRAD-capable slots and cards on the system and perform OL* operations

  See *Interface Card OL* Support Guide*.

  — i - I/O Tree

  View all devices on the system

  (Also accessible with `/usr/sbin/pdweb -t`)

- e - Resource Management

  — Event Monitoring Service

  See *Using the Event Monitoring Service*.

  (Also accessible with `/opt/sfm/bin/evweb`)

- f - Disks and File Systems
  - f - File Systems

    View or Manage File Systems
  - l - Logical Volumes

    View or Manage Logical Volumes
  - v - Volume Groups

    View or Manage Volume Groups
  - d - Disks

    View or Manage Disk Devices

  See *HP-UX System Administrator's Guide: Overview* and *HP-UX System Administrator's Guide: Logical Volume Management*.

  (Also accessible with `/usr/sbin/fsweb`)
- g - Display
  - Monitor Configuration
  - Xserver Configuration
- k - Kernel Configuration
  - t - Tunables

    View or modify kernel tunables

    See *kctune*(1M)
  - m - Modules

    View or modify kernel modules and drivers

    See *kcmodule*(1M)
  - a - Alarms

    View or modify alarms for kernel tunables

    See *kcalarm*(1M)
  - l - Log Viewer

    View the changes made to kernel tunables or modules

    See *kclog*(1M)
  - u - Usage

    View usage of kernel tunables

    See *kcusage*(1M)

  See "Configuring the Kernel" in the *HP-UX System Administrator's Guide: Configuration Management*.

(Also accessible with `/usr/sbin/kcweb -t`)

- n - Networking and Communications
  - s - Network Services Configuration
    - b - Bootable Devices
      - b - DHCP Device Groups Booting from This Server
      - r - Devices for which Boot Requests are Relayed to Remote Servers
      - f - Fixed-Address Devices Booting from This Server
    - v - DHCPv6

      c - Configuring DHCPv6 Server

      s - Configuring Default DHCPv6 Client Settings

      h - Configuring a Host to Act as a DHCPv6 Relay Agent

      r - Configuring DHCPv6 Relay Interface Mappings

      p - Configuring DHCPv6 Address Pools

      d - Configuring DHCPv6 Client Duid Groups

      g - Configuring DHCPv6 Device Groups
    - d - DNS (BIND)

      l - DNS Local Name Server

      r - DNS Resolver
    - h - Hosts

      h - Local Hosts File
    - n - NIS
    - s - Name Service Switch
    - k - Network Services
    - f - Networked File Systems

      s - Share/Unshare File System

      a - Automounted Remote File Systems

      n - Netgroups
      - Local Netgroups
    - r - Routes
    - c - System Access

      i - Internet Services

      r - Remote Logins
    - t - Time

      s - System Clock

b - NTP Broadcasting

n - NTP Network Time Sources

See “Configuring Networking” in the *HP-UX System Administrator’s Guide: Configuration Management*.

See also *NFS Services Administrator’s Guide*.

(Also accessible with `/usr/sbin/ncweb -t`)

— i - Network Interfaces Configuration

◦ n - Network Interface Cards

See *HP-UX LAN Administrator’s Guide*.

◦ v - Virtual LANs

See *HP-UX VLAN Administrator’s Guide*.

◦ t - Tunnels

(Also accessible with `/usr/sbin/ncweb -t`)

- p - Printers and Plotters
  — Print Requests
  — Printers and Plotters
  — Save/Restore Spooler Configuration

  See “Configuring Printers” in the *HP-UX System Administrator’s Guide: Configuration Management*.
- s - Software Management
  — i - Install Software
  — r - Remove Installed Software
  — l - Interactive List, Installed Software
  — s - Quick List, Installed Software
  — p - Quick List, Installed Patches
  — c - Copy Depot Software
  — m - Remove Depot Software
  — d - Interactive List, Depot Software
  — u - Update HP-UX Operating Environment
- u - Accounts for Users and Groups
  — l - Local Users

  View or Configure Local Users (if NIS is *not* configured).

  — n - NIS Users

  View or Configure NIS Users (if NIS is configured).

— g - Groups

View or Configure Groups.

— t - Templates

View or Configure User Templates.

See "Configuring Users and Groups" in the *HP-UX System Administrator's Guide: Configuration Management*.

(Also accessible with `/usr/sbin/ugweb -t`)

Starting Text-Based HP SMH

To run HP SMH, you must be superuser or have been granted access (see "Giving User's Limited Access to Text-Based HP SMH" in the *HP-UX System Administrator's Guide: Configuration Management*).

Portions of HP SMH can use the X Window System to display enhanced screens. You can choose to have those screens displayed as text graphics instead. The X screens allow you to use the mouse pointer to navigate the screens. The text screens and the menu displays use keyboard controls, notably **Tab**, the arrow keys, **Enter**, and certain letter keys, as indicated on the screen. **Esc** usually ends the current operation. On a menu display, **x** terminates the program.

- To start text-based HP SMH modules with the X Window interface,
  1. Enable the X Window system as described in *HP-UX System Administrator's Guide: Configuration Management*.
  2. Run the module with the `-t` option:

     ```
     # /usr/sbin/fsweb -t # Disks and File Systems
     # /usr/sbin/kcweb -t # Kernel Configuration
     # /usr/sbin/ncweb -t # Networking and Communications
     # /usr/sbin/pdweb -t # Peripheral Devices
     # /usr/sbin/secweb -t # Security Attributes Config
     # /usr/sbin/ugweb -t # Accounts for Users and Groups
     ```

     Note: The `-t` option is not available for `/usr/sbin/smh`.

  If the X Window interface is not available, the modules use the alternate text graphic display.

- To start text-based HP SMH without the X Window interface, you must unset the `DISPLAY` environment variable. For example, you can enter the following:

  ```
  # ( unset DISPLAY ; /usr/sbin/smh )
  ```

  This unsets the `DISPLAY` variable while HP SMH executes. When HP SMH ends, the value of `DISPLAY` is restored. Notice the enclosing parentheses and the semicolon between the commands.

  Similarly, you can start the modules without the X Window interface. For example,

```
# ( unset DISPLAY ; /usr/sbin/ugweb )
```

Giving Users Limited Access to Text-Based HP SMH

As system administrator, you can give limited text-based HP SMH access to non-superusers individually by user name and collectively by primary group name.

NOTE: The privileges assigned to users and groups by the text-based restricted HP SMH do not apply to the web-based HP SMH.

1. Activate Restricted HP SMH.

   ```
   # /usr/sbin/smh -r
   ```

2. You can assign text-based HP SMH privileges by user and by group. You can toggle between the lists of defined users and groups with the **u** and **g** keys, respectively.
3. To select a user or group, move the highlight to that entry and press **Enter**. The list of text-based HP SMH areas is displayed.

   ```
   Resource Manager
   Disks and File Systems Display
   Kernel Configuration
   Printers and Plotters
   Networking and Communications
   Peripheral Devices
   Security Attributes Configuration Software Management
   Auditing and Security
   Accounts for Users and Groups
   ```

4. Choose one of the following:
   - To assign an area, highlight it and press **e**.
   - To assign all areas, press **E**.
   - To disable an area, highlight it and press **d**.
   - To disable all areas, press **D**.

   You can repeat these operations in any combination. The changes are displayed each time you press a key.
5. Press `s` to save the changes.
6. Press **Esc** to return to the previous screen.
7. Press **x** to exit from the program.

User and group privileges are managed separately. Group privileges apply to all users for which it is their primary group, as shown in `/etc/passwd`. A user can acquire a privilege individually, through its group, or both.

When privileged users run `/usr/sbin/smh`, they run text-based HP SMH. They have superuser status in the defined areas and will see only those HP SMH areas in the menu. All other areas of HP SMH are hidden. When users without special access to

HP SMH try to run `smh`, they will receive a message that they must be superuser to execute HP SMH.

When a restricted version of HP SMH is running, there are no shell escapes on terminals and the list menu is disabled. This prevents users from getting superuser access to restricted areas of HP SMH.

2 Booting and Shutdown

This chapter contains information on the following topics:

- "Booting Systems" (page 35)
  - "Booting HP-UX on HP Integrity Servers: Details and Variations" (page 36)
  - "Booting HP-UX on HP 9000 (PA-RISC) Systems: Details and Variations" (page 56)
  - "Speeding the Boot: SpeedyBoot" (page 69)
- "Customizing Start-up and Shutdown" (page 79)
- "Shutting Down Systems" (page 82)
  - "Types of Shutdown" (page 83)
  - "Special Considerations for Shutting Down Certain Systems" (page 88)
  - "Avoiding a Shutdown When Possible" (page 90)
- "Configuring Dump Devices" (page 90)

For an overview and more descriptive information of startup and shutdown, see *HP-UX System Administrator's Guide: Overview*.

Booting Systems

The HP-UX operating system currently runs on two different hardware platforms:

- **HP 9000 Systems** — PA-RISC processor family
- **HP Integrity Servers** — Itanium processor family, including the HP Integrity server blades, HP Integrity Superdome, and HP Integrity Superdome 2.

An HP Integrity Server uses the Extensible Firmware Interface (EFI). If your system displays the EFI boot manager following the initial firmware test results, then you are booting an HP Integrity Server.

If you are booting an HP Integrity Server see "Booting HP-UX on HP Integrity Servers: Details and Variations" (page 36).

If you are booting a PA-RISC System see "Booting HP-UX on HP 9000 (PA-RISC) Systems: Details and Variations" (page 56)

For additional information about booting nPartitions and Virtual Partitions, see the *nPartition Administrator's Guide* and *HP-UX Virtual Partitions Administrator's Guide*.

Mass Storage Stack for HP-UX 11i Version 3

HP-UX 11i v3 provides a representation of device special files and hardware paths for mass storage devices, that increases the reliability, adaptability, performance, and scalability of the mass storage stack. The mass storage stack manages I/O devices, such as SCSI logical units (LUNs).

A new feature, the Storage Enclosure Framework feature, has been added to this release. The Storage Enclosure Framework enables HP-UX to identify enclosures attached to the system and to identify the LUNs, lunpaths, target paths, and target ports associated with an enclosure. For more information about the Storage Enclosure Framework, see *scsimgr*(1M)

For more information about the mass storage stack, see the *Next Generation Mass Storage Stack* white paper.

HP-UX 11i v3 Device Special Files

HP-UX 11i v3 provides persistent DSFs (Device Special files) for mass storage devices. A single persistent DSF is created for each LUN, not bound to the path to the device as in prior HP-UX releases, but to the LUN's Worldwide Identifier (WWID), a unique and permanent identifier of the LUN. This makes the DSF persistent and agile, that is, independent from the physical paths to the device. This also enables transparent multi-pathing, meaning that any available path to the device can transparently be selected to access it. An example of persistent DSF name is /dev/disk/disk13.

NOTE: Persistent DSFs will remain persistent for the life of a system, even after a recovery. However, they are not persistent if you cold reinstall an HP-UX 11i v3 system.

HP-UX 11i v3 Hardware Paths

HP-UX 11i v3 provides a representation of hardware paths for mass storage devices, referred to as a *lunpath hardware path*, which coexists with the legacy representation of hardware paths already used in versions prior to HP-UX 11i v3.

The lunpath hardware path format enables the use of more targets and LUNs than are permitted in the legacy addressing scheme. It is identical in format to a legacy hardware path, up to the HBA, and represents the same path to the LUN. Beyond the HBA, additional elements representing a transport-dependent target address (for instance, a target port World-Wide Name for Fibre Channel or a port id for SCSI) and a 64-bit SCSI LUN address, are printed in hexadecimal.

Note: the hardware path elements size has been increased from 8 bits to 64 bits to fit these additional elements.

The lunpath hardware path format may be used to specify boot paths as explained further in this section.

For more information about the format of hardware paths, see *HP-UX System Administrator's Guide: Overview.*

Booting HP-UX on HP Integrity Servers: Details and Variations

HP-UX System Administrator's Guide: Overview describes the basic sequence of events that occurs when you turn on, reset, or reboot an HP Integrity Server. This section

covers the boot process more thoroughly because there are times when you need to manually control the boot process; for example:

- When you need to boot your system from a device other than the device from which you normally boot.
- When you need to boot your system from a kernel file other than the kernel file from which you normally boot.
- When you need to boot the system into Single-User Mode to ensure that special tasks you are doing are not affected by other users of the system.
- When you need to boot your system into LVM Maintenance mode to correct a problem with your computer's logical volumes or volume groups.
- When you are installing, or updating to a new release of HP-UX.

Here is a detailed look at the boot process, and its variations.

CAUTION:

ACPI Configuration for HP-UX Must Be "default" on nPartitionable HP Integrity Servers

HP-UX will not boot on an nPartition-capable system if the ACPI configuration value is not set to "`DEFAULT`". A setting other than "`DEFAULT`" can exist, for example, if the nPartition was previously running a non-HP-UX operating system that required a different value.

To check the current ACPI configuration, at the EFI Shell interface enter the `acpiconfig` command with no arguments. If the `acpiconfig` value is not set to `default`, then HP-UX cannot boot; in this situation you must reconfigure `acpiconfig` or else booting will be interrupted with a panic when launching the HP-UX kernel.

To set the ACPI configuration for HP-UX: in the EFI Shell interface enter the `acpiconfig default` command, and then enter the `reset` command for the nPartition to reboot with the proper (`default`) configuration for HP-UX.

A Standard Boot

Here are more details about what happens during a typical HP-UX boot-up sequence on an HP Integrity Server.

1. **Power on external devices:** If necessary, turn on all external peripherals and devices that are attached to your computer (for example, disk drives, disk arrays, tape drives, printers, terminals, bus converters).

   Once the devices have completed their self-check tests, proceed to the next step.

2. **Power on your system (or nPartition):** Turn on or reset the computer or nPartition.

   System hardware (or hardware associated with an nPartition you are booting) will go through a series of self-tests to verify that the processors, memory, and other system components are in working order.

3. **Boot device selection:** Your system (or the nPartition you are booting) must locate a kernel file from which to boot. There are two parts to the search:

   Part 1 determine the hardware path to the boot device

   Part 2 determine which kernel file on the hardware path to boot (see Step 4)

   Path variables stored in non-volatile memory set up to three possible boot paths from which to attempt a boot:

   PRI The **PRI**mary boot path is the first boot path to try. Set the value of this path to point to the device from which you will boot most often.

   HAA The **H**igh-**A**vailability **A**lternate boot path is the path from which you want your system to boot should your primary boot path fail.

   ALT The **ALT**ernate boot path is the hardware path to an alternate boot source (for example, a tape drive, network-based boot source, or optical disc drive).

   On HP Integrity Servers, the `PRI` boot path is tried during an automatic boot. You can manually override an automatic boot by interrupting the boot process before the `AUTOBOOT DELAY` expires. If an autoboot from the primary boot path (first item in the Boot Options List) is not possible, you will need to manually select a boot path from the EFI Boot Manager menu.

   Boot disks on HP Integrity servers contain a special partition called an EFI partition. The EFI partition, a derivative of the FAT file system commonly found on PCs, contains EFI applications that can be run before HP-UX is initiated. One such application, the EFI boot manager, is automatically launched and in turn launches the HP-UX boot loader, `hpux.efi` (also an EFI application).

NOTE: A diagram and brief description of the disk layout for disks containing EFI partitions is available in the *HP-UX System Administrator's Guide: Logical Volume Management* volume.

4. **Kernel file selection:** Once a boot device is selected, the HP-UX-specific boot loader `hpux.efi` is initiated. `hpux.efi` uses the contents of the `AUTO` file on the selected boot device to locate the kernel file to boot.

   Typically, the `AUTO` file contains:

   ```
   boot vmunix
   ```

   which tells `hpux.efi` to load the kernel from the file called `vmunix` from the boot file system, later to be mounted on the root file system under `/stand`, so that the booted kernel can be found as the file `/stand/vmunix`.

5. **Load and initiate the HP-UX operating system:** `hpux.efi` then opens, and loads the HP-UX kernel into memory and initiates it.

6. **HP-UX goes through its initialization process and begins normal operation.**

Automatic Versus Manual Booting

Whether your system boots automatically (providing for the option of unattended booting in the case of a power failure or other unexpected boot situations) or requires manual intervention is determined by several things, most notably:

- the setting of the `autoboot` flag in non-volatile memory
- whether an `AUTO` file is present in the EFI partition on the selected boot device
- whether you intend to boot from your system's primary boot device
- whether your primary boot device (or the High-Availability Alternate boot device) is available

Usually, the primary boot path points to the device from which you most frequently boot and that device is available. If the `autoboot` flag is enabled, your system will automatically boot from the selected boot device (following a preset time-out).

`autoboot on` — If the `autoboot` flag is set to `on`, `hpux.efi` will attempt to boot using the items in the boot options list, in the order specified. It reads the `\EFI\HPUX\AUTO` file from the EFI file system on the device that you are booting from. `hpux.efi` uses the contents of `AUTO` to locate the kernel file to load and determine which boot options (if any) to use. It then loads and initiates the kernel.

If no `AUTO` file is located the boot process stops at the `hpux.efi` loader (you will see the `HPUX>` prompt) and you can manually boot HP-UX or perform other tasks.

`autoboot off` — If the autoboot flag is set to `off` the boot process stops at the EFI Boot Manager from which you can manually boot HP-UX or perform other tasks.

Overriding an Automatic Boot

If the `autoboot` flag in the nonvolatile memory of your system or nPartition is enabled, your system or nPartition will attempt to automatically boot following a boot delay. By default, the boot delay is set to 10 seconds however you can change this.

To override an automatic boot, press the space bar before the autoboot delay period expires. Instead of continuing with the autoboot, your system or nPartition will allow you to interact with the EFI Boot Manager.

NOTE: Almost any key will perform the same action as the space bar, however the **ENTER** key will start the boot sequence immediately, and other keys might be meaningful to the boot manager (for example, pressing **v** will move the currently selected boot manager menu option down one item).

You can override an automatic boot to manually interact with the EFI Boot Manager to:

- Specify a boot device (other than that which would be automatically used)
- Specify a boot kernel file (other than that which would be automatically used)
- View or adjust your system's pre-boot settings

At this point, you can select a device from which to boot using the options provided in the EFI Boot Manager's main menu, or you can choose to interact with the EFI shell to boot your system.

Using the EFI Shell to Manually Boot Your System

To use the EFI shell to boot your system:

Procedure 2-2 Booting from the EFI Shell

1. Access the EFI Shell.

   From the system console, use the up/down arrow keys to select the "`EFI Shell`" entry from the EFI Boot Manager menu to access the shell.

2. Access the EFI System Partition for the HP-UX boot device.

   Use the `map` EFI Shell command to list the file systems (`fs0`, `fs1`, and so on) that are known and have been mapped.

   To select a file system to use, enter its mapped name followed by a colon (`:`). For example, to operate with the boot device that is mapped as `fs0`, enter **`fs0:`** at the EFI Shell prompt. When you hit **Enter** to complete the command the shell prompt will change to reflect your device selection: (`fs0:\>`)

   If the `map` command shows a lot of devices you can use the `-b` option to make it show the output one screen at a time.

3. Enter **`HPUX`** at the EFI Shell command prompt to launch the `HPUX.EFI` loader from the currently selected boot device.

   If needed, you can specify the loader's full path by entering **`\EFI\HPUX\HPUX`** at the EFI Shell command prompt.

4. Allow the `HPUX.EFI` loader to proceed with the `boot` command specified in the `AUTO` file, or manually specify the `boot` command.

   By default, the `HPUX.EFI` loader boots using the loader commands found in the `\EFI\HPUX\AUTO` file on the EFI System Partition of the selected boot device. The `AUTO` file typically contains the `boot vmunix` command.

   To interact with the `HPUX.EFI` loader, interrupt the boot process (for example, type a **space**) within the time-out period provided by the loader. To exit the loader use the `exit` command; this will take you back to EFI.

Adjusting the Autoboot Delay

By default, the automatic boot delay is set to 10 seconds. You can change this value:

Example 2-1 Setting the autoboot delay using the EFI Boot Manager's Boot Options:

1. Select "`Boot Option Maintenance Menu`" from the boot manager's main menu.
2. Select "`Auto Boot TimeOut`" from the boot option maintenance menu.
3. Select "`Set TimeOut Value`".
4. Enter the *`number of seconds`* you want to use for the boot delay (for example 30).

Example 2-2 Setting the autoboot delay using the EFI Shell's autoboot command:

To set the autoboot delay to 30 seconds, use the EFI Shell command:

```
autoboot 30
```

Enabling / Disabling Autoboot

The value of the `autoboot` flag can be set or changed in several ways:

Example 2-3 Enable Autoboot (using EFI Shell's autoboot command)

```
Shell> autoboot on
```

Example 2-4 Disable Autoboot (using EFI Shell's autoboot command)

```
Shell> autoboot off
```

Example 2-5 Enable Autoboot (using setboot from a running HP-UX system)

```
/usr/sbin/setboot -b on
```

Example 2-6 Disable Autoboot (using setboot from a running HP-UX system)

```
/usr/sbin/setboot -b off
```

Booting from an Alternate Boot Source

There are times when you need to boot from a device other than the device from which you normally boot. For example, if your primary boot disk fails, you need to boot your system either from a different disk or from another recovery medium.

Booting from an Alternate Boot Device

You can boot from an alternate device in following ways. If your system is set up to automatically boot you will need to override the autoboot sequence by hitting any key on the console keyboard during the autoboot delay (time-out) period.

- If the alternate device from which you want to boot is listed in the boot options menu (the main EFI Boot Manager menu), use the arrow keys to highlight the entry for the alternate device and press **Enter** on the keyboard to boot from that device.
- If the alternate device from which you want to boot is *not* listed in the boot options menu:
  1. Select "`EFI Shell [Built-in]`" from the boot options menu to run the EFI shell.
  2. Enter **`map`** at the EFI shell prompt to list bootable devices on your system.

     The devices will be listed. Look for entries that begin with `fs#:` (where `#` is a number such as 0, 1, 2, 3, etc.).

     If the `map` command shows a lot of devices you can use the `-b` option to make it show the output one screen at a time.
  3. Determine which entry maps to the device from which you are trying to boot, and enter the `fs#:` name at the shell prompt.

     For example, if the entry for the device you want is tagged as "`fs0:`", enter **`fs0:`** at the shell prompt:

     ```
     Shell> fs0:
     ```

     The device associated with entry `fs0:` is now the selected boot device. The EFI Shell prompt will change to reflect this.
  4. Enter **`hpux`** to start the boot loader. The boot loader (`hpux.efi`) will now run and use the `AUTO` file *on the selected device* to determine which kernel file to use.

NOTE: On partitionable systems, the default is not to search all cells and their interface cards for devices, this is done to allow the boot process to proceed faster. If the device from which you want to boot is not attached to an I/O card on the core cell, you must use the search command at the EFI prompt to allow you to find additional devices on other cells and I/O slots. Once a device is added to the boot manager menu that is located on a different cell, EFI enumerate devices on that I/O card while performing future boots.

On HP Integrity Superdome 2 systems, on an initial boot (clear NVRAM), UEFI drivers are connected to the lowest numbered Integrity Blades and BIOX with I/O devices assigned to the partition. On the next boot, drivers are not connected unless a boot option is launched. If the UEFI Shell, Boot Maintenance Manager, or Device Manager is launched, drivers are connected to the lowest number Integrity Blade and BIOX with I/O, and any boot options that might have been created from a previous boot. For more information on the search command see *nPartition Administrator's Guide* or the*search*(1M) manpage from the UEFI Shell.

Booting from an Alternate Kernel File

The default kernel file name (and the kernel file name that is usually used) is `vmunix`. The `AUTO` file in the EFI partition on a boot device typically contains the entry: "`boot vmunix`" which references the file `vmunix` in the `/stand` file system on the selected boot device.

If you normally boot from the kernel file `/stand/vmunix` but (for example) need to temporarily boot from an alternate kernel file, follow this procedure substituting *`your kernel file name`* for `testvmunix`:

1. If your system automatically boots, interrupt the autoboot sequence by hitting any key on the console keyboard during the autoboot (time-out) delay.
2. Select `EFI Shell [Built-in]` from the boot options menu to start the EFI shell.

3. Make sure the selected boot device is the one that contains the kernel file from which you want to boot. If you are not sure:
   a. Enter **map** at the EFI shell prompt to list bootable devices on your system.

      The devices will be listed with entries that begin with `fs#:` (where # is a number such as 0, 1, 2, 3, etc.). For example:

```
fs0  : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part1,Sig88F40A3A-B992-11E1-8002-D6217B60E588)
fs1  : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part3,Sig88F40A9E-B992-11E1-8004-D6217B60E588)
blk0 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)
blk1 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part1,Sig88f40A3A-B992-11E1-8002-D6217B60E588)
blk2 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part1,Sig88f40A6C-B992-11E1-8003-D6217B60E588)
blk4 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Secondary,Master)
```

   b. Determine which entry maps to the device containing the kernel file you are trying to boot from, and enter the `fs#:` name at the shell prompt.

      For example, if the entry for the device from which you want to boot is tagged as "`fs7:`", enter **`fs7:`** at the shell prompt:

```
Shell> fs7:
```

      The device associated with entry `fs7:` is now the selected boot device.

4. Enter the command **`hpux`** at the shell prompt and be prepared to stop the autoboot sequence (again by hitting any key on the console keyboard) if you see a countdown timer showing that an autoboot is about to commence.

NOTE: If the `AUTO` file on the now selected boot device will cause the system to boot from the alternate kernel file you are trying to use, there is no need to interrupt this second autoboot sequence. Otherwise, stop the automatic boot.

5. If you stopped the automatic boot in the previous step you should now be in the HP-UX boot loader; the prompt should now be "`HPUX>`".

   At the boot loader prompt, enter the command **`boot` *`filename`*** where *`filename`* is the name of the kernel file from which you are trying to boot.

Example 2-7 Booting from an alternate kernel file called "testvmunix"

```
HPUX> boot testvmunix
```

Changing the PRI, HAA, and ALT Boot Paths

On HP Integrity Servers, the primary, high-availability alternate, and alternate boot paths are based on the first, second, and third items that appear in the boot options list for the server, respectively.

You can manage the boot paths using the `setboot` command when HP-UX is running, or by using the "`Boot Option Maintenance Menu`" in the EFI Boot Manager.

Setting the PRI, HAA, and ALT Boot Paths Using the HP-UX setboot Command:

When you use `setboot` to configure the first (`PRI`), second (`HAA`), or third (`ALT`) item in the boot options list, the new device path that you specify either *replaces* the original boot option, or it is *inserted* in the original's place (with the original item being shifted toward the end of the boot options list):

- If the boot option is currently not set to an HP-UX device, the new boot device path is inserted as a new item in the boot options list.

  In this case the original list item, if any, moves toward the end of the boot options list and the new boot device path becomes the first (`PRI`), second (`HAA`), or third (`ALT`) item in the list, as specified by `setboot`.

- If the boot option is currently set to an HP-UX device and the list item has the standard description (for example, "`HP-UX Primary Boot for PRI`" or "`HP-UX Alternate Boot for ALT`") then the new boot device path replaces the original item in the boot options list.
- If the boot option currently is set to an HP-UX device and the list item's description is not standard for its place in the boot options list, then the new boot device setting is inserted as a new item in the boot options list.

  In this case the original list item is moved toward the end of the boot options list.

NOTE: The boot device path that you specify in the `setboot` command (*`path`* in the following examples) must be a valid HP-UX hardware path to a bootable HP-UX device.

Starting with HP-UX 11i version 3, the persistent DSF name and the lunpath hardware path are valid entries to the `setboot` command, in addition to the legacy hardware path. Regardless of the type of argument passed in input to `setboot`, `setboot` stores in stable storage and displays in output an active lunpath hardware path to the device. This lunpath hardware path may be automatically replaced by another active lunpath upon failure of the initially configured lunpath. For more details, see the *setboot(1M) in HP-UX 11i v3* white paper located on HP Business Support Center website: HP-UX Core Docs.

- Use the `setboot -p` *`path`* command, where *`path`* is a legacy hardware path, to set the primary boot path, for example:

  ```
  /usr/sbin/setboot -p 0/0/2/0/0.6
  ```

- Use the `setboot -h` *`path`* command where *`path`* is a lunpath hardware path, to set the high-availability alternate boot path, for example:

  ```
  /usr/sbin/setboot -h
  0/5/1/0.0x50001fe15001eead.0x4001000000000000
  ```

- Use the `setboot -a` *`path`* command, where *`path`* is a persistent DSF, to set the alternate boot path, for example:

  ```
  /usr/sbin/setboot -a /dev/disk/disk13
  ```

Setting the PRI, HAA, and ALT Boot Paths Using the Boot Option Maintenance Menu in the EFI Boot Manager:

You can use the Boot Option Maintenance Menu in the EFI Boot Manager to manage the PRI, HAA, and ALT boot paths. Just remember that:

PRI The primary boot path (PRI) corresponds to the *first* boot option in the list

HAA The high-availability alternate boot path (HAA) corresponds to the *second* boot option in the list

ALT The alternate boot path (ALT) corresponds to the *third* boot option in the list

NOTE: You can have more than three items in your boot options list. The first three correspond to the boot paths as listed above. Additional items can be chosen manually from the boot options list during a manual boot.

1. Select "`Boot Option Maintenance Menu`" from the EFI Boot Manager's main menu
2. Use the following three Boot Option Maintenance Menu items to edit the boot options list so that it reflects the devices on your system that you want to use for

your PRI, HAA, and ALT boot paths (and any additional boot paths you want to add to the list):

`Add a Boot Option`	Presents you with a list of possible boot devices and allows you to select one to add to your boot options list
`Delete Boot Option(s)`	Allows you to interactively delete one or more entries from your boot options list
`Change Boot Order`	Allows you to reorder your boot options list

3. When the boot options list for your system is as you want it, select "`Exit`" to return to the EFI Boot Manager's main menu (which should now reflect your new edits to the boot options list).

Changing the Contents of an AUTO File on a Boot Device

On an HP Integrity Server, during an automatic boot (and some manual boots), the file `\EFI\HPUX\AUTO` on the device from which you are booting is used to locate the kernel file from which to boot.

Typically the contents of the AUTO file are "`boot vmunix`". You can temporarily override the contents of the AUTO file, for example to boot from an alternate kernel file (see "Booting from an Alternate Kernel File" (page 43)), but if you want to boot from the other kernel file by default, or want to regularly use certain boot options, you need to change the contents of the AUTO file to reflect the appropriate settings.

NOTE: The AUTO file can only specify the `boot` command. To issue other `hpux.efi` loader commands, you must interact directly with the loader.

There are three basic ways to change the contents of the AUTO file on a device. Two of these can only be accomplished using the pre-boot EFI environment. The third can be accomplished while HP-UX is running.

- Changing the AUTO file from the EFI Shell (pre-boot)
- Changing AUTO from the HPUX.EFI Boot Loader (pre-boot)
- Changing AUTO from a Running HP-UX Environment

Procedure 2-6 Changing the AUTO file from the EFI Shell (pre-boot)

This procedure cannot be done from a running HP-UX system. It assumes that your system has not yet been booted. If you need to change the contents of a device's AUTO file while HP-UX is running, see "Changing AUTO from a Running HP-UX Environment" (page 51).

To list and configure an HP-UX boot device's AUTO file from the EFI Shell use EFI Shell commands (such as `cd`, `ls`, and `edit`) to display and edit the `EFI\HPUX\AUTO` file on the selected device.

1. **Access the EFI Shell environment** using the server's (or nPartition's) system console. Access the system console either via the server's management processor (MP) or via a hardwired console terminal.

   If necessary, interrupt the autoboot process by hitting a key during the autoboot time-out period. The EFI Boot Manager will display the boot options menu (the EFI main menu).

   From the boot options menu, select `EFI Shell`.

2. Select the device with the `AUTO` file that you want to change.

IMPORTANT: Do not forget this step, especially if you have multiple bootable devices. On HP Integrity Servers every bootable device can have its own `AUTO` file. If you have not selected the device containing the `AUTO` file you want to change, you might be editing an `AUTO` file on a different device.

To list all currently mapped file systems, enter **map** at the EFI Shell prompt:

```
Shell> map
```

The `map` command displays all file systems that are known and have been mapped. For example:

```
fs0  : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part1,Sig88F40A3A-B992-11E1-8002-D6217B60E588)
fs1  : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part3,Sig88F40A9E-B992-11E1-8004-D6217B60E588)
blk0 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)
blk1 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part1,Sig88f40A3A-B992-11E1-8002-D6217B60E588)
blk2 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part1,Sig88f40A6C-B992-11E1-8003-D6217B60E588)
blk4 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Secondary,Master)
```

If the `map` command shows a lot of devices you can use the `-b` option to make it show the output one screen at a time.

In the list that is displayed locate the entry corresponding to the device containing the `AUTO` file you want to change. Look at the entries in the list that begin with the string `fs#`, where # will be a number (for example `fs0`, `fs1`, `fs2` ... and so on). At the EFI Shell prompt enter the `fs#` for the desired device followed by a colon:

```
Shell> fs0:
```

Your device is now selected and the EFI Shell prompt will change to reflect that:

```
fs0:\>
```

3. **Change directories to where the AUTO file is located.** In the EFI file system for each HP-UX bootable device the AUTO file is located in the \EFI\HPUX directory:
   fs0:\> **cd \EFI\HPUX**

   The prompt changes again to reflect your new location:
   fs0:\EFI\HPUX>

   a. You can display the contents of the directory using the ls command:
      fs0:\EFI\HPUX> **ls**

```
Directory of: fs0:\EFI\HPUX
  06/03/04  03:31p <DIR>              512  .
  06/03/04  03:31p <DIR>              512  ..
  06/03/04  03:35p                421,590  HPUX.EFI
  06/03/04  03:35p                 24,576  NBP.EFI
  06/03/04  03:35p                     12  AUTO
          3 File(s)     446,196 bytes
          2 Dir(s)

fs0:\EFI\HPUX>
```

   b. You can display the current contents of the AUTO file using the cat command:
      fs0:\EFI\HPUX> **cat AUTO**

```
FILE: fs0:\EFI\HPUX\AUTO, Size 12

boot vmunix

fs0:\EFI\HPUX>
```

4. To **change the contents of the AUTO file** you can either use the edit command to edit the file using the full-screen EFI editor, or use the echo command and redirect its output to the AUTO file:
   - To use the edit command, enter **edit AUTO** and configure the AUTO file using the full-screen editor.

     To save changes to the file, depending on the system you have and whether you are using a hardwired console or network-based access, press the "**F2**" key or type **Esc 2** (press "**Esc**" then press "**2**"). Use the editor's on-screen prompts to determine which key sequence to use.

     To exit the EFI editor press the "**F3**" key (or type **Esc 3** depending on your system as described in the previous paragraph).
   - To configure the AUTO file *without* using the full-screen editor, use the echo command:

     fs0:\EFI\HPUX> **echo boot testvmunix > auto**

   The above command replaces the previous contents (if any) of the AUTO file with the string "boot testvmunix". Substitute the name of your kernel file for testvmunix in the example.

NOTE: Because the EFI Shell (EFI file system) is not case sensitive "auto" and "AUTO" (in the previous example) are considered equivalent.

As with HP-UX shells, in the above example the ">" character causes the echo command's output to be redirected to the "auto" file. If auto exists its contents are overwritten. If auto does not exist it is created and will contain the output of the echo command.

5. **Verify the new contents of the AUTO file.** Use the command **cat AUTO** to verify that the contents of AUTO now reflect what you want them to.

Procedure 2-7 Changing AUTO from the HPUX.EFI Boot Loader (pre-boot)

To list and configure an HP-UX boot device's AUTO file from within the HPUX.EFI loader use the showauto and setauto loader commands.

1. Access the HPUX.EFI loader for the boot device that contains the AUTO file you want to configure.

   You can do this either by launching the loader from the EFI Shell interface, or by selecting the device from the EFI Boot Manager and interrupting the HP-UX boot process to access the loader's HPUX> prompt.

NOTE: If you use the EFI Shell interface, be sure to select the correct boot device before starting the HPUX.EFI boot loader or you might change the wrong AUTO file. For details on how to select the correct device, see "Changing the AUTO file from the EFI Shell (pre-boot)" (page 47).

2. At the HP-UX boot loader's HPUX> prompt, enter the showauto command to display the current contents of the AUTO file:

```
HPUX> showauto

\EFI\HPUX\AUTO => boot vmunix

HPUX>
```

3. Enter the setauto command to delete or modify the AUTO file.
   - setauto -d deletes the AUTO file from the current boot device. You might want to do this if you want to disable automatic booting.
   - setauto *string* sets the AUTO file to contain the string specified.

     The string specified must be of a form of the boot loader command. No other HPUX.EFI commands are allowed in the AUTO file.

boot	Specifies to boot the /stand/vmunix HP-UX kernel with no boot options. For example: setauto boot creates an AUTO file that contains only the boot command.

`boot` *`kernel`*	Specifies to boot from the named kernel file. For example: `setauto boot testvmunix` creates an `AUTO` file that contains only the `boot testvmunix` command.
`boot` *`option kernel`*	Specifies to boot the specified kernel file using the loader option given. For example: `setauto boot -is vmunix` command creates an `AUTO` file containing `boot -is vmunix` (which indicates to boot in single-user mode, as specified by the `-is` option). See the *hpux*(1M) manpage for details on loader options, which include LVM maintenance mode (`-lm`), VxVM maintenance mode (`-vm`), tunable maintenance mode (`-tm`), and others.

4. Enter the `showauto` command again to verify the `AUTO` file's new configuration.

Procedure 2-8 Changing AUTO from a Running HP-UX Environment

Changing the AUTO file for a given HP-UX boot device from within a running HP-UX operating system is a three step process:

1. Copy the `AUTO` file from the EFI partition on the boot device to a file on an HP-UX file system.
2. Edit the contents of the `AUTO` file to reflect the new settings.
3. Copy the edited `AUTO` file back to the EFI partition on the boot device.

1. Copy the AUTO file from the EFI partition on the boot device to a file on an HP-UX file system. Use the efi_cp command to do this. See *efi_cp*(1M) for details. For example, if the EFI file system represented by the device file /dev/rdsk/c1t4d0s1 contains the AUTO file you want to change, use the following command to copy the AUTO file to your current directory:
```
efi_cp -d /dev/rdsk/c1t4d0s1 -u /EFI/HPUX/AUTO AUTO
```

IMPORTANT: The -u option in the command above tells efi_cp to copy the AUTO file from the EFI file system to the HP-UX file system. Think of it as copying the file *up* from the lower level EFI pre-boot environment. In Step 3 of this procedure, the efi_cp command, used *without* the -u option, will copy the edited AUTO file back to the EFI file system.

The most difficult part of this step is determining which device file to use to reference the proper EFI file system. If the AUTO file you want to change is the one associated with the device you are currently booted from, here is one way to determine which device file to use:

Example 2-8 Determining the EFI disk partition of your current boot device using LVM

Note, if you are using VxVM instead of LVM, see the VERITAS Volume Manager documentation.

1. Use the bdf command to display the device file for the logical volume that contains your boot directory (/stand):
```
bdf|grep /stand
```
```
/dev/vg00/lvol1    1835008  150288 1671656    8% /stand
```
In this case (and probably in most cases) the device file for the /stand logical volume is /dev/vg00/lvol1.

2. Next, use the lvdisplay command to determine the name of the device file(s) of the physical devices associated with the logical volume in the previous step of this example (use grep and tail to filter the lines you need):
```
lvdisplay -vk /dev/vg00/lvol1|grep /dev|tail +3
```
```
 /dev/disk/disk3_p2      112       112
```
In this example, the *HP-UX file system* on the *one* physical device associated with the /stand directory (the directory containing the kernel file we booted from) is /dev/disk/disk3_p2. The "p2" at the end of the file name refers to partition number 2 on the physical device. This is usually the partition on the disk that contains HP-UX file systems. The EFI partition is almost always contained in partition 1, so if you change the "p2" to "p1" in the file name you should have the device file you need to use for the efi_cp command (/dev/disk/disk3_p1).

3. If the logical volume containing the `/stand` file system contains more than one physical device, you have a little more work to do. You have to determine which of them you booted from, or more importantly, which one you will boot from after changing its AUTO file. Though not always, it is usually the device associated with your PRI (primary) boot path.

   Use the `setboot` command with no options to determine which device your primary boot path currently points to, then use the `lssf` command with each device file associated with the logical volume containing `/stand`. Look for which device file has a hardware address that matches your primary boot path. Change the "`p2`" to "`p1`" as in the previous sub-step and you have the name to use with `efi_cp`.

NOTE: You can use this procedure with devices other than your current boot device if you have multiple devices you alternately boot from. Example 2-8 "Determining the EFI disk partition of your current boot device using LVM" describes a common occurrence.

2. Use the method or editor of your choice to **change the contents of the `AUTO` file** in your current directory. For example, you might want to change the contents of the AUTO file to automatically boot from an alternate kernel file:

   Before the change AUTO contains:
   ```
   boot vmunix
   ```
   After your edits AUTO contains:
   ```
   boot testvmunix
   ```

3. Copy the changed `AUTO` file back to the EFI file system using the `efi_cp` command *(without the `-u` option)*:
   ```
   efi_cp -d /dev/rdsk/c1t4d0s1 AUTO /EFI/HPUX/AUTO
   ```

Booting into Single-User Mode

You can boot HP-UX in single-user mode by using the following procedure:

Procedure 2-9 Booting HP-UX Into Single-User Mode on HP Integrity Servers

From the EFI Shell environment, boot in single-user mode by stopping the boot process at the `HPUX.EFI` interface (the HP-UX Boot Loader prompt, `HPUX>`) and enter the `boot -is vmunix` command.

1. Access the EFI Shell environment for the nPartition on which you want to boot HP-UX in single-user mode.

   Login to the service processor (MP or GSP) and enter `CO` to access the Console list. Select the nPartition console.

   When accessing the console, confirm that you are at the EFI Boot Manager menu (the main EFI menu). If at another EFI menu, select the **Exit** option from the sub-menus until you return to the screen with the `EFI Boot Manager` heading.

   From the EFI Boot Manager menu, select the `EFI Shell` menu option to access the EFI Shell environment.

2. Make sure the selected boot device is the one that contains the kernel file from which you want to boot. If you are not sure:

   a. Enter **map** at the EFI shell prompt to list bootable devices on your system.

      The devices will be listed with entries that begin with `fs#:` (where # is a number such as 0, 1, 2, 3, etc.). For example:

      ```
      fs0  : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part1,Sig88F40A3A-B992-11E1-8002-D6217B60E588)
      fs1  : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part3,Sig88F40A9E-B992-11E1-8004-D6217B60E588)
      blk0 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)
      blk1 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part1,Sig88f40A3A-B992-11E1-8002-D6217B60E588)
      blk2 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Primary,Master)/HD(Part1,Sig88f40A6C-B992-11E1-8003-D6217B60E588)
      blk4 : Acpi(HWP0002,500)/Pci(2|0)/Ata(Secondary,Master)
      ```

      If the `map` command shows a lot of devices you can use the `-b` option to make it show the output one screen at a time.

   b. Determine which entry maps to the device containing the kernel file you are trying to boot from, and enter the `fs#:` name at the shell prompt.

      For example, if the entry for the device you want (from a list that is longer than the above example) is tagged as "`fs7:`", enter **fs7:** at the shell prompt: `Shell> fs7:`

      The device associated with entry `fs7:` is now the selected boot device.

3. When accessing the EFI System Partition for the desired boot device, issue the `HPUX` command to invoke the `\EFI\HPUX\HPUX.EFI` loader on the selected device.
4. Boot to the HP-UX Boot Loader prompt (`HPUX>`) by typing any key within the ten seconds given for interrupting the HP-UX boot process. You will use the `HPUX.EFI` loader to boot HP-UX in single-user mode in the next step.

   After you type a key, the `HPUX.EFI` interface (the HP-UX Boot Loader prompt, `HPUX>`) is provided. For help using the `HPUX.EFI` loader, type the `help` command. To return to the EFI Shell, type `exit`.

   ```
   fs7:\> hpux

   (c) Copyright 1990-2002, Hewlett Packard Company.
   All rights reserved

   HP-UX Boot Loader for IA64  Revision 1.723
   ```

```
Press Any Key to interrupt Autoboot
\efi\hpux\AUTO ==> boot vmunix
Seconds left till autoboot -   9
```

[User Types A Key to Stop the HP-UX Boot Process and Access the HPUX.EFI Loader]

```
   Type 'help' for help

HPUX>
```

5. At the `HPUX.EFI` interface (the HP-UX Boot Loader prompt, `HPUX>`) enter the `boot -is vmunix` command to boot HP-UX (the `/stand/vmunix` kernel) in single-user (`-is`) mode. If you are booting from a different kernel file into single-user mode substitute the other file's name for `vmunix`. The `-is` option is what specifies single-user mode.

```
HPUX> boot -is vmunix
> System Memory = 4063 MB
loading section 0
.................................................. (complete)
loading section 1
........ (complete)
loading symbol table
loading System Directory(boot.sys) to MFS
....
loading MFSFILES Directory(bootfs) to MFS
......
Launching /stand/vmunix
SIZE: Text:25953K + Data:3715K + BSS:3637K = Total:33306K

Console is on a Serial Device
Booting kernel...
```

6. If you are accessing the system console through the management processor and you are no longer using it, exit the console and service processor interfaces.

   To exit the EFI environment type **^B** (**Control-B**); this exits the nPartition console and returns to the service processor Main Menu. To exit the service processor, type `X` at the Main Menu.

Booting into LVM (or VxVM) Maintenance Mode

The procedure for booting HP-UX into LVM Maintenance Mode is the same as for booting into single user mode (See "Booting HP-UX Into Single-User Mode on HP Integrity Servers" (page 53) for details), except use the `-lm` boot option instead of the `-is` boot option:

```
HPUX> boot -lm vmunix
```

For VxVM Maintenance Mode use:

```
HPUX> boot -vm vmunix
```

Booting HP-UX on HP 9000 (PA-RISC) Systems: Details and Variations

A Standard Boot (PA-RISC Systems)

Here are more details about what happens during a typical HP-UX boot-up sequence on an HP 9000 System. If you are booting an HP Integrity Server see "Booting HP-UX on HP Integrity Servers: Details and Variations" (page 36).

1. **Power on external devices:** If necessary, turn on all external peripherals and devices that are attached to your computer (for example, disk drives, tape drives, printers, terminals, bus converters).

   Once the devices have completed their self-check tests, proceed to the next step.

2. **Power on your system (or nPartition):** Turn on or reset the computer or nPartition.

   System hardware or hardware associated with an nPartition you are booting will go through a series of self-tests to verify that the processors, memory, and other system components are in working order.

3. **Boot device selection:** Your system (or the nPartition you are booting) must locate a kernel file to boot from. There are two parts to the search:

   Part 1 determine the hardware path to the boot device

   Part 2 determine which kernel file on the hardware path to boot (see Step 4)

   Path variables stored in non-volatile memory set up to three possible boot paths from which to attempt a boot:

   PRI The **PRI**mary boot path is the first boot path to try. Set the value of this path to point to the device from which you will boot most often.

   HAA The **H**igh-**A**vailability **A**lternate boot path, on systems that support it, is the path you want your system to boot from should your primary boot path fail.

   ALT The **ALT**ernate boot path is the hardware path to an alternate boot source (for example, a tape drive, network-based boot source, or optical disc drive).

   On some systems only the primary boot path is automatically tried. On those systems, in order to boot from the alternate boot path you need to override the 10 second autoboot delay.

   On other systems, firmware can be configured to associate various boot actions with each boot path. These boot actions allow you to tell the system:

   - whether to attempt or ignore a boot path
   - if unsuccessful booting from a boot path, whether or not to try the next path in the sequence PRI -> HAA -> ALT
   - whether or not to use the Boot Console Handler (BCH) interface

   For information about the specific hardware paths available on your system, see the output of `ioscan` (see *ioscan*(1M) for details on how to run `ioscan`). Also, some path information is physically printed on your system.

Usually, the primary boot path points to the device from which you most frequently boot and that device is available.

Once the boot device has been initialized, PDC (firmware routines) access a specially formatted area on the boot device, called a LIF volume. PDC loads the Initial System Loader (ISL) into memory and transfers control to it.

4. **Kernel file selection:** If uninterrupted (and if the autoboot flag is enabled -- See "Automatic Versus Manual Booting" (page 57)) ISL will load and initiate the HP-UX-specific boot loader `hpux`.
5. **Load and initiate the HP-UX operating system:** HP-UX uses the contents of the `AUTO` file in the LIF area on the boot device to:
   1. Locate the kernel file to boot.
   2. Load the HP-UX kernel into memory.
   3. Initiate the HP-UX kernel.

   Typically, the `AUTO` file contains:

   ```
   hpux vmunix
   ```

   which tells `hpux` to load the kernel from the file called `vmunix` from the default file system (`/stand` -- the file `/stand/vmunix`).
6. **HP-UX goes through its initialization process and begins normal operation.**

Automatic Versus Manual Booting

PDC sets up the boot and console devices using the Boot Console Handler (BCH). Which actions the BCH takes once the console and boot devices have been initialized depend on whether or not the operator manually interrupts an autoboot, and on the state of two flags in nonvolatile memory: `autoboot` and `autosearch`.

Overriding an Automatic Boot

To override an automatic boot, hit any key on the console keyboard within the autoboot delay period (usually 10 seconds). The Boot Console Handler will display its main menu and allow you to interact with it.

Enabling / Disabling Autoboot

HP 9000 systems running HP-UX are usually set up to boot automatically when their power is turned on. This is an important feature when systems are installed in locations that are not always attended by an operator or system administrator. Should the power fail at the computer site, the system can (usually) reboot itself without input from an operator. The `autoboot` feature is also a convenience.

There are times when you do not want systems to automatically boot themselves, such as when you want to boot from a different device or kernel file. See "Booting from an Alternate Device" (page 64) or "Booting from an Alternate Kernel" (page 66).

The following table describes how the autoboot and autosearch flag settings affect the boot sequence:

Table 2-1 How autoboot and autosearch Flag Settings Affect the Boot Sequence

autoboot	autosearch	Boot Type	What happens
OFF	OFF	Manual Boot	The BCH interacts with the user to obtain the bootable device path
OFF	ON	Boot Search	The BCH skips the primary path and tries alternate path. If the alternate paths are not configured to boot or fail, the BCH interacts with the user to select one
ON	OFF	Auto Boot	The BCH tries the primary boot path; if it is not bootable, the BCH interacts with the user to obtain a bootable device path
ON	ON	Auto Search	The BCH tries the primary boot path; if it is not bootable, the BCH tries next path.

To have your computer boot itself when powered on or reset, the `autoboot` flag should be enabled.

To require action by an attendant to boot the computer, the `autoboot` flag should be disabled.

Setting the Value of the autoboot Flag

The values of the autoboot and auto search flags can be set or changed in several ways:

- In the pre-boot environment, you can set them from the Boot Console Handlers configuration menu.
- From a running HP-UX system you can use the `setboot` command.

Procedure 2-11 Setting Autoboot and Autosearch Flags Using the Boot Console Handler

NOTE: Starting with HP-UX 11i v3, the boot path may be specified using either the legacy hardware path format or the lunpath hardware path format for mass storage devices. When using the lunpath hardware path format, a few things need to be noted.

- Some elements of the lunpath hardware path (the target address and the LUN address) may have a size up to 64 bits. The BCH interface can only handle a maximum size of 32 bits. Therefore, all elements greater than 32 bits must be entered in a special way. These elements must be split into two 32-bit elements and entered as 2 elements separated by a `'.'`, for instance, the `hw` path `0/5/1/0.0x5000fe15001eead.0x4001000000000000` would be entered as `0/5/1/0.0x50001fe1.0x5001eead.0x40010000` (last null element omitted).

  Note: You can use `ioscan -Ne` to generate the split form above.

- In the BCH menu, boot paths set to a lunpath hardware path will be displayed using the split form described above.

  Note: Few older systems display elements in decimal only. For these systems, the above path would look like `0/5/1/0.13242185441.134203917.1073807360`. Users need to convert each element to HEX to recognize the target port and the LUN address.

- The Search command in the BCH menu behaves the same way as on versions prior to HP-UX 11i v3 and does not display any information about the lunpath hardware paths. Therefore, in order to enter a lunpath hardware path, the user needs to know in advance the path to enter as it cannot be selected from the Search menu.

1. After powering on or resetting your computer (or nPartition) take control of the boot process by hitting any key on the console keyboard so that `autoboot/autosearch` will not boot the system automatically (if they are currently enabled). The Boot Console Handler will display its main menu.

   The Boot Console Handler (BCH) will display its main menu and prompt for a command:

   ```
   Main Menu: Enter command >
   ```

2. Access the BCH Configuration menu by entering `CO` at the Main menu, and set the boot action for each boot path, as desired, by using the `PATHFLAGS` command.

   At the BCH Configuration menu, you can list the path flags (boot actions) for all boot path variables by entering `PATHFLAGS` with no arguments

   To set the boot action for each of the boot paths, enter `PATHFLAGS` *`VAR action`*, where *`VAR`* is the boot path Variable (PRI, HAA, ALT) and *`action`* is the boot action (0 for "go to BCH", 1 for "boot, if fail, go to BCH", 2 for "boot, if fail try next path", or 3 for "skip this path, try next path").

   For example, to configure the system to boot from the PRI device or (if PRI fails to boot) the HAA device, use the following two BCH Configuration commands: PATHFLAGS PRI 2 and PATHFLAGS HAA 1, as shown below:

```
Configuration Menu: Enter command > PATHFLAGS PRI 2

     Primary Booth Path Action
          Boot Actions: Boot from this path.
          If unsuccessful, got to the next path.

Configuration Menu: Enter command > PATHFLAGS HAA 1

     HA Alternate Boot Path Action
          Boot Actions: Boot from this path.
                        If unsuccessful, go to next path.

Configuration Menu: Enter command >
```

   For other help in setting path flags, enter HELP PATHFLAGS at the BCH Configuration menu prompt.

Setting Autoboot and Autosearch Flags Using the HP-UX `setboot` Command You can set the values of the autoboot and autosearch flags from a running HP-UX system. To do this, use the `setboot` command (see *setboot*(1M) for complete details).

Example 2-9 Enabling the Autoboot Flag Using `setboot`

```
/usr/sbin/setboot -b on
```

Example 2-10 Disabling the Autoboot Flag Using `setboot`

```
/usr/sbin/setboot -b off
```

Example 2-11 Enabling the Autosearch Flag Using `setboot`

```
/usr/sbin/setboot -s on
```

Example 2-12 Disabling the Autosearch Flag Using `setboot`

```
/usr/sbin/setboot -s off
```

Changing the PRI, HAA, and ALT Boot Paths

HP 9000 systems allow you to define a primary boot path and an alternate boot path, and in many cases a high-availability alternate boot path.

The primary boot path allows `autoboot` to work properly, and all three definitions allow you to easily refer to the corresponding hardware paths when you need to (for example, in the Boot Console Handler you can use the command "`boot alt`" to boot from the hardware device associated with the `ALT` boot path).

You can manage the boot paths using the `setboot` command when HP-UX is running, or by using the Boot Console Handler interface in a pre-boot environment.

Setting the PRI, HAA, and ALT Boot Paths using the HP-UX `setboot` command: When you use `setboot` to configure the primary (`PRI`), high-availability alternate (`HAA`), or alternate (`ALT`) boot paths, the new device path that you specify *replaces* the original boot option setting.

NOTE: The boot device path that you specify in the `setboot` command (*`path`* in the following examples) must be a valid HP-UX hardware path to a bootable HP-UX device.

Starting with HP-UX 11i version 3, the persistent DSF name and the lunpath hardware path are valid entries to the `setboot` command, in addition to the legacy hardware path. Regardless of the type of argument passed in input to `setboot`, `setboot` stores in stable storage and displays in output an active lunpath hardware path to the device. This lunpath hardware path may be automatically replaced by another active lunpath upon failure of the initially configured lunpath. For more details, see the *setboot(1M) in HP-UX 11i v3* white paper located on HP Business Support Center website: HP-UX Core Docs.

- Use the `setboot -p` *`path`* command, where *`path`* is a legacy hardware path, to set the primary boot path, for example:

  ```
  /usr/sbin/setboot -p 0/0/2/0/0.6
  ```

- Use the `setboot -h` *`path`* command where *`path`* is a lunpath hardware path, to set the high-availability alternate boot path, for example:

  ```
  /usr/sbin/setboot -h
  0/5/1/0.0x50001fe15001eead.0x4001000000000000
  ```

- Use the `setboot -a` *`path`* command, where *`path`* is a persistent DSF, to set the alternate boot path, for example:

  ```
  /usr/sbin/setboot -a /dev/disk/disk13
  ```

Procedure 2-12 Setting the PRI, HAA, and ALT Boot Paths Using the Boot Console Handler

NOTE: A few older systems display elements in HEX. These systems are the rp4440, rp3440, rp3410, and HP 9000 Superdome servers.

1. After powering on or resetting your computer (or nPartition) take control of the boot process by hitting any key on the console keyboard so that `autoboot/autosearch` will not boot the system automatically (if they are currently enabled). The Boot Console Handler will display its main menu.

   The Boot Console Handler (BCH) will display its main menu and prompt for a command:

   ```
   Main Menu: Enter command >
   ```

2. Enter one of the following BCH commands (depending on your needs):

Example 2-13 Setting the PRI (Primary Boot Path) Using the BCH

Example: Set the primary boot path address to 0/0/0/2/0.5

```
Main Menu: Enter Command > pa pri 0/0/0/2/0.5
```

TIP: In the above command **pa** is a shortcut for the `path` command. In the Boot Console Handler interface, you can often abbreviate commands and options (**pri** for "primary"). See the help system in the BCH interface for acceptable abbreviations.

Example 2-14 Setting the HAA (High-Availability Alternate Boot Path) Using the BCH

Example: Set the high availability alternate boot path address to 0/0/0/3/1.6

```
Main Menu: Enter Command > pa haa 0/0/0/3/1.6
```

Example 2-15 Setting the ALT (Alternate Boot Path) Using the BCH

Example: Set the alternate boot path address to 0/0/0/3/0.6

```
Main Menu: Enter Command > pa alt 0/0/0/3/0.6
```

Example 2-16 Setting the ALT (Alternate Boot Path) Using the BCH

Example: Set the alternate boot path address to the lunpath hardware path 0/0/0/3/0.0x50001fe15001eead.0x4001000000000000

```
Main Menu: Enter Command > pa alt
0/0/0/3/0.0x50001fe1.0x5001eead.0x40010000
```

Booting PA-RISC Systems from an Alternate Boot Source

A boot source consists of two parts:

- A **boot device** containing a file system where kernel files are stored.
- A **kernel file** containing the kernel to boot.

Your primary boot source is a kernel file on your primary boot device. This is where (if your system is set up for automatic booting) your system will boot from during an autoboot.

You can override where your system boots from by manually interrupting the automatic boot and specifying a different boot device or a different kernel file on your primary boot device.

Booting from an Alternate Device

There are times when you will need to boot from a device other than the device that you normally boot from. For example, if your primary boot disk fails, you might need to boot your system either from a different disk or from a recovery tape.

Procedure 2-13 Using the Boot Console Handler to Boot from an Alternate Boot Device

1. After powering on or resetting your computer (or nPartition) take control of the boot process by hitting any key on the console keyboard so that `autoboot/autosearch` will not boot the system automatically (if they are currently enabled). The Boot Console Handler will display its main menu.

   The Boot Console Handler (BCH) will display its main menu and prompt for a command:

   ```
   Main Menu: Enter command >
   ```

2. Use the BCH `boot` command to specify where you want to boot the system from.

   You can issue the `BOOT` command in any of the following ways:

   - **`BOOT`**

     Issuing the `BOOT` command with no arguments boots the device at the primary (PRI) boot path.

   - **`BOOT`** ***bootvariable***

     This command boots the device indicated by the specified boot path, where *bootvariable* is the PRI, HAA, or ALT boot path.

     For example, `BOOT HAA` boots the high-availability alternate boot path.

   - **`BOOT LAN INSTALL`** or **`BOOT LAN.`*`ip-address`*** **`INSTALL`**

     The `BOOT... INSTALL` commands boot the system from any available Ignite server or from the Ignite server specified by IP-address. For more information on what happens when doing an installation boot, see the *Ignite-UX Installation Booting* white paper available on HP Business Support Center website:

     `HP-UX Core Docs`

   - **`BOOT`** ***path***

     This command boots the device at the specified *path*. You can specify the *path* in HP-UX hardware path notation (for example, `0/0/2/0/0.13`) or in "path label" format (for example, `P0` or `P1`).

NOTE: If you specify the *path* in "path label" format then *path* refers to a device path reported by the last BCH `SEARCH` command.

Example 2-17 Boot from the boot device specified in the ALT boot path

```
Main Menu: Enter command or menu > boot alt
```

Example 2-18 Boot from the boot device specified at hardware address 0/0/2/0/0.14:

```
Main Menu: Enter command or menu > boot 0/0/2/0/0.14
```

Example 2-19 Boot from the boot device specified at path label P2:

```
Main Menu: Enter command or menu > search
PATH# Device Path (dec)          Device Type
----- -------------------        ------------
P0    0/0/2/0/0.13               Random access media
P1    0/0/2/0/0.14               Random access media
```

```
P2     0/0/2/0/0.0                    Random access media

Main Menu: Enter command or menu > boot P2
```

Example 2-20 Boot from the default HP-UX install server

```
Main Menu: Enter command or menu > boot lan
```

Example 2-21 Boot from the HP-UX install server at 192.*nn.xx.yyy*

```
Main Menu: Enter command or menu > boot lan.192.nn.xx.yy
INSTALL
```

Booting from an Alternate Kernel

If you have built a new kernel, or have an alternate kernel file that you want to boot from:

- Boot from the device containing the alternate kernel file using the BOOT command from the BCH interface.

  After you issue the BOOT command, the BCH interface prompts you to specify whether you want to stop at the ISL prompt.

  To boot the from the HP-UX kernel file represented in the AUTO file on the boot device without stopping at the ISL prompt, enter **n** to automatically proceed past ISL and execute the contents of the AUTO file on the selected device. By default the AUTO file is configured to load /stand/vmunix though you can change that (See "Changing the Contents of the Autoexecute File" (page 67)).

```
Main Menu: Enter command or menu > BOOT PRI

     Primary Boot Path:  0/0/1/0/0.15


 Do you wish to stop at the ISL prompt prior to booting? (y/n) >> n


ISL booting  hpux

Boot
: disk(0/0/1/0/0.15.0.0.0.0.0;0)/stand/vmunix
```

  To boot an HP-UX kernel other than that which is pointed to in the AUTO file, or to boot HP-UX in single-user or LVM-maintenance mode, stop at the ISL prompt and specify the appropriate arguments to the hpux loader.

  Specify the HP-UX path name of the alternate kernel file that you want to boot as part of the *devicefile* argument in the hpux boot command. For example:

```
ISL>hpux boot disk(1/0/12/1/1.5.0)/stand/alt_kernel_file_name
```

Changing the Contents of the Autoexecute File

On HP 9000 systems, an important part of what makes an automatic boot possible is a file known as an **autoexecute file** that contains the command that you normally use to boot the HP-UX operating system (the `hpux` command that you would enter at the `ISL>` prompt). The contents of this file are used during the boot process when some or all of the `hpux` command elements have been omitted from the command given to ISL, as in the case of automatic booting.

The **autoexecute file** is not located in any HP-UX file system because its contents are needed before HP-UX is running (before HP-UX can access its file systems). Instead, the autoexecute file, called `AUTO`, is located in the LIF area (sometimes called the boot area) on one of your bootable disks. This is the area is where ISL itself resides.

You rarely need to change the contents of the `AUTO` file. However, there are occasions when you might want to, such as when you create a new kernel file (with a name other than the default, `/stand/vmunix`) that you regularly want to boot from, or to boot from a device on a different disk from where ISL resides.

To create new contents for the `AUTO` file, use the `/usr/sbin/mkboot` command:

`mkboot -a "`*`contents of autofile`*`" `*`device_file_name`*

Example:

```
mkboot -a "hpux disc(8.0.1;0)/stand/vmunix.new" /dev/rdsk/c0t0d0
```

See *mkboot*(1M) for details.

To display the `AUTO` file when HP-UX *is running*, enter:

```
/usr/bin/lifcp /dev/rdsk/c0t0d0:AUTO -
```

You can also display the boot command string in the `AUTO` file at the `ISL>` prompt:

```
ISL> lsautofl
```

Booting into Single-User Mode

If you need to boot a system into single-user mode, for example to make sure no one else logs on when you boot the system to do maintenance work:

1. After powering on or resetting your computer (or nPartition) take control of the boot process by hitting any key on the console keyboard so that `autoboot/autosearch` will not boot the system automatically (if they are currently enabled). The Boot Console Handler will display its main menu.

   The Boot Console Handler (BCH) will display its main menu and prompt for a command:

   ```
   Main Menu: Enter command >
   ```

2. Boot the desired device using the **`BOOT`** command at the BCH interface, and specify that the boot process stop at the ISL prompt (reply **`y`** to the “stop at the ISL prompt” question).

```
Main Menu: Enter command or menu > BOOT ALT

 Alternate Boot Path: 0/0/0/3/0.6


 Do you wish to stop at the ISL prompt prior to booting? (y/n) >> y

Initializing boot Device.

Boot IO Dependent code (IODC) Revision 2

Boot Path Initialized.

HARD Booted.

ISL Revision A.00.44 Mar 12, 2003

ISL>
```

3. From the ISL prompt, issue the Secondary System Loader (hpux) command to boot the HP-UX kernel in single-user mode:

Example 2-22 Boot HP-UX in single-user mode on an HP 9000 System:

```
ISL>hpux -is boot /stand/vmunix
```

To exit the ISL prompt and return to the BCH interface, issue the EXIT command instead of specifying the above hpux loader command.

See the *hpux*(1M) manpage for a detailed list of other hpux loader options.

Example 2-23 Example Single-User HP-UX Boot

```
ISL Revision A.00.44 Mar 12, 2003

ISL> hpux -is /stand/vmunix

Boot
: disk(0/0/2/0/0.13.0.0.0.0.0;0)/stand/vmunix
8241152 + 1736704 + 1402336 start 0x21a0e8

....

INIT: Overriding default level with level 's'

INIT: SINGLE USER MODE

INIT: Running /sbin/sh
#
```

The system will boot into single-user mode; watch for the confirmation messages:

```
INIT: Overriding default level with level `s'
```

```
INIT: SINGLE USER MODE
```

4. If you accessed the system console and service processor (management processor) interfaces via a network, exit the console and service processor interfaces if finished using them.

   To exit the BCH environment type **^B** (**Control-B**); this exits the nPartition or system console and returns to the service processor Main Menu. To exit the service processor, type `X` at the Main Menu.

Booting into LVM Maintenance Mode

To boot HP-UX in LVM Maintenance mode follow the procedure for booting HP-UX into single-user mode (See "Booting into Single-User Mode" (page 67)):

```
ISL> hpux -lm boot
```

The boot/root logical volumes are the only logical volumes that are in a known place when your LVM configuration data has been lost. Maintenance mode is useful on such systems if a standard boot has failed due to LVM configuration problems. You must resolve the LVM configuration problem and then reboot.

CAUTION: When you boot your system in maintenance mode, *do not activate the root volume group* and *do not change to multi-user mode* (for example, by specifying `/sbin/init 2`). If you do, you might corrupt the root file system.

When you have repaired or restored the LVM configuration information, reboot the system using the `reboot` command with the `-n` option. This avoids overwriting your disk-based repairs with the old information still stored in memory buffers.

```
/usr/sbin/reboot -n
```

You can find more information about LVM in *HP-UX System Administrator's Guide: Logical Volume Management*.

Speeding the Boot: SpeedyBoot

On many HP Integrity Servers and HP 9000 Systems, a firmware based feature called SpeedyBoot allows you to bypass some of the boot-time system tests in order to boot your system more quickly.

NOTE: HP recommends that *all* self tests be performed, but recognizes the need to have your system available as quickly as possible.

If you are confident that your system hardware is functioning properly, you may choose to skip certain boot-time system tests in favor of having your system boot up more quickly.

The SpeedyBoot features of your system allow you to specify which tests to perform (or skip) and whether to do this only for the next boot or for the next and all subsequent

boots. There are several ways to define which tests are performed. Which you use depends on:

- whether your system is running or not when you configure SpeedyBoot settings
- whether your system is an HP Integrity Server or an HP 9000 System[1]
- whether you want to configure the SpeedyBoot settings for only the next boot or for all subsequent boots as well
- which release of HP-UX you are running (if you configure it using the `setboot` command)

SpeedyBoot is achieved by reducing the number of firmware tests that are performed at boot time. You specify which tests are performed. The tests include:

- early CPU tests
- late CPU tests
- memory initialization (HP Integrity Servers only)
- full memory tests
- platform dependent tests (HP Integrity Servers only)
- I/O hardware tests (HP Integrity Servers only)
- processor hardware tests (HP 9000 Systems only)
- central electronic complex tests (HP 9000 Systems only)
- chipset tests (HP Integrity Servers only)

You can be independently specify which tests will be performed:

- for the next boot only
- for all subsequent boots

The tests are described in "System Boot Tests" (page 71).

NOTE: By turning off some or all of the boot tests, you can shorten boot time, perhaps significantly. However, in the event of a system panic or boot failure, *all tests* will be executed on the subsequent boot.

1. SpeedyBoot on HP 9000 Systems is supported only on systems with firmware that supports the Boot Console Handler (BCH). Some older platforms can be upgraded with new firmware that supports SpeedyBoot.

System Boot Tests

When your system boots, it performs the tests described in Table 2-2. These are keywords for the hardware tests that are executed by processor-dependent code (PDC) or firmware upon a boot or reboot of the system.

Table 2-2 SpeedyBoot Tests

Test Name	Values	Description

`all`	`on`
	`off`
	`partial`
		All the listed tests.

`SELFTESTS`	`on`
	`off`
	`partial`
		Includes the `early_cpu` and `late_cpu` tests. This is equivalent to the `SELFTESTS` option in the boot console handler (BCH) service menu. The difference is that `setboot` can control the sub-tests separately, while BCH cannot.

`early_cpu`	`on` `off`	When `on`, run firmware, cache, and CPU-specific tests. Performed out of firmware. When `off`, skip the tests.
`late_cpu`	`on` `off`	When `on`, run firmware, cache, and CPU-specific tests. Performed out of memory and therefore faster than the `early_cpu` tests. When `off`, skip the tests.

`FASTBOOT`	`on`
	`off`
	`partial`
		Includes the `full_memory` and `PDH` tests on HP 9000 Systems (PA-RISC). Includes the Platform and Full_memory tests on HP Integrity Servers. This is equivalent to the `FASTBOOT` option in the boot console handler (BCH) service menu. The difference is that `setboot` can control the subtests separately, while BCH cannot. Note: When `FASTBOOT` is `on`, the tests *are* performed, and vice versa.

`full_memory` *(Note lowercase "f")*	`on` `off`	When `on`, run write, read-write, and read tests on all memory locations. When `off`, only initialize memory. *Supported only on HP 9000 (PA-RISC based) systems.*
`Platform`	`on` `off`	When `on`, enables general platform hardware tests. When `off`, do not perform platform hardware tests. *Supported only on HP Integrity Servers.*
`Full_memory` *(Note Uppercase "F")*	`on` `off`	When `on`, enables full destructive memory tests. When `off`, do not perform full destructive memory tests. *Supported only on HP Integrity Servers.*
`PDH`	`on` `off`	Processor-dependent hardware. When `on`, test a checksum of read-only memory (ROM). When `off`, do not.
`CEC`	`on` `off`	Central electronic complex. When `on`, test low-level bus converters and I/O chips. When `off`, do not. `CEC` is not available on all systems.

Table 2-2 SpeedyBoot Tests *(continued)*

Test Name	Values	Description
`Memory_init`	`on` `off`	When `on`, enables full destructive memory tests. When `off`, do not perform full destructive memory tests. *Supported only on HP Integrity Servers.*
`IO_HW`	`on` `off`	IO hardware tests. When `on`, enables system firmware (or EFI drivers) to perform all the tests of IO hardware (for boot devices only). When `off`, do not perform these tests. *Supported only on HP Integrity Servers.*
`Chipset`	`on` `off`	When on, enables chipset tests. When off, do not perform chipset tests. *Supported only on HP Integrity Servers.*

Viewing your System's SpeedyBoot Settings

If your system is currently booted, you can display the SpeedyBoot settings using the -v option to the setboot command:

Example 2-24 Displaying Current SpeedyBoot Settings for your System (HP 9000 sample output)

```
setboot -v
TEST            CURRENT     SUPPORTED     DEFAULT     NEXT BOOT
----            -------     ---------     -------     ---------
all             partial     partial       partial     partial
  SELFTESTS     partial     yes           on          partial
    early_cpu   off         yes           on          off
    late_cpu    on          yes           on          on
  FASTBOOT      partial     yes           on          partial
    full_memory off         yes           on          off
    PDH         on          yes           on          on
  CEC           off         no            off         off
```

Example 2-25 Displaying Current SpeedyBoot Settings for your System (HP Integrity Server sample output)

```
setboot -v
Primary bootpath : <none>
HA Alternate bootpath : 0/0/0/1/0
Alternate bootpath : <none>
Autoboot is ON (enabled)
TEST            CURRENT         DEFAULT
----            -------         -------
all             partial         partial
  SELFTESTS     on              on
    early_cpu   on              on
    late_cpu    on              on
  FASTBOOT      on              on
    Platform    on              on
    Full_memory on              on
  Memory_init   on              on
  IO_HW         off             off
  Chipset       on              on
```

Table 2-3 SpeedyBoot Status Table Headers

Column	Description
Test	The keyword names of the tests that can be controlled by SpeedyBoot. See Table 2-2 (page 71).
Current	The current setting of each test. `on` means the test is normally executed on each boot. `off` means the test is normally omitted on each boot. `partial` means some of the subtests are normally executed on each boot.
Supported	Whether the test is supported by the system firmware. `yes` means the test is supported. `no` means the test is not supported. `partial` means some of the subtests are supported.

Table 2-3 SpeedyBoot Status Table Headers *(continued)*

Column	Description
Default	The default values for each test. `on`, `off`, and `partial` are the same as for **Current**.
Next Boot	The values for each test that will be used on the next boot. If they are different from **Current**, the **Current** values will be reestablished after the next boot. `on`, `off`, and `partial` are the same as for **Current**.

Configuring Boot-Time System Tests from the BCH Menu (HP 9000 Systems Only)

From the BCH Configuration Menu use the `FASTBOOT` command to configure SpeedyBoot settings for a system (or nPartition).

1. Access the system console for your system or nPartition and reset the partition to return to the BCH Main Menu.

   After powering on or resetting your computer (or nPartition) take control of the boot process by hitting any key on the console keyboard so that `autoboot/autosearch` will not boot the system automatically (if they are currently enabled). The Boot Console Handler will display its main menu.

2. At the BCH Main Menu, enter the `co` command to enter the BCH Configuration Menu.
3. At the BCH Configuration Menu use the `FASTBOOT` command to list or configure the SpeedyBoot settings.

   Enter `FASTBOOT` with no arguments to display the current SpeedyBoot settings for your system or nPartition.

NOTE: HP recommends that *all* self tests be performed, but recognizes the need to have your system available as quickly as possible.

To enable all tests, use the `FASTBOOT RUN` command at the BCH Configuration menu.

To *disable* an individual test, enter: `FASTBOOT` *`test`* `SKIP`, where *`test`* is the name of the self test (“`PDH`”, “`EARLY`”, or “`LATE`”).

To *enable* an individual test, enter: `FASTBOOT` *`test`* `RUN`.

For details on setting self tests, enter: `HELP FASTBOOT` at the BCH Configuration Menu

4. Repeat Step 3 until the settings reflect your desired settings, then reboot your system.

Configuring Boot-Time System Tests from the EFI Shell (HP Integrity Servers Only)

From the EFI Shell environment use the `boottest` command to manage the SpeedyBoot settings for a system (or nPartition).

1. Access the EFI Shell environment for your system (or the nPartition you want to configure).

   To access the EFI Shell, reboot or reset your system (or nPartition). Interrupt the automatic boot process if necessary and use the up/down arrow keys to highlight the "`EFI Shell`" menu item and hit **Enter** to select it.

2. In the EFI Shell environment use the `boottest` command to list, enable, or disable boot-time system tests for your system (or nPartition).

   To display the list of supported boot-time system tests, enter the `boottest -h` command at the EFI Shell prompt:

   ```
   Shell> boottest -h

   Usage: BOOTTEST [on|off] | [[test] [on|off]]
   test : early_cpu, late_cpu, platform, chipset,
   io_hw, mem_init, mem_test

   Shell>
   ```

   You can enable or disable any of the boot-time system tests by specifying the name of the test to as an argument to `boottest`.

   In the following boottest command synopsis *`testname`* is one of the following system tests:

   - `early_cpu`
   - `late_cpu`
   - `platform`
   - `chipset`
   - `io_hw`
   - `mem_init`
   - `mem_test`

`boottest`	Display the current boot-time system test configuration
`boottest` *`testname`*	Display the current setting for the specified test (*`testname`*). For example: `boottest mem_test` displays the memory self-test settings.
`boottest on`	Enable *all* boot-time system tests. HP recommends this but recognizes your needs may require disabling some boot-time system tests.
`boottest off`	Disable *all* boot-time system tests. Disabling all self tests is usually not recommended.

`boottest testname on` — Enable the specified test (*testname*). For example: `boottest io_hw on` enables the boot-time I/O hardware self tests.

`boottest testname off` — Disable the specified test (*testname*). For example: `boottest Chipset off` disables the Chipset boot-time system test.

3. Repeat Step 2 until the settings reflect your desired settings, then reboot your system.

Configuring Boot-Time System Tests from a Booted System

SpeedyBoot tests are configured with three `setboot` options:

`-v` — Displays a status table of the SpeedyBoot test settings.

`-t testname=value` — Change the value for the test *testname* in nonvolatile memory to *value* for all following boots. The changes are reflected in the **Current** and **Next Boot** columns of the SpeedyBoot table.

testname — One of the following keywords, as described in Table 2-2 (page 71):

- `all`
- `SELFTESTS`
- `early_cpu`
- `late_cpu`
- `FASTBOOT`
- `full_memory`
- `PDH`
- `CEC`

value — One of:

- `on`

  Enable the test.

- `off`

  Disable the test.

- `default`

  Reset the test to the system default, which is shown in the **Defaults** column of the SpeedyBoot table.

NOTE: The `-t` option (*lowercase t*) is supported only on HP 9000 Systems. To change SpeedyBoot settings for all subsequent boots on an HP Integrity Server, use the pre-boot environment, the EFI shell. See "Configuring Boot-Time System Tests from the EFI Shell (HP Integrity Servers Only)" (page 75) for details.

`-T testname=value` Change the *`value`* for the test *`testname`* for the next system boot only. The changes are reflected in the **Next Boot** column of the SpeedyBoot table. The change does not modify nonvolatile memory, so the permanent values, shown in the **Current** column, are restored after the boot. *`testname`* and *`value`* are the same as for the `-t` option.

Using `setboot` to Configure SpeedyBoot Settings

The following extended example shows the results of various changes on the SpeedyBoot status table. It is a good idea to include the `-v` option in each command so that the table is displayed after the changes are made.

Let us start off in the default state (`CEC` is not supported in this example system, so its default is `off`, and it cannot be changed.)

```
# setboot -t all=default -v
Primary bootpath : 10/0.0.0
Alternate bootpath : 10/12/5.0.0

Autoboot is ON (enabled)
Autosearch is OFF (disabled)

TEST            CURRENT        SUPPORTED      DEFAULT        NEXT BOOT
----            -------        ---------      -------        ---------
all             partial        partial        partial        partial
  SELFTESTS     on             yes            on             on
    early_cpu   on             yes            on             on
    late_cpu    on             yes            on             on
  FASTBOOT      on             yes            on             on
    full_memory on             yes            on             on
    PDH         on             yes            on             on
  CEC           off            no             off            off
```

If you have to boot the system a number of times due to some sort of installation or update, you can speed it up if you turn all the tests off:

```
# setboot -t all=off -v
Primary bootpath : 10/0.0.0
Alternate bootpath : 10/12/5.0.0

Autoboot is ON (enabled)
Autosearch is OFF (disabled)

TEST            CURRENT        SUPPORTED      DEFAULT        NEXT BOOT
```

```
----            -------       ---------     -------       ---------
all             off           partial       partial       off
  SELFTESTS     off           yes           on            off
    early_cpu   off           yes           on            off
    late_cpu    off           yes           on            off
  FASTBOOT      off           yes           on            off
    full_memory off           yes           on            off
    PDH         off           yes           on            off
  CEC           off           no            off           off
```

Now, let us change the previous to set the normal boot to do only the `late_cpu` and the `full_memory` tests, skipping the slower `early_cpu` tests and the `PDH` tests:

```
# setboot -t late_cpu=on -t full_memory=on -v
Primary bootpath : 10/0.0.0
Alternate bootpath : 10/12/5.0.0

Autoboot is ON (enabled)
Autosearch is OFF (disabled)

TEST            CURRENT       SUPPORTED     DEFAULT       NEXT BOOT
----            -------       ---------     -------       ---------
all             partial       partial       partial       partial
  SELFTESTS     partial       yes           on            partial
    early_cpu   off           yes           on            off
    late_cpu    on            yes           on            on
  FASTBOOT      partial       yes           on            partial
    full_memory on            yes           on            on
    PDH         off           yes           on            off
  CEC           off           no            off           off
```

Finally, let us set up the next boot to test everything, and then test only `late_cpu` on subsequent boots.

```
# setboot -t full_memory=off -T all=on -v
Primary bootpath : 10/0.0.0
Alternate bootpath : 10/12/5.0.0

Autoboot is ON (enabled)
Autosearch is OFF (disabled)

TEST            CURRENT       SUPPORTED     DEFAULT       NEXT BOOT
----            -------       ---------     -------       ---------
all             partial       partial       partial       partial
  SELFTESTS     partial       yes           on            on
    early_cpu   off           yes           on            on
    late_cpu    on            yes           on            on
  FASTBOOT      partial       yes           on            on
    full_memory on            yes           on            on
    PDH         off           yes           on            on
  CEC           off           no            off           off
```

Breaking Out of the Boot Screen

An HP-UX system displays an informational screen as it boots, showing what subsystems are being started. Normally, you should not touch the keyboard until you

are prompted to log in, but occasionally, if something has gone wrong (for example if a critical subsystem has failed to start for some reason) you may want to abort the boot. You can do this by entering

Control-|

CAUTION: You should now shut down the system immediately.

Customizing Start-up and Shutdown

This section explains how to make applications and services start automatically on boot and stop on shutdown.

To automate starting and stopping a subsystem you need to do all of the following:

1. Decide at what run level(s) you want the subsystem to start and stop.

   Typically, subsystems get stopped at one run level lower than the one they were started in, so a subsystem started at run level 3 will be stopped at run level 2. You will probably want to start your subsystem at level 1, 2 or 3.

   Generally, these run levels perform the following functions:

   Run level 1: minimal system configuration

   Run level 2: multi-user services, except NFS server

   Run level 3: NFS server (to share local file systems)

   To see exactly what is being started on your system at each run level, look at `/sbin/rc`*n*`.d/S*`, where *n* is the run level.

   Unless your subsystem depends on NFS-export services such as `rpc.mountd` and `nfsd`, run level 2 is a good place to start it.

   Run level 2 is a safe, as well as usually a logical, choice because it has a placeholder which HP guarantees will not be overwritten by future releases of HP or third-party software; there is no such placeholder, and hence no such guarantee, at the other run levels.

2. Write a script to start and stop the subsystem, and an accompanying configuration script to tell the boot process whether or not this script should be run.

   Use the template `/sbin/init.d/template`; see the example below.

3. Create symbolic links that will cause your script to be run at the right place in the boot and shutdown sequences.

   See the example below.

4. Reboot the system to make sure everything works.

   On a busy system, this may be inconvenient, but beware of testing on a configuration other than the one on which your subsystem will actually run; any

differences in start-up/shutdown configuration between the test system and the production system may invalidate the test.

Example:

This example shows one way to automate the start-up of a server daemon, called `web_productname_daemon`:

1. Decide on run level:
   a. See what's started at run level 2:

      ```
      ls /sbin/rc2.d/S*
      /sbin/rc2.d/S008net.sd
      /sbin/rc2.d/S560SnmpMaster
      /sbin/rc2.d/S100swagentd
      /sbin/rc2.d/S565SnmpHpunix...
      ```

   b. See what's started at run level 3:

      ```
      ls /sbin/rc3.d/S*
      /sbin/rc3.d/S100nfs.server
      ```

      `/sbin/rc3.d/S100nfs.server` is a link to `/sbin/init.d/nfs.server`, which starts up `portmap`, `rpc.mountd`, `nfsd` and related functions. Since none of these are needed by the `web_productname` daemon, it is safe to start it in run level 2, using the placeholder number 900 (see below).

      Similarly, we stop the script in run level 1, using the placeholder number 100.

2. Write the start-up/shutdown and configuration scripts.

   You can use `/sbin/init.d/template` as a basis, and create the following start-up/shutdown script, saving it as `/sbin/init.d/web_productname`:

```
#!/sbin/sh

PATH=/usr/sbin:/usr/bin:/sbin
export PATH
web_productname_daemon="web_productname"

rval=0

killproc()
{
 pid=`ps -e | awk '$NF~/'"$1"'/ {print $1}'`
 if [ "X$pid" != "X" ]
 then
    if kill "$pid"
    then
       echo "$1 stopped"
    else
       rval=1
       echo "Unable to stop $1"
    fi
 fi
}


case $1 in
```

```
'start_msg')
        # message that appears in the startup checklist
        echo "Starting the web_productname daemon"
        ;;

'stop_msg')
        # message that appears in the shutdown checklist
        echo "Stopping the web_productname daemon"
        ;;
'start')
        # source the configuration file
        if [ -f /etc/rc.config.d/web_productname]
        then
           . /etc/rc.config.d/web_productname
        else
           echo "ERROR: /etc/rc.config.d/web_productname           MISSING"
        fi

        # Check to see if the web_productname daemon exists,
       # is executable and should be started
        if [ "$WEB_PRODUCTNAME" -eq 1 -a -x
           "$WEB_PRODUCTNAMEHOME/$web_productname_daemon" ]
        then
           cd $WEB_PRODUCTNAMEHOME
           ./$web_productname_daemon
           print "$web_productname_daemon started"
        else
           print "failed to start $web_productname_daemon"
           rval=2
        fi
        ;;

'stop')
        killproc $web_productname_daemon
        ;;

*)
        echo "usage: $0 {start|stop|start_msg|stop_msg}"
        rval=1
        ;;
esac

exit $rval
```

Then create a configuration file, `/etc/rc.config.d/web_productname`, to tell the above script where to find the `web_productname`daemon and whether or not to start it up (1=yes; 0=no):

```
#!/sbin/sh#
# v1.0  web_productname startup/kill config
# WEB_PRODUCTNAME:       Set to 1 to start
#                      web_productname_daemon
# WEB_PRODUCTNAMEHOME: home dir for web_productname
WEB_PRODUCTNAME=1
WEB_PRODUCTNAMEHOME=/sample/web_productname/binhp
```

NOTE: Setting the start-up variable (`WEB_PRODUCTNAME` in this case) to 0, rather than deleting the script, is the way to remove a subsystem from the start-up sequence. This is particularly important in the case of HP and third-party scripts; do not edit them, delete them or move them; simply change the variable in the appropriate script under `/etc/rc.config.d/` to 0 if you don't want the corresponding start-up script to run.

3. Create symbolic links that cause the script to be run at the right place in the boot and shutdown sequences.

   Since HP guarantees that scripts using the number 900 in run level 2 will not be overwritten when we upgrade the system or add HP or third-party software, and run level 2 is a good place to start the `web_productname`daemon, we assigned our script number 900 and linked it into the `/sbin/rc2.d`directory:

   ```
   ln -s /sbin/init.d/web_productname /sbin/rc2.d/S900web_productname
   ```

   The S indicates "start" and the 900 determines starting order within the run level, so our script starts late (currently last) in run level 2.

   Similarly, HP guarantees scripts using the number 100 in run level 1 will not be overwritten, so we also assigned our script the number 100 and linked it into the `/sbin/rc1.d` directory, this time with a K (for "kill") code letter:

   ```
   ln -s /sbin/init.d/web_productname /sbin/rc1.d/K100web_productname
   ```

   This means that the `web_productname` daemon is stopped after most other functions in run level 1 as the system shuts down.

4. Test the script itself, and test that it works correctly in the start-up and shutdown processes.

   Run `/sbin/init.d/web_productname` several times "by hand" to debug it, then install it (as described in step 3 above) on a test system which you rebooted to test that the daemon was started and stopped correctly, then finally install it on the production system and reboot that system.

Shutting Down Systems

- "Types of Shutdown" (page 83)
  - "Normal (Planned) Shutdown" (page 83)
  - "Power Failure" (page 86)
  - "Unclean Shutdowns" (page 87)
  - "System Crashes / HP-UX Panics" (page 88)
- "Special Considerations for Shutting Down Certain Systems" (page 88)
  - "Mail Server" (page 88)
  - "Name Server" (page 89)

— “Network Gateway” (page 89)
— “NFS File Server” (page 89)
— “NFS Client” (page 90)
- “Avoiding a Shutdown When Possible” (page 90)

For additional information on shutting down systems, see *HP-UX System Administrator's Guide: Overview*.

Types of Shutdown

There are various types of shutdown, both planned, and unplanned. This section covers several common situations:

- A “Normal (Planned) Shutdown” (page 83)
- “Power Failure” (page 86)
- “System Crashes / HP-UX Panics” (page 88)
- “Unclean Shutdowns” (page 87)

Normal (Planned) Shutdown

Hopefully, most of your system shutdowns will be of this type. With a normal shutdown, you have time to prepare the system and its users so that the system can be restarted and work can continue with no loss of data, and as little disruption as possible.

As mentioned in the overview to this section, it is important not to simply turn off your computer (as you might be able to do with a personal computer).

To maximize system performance, recently used data from disk files is kept and updated in memory. Periodically (by default, every 30 seconds), a program called `sync` is run to make sure the file systems on disk are kept up to date in the event of an unplanned shutdown (the on-disk file systems are **synchronized** with the memory-based changes). But, if it's been 29 seconds since the last run of `sync`, there are probably memory based changes that are not yet reflected on disk. If the system crashes now, this can cause inconsistencies in file system structures on disk (which, although not usually the case, can cause corrupt files or loss of data).

Also, users of both your system and other systems in the network that depend on your system for some resource will be affected. It is always best to notify them in advance of any planned shutdown so that they can plan for the shutdown and minimize the impact to their work.

The basic procedure for a planned shutdown of your system is:

1. Notify anyone who is likely to be affected by the shutdown of your system. You can do this by:
   - e-mail
   - the `wall` command (see *wall*(1M)) — notifies only users of your system, not users of other systems that are likely to be affected by a shutdown of your system
   - calling them on the phone, or speaking to them in person

   However you do it, the critical thing is to notify them as far in advance as possible of your planned shutdown. If you notify them far in advance of the planned shutdown, it is also a good idea to give them a reminder as the time for the shutdown approaches.

2. Once everyone has been notified and had a chance to prepare for the shutdown, execute the `shutdown` command to initiate an ordered shutdown of your system.

   There are basically three types of system shutdown:

   1. Shutdown with immediate reboot (use`shutdown`'s `-r` option)
   2. Shutdown with system halt (use `shutdown`'s `-h` option)
   3. Put system in single-user mode for system maintenance (use neither the `-r` nor the `-h` option)

   Common Variations of the shutdown Command Here are some examples of `shutdown` commands to show you each type of system shutdown. `shutdown` is by default an interactive program. Other than telling `shutdown` whether or not you want to halt or reboot the system, information omitted from the command line will be prompted for. If you do not tell shutdown that you want to halt or reboot the computer, it will assume that you want to bring the system to single-user mode.

Example 2-26 Shutdown and Reboot

To immediately shut down the system and reboot it:

```
/sbin/shutdown -r 0
```

Example 2-27 Shutdown and Reboot with Wait

To shut down the system and immediately reboot it after first giving the users of the system three minutes (180 seconds) to clean up their work-in-progress and log out:

```
/sbin/shutdown -r 180
```

Example 2-28 Shutdown and Halt

To immediately shut down the system and halt it so that it can safely be powered off:

```
/sbin/shutdown -h 0
```

Example 2-29 Shutdown to Single-User Mode

To shut the system down to single-user mode, use neither the **`-h`** or the **`-r`** options to the shutdown command. A grace period is allowed: in this example seven minutes (420 seconds):

```
/sbin/shutdown 420
```

NOTE: *You must have permission to shut down an HP-UX system*! Obviously, this command can have serious consequences and is therefore to be used with caution. It is not a command that everyone should be able to use.

Permission to shut down the system is normally reserved for superusers only. However, there is a mechanism that you can use to assign permission to other users so that they can shut down the system should the need arise when a superuser is not around. The `/etc/shutdown.allow` file enables superusers to specify who has permission to shut down the system in their absence. For details, see the *shutdown*(1M) manpage.

When run, `shutdown` ensures an orderly shutdown of the system by doing the following:

- Resets the `PATH` environment variable to the value:

  `/usr/bin:/usr/sbin:/sbin`

- Resets the `IFS` environment variable to the value:

  `space tab newline`

- Verifies that the user attempting to shut down the system has permission to do so (checks the `/etc/shutdown.allow` file).
- Changes the **current working directory** to the root directory (`/`).
- Runs the `sync` command to be sure that file system changes still in memory are updated in the superblocks and file system structures on disk. *This is one of shutdown's most important functions!*
- Sets the real user ID to that of the superuser (see *setuid*(2) for information on user IDs).
- Sends a broadcast message to all users currently logged in to the system telling them that the system is about to be shut down. There is a default broadcast message, but you can specify your own if you prefer.
- `/sbin/rc` is executed to shut down subsystems, unmount file systems, and perform other tasks to bring the system to run level 0, where it is safe to power off your system if you do not plan to immediately reboot it.
- Finally, if you are not shutting down your system down to single-user mode (see Example 2-29 (page 85)), the program `/sbin/reboot` is executed to halt your system or reboot it if the `-h` or `-r` option (respectively) was specified.

Power Failure

Not every shutdown can be planned for. An unexpected power failure is an example of an unplanned shutdown.

Many HP-UX systems can be equipped with uninterruptible power supplies (UPSs) to allow you to maintain power to your systems for a short while following the failure of your computer's primary power source. If the power failure is brief, systems equipped with UPSs will not be affected by the power failure at all. If the power failure appears as though it will last for a long time, you can use the buffer period provided by an uninterruptible power supply to perform a normal shutdown. See "Normal (Planned) Shutdown" (page 83).

Computers equipped with HP PowerTrust uninterruptible power supplies can also be monitored by a special daemon called `upsmond`, which, when running, always resides in memory (is not swapable). `upsmond` communicates with the power supplies, and when power has been off for longer than a pre-configured time period, `upsmond` will perform a clean shutdown of your system automatically.

Not all HP-UX systems are equipped with uninterruptible power supplies. If yours is not, an unclean shutdown is the likely result of a power failure. No memory dump will be performed, and it is possible that buffers of recent disk changes still reside in memory, and have not been written to disk by the `sync` program. See "Unclean Shutdowns" (page 87) for details.

When a power failure occurs, it is good practice to turn off the power switches to your computer and its peripherals. This will reduce the chances of a power surge harming your equipment when the power comes back on. After the power is restored, follow normal boot procedures. See "A Standard Boot " (page 37).

Unclean Shutdowns

When a system is properly shut down, all memory-based file system changes are written to disk and the file systems on disk are marked as being clean. However, if an improper shutdown (for example, a power failure) occurs, the memory-based information might not be written to disk and therefore certain file systems will not have their "clean" flag set (because, in fact, they might have structural problems as a result of the memory-based information not being written to disk).

When this happens, a special activity occurs during the boot process. The `file system consistency checker` (`fsck`), when checking for clean flags on all file systems represented in the file `/etc/fstab`, will detect that file systems exist that do not have clean flags set. For these file systems, `fsck` will perform a check/repair operation to locate and fix any problems that resulted from the improper shutdown. In nearly all cases, `fsck` can find and fix all of the structural problems and the file system can then be marked clean.

On rare occasions, the file system corruption is beyond what `fsck` can automatically correct. In these cases `fsck` will terminate with an error message indicating that you need to use it in an interactive mode to fix the more serious problems. In these cases data loss is likely. Before using `fsck` in interactive mode, try to back up any critical files by moving them to another file system or backing them up to tape, if a backup copy of them does not already exist.

For a more detailed discussion of using `fsck` to repair file systems, see the following manpages:

- *fsck*(1M)
- *fsck_cachefs*(1M)
- *fsck_hfs*(1M)
- *fsck_vxfs*(1M)

System Crashes / HP-UX Panics

Although rare, sometimes systems can shut themselves down unexpectedly in an event known as a system crash or system panic. For a detailed description of what to do if this happens, and an explanation of what takes place following a system crash, see "Configuring Dump Devices" (page 90).

Single-User Mode

A special operating mode, called **single-user mode**, is available on HP-UX systems. While your system is in single-user mode only the console is active, and a lot of the subsystems for HP-UX are not running. This mode is usually used for system maintenance. There are two ways to put your system into single-user mode:

1. Boot the system into single-user mode (for information on booting Itanium Server systems into single-user mode see "Booting into Single-User Mode" (page 53), or for information about booting PA-RISC servers into single-user mode see"Booting into Single-User Mode" (page 67)).
2. Shut the system down into single-user mode from a higher running mode (see "Normal (Planned) Shutdown" (page 83)).

Special Considerations for Shutting Down Certain Systems

People who are not direct users of your system can still be affected by its absence from the network (when it has been shut down). If your system is serving one or more of the following functions, you need to at least consider the impact to users of other systems when you plan to take your system down; and, if possible, you should try to let them know in advance that they will be affected, so that they can prepare for the event.

Mail Server

If your system is a mail server, it receives e-mail on behalf of its users, and is often the computer handling the outgoing e-mail for them too. When your system is down, incoming mail is usually held by other computers in the network for delivery when your system is back on line. If your computer will be down for an extended period of time, it is possible that others sending e-mail to your computer's users will have their e-mail returned as being undeliverable.

And, of course, users receiving e-mail through your system will not be able to do so while your system is down.

Name Server

If your computer is a network **name server** (for example, a DNS name server), it is responsible for translating computer alias names into IP addresses for its own users and those who have configured their systems to use your computer as their name server. Usually systems are configured to use multiple sources for **name switch** information so if your system is down, they can use an alternate name server, a local **hosts file**, or directly use IP addresses to access remote machines until your system is back on line.

You can configure which systems (or other sources) a computer will use to map computer names to IP addresses by editing the file `/etc/resolv.conf`.

Network Gateway

If your computer is serving as a **network gateway** computer: that is, it has several network interface cards in it, and is a member of multiple networks (subnets), your computer's absence on the network can have a *huge* impact on network operations. An example of this is the computer called `flserver` in the Sample Network. While such a computer is down, computers on one of the subnets are unable to communicate with computers on other subnets, unless other gateway computers exist that can handle the traffic.

Plan very carefully for such shutdowns and make sure users of the network are notified as far in advance as possible that they will be unable to communicate with computers on the other subnets.

TIP: If you have multiple subnets in your network, try whenever possible to build redundancy into the network so that you can freely take a computer off line without prohibiting network traffic flow.

NFS File Server

If your computer is an NFS file server, other computers in the network may have mounted one or more of your computer's file systems to be a part of their own directory trees. When your system goes down, attempts to access the files or directories of your system by users on the other systems will result in those accesses hanging if the file systems have been hard mounted, or returning an error if they have been soft mounted. After your system reboots the client systems may operate normally or return a stale file handle error. If a stale file handle error occurs, you can unmount then remount the file system, the other systems will likely require a reboot once your system is back on line before those systems will again be able to access your computer's file systems.

The best course of action is to alert the administrators of systems who have NFS-mounted file systems from your computer to *unmount the NFS-mounted file systems before you shut down your system!* By doing this, they will simply need to re-mount the NFS file systems from your computer when your computer is back on line. No reboot of the other systems will be required.

See the `mount_nfs(1m)` manpage for information on mount options like “hard” and “soft”.

NOTE: This can have a cascading effect. For example, if `computer A` has NFS-mounted a file system from `computer B`, and `computer B` needs to be rebooted because it had NFS-mounted a different file system from `computer C`, which was shut down without notice. It is important for the administrator of `computer B` to warn the administrator of `computer A` to unmount any NFS-mounted file systems from `computer B`, or `computer A` will *also* need to be rebooted as an indirect consequence of `computer C` being shut down.

NFS Client

Provided that NFS clients are not also acting as NFS servers for other computers (`computer B` in the preceding note is acting as both NFS client and server), it is safe to shut them down without affecting the NFS server. It will simply be necessary to remount the file system from the NFS server when the NFS client has rebooted. This is probably done automatically during the boot-up process.

Avoiding a Shutdown When Possible

As described earlier, there are times when a normal, planned shutdown is appropriate. But as server downtime becomes less desired and accepted, on-line addition and replace functionality can help you to avoid shutting down a server in many cases.

On-line Addition and Replacement of PCI Cards (OLA/R)

HP-UX’s On-line Addition and Replacement of PCI Cards (OLA/R) features enable you to replace a faulty interface card or add a new interface card to a running system, without impacting the system’s users.

See the *Configuring HP-UX for Peripherals* manual for detailed OLA/R concepts and procedures.

Configuring Dump Devices

HP-UX system crashes (system panics) are rare, but when they do occur you want to be prepared to capture the contents of memory so that if necessary you can analyze (or have an expert analyze) the memory content to try to determine what caused the crash.

For a discussion on what happens when the HP-UX system crashes, and the elements of the crash dump cycle, read the section called “Abnormal Shutdowns” in the *HP-UX System Administrator’s Guide: Overview* volume.

Beginning with HP-UX 11i version 3, the preferred way to configure the dump behavior and dump devices on your system is to use the `crashconf` command. For details on using `crashconf`, see the *crashconf*(1M) manpage.

For additional information about configuring your system for crash dumps, see the following manpages:

- *ioscan*(1M)
- *fstab*(4)
- *alwaysdump*(5)
- *dontdump*(5)
- *dump_compress_on*(5)
- *dump_concurrent_on*(5)

3 Managing Systems

This chapter describes routine tasks when managing a single-user or multiuser system. The following main tasks are described:

- "Managing Disks - Quick Reference Examples" (page 93)
- "Managing Large Files" (page 114)
- "Managing FTP" (page 117)
- "Backing Up Data" (page 120)
- "Restoring Your Data" (page 137)
- "Backing Up and Recovering Directories: Quick Reference for tar" (page 140)
- "How To:" (page 141)
  - "Determining What Version of the HP-UX Operating System is Running" (page 141)
  - "Checking the System's Run Level" (page 141)
  - "Scheduling a cron Job" (page 142)
  - "Adding Users to a Workgroup" (page 142)
  - "Managing Groups of Distributed Systems or Serviceguard Clusters" (page 152)
  - "Exporting a File System (HP-UX to HP-UX)" (page 147)
  - "Moving Resources" (page 148)
  - "Popping the Directory Stack" (page 149)
  - "Continuing to Work During a Scheduled Downtime" (page 149)
  - "Diagramming a System's Disk Usage" (page 150)
  - "Finding Large Files" (page 151)
  - "Examining File System Characteristics" (page 151)
- "Adding Peripherals " (page 152)

Managing Disks - Quick Reference Examples

NOTE: All of the procedures that follow require you to be the root user on the system you are modifying.

- "Adding a Disk to a Volume Group" (page 94)
- "Adding a Logical Volume" (page 95)
- "Adding a Logical Volume with Mirroring" (page 96)
- "Extending a Logical Volume" (page 97)
- "Extending a Logical Volume When You Can't Use HP SMH" (page 98)
- "Reducing a Logical Volume" (page 101)
- "Removing a Logical Volume" (page 106)

- "Adding a Mirror for an Existing Logical Volume Using Non-strict Mirroring" (page 107)
- "Removing a Mirror from a Logical Volume" (page 109)
- "Moving a Directory to a Logical Volume on Another System" (page 111)

Adding a Disk to a Volume Group

For detailed information and instructions about adding a disk, see *HP-UX System Administrator's Guide: Logical Volume Management*. What follows is a quick reference; we'll be using HP SMH.

1. Shut down and power off the system.

   See "Shutting Down Systems" (page 82).

2. Connect the disk to the system and the power supply.
3. Power up the disk.
4. Boot the system.

   See "Booting Systems" (page 35).

5. Access the HP SMH Homepage:

   `http://`*`system`*`:2301`

6. Select **Tools**, **Disks and File Systems**, **Disks**. The new disk to be added should be present in the list of devices and display "unused" in the Use column. The disk can be added to an existing volume group or added to a new volume group.

   To add an unused disk to a new volume group, click on the **Volume Groups** tab. This will display existing volume groups. Click on the **Create VG...** action on the right side of the page. Enter a name for the new volume group. Click on **Select Unused Disk(s)...** This will display a list of unused disks available for assignment. Select the desired disks. Click on **Select**. Configure any desired options. Click on **Create**.

   To add the disk to an existing volume group, the disk must be labeled as "unused". Click on the **Volume Groups** tab. This will display the existing volume groups. Select the target volume group from the displayed list. Click on the **Extend VG...** action on the right side of the page. Click on **Select Unused Disk(s)**, select the desired disk and click on **Select**. Configure the desired options and click on **Extend**.

   You can use HP SMH to configure the disk as LVM disks, with or without disk mirroring if you so decide (see *HP-UX System Administrator's Guide: Logical Volume Management*).

   If the driver for this disk is not already configured into the kernel, you can use HP SMH to configure it. In this case, a reboot might be required before you can use the disk.

   To export the volume group to other systems in the workgroup, click on the **Volume Groups** tab and select **Export VG...** from the list of actions on the right side of the page. Select the desired option and click on **Export**.

   See *HP-UX System Administrator's Guide: Logical Volume Management*) for more information.

Adding a Logical Volume

For a detailed discussion of LVM (Logical Volume Manager) see *HP-UX System Administrator's Guide: Logical Volume Management*. The following is a quick reference using HP SMH.

NOTE: To configure a logical volume with disk striping, you must have more than one physical volume in the volume group. The option to stripe logical volumes is hidden in SMH if this is not true (see "Setting Up Disk Striping" in the *HP-UX System Administrator's Guide: Logical Volume Management*).

1. Decide how much disk space the logical volume will need.

   For example, you might want to add 200MB of swap, or you might be adding a new project that you expect to grow to 500MB.

2. Access the HP SMH Homepage

3. Find a volume group that has as much free space as you need.

   Select **Tools**, **Disks and File Systems**, **File Systems**. Click on the **Volume Groups** tab. This will display a list of volume groups and the free space for each.

   You might see, for example, that volume group `vg01` has 600MB of free (unallocated) space.

4. Identify a volume group with sufficient free space for your new Logical Volume.
5. Click on the **Logical Volumes** tab. Select **Create LV...** from the list of actions on the right side of the page.
6. Select the volume group you have identified to provide the space for the Logical Volume. Enter a name, size and other configuration information for the new Logical Volume. Click on **Create**.
7. For example, you might create a logical volume named `lvol7`, occupying 500MB.

To share the new file system(s) with other systems in the workgroup, go to **Tools Network Services Configuration Network File Systems** page in the HP System Management Homepage, select the **Share/Unshare File Systems (Export FS)** item and use the following page to define which local file systems are shared to which external systems. See *HP-UX System Administrator's Guide: Logical Volume Management*.

As a result of all this, HP SMH creates a new logical volume and mounts it on a new file system, for example, `/dev/vg01/lvol7` mounted on `/work/project5`.

Creating a File System

You can create a new file system from a Logical Volume using HP SMH.

1. Access the HP SMH Homepage.
2. Select **Tools**, **Disks and File Systems**, **File Systems**. Click on the desired **Add File System** actions on the right side of the page, **Add HFS...** for example.
3. Enter a Mount Point and click **Select Unused LV...** A list of available Logical Volumes will be displayed.
4. Select the desired Logical Volume. Click **Select**. You will be returned to the **Add File System** page.
5. Select the desired File System attributes and Mount Options. Click the **Add *`file_system_type`*** button at the bottom of the page.

Adding a Logical Volume with Mirroring

For detailed discussion of mirroring see *HP-UX System Administrator's Guide: Logical Volume Management*. The following example uses HP SMH.

1. Decide how many mirror copies you want.

   For the purposes of this example, we'll assume you want one mirror; that is, you'll be keeping two copies of the data online, the original and a mirror copy.

2. Decide how much disk space the logical volume will need.

   For example, you might be adding a new project that you expect to grow to 500MB. In this case you need a volume with at least 1000MB of free space, 500MB for the original and 500MB for the mirror copy.

3. Access the HP SMH Homepage.
4. Select **Tools**, **Disks and File Systems**, **Volume Group**. Select a volume group that has as much free space as you need.

   If you will be using **strict mirroring** (which HP recommends) the volume group needs to contain a logical volume that has at least 500MB on each of two disks; strict mirroring ensures that the mirror copy is on a separate disk from the original data.

   Look in the `Free` column; the numbers listed here represent the disk space in each volume group that is not currently allocated to any logical volume.

   You might see, for example, that volume group `vg01` has 1800 MB of unallocated space out of a total of about 2500 MB, and you might also see in the Detailed view at the bottom of the page that`vg01` is spread across two disks. In this case it's likely that each disk has 500 MB free.

5. Click on the **Logical Volumes** tab at the top of the page. Select the Logical Volume to be mirrored and click on the **Add Mirror(s)...** action on the right side of the page. The **Add Mirror(s)** page is displayed.
6. Enter the number of mirrored data images desired (in this example one), and desired options. You can place the mirrored Logical Volume on a different physical drive by clicking on **Select PV(s)...** This will display available drives. Click **Add**.
7. If there is only one physical volume available you may need to change the *Allocation Policy* setting for the Logical Volume to *Non-Strict*. The setting can be changed by selecting the Logical Volume to be mirrored from the list on the Logical Volumes page and clicking on the **Modify LV...**action on the right side of the page.

   HP SMH will create a logical volume that occupies 500 megabytes on each Logical Volume (the original data and a mirror copy). The Mirrors column of the Logical Volumes page should now show "1" for the selected Logical Volume.

Extending a Logical Volume

For detailed discussion of LVM (Logical Volume Manager) see *HP-UX System Administrator's Guide: Logical Volume Management*. The following example uses HP SMH.

1. Decide how much more disk space the logical volume will need.

   For example, you might want to add 200 MB of swap, or an existing project might need an additional 1000 MB.

2. Make sure no one has files open in any file system mounted to this logical volume and that it is no one's current working directory, for example:

   ```
   fuser -cu /work/project5
   ```

NOTE: If the file system is shared with other systems (exported), use the `fuser` command to check on the systems it is shared with to verify that no one is using it. Then unmount it on those systems before unmounting it on the server.

3. Unmount the file system; for example:

   ```
   umount /work/project5
   ```

4. Access the HP SMH Homepage.
5. Select **Tools**, **Disks and File Systems**, **Logical Volumes**. The Logical Volumes page will be displayed.
6. Select the logical volume you want to extend and click on the **Extend LV...** action on the right side of the page. The Extend LV page will be displayed.
7. Check to make sure that the *Available Space in VG* is sufficient for the desired increase. Enter the new total space in the *New Size* field. Click on **Extend**. When the process is completed click on **Back** to return to the Logical Volumes page. Note that the size of the selected Logical Volume has been increased.
8. Remount the file system; for example:

   ```
   mount /dev/vg01/lvol5 /work/project5
   ```

9. If `/work/project5` will continue to be used by NFS clients, share it again on the server:

   (`shareall -F nfs /work/project5`)

   and remount it on the clients:

   ```
   mount -F nfs serversys: /work/project5 /work/localproject5
   ```

Extending a Logical Volume When You Can't Use HP SMH

Before you can extend a logical volume, you must unmount the file system mounted to it. In the case of system directories, such as `/var` and `/usr`, you will need to be in single-user mode to do this.

NOTE: Extending the logical volume that contains the **root directory** (/) is a special case. This also applies to `/stand` if you have separate root and boot file systems. You will not be able to extend the root file system using the procedure described below because the current root file system cannot ever be unmounted as required by `extendfs` and it must also be contiguous. Thus, you will not be able to extend it, even if you shut down to single-user mode. Although `/stand` can be unmounted in single-user mode, changing `/stand` without knowing exactly what to do may render your system unbootable.

To extend the current root file system, do *one of* the following:

- Create a recovery archive using Ignite-UX and recover the system interactively, changing the size of the root and/or boot file system during the recovery.
- Have created and mounted another root disk (a replacement for your current root disk having the sizes for root and boot file systems that you require).

If you are using the Veritas File System (VxFS) as your root file system and have the VxFS (OnLineJFS) product, you can extend the original root file system without unmounting provided there is sufficient *contiguous* disk space available.

See *HP-UX System Administrator's Guide: Logical Volume Management* for additional information.

In the example that follows, we extend `/usr`, which means you cannot use HP SMH, because it resides in `/usr/sbin`.

If you are trying to update the system to a new HP-UX release, and have seen the following error message in `swinstall`:

```
ERROR:    The used disk space on filesystem "/usr" is estimated to
          increase by 57977 Kbytes.
          This operation will exceed the minimum free space
          for this volume.  You should free up at least 10854
          Kbytes to avoid installing beyond this threshold of
          available user disk space.
```

In this example, you need to extend the `/usr` volume by 10 MB, which actually needs to be rounded up to 12 MB.

1. Log in as `root`
2. Find out if any space is available:

   `/sbin/vgdisplay`

   You'll see output something like this:

   ```
   - Volume groups -
   VG Name                     /dev/vg00
   VG Write Access             read/write
   VG Status                   available
   Max LV                      255
   Cur LV                      8
   ```

```
Open LV           8
Max PV            16
Cur PV            1
Act PV            1
Max PE per PV     2000
VGDA              2
PE Size (Mbytes)  4
Total PE          249
Alloc PE          170
Free PE           79
Total PVG          0
```

The `Free PE` entry indicates the number of 4 MB extents available, in this case, 79 (316 MB)

3. Change to single-user state:

   /sbin/shutdown

   This will allow `/usr` to be unmounted (see below).

4. Check to see where `/usr` is mounted (`/dev/vg00/lvol7` by default):

   /sbin/mount

   You'll see output such as:

   ```
   / on /dev/vg00/lvol1 defaults on Sat Jun 30 23:19:19 2007
   /usr on /dev/vg00/lvol7 defaults on Wed Jun 27 23:19:28 2007
   ```

5. Extend the logical volume:

   /sbin/lvextend -L *new_size* /dev/vg00/lvol7

   For example,

   /sbin/lvextend -L 332 /dev/vg00/lvol7

   increases the size of this volume to 332 MB.

6. Unmount `/usr`:

   /sbin/umount /usr

   This is required for the next step, since `extendfs` can only work on unmounted volumes.

7. Extend the file system size to the logical volume size; for example:

   /sbin/extendfs /dev/vg00/rlvol7

8. Remount `/usr`:

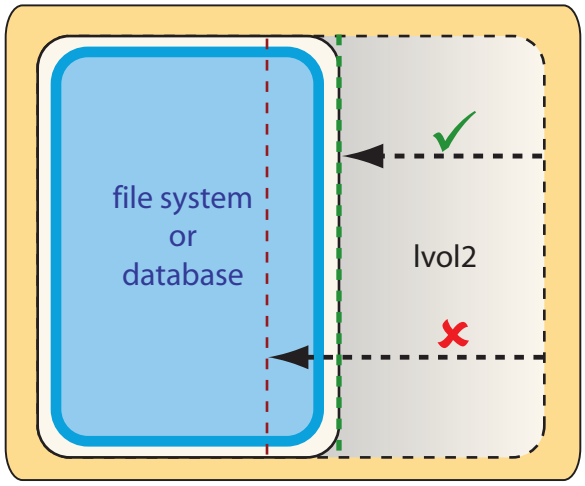
   /sbin/mount /usr

9. Reboot the system:

   /sbin/reboot -r

Reducing a Logical Volume

Here are several examples showing how to reduce the size of logical volumes containing mounted file systems. The specific procedure to do this varies depending on the type of file system you are working with.



CAUTION: Before reducing the size of a logical volume that contains a file system, database, or other important data, *back up the data!* Even if a file system currently occupies less space than the new (reduced) size of the logical volume, there is a chance you could lose data due to truncation when you reduce the size of the logical volume that contains them.

Reduce the size of the contents (the file system or database) *before* reducing the size of the container (the logical volume) to avoid truncating data or critical file system structures.

NOTE: Though the examples presented here are based on manual commands, the HP System Management Homepage can do many of the steps in this procedure for you.

Example: Reducing the size of a logical volume containing a VxFS file system

Procedure summary:

- Make sure no one is actively using the file system during the procedure
- Backup the data (for safety)
- Use `fsadm` to reduce the size of the file system so that when you reduce the size of the surrounding logical volume, none of the file system structures or data are truncated

- Use `lvreduce` to reduce the size of the surrounding logical volume
- Verify and (only if necessary) restore any lost data to the newly resized logical volume

To reduce the size of the logical volume `/dev/vg01/lvol2` containing a VxFS file system currently mounted to the directory `/work/project5` where the new (smaller) size of the logical volume is to be 500MB:

1. **Make sure no one has files open in any file system on the logical volume and that no one's current working directory is contained within the file system:**

   ```
   fuser -cu /work/project5
   ```

NOTE: If the file system is shared with other systems, check on those other systems that no one is using it (`fuser` works on NFS-mounted file systems as well as local ones). Then unmount it from the remote client systems before unmounting it from the server.

2. **Back up the data in the file system:**

   Using a utility like `tar` or `pax`, backup the data contained in the logical volume you are about to reduce. If your logical volume contains a database, use a backup method appropriate for that database. In this example, to back up `/work/project5` to a tape device:

   ```
   cd /work/project5
   pax -w -f /dev/rtape/tape4QIC150 .
   ```

   Or, copy the contents of the file system to a temporary location not within the logical volume you are attempting to reduce:

   ```
   pax -rw /work/project5 /somewhere_else/project5
   ```

   You can use a different backup utility or application but, however you do it, *protect your data* in case they are damaged by the logical volume reduction!

3. **Before shrinking the size of the logical volume (the container), ensure that the file system (the contents) will fit in the new smaller size.**
   In this example:
   - The container is the logical volume `/dev/vg01/lvol2`
   - The content is the file system currently mounted to `/work/project5`

   Use the `fsadm` command with the `-b` option to reduce the size of a VxFS file system so that it will fit inside the smaller logical volume. As `fsadm` reduces the size of the file system, it moves any data that reside in disk space being released so that all file system data reside in the disk space that will remain part of the file system after the reduction. This also ensures that you can safely reduce the size of the surrounding logical volume without truncating important file system structures.

Though you should have made a backup of your data in the previous step for safety, `fsadm` usually eliminates the need to use that backup to restore lost data.[2]

In this example:

```
fsadm -b 512000 /work/project5
```

NOTE: For VxFS file systems, the `fsadm` command uses `DEV_BSIZE`-byte sectors as the units for the `-b` option. In this example (and probably on your system)[3], `DEV_BSIZE=1024`. Therefore, `-b 512000` represents 500MB in the above command.

4. Determine the new size for the logical volume, based on the new (smaller) size of the file system.

   If the logical volume contains a file system (as in this example), the new size of the logical volume should be at least as large as the file system that it will contain. To determine the current size of a file system, use the `bdf` command. `bdf` will show you the size of all mounted volumes (in kilobytes). The `kbytes` column of `bdf`'s output shows the space currently allocated to each file system.

   ```
   #bdf
   Filesystem          kbytes    used   avail %used Mounted on
   /dev/vg00/lvol3    1048576  310784  732088   30% /
   /dev/vg00/lvol1    1835008  150288 1671656    8% /stand
   /dev/vg00/lvol8    4587520  603288 3956664   13% /var
   /dev/vg00/lvol7    4423680 2976080 1436312   67% /usr
   /dev/vg00/lvol4     524288   72672  448096   14% /tmp
   /dev/vg00/lvol6    7274496 4211304 3039272   58% /opt
   /dev/vg00/lvol5     114688    5792  108056    5% /home
   /dev/vg01/lvol2     512499   49142  412107   11% /work/project5
   #
   ```

5. Unmount the file system. `lvreduce` will not reduce the size of a logical volume containing a mounted file system.

   ```
   umount /work/project5
   ```

6. Reduce the size of the logical volume:

   ```
   lvreduce -L 500 /dev/vg01/lvol2
   ```

   This reduces the logical volume`/dev/vg01/lvol2` to 500MB.

7. Mount the file system:

   ```
   mount /dev/vg01/lvol2 /work/project5
   ```

   This mounts the file system back to the directory where it was previously mounted.

2. This requires Version 3 or above disk layout. In older disk layouts, file system structural components are fixed, so reducing the size of a file system fails if there are file system resources in use in the sectors being removed. See *fsadm_vxfs*(1M) for additional details.
3. `DEV_BSIZE` is defined in the file `/usr/include/sys/param.h` (`<sys/param.h>`)

NOTE: If the reason you are reducing the size of the logical volume is to use it for a different purpose, you might want to mount it to a different directory. This is fine.

8. Verify that the data (if any) contained in the newly resized and remounted file system has not been damaged. If necessary restore any damaged data (or to be safe, the entire file system) from the backup you previously made. For example:

   ```
   cd /somewhere_else
   pax -rw . /work/project5
   ```

   recovers the files from the alternate location `somewhere_else`, created using the second `pax` command in Step 2.

9. If `/work/project5` was previously, and will continue to be, used by NFS clients, re-share it from the server:

   ```
   share -F nfs /work/project5
   ```

   and remount it on the clients:

   ```
   mount -F nfs serversys:/work/project5 /work/localproject5
   ```

Example: Reducing the size of a logical volume containing an HFS file system

HFS file systems cannot be manipulated while mounted an online to the extent that VxFS file systems can. Therefore, the procedure to reduce a logical volume that contains a mounted HFS file system is a bit different than the previous example.

If the file system mounted to `/work/project5` is an HFS file system (and if the size of that file system needs to be reduced to accommodate the pending reduction of its surrounding logical volume) you need to remove the existing file system and make a new (smaller) file system in its place:

Procedure summary:

- Make sure no one is actively using the file system during the procedure
- Backup the data (for later restoration)
- Unmount the file system
- Use `lvreduce` to reduce the size of the surrounding logical volume
- Use `newfs` to make a new HFS file system on the newly resized logical volume
- Mount the new file system
- Restore the data from the backup you previously made

To reduce the size of the logical volume`/dev/vg01/lvol2` containing an HFS file system that is currently mounted to the directory `/work/project5` where the new (smaller) size of the logical volume is to be 500MB:

1. **Make sure no one has files open in any file system on the logical volume and that no one's current working directory is contained within the file system:**

   ```
   fuser -cu /work/project5
   ```

NOTE: If the file system is shared with other systems, check on those other systems that no one is using it (`fuser` works on NFS-mounted file systems as well as local ones). Then unmount it from the remote client systems before unmounting it from the server.

2. **Back up the data in the file system:**

   Using a utility like `tar` or `pax`, backup the data contained in the logical volume you are about to reduce. If your logical volume contains a database, use a backup method appropriate for that database. In this example, to back up `/work/project5` to a tape device:

   ```
   cd /work/project5
   pax -w -f /dev/rtape/tape4QIC150 .
   ```

   Or, copy the contents of the file system to a temporary location not within the logical volume you are attempting to reduce:

   ```
   pax -rw /work/project5 /somewhere_else/project5
   ```

IMPORTANT: However you do it, *backup your data*! You *will* need to restore the data from this backup later in this procedure!

3. Unlike with VxFS file systems, you cannot use the `-b` option to the `fsadm` command to reduce the size of an HFS file system. Instead, unmount the HFS file system:

   ```
   umount /work/project5
   ```

4. Reduce the size of the logical volume:

   ```
   lvreduce -L 500 /dev/vg01/lvol2
   ```

   This reduces the logical volume`/dev/vg01/lvol2` to 500MB. It also probably destroyed the integrity of the previously existing file system by truncating a portion of its data and file system structures. This is why you made the backup in Step 2.

5. Use `newfs` to make a fresh file system structure on the newly reduced logical volume:

   ```
   # newfs -F hfs /dev/vg01/rlvol2
   mkfs (hfs): Warning - 208 sector(s) in the last cylinder are not allocated.
   mkfs (hfs): /dev/vg01/rlvol2 - 524288 sectors in 1561 cylinders of 12 tracks, 28 secs
   536.9Mb in 98 cyl groups (16 c/g, 5.51Mb/g, 832 i/g)
   Super block backups (for fsck -b) at:
       16,   5424,  10832,  16240,  21648,  27056,  32464,  37872,  43280,  48688,
    54096,  59504,  64912,  70320,  75728,  81136,  86032,  91440,  96848, 102256,
   107664, 113072, 118480, 123888, 129296, 134704, 140112, 145520, 150928, 156336,
   161744, 167152, 172048, 177456, 182864, 188272, 193680, 199088, 204496, 209904,
   215312, 220720, 226128, 231536, 236944, 242352, 247760, 253168, 258064, 263472,
   268880, 274288, 279696, 285104, 290512, 295920, 301328, 306736, 312144, 317552,
   322960, 328368, 333776, 339184, 344080, 349488, 354896, 360304, 365712, 371120,
   376528, 381936, 387344, 392752, 398160, 403568, 408976, 414384, 419792, 425200,
   ```

```
430096, 435504, 440912, 446320, 451728, 457136, 462544, 467952, 473360, 478768,
484176, 489584, 494992, 500400, 505808, 511216, 516112, 521520
#
```

6. Mount the new (smaller) file system:

   `mount /dev/vg01/lvol2 /work/project5`

   This mounts the file system back to the directory where it was previously mounted.

NOTE: If the reason you are reducing the size of the logical volume is to use it for a different purpose, you might want to mount it to a different directory. This is fine.

7. If necessary restore the data from the backup you made in Step 2. For example:

   `cd /somewhere_else`
   `pax -rw . /work/project5`

   recovers the files from the alternate location `somewhere_else`, created using the second `pax` command in Step 2.

8. If `/work/project5` was previously, and will continue to be, used by NFS clients, reshare it from the server:

   `share -F nfs /work/project5`

   and remount it on the clients:

   `mount -F nfs serversys:/work/project5 /work/localproject5`

Removing a Logical Volume

In this example we'll assume you want to remove a logical volume that is either unused or contains obsolete data. The following example uses HP SMH.

CAUTION: Removing a logical volume will destroy the contents of any file system it contains.

1. Access the HP SMH Homepage.
2. Select **Tools**, **Disks and File Systems**, **Logical Volumes**. The Logical Volumes page will be displayed.
3. Select the logical volume you want to remove and click on the **Remove LV...** action on the right side of the page. The Remove Logical Volume page will be displayed.

   Click **Remove**.

You can now use this space to extend an existing logical volume, or to build a new logical volume.

Adding a Mirror for an Existing Logical Volume Using Non-strict Mirroring

For detailed discussion of mirroring see "Creating and Modifying Mirrored Logical Volumes" in the *HP-UX System Administrator's Guide: Logical Volume Management*. The following example uses HP SMH.

1. Decide how many mirror copies you want. For the purposes of this example, we'll assume you want one mirror and the size of the logical volume is 500MB. There will be two copies of the data, the original and a mirror copy.
2. Access the HP SMH Homepage.
3. Select **Tools**, **Disks and File Systems**, **Volume Groups**. A list of volume groups will be displayed.
4. Select the volume group containing the logical volume you wish to mirror. This will display a list of the logical volumes making up the volume group at the bottom of the page along with free space in the volume group.

   Look in the `Free` column of the volume group that you selected. Make sure the volume group has enough free space for the mirror. In this example, an additional 500 MB.

   If you want to use **strict mirroring** (which HP recommends because it keeps the "mirror" data on a separate disk from the original data) see the next example.
5. Click on the **Logical Volumes** tab at the top of the page. This will display the logical volumes.
6. Select the logical volume you want to mirror. This will display the logical volume actions.
7. Click on the **Add Mirror(s)...** action on the right side of the page. The **Add Mirror(s)** page is displayed.
8. Enter the number of mirrored data images desired (in this example one), and desired options. Since you are using non-strict mirroring you can let the HP SMH select the location for the mirror data. You can place the mirrored Logical Volume on a different physical drive by clicking on **Select PV(s)...** This will display available drives. Click **Add**.
9. If there is only one physical volume available, you may need to change the *Allocation Policy* setting for the logical volume to *Non-Strict*. The setting can be changed by selecting the logical volume to be mirrored from the list on the **Logical Volumes** page and clicking on the **Modify LV...**action on the right side of the page.

   HP SMH will create a logical volume that occupies 500 megabytes on each logical volume (the original data and a mirror copy). The **Mirrors** column of the **Logical Volumes** page should now show "1" for the selected logical volume.

Adding a Mirror to an Existing Logical Volume Using Strict Mirroring

For detailed discussion of mirroring and allocation policies see “Creating and Modifying Mirrored Logical Volumes” in the *HP-UX System Administrator’s Guide: Logical Volume Management*. The following example uses HP SMH.

HP recommends that you use **strict mirroring** because it keeps the “mirror” data on a separate disk from the original data. This free space must be on a disk or disks not currently used by the file system you want to mirror. If you enable the “enforce strict mirroring “ feature, a mirror copy will not be created unless this condition can be met.

Mirroring allocation policy can be set during the logical volume creation process or by modifying the allocation setting of an existing logical volume.

1. Decide how many mirror copies you want. For the purposes of this example, we’ll assume you want one mirror and the size of the volume is 500MB. There will be two copies of the data, the original and a mirror copy.
2. Access the HP SMH Homepage.
3. Select **Tools**, **Disks and File Systems**, **Logical Volumes**. A list of logical volumes will be displayed.
4. Select the logical volume you want to mirror. This will display detailed information about the selected logical volume at the bottom of the page. Make sure the **Properties** tab of the **Detailed View** display is selected. Check to see that the **Allocation State** is set to the desired strict selection.
5. Enter the number of mirrored data images desired (in this example one), and desired options. Since you are using strict mirroring you can let the HP SMH select the location for the mirror data. You can place the mirrored Logical Volume on a different physical drive by clicking on **Select PV(s)...** This will display available drives. Click **Add**.
6. If you need to change the allocation setting, click on the **Modify LV ...** action on the right side of the page, and select the desired allocation policy.
7. If the allocation setting is correct, click on the **Add Mirror(s) ...** action on the right side of the page. This will display the **Add Mirror(s)** page.
8. Enter the number of mirrors desired (in this example, one) and select whether you want HP SMH to make the physical volume allocation or you want to manually select the physical volume. If you want to select the physical volume, click on the **Select PV(s)** button to view available devices and make a manual selection. After making a selection the **Add Mirror(s)** page is again displayed.
9. Click on the **Add** button. If all of the conditions specified (additional disks, free memory, and so forth) can be met, the new mirror will be created. If not, the process will terminate with an error message.

Removing a Mirror from a Logical Volume

For detailed discussion of mirroring see *HP-UX System Administrator's Guide: Logical Volume Management*. The following is a quick reference; we'll be using HP SMH.

1. Access the HP SMH Homepage.
2. Select **Tools**, **Disks and File Systems**, **Logical Volumes**. This will display a list of the logical volumes.
3. Select the logical volume for which you want to remove one or more mirror data images and click on the **Remove Mirror(s)...** action on the right side of the page. This will display the **Remove Mirror(s)** page.
4. Enter the new desired number of mirror images. If there is only one mirror image, enter "`0`". If there are more than one mirror images and you are not deleting all of them you can either select the ones to remove or have HP SMH select the images to remove. Click **Remove**.
5. If the removal process is not successful, an error message will be displayed. If the procedure was successful click on Done to return to the **Logical Volumes** page. Check to see that the count in the **Mirrors** column has been updated for the logical volume.

Replacing a Mirrored Disk in a Logical Volume

The following method uses `pvchange` to temporarily disable links to a disk. For an alternate approach to replacing a mirror, see *HP-UX System Administrator's Guide: Logical Volume Management*.

1. Before replacing the disk, minimize any potential loss of data due to its removal; confirm that any mirrored logical volumes using the disk are mirrored onto a separate disk and that those mirror copies are current. You can find the list of logical volumes using the disk using `pvdisplay`:

   `pvdisplay -v /dev/dsk/`*`cntndn`*

   For each of those logical volumes, you can use `lvdisplay` to check which logical extents are mapped onto the disk, and if there's a current copy of that data on another disk:

   `lvdisplay -v /dev/`*`vol_group`*`/lvol`*`n`* `|` `grep /dev/dsk/`*`cntndn`*

2. Back up the volume group configuration:

   `vgcfgbackup /dev/`*`vol_group`*

3. If any of the logical volumes on the disk have a time-out assigned that isn't the default (zero), temporarily disable the time-out. For each logical volume:

   `lvchange -t 0 /dev/`*`vol_group`*`/lvol`*`n`*

4. Temporarily disable all paths to the disk:

   `pvchange -a N /dev/dsk/`*`cntndn`*

Once the command completes, proceed to the next step.

5. Physically disconnect the bad disk and connect the replacement.
6. If you are replacing a mirror of the boot disk, set up the boot area on the disk.
   a. If this is an HP Integrity Server, partition the disk using the `idisk` command, as described in *HP-UX System Administrator's Guide: Logical Volume Management*. You do not need to run `insf` or `pvcreate`, since you are replacing an existing physical volume.
   b. Use the `mkboot` command to set up the boot area:

      `mkboot /dev/rdsk/cntndn`

      On HP Integrity Servers, use the `-e` and `-l` options to the `mkboot` command to copy EFI utilities to the EFI partition:

      `mkboot -e -l /dev/rdsk/cntndn`

   c. Update the root volume group information:

      `lvlnboot -R /dev/vg00`

7. Restore LVM configuration information to the added disk:

   `vgcfgrestore -n /dev/vol_group /dev/rdsk/cntndn`

8. Reattach each link to the physical volume using `pvchange`:

   `pvchange -a y /dev/dsk/cntndn`

   or reattach all the detached links in the volume group using `vgchange`:

   `vgchange -a y /dev/vol_group`

   Once any links to the physical volume are reattached, LVM will synchronize the data on the disk with other mirror copies of the data. There is no need to manually synchronize the mirrors using `vgsync`.

9. If any of the logical volumes on the disk had a non-default time-out assigned, restore the previous time-out:

   `lvchange -t value /dev/vol_group/lvoln`

NOTE: You can use the same procedure to replace a disk that contains *unmirrored* logical volumes. However, by removing the disk, you will permanently lose any unmirrored data on that disk. Therefore, before starting this procedure, confirm that you have a backup of any unmirrored logical volume, then halt any applications using it, and unmount any file system mounted on it. After replacing the disk and activating the volume group, do not use those unmirrored logical volumes until you have recovered them from backup.

Moving a Directory to a Logical Volume on Another System

In this example we'll move a 500MB directory, `/projects`, from a system (named `wsb2600`) that is using "whole-disk" access, to a new logical volume, `/work/project6`, on a file server. We will assume that the `wsb2600` is sharing the directory with all the other systems.

The system's name is `wsb2600`; the file server is `fp_server`.

1. **Do this step on the original server, that is, the system you plan to move the directory from, `wsb2600` in this example.**

   Make sure that `/work/project6` exists and is empty on all the systems. That is, use:

   ```
   mkdir /work/project6
   ```

   Find out how much space `/projects` takes up on `wsb2600`:

   ```
   du -s /projects/
   887740        (about 430 MB)
   ```

   `du` reports the size of a directory in 512-byte blocks; dividing by 2048 gives the size in megabytes.

2. **Do this step on the new server, that is, the system you plan to move the directory to, `fp_server` in this example.**

   Find a volume group on `fp_server` with at least as much space as `/projects` currently occupies on `wsb2600`.

   The HP SMH `Volume Groups` menu shows the free space for each volume group in megabytes; the `pvdisplay` command provides the same information in terms of physical extents; multiply `Free PE` by four to get free space in megabytes.

3. **Do this step on the new server, that is, the system you plan to move the directory to, `fp_server` in this example.**

   After selecting a volume group with sufficient space, create a new logical volume in it.

   You can do this on the command line - for example,

   ```
   lvcreate -L 500 /dev/vg02
   ```

or you can use HP SMH.

Choose the `Now` and `On Boot` boxes for when to mount - choosing `On Boot` automatically creates an entry in `/etc/fstab`.

4. **Do this step on each NFS client in the workgroup.**

   Edit `/etc/fstab` (or `/etc/checklist`) to remove the NFS import of `/projects` from `wsb2600` and replace it with an NFS import from `fp_server` (you must be superuser on each system).

   Find the line in `/etc/fstab` that looks something like this:

   ```
   wsb2600:/projects /projects nfs rw,intr 0 0
   ```

   and change it to something like this:

   ```
   fp_server:/work/project6 /work/project6 nfs rw,intr 0 0
   ```

5. **Do this step on each NFS client in the workgroup.**

   Now all users must stop working in `/projects` and close all files under `/projects`.

6. **Do this step on each NFS client in the workgroup.**

   When everyone is out of `/projects`, unmount `/projects` on each system; as superuser:

   ```
   umount /projects
   ```

   If the `umount` fails on any system, run `fuser -cu` to see if anyone on that system still has files open, or is working in a directory, under `/projects`:

   ```
   fuser -cu /projects
   ```

   You can also force an unmount using `umount -f` *`path`*. This will unmount file systems even if they are in use.

NOTE: `fuser` will not be aware of files opened in other directories within an editor.

7. **Do this step on the original server, that is the system where the directory that is to be moved currently resides, in this example, `wsb2600`.**

   Back up `/projects`.

   For example, to back up `/projects` to the system default tape device:

   ```
   cd /projects
   tar cv .
   ```

NOTE: In this example, we are changing the file system's name, as well as moving it, so `tar cv /projects` is *not* the right way to back it up; specify an absolute path name only if you want `tar` to recover the data to that path name.

8. **Do this step on the new server, that is, the system you are moving the directory to,`fp_server` in this example.**

   Recover the files onto `fp_server`; for example,

   ```
   cd /work/project6
   tar xv
   ```

   This copies the entire contents of the tape in the system default tape drive to `/work/project6`.

9. **Do this step on the new server, that is, the system you are moving the directory to, `fp_server` in this example.**

   Export the directory; for example, by editing`/etc/dfs/dfstab` to include an entry for the file system. The entries are of the form:

   `share [-F` *`fstype`*`] [-o` *`options`*`] [-d "`*`text`*`"] `*`pathname`*

   For the file system in this example the entry would be:

   ```
   share -F NFS -o anon=65534 -d "work directory" /work/project6
   ```

   and running the `shareall` command to force the system to reread `/etc/dfs/dfstab`:

   ```
   shareall -F nfs
   ```

   You can also use HP SMH to perform this task; see *HP-UX System Administrator's Guide: Configuration Management*.

NOTE: If this system is not already sharing file systems, you may need to configure it as an NFS server; check that `/etc/rc.config.d/nfsconf` has `NFS_SERVER=1`, or use HP SMH to verify that `NFS SERVER` is enabled; see *HP-UX System Administrator's Guide: Configuration Management*.

10. **Do this step on each NFS client in the workgroup.**

    Mount the imported file system:

    ```
    mount -a
    ```

Once everyone has verified that their files are intact in their new location (`/work/project6` in this example), you can remove `/projects` from `wsb2600`, freeing the space for other uses.

Managing Large Files

HP-UX supports large files (greater than 2 GB), however, when working with large files be aware of these issues:

- You cannot perform interactive editing on large files. For example, if you try to run `vi` on a large file, the following error message appears:

  ```
  vi large_file
  "large_file" Value too large to be stored in data type
  ```

- You cannot mail a large file.
- You cannot print a large file.

Creating a Large-Files File System

If you want a file system to support large files (greater than 2 GB), then large files must be enabled.

HFS file systems

The default for HFS file systems is `nolargefiles`. To enable the use of large files, you must explicitly enable this feature.

You can create a large-files file system using the `mkfs` command or the `newfs` command.

VxFS file systems

The default for VxFS file systems is `largefiles`. To prevent the use of large files, you must explicitly disable them for VxFS file systems.

In case the default changes in a future release, it is a good idea to explicitly set either the `largefiles` or `nolargefiles` option when you create a file system. See theexamples in the following sections.

Examples of Creating a Large Files File System

The following examples show different ways to create a large-files file system.

```
/usr/sbin/mkfs -F hfs -o largefiles /dev/vg02/rlvol1
/usr/sbin/newfs -F hfs -o largefiles /dev/vg02/rlvol1
/usr/sbin/mkfs -F vxfs -o largefiles /dev/vg02/rlvol1
/usr/sbin/newfs -F vxfs -o largefiles /dev/vg02/rlvol1
```

Examples of Creating a No-Large-Files File System

The following examples show different ways to create a file system that will *not* support large files.

```
/usr/sbin/mkfs -F hfs -o nolargefiles /dev/vg02/rlvol1
/usr/sbin/newfs -F hfs -o nolargefiles /dev/vg02/rlvol1
```

```
/usr/sbin/mkfs -F vxfs -o nolargefiles /dev/vg02/rlvol1
/usr/sbin/newfs -F vxfs -o nolargefiles /dev/vg02/rlvol1
```

Changing from a Large-Files File System

You can change a file system back and forth between `largefiles` and `nolargefiles` using the HP System Management Homepage (HP SMH) or the `fsadm` command (shown below).

To make the change using the HP System Management Homepage:

1. Navigate to the `File Systems` configuration page (**Tools** → **Disks and File Systems** → **File Systems**)
2. Select the file system that you want to change
3. From the action list on the right side of the page, select:
   - **Modify HFS**, if the file system requiring alteration is an HFS file system, or
   - **Modify VxFS**, if the file system requiring alteration is a VxFS file system

NOTE: Only the appropriate action for the selected file system will be displayed.

HFS file systems:

To convert an HFS file system from `largefiles` to `nolargefiles`, the file system must be in a clean state[4] and must be unmounted. Also, in order for the `fsadm` command to succeed in the conversion from a `largefiles` mode to a `nolargefiles` mode, you must first remove an files that are greater than 2GB in size.

The following example shows how to convert a `largefiles` HFS file system to a `nolargefiles` HFS file system.

```
# fsck -F hfs /dev/vg03/lvol2
fsck: /dev/vg03/lvol2: mounted file system

continue (y/n)? y
** /dev/vg03/lvol2
** Last Mounted on /testHFS
** Phase 1 - Check Blocks and Sizes
** Phase 2 - Check Pathnames
** Phase 3 - Check Connectivity
** Phase 4 - Check Reference Counts
** Phase 5 - Check Cyl groups
2 files, 0 icont, 9 used, 512490 free (10 frags, 64060 blocks)
***** MARKING FILE SYSTEM CLEAN *****

***** FILE SYSTEM WAS MODIFIED *****
#/usr/sbin/umount /myfilesystem
#/usr/sbin/fsadm -F hfs -o nolargefiles /dev/vg03/rlvol2
```

4. Use the `fsck` command to check the state of, and if necessary repair HFS file systems. See the *fsck*(1M) and *fsck_hfs*(1M) manpages

VxFS file systems: Unlike HFS file systems, VxFS file systems can be switched between `largefiles` and `nolargefiles` without unmounting (and without requiring an `fsck` operation to verify file system state). However, as with HFS file systems, you must remove any large files (files with size greater than 2GB) from the file system before a switch between `largefiles` to `nolargefiles` will succeed.

NOTE: `largefiles` and `nolargefiles` are mount options to file systems. If you manually switch a file system between one mode and another, you *might* need to edit the corresponding entry in the file `/etc/fstab` so that future mounts and boots will mount the file system using the proper mode.

Command Support for Large Files

All of the file system administration commands, as well as all file system *user* commands, for HFS and VxFS support large files (greater than 2 GB in size).

If a command that does not support large files encounters a large file, the command will return an [`EOVERFLOW`] error and print a message like the following:

```
Value too large to be stored in data type
```

Repairing a Large-Files File System with fsck

The *fsck*(1M) command repairs damaged file systems. Typically, large files should not appear in a no-large-files file system. There are two ways `fsck` recovers from this situation if a large file does appear.

In the first scenario, you use `fsck` in the interactive mode. `fsck` finds a large file on a no-large-files file system, marks the file system dirty and stops. You can then correct the situation using the `fsadm`command with the `-o largefiles` option. The `fsck` command repairs the file system, which you are then able to mount. This scenario would preserve the large file, if `fsck` did not find it corrupt in any other way.

In the second scenario, using non-interactive mode, `fsck` purges the large file on a no-large-files file system. `fsck` assumes the superblock to be accurate based on its accuracy checks since the probability of a superblock being corrupt is insignificant when compared to the instance of a large file manifesting in a no-large-files file system. Consequently, `fsck` will remove the large file from a file system it believes should not contain large files.

The `mount` Command and Large-Files File Systems

The `mount` command supports large-files file systems and provides you with a method of ensuring that no large-files file systems are mounted on the system.

The `mount` command uses the same two options as the `mkfs`, `newfs`, and `fsadm` commands (`largefiles`and `nolargefiles`). `mount` will not mount a large-files file system if the `-o nolargefiles` option is specified. Conversely, the `mount` command will not mount a no-large-files file system if the `-o largefiles` option is specified.

If no option is provided to `mount`, it will use the state of the file system itself to determine if it is mounted as `largefiles` or `nolargefiles`.

NOTE: Changing VxFS file systems between `largefiles` and `nolargefiles` updates the mount attributes online (in the file `/etc/mnttab`). It does not update the file `/etc/fstab`. If you explicitly specify `largefiles` or `nolargefiles` in an `fstab` entry and the current attributes of the file system do not match, future mounts may fail. If that occurs, you will need to change the entry in `fstab` to match so the mount will succeed.

For More Information on Large Files

See the following:

- "Backing Up Large Files" (page 135)
- *HP-UX Large Files White Paper Version 1.4*

Managing FTP

There are five files used to hold FTP configuration information. These files are listed in Table 3-1. The `/etc/ftpd/ftpaccess` configuration file is the primary configuration file for defining how the `ftpd` daemon operates. It is not necessary to enable the `ftpaccess` file in order to run `ftpd`.

The configuration files allow you to configure FTP features, such as the number of FTP login tries permitted, FTP banner displays, logging of incoming and outgoing file transfers, access permissions, use of regular expressions, etc. For complete details on these files, see the *ftpaccess*(4), *ftpgroups*(4), *ftpusers*(4), *ftphosts*(4), and *ftpconversion*(4) manpages.

If the `ftpaccess` file is enabled:

- Settings in the `ftpaccess` file override any similar settings in the other files.
- Any settings in the other files that are not present in `ftpaccess` are treated as supplemental or additional configuration information.

If the `ftpaccess` file is disabled:

- The settings in the `ftpusers`, `ftphosts`, and `ftpconversion` files will be used.
- The `ftpgroups`file will not be used.

Enabling/Disabling the `/etc/ftpd/ftpaccess` Configuration File

- To enable the `/etc/ftpd/ftpaccess` file, specify the `-a` option for the `ftp` entry in the `/etc/inetd.conf` file. For example,

```
ftp  stream tcp nowait root /usr/lbin/ftpd ftpd -a -l -d
```

(The `-l` option logs all commands sent to the `ftpd` server into `syslog`. The `-d` option logs debugging information into `syslog`.)

- To disable the `/etc/ftpd/ftpaccess` file, specify the `-A` option for the `ftp` entry in the `/etc/inetd.conf` file. For example,

  ```
  ftp  stream tcp nowait root /usr/lbin/ftpd ftpd -A -L -d
  ```

The `FTP` configuration files enable you to define how `ftp` works, as described in the following table.

Table 3-1 FTP Configuration Files

`/etc/ftpd/ftpaccess`	The primary configuration file defining the operation of the `ftpd` daemon. For more information see *ftpaccess*(4).
`/etc/ftpd/ftpconversions`	Defines options for compression/decompression and `tar`/`untar` operations. For more information see *ftpconversions*(4).
`/etc/ftpd/ftphosts`	Lets you allow/deny FTP account access according to source IP addresses and host names. For more information see *ftphosts*(4).
`/etc/ftpd/ftpusers`	Restricts FTP access for specified users. For more information see *ftpusers*(4).
`/etc/ftpd/ftpgroups`	The group password file for use with the SITE GROUP and SITE GPASS commands. For more information see *ftpgroups*(4).

Verifying the Path Names of FTP Configuration Files

To verify the path names of all FTP configuration files, enter:

`/usr/bin/ckconfig`

For more information see the *ckconfig*(1) manpage.

Getting Information about FTP Users

To display the current number of users for each class and the limit for each class of users as defined in the `/etc/ftpd/ftpaccess` file, enter:

`/usr/bin/ftpcount`

To display the current process information for each user logged into the FTP server, enter:

`/usr/bin/ftpwho`

See the *ftpcount*(1) and *ftpwho*(1) manpages for more information

Creating an FTP Shutdown Message

The `ftpshut` command allows you to create a shutdown message file that warns users before FTP shuts down. The FTP daemon checks this file at intervals to determine the shutdown time. (You must be superuser to execute `ftpshut`.)

After the shutdown has occurred, you must enter the `ftprestart` command to remove all the shutdown message files from the real, anonymous, and virtual user accounts. These message files are created by the `ftpshut` utility.

For details on creating a FTP shutdown message, see the *ftpshut*(1) and the *ftprestart*(1) manpages and also Chapter 2 of the *Installing and Administering Internet Services* manual.

Logging FTP Session Information

You can specify FTP session logging using the `log commands` keyword in the `/etc/ftpd/ftpaccess` file.

`log commands` Enables/disables logging of an FTP session to `syslog`, including commands, logins, login failures, and anonymous `FTP` activity. (This entry overrides the `-L` option specified for the `ftp` entry in `/etc/inetd.conf`.)

NOTE: To enable the `/etc/ftpd/ftpaccess` file, you must specify the `-a` option in the `ftp` entry of the `/etc/inetd.conf`file.

For details on the `log commands` keyword, see the *ftpaccess*(4) manpage.

Logging FTP File Transfers

You can log file transfer information from the FTP server daemon to the `/var/adm/syslog/xferlog` log file. The `xferlog` file records file transfer information such as current time, file transfer time, remote host, file name, file size, whether the file transfer was in ASCII or binary format.

Configuring Logging in the /etc/ftpd/ftpaccess File

To log incoming and outgoing FTP file transfers edit the `/etc/ftpd/ftpaccess` file, using the `log transfers` keyword.

`log transfers` Enables/disables logging of file transfers for real or anonymous FTP users to`/var/adm/syslog/xferlog`. Logging of transfers to the server (incoming) can be enabled separately from transfers from the server (outgoing).

NOTE: To enable the `/etc/ftpd/ftpaccess` file you must specify the `-a` option in the `ftp` entry of the `/etc/inetd.conf`file.

For more information, see the *ftpaccess*(4) manpage and the *xferlog*(5) manpage.

Setting Up Virtual FTP Support

Virtual FTP support allows you to manage an FTP server for two or more separate domains on the same machine.

Using virtual FTP, you can configure systems so that `user1` connecting via `ftp` to `ftp.domain1.com` gets one FTP banner and FTP directory, while `user2` connecting via `ftp` to `ftp.domain2.com` gets another banner and directory. You can create a different set of configuration files `ftpaccess`, `ftpconversions`, `ftphosts`, `ftpusers`, and `ftpgroups` for each virtual FTP site. (This occurs even though the users are on the same machine and are using the same ports.

For detailed information about setting up virtual FTP support, see Chapter 2 of the *Installing and Administering Internet Services* manual.

NOTE: Setting up a virtual FTP server requires IP address aliasing.

Backing Up Data

One of the most important goals of system administration is to protect the integrity of the valuable data on a system. There are several aspects to this (for example, securing the system against intruders, and protecting the system's data against deliberate or accidental removal). Many things (for example device failure) can cause data loss, and there are many tools to insure you can recover valuable data in the event of a loss of the primary copy:

Data Backups	By making copies of disk-based data onto external media that you can store away from your system you ensure that you can recover the data should something happen to your primary copies. Data can also be shipped over a network to a computer at a different location. The important thing is to have copies of all your important data somewhere other than on your system. To protect against loss from flood, fire, or other disasters, you should store at least one copy of all important data in a location other than where your system resides. The term **data backup** usually refers to the act of making an offline copy of the data being protected.
Disk Mirroring	By making multiple identical copies of all data as they are written, you ensure that you can recover/access data (from a mirror copy) in the event a device fails and the copy of the data that is on it is destroyed.
RAIDs	Redundant Arrays of Independent Disks are another form of mirroring data.
Serviceguard	HP sells a product called Serviceguard, specifically designed to protect not only disk based data but also all aspects of your

computing environment, minimizing the downtime that can result from the loss of use of a specific server or some of its peripherals.

This section deals with data backups. For additional information on the other ways of protecting your data (mentioned above), see "Using High Availability Strategies" (page 201).

There are many utilities to back up your data to offline media (for example, optical media or magnetic tape such as DLT cartridges).

Table 3-3 compares several commonly used utilities based on many important backup criteria. This discussion focuses on the file backup and file recovery procedures of HP Data Protector, `pax`, `tar`, and `cpio`. Online backup of a VxFS snapshot file system is also explained. See the HP-UX Reference for information on the other backup and restore utilities: `dump`, `ftio`, `restore`, `rrestore`, `vxdump`, and `vxrestore`.

The following topics are described in this section:

- "Choosing the Type of Storage Device" (page 121)
- "Choosing a Backup/Recovery Utility" (page 122)
- "Determining What Data to Back Up" (page 125)
- "Determining How Often to Back Up Data" (page 126)
- "Full Backups vs. Incremental Backups" (page 126)
- "Setting Up an Automated Backup Schedule" (page 132)
- "Creating an Automated Backup Schedule" (page 133)
- "Activating an Automated Backup Schedule" (page 134)
- "Backing Up If You Are Using LVM" (page 134)
- "Backing Up Large Files" (page 135)
- "Backing Up a VxFS Snapshot File System" (page 136)

Choosing the Type of Storage Device

When you evaluate which media to use to back up your data, consider the following:

- How much data do you need to back up (rough estimate)?
- How quickly will you need to retrieve the data?
- What types of storage devices do you have access to?
- How automated do you want the process to be? (For example, will an operator be executing the backup interactively or will it be an unattended backup?)
- How quickly will you need to complete a backup?

NOTE: To ensure against the possible destruction of your system and its data, store the backup media *away* from your system.

Use Table 3-2: "Criteria for Selecting Media " (page 122) to help you determine which storage device to use for your backups. This table compares the supported device types

relative to each other; it does not give specific values. For detailed information, consult the documentation that came with your tape or disk drive for capacity information about the storage media.

Table 3-2 Criteria for Selecting Media

Storage Device Type	Holds Lots of Data?	Recovers and Backs Up Data Quickly?	Suggested for Unattended Backup?
DLT tape drive	Excellent	Excellent	No [1]
DLT tape library	Excellent	Excellent	Yes
DDS format (DAT) tape drive	Very Good	Good	No [1]
DDS format (DAT) tape drive autoloader	Very Good	Good	Yes
Hard disk	Good	Excellent	No
Optical disk multi-disk library	Good	Good	Yes [1]
Optical disk single drive	Good	Good	No [1]

1 You can perform an unattended (automatic) backup if all of the data will fit on one tape, optical disk, and so on.

Choosing a Backup/Recovery Utility

There are a number of different backup methods you may wish to choose from depending on your system backup needs and your workgroup configurations. Some recommended backup methods are:

- HP Data Protector
- HP SMH (System Management Homepage)
- HP-UX `fbackup`/`frecover` utilities

Choosing HP Data Protector for Backup

HP Data Protector automates high-performance backup and recovery from disk or tape. It enables you to back up to a large number of backup devices simultaneously and supports high-end devices in very large libraries.

HP Data Protector provides various backup capabilities such as local backup, network backup, online backup, synthetic backup, backup with object mirroring, and built-in support for parallel data streams allow you to tune your backups to best fit your requirements.

For more information about HP Data Protector, see the HP Data Protector websitehttp://www.hp.com/go/dataprotector.

Choosing an HP-UX Backup/Recovery Utility

Table 3-3 compares several HP-UX backup utilities based on selected tasks. For details about specific commands, see the associated manpage.

Table 3-3 A Comparison of some HP-UX Backup/Recovery Utilities

Task	Backup Utility				
	`fbackup` `frecover`	`cpio`	`tar`	`dump` `restore`[1]	`vxdump` `vxrestore`[2]
Recover from tape errors	Minimal data loss.	`resync` option causes some data loss.	Not possible.	Skips over bad tape.	Skips over bad tape.
Efficient use of tape	Medium.	Low.	High.	High.	High.
Backup/ restore across a network	Possible.[3]	Possible[4]	Possible.[5]	Possible. [6]	Possible. [7]
Append files to the same backup tape	Not possible.	Can use the no-rewind device file to append multiple dumps.	Use `tar -r`.	With `dump`, can use the no-rewind device file to append multiple dumps. [8]	With `vxdump`, can use the no-rewind device file to append multiple dumps. [8]
Multiple, independent backups on a single tape	Not possible (`fbackup` rewinds the tape).	Use `mt` with no-rewind device to position the tape, then use `cpio`.	Use `mt` with no-rewind device to position the tape, then use `tar`.	Use `mt` with no-rewind device to position the tape, then use `dump`. [8]	Use `mt` with no-rewind device to position the tape, then use `vxdump`. [8]
List the files on the tape	Relatively easy[9]	Complex (must search entire backup).[10]	Complex (must search entire backup). [11]	Relatively easy.[12]	Relatively easy.[13]
Verify backup (Also see the above entry.)	Use the `-xNv` options.	Not possible.	Not possible.	Not possible.	Not possible.
Find a particular file	Relatively easy; use `frecover`.	Complex (Wildcards are allowed; searches the entire tape.)	Complex (Wildcards *not* allowed; searches the entire tape.)	Relatively easy; interactive commands available. [14]	Relatively easy; interactive commands available. [15]

Table 3-3 A Comparison of some HP-UX Backup/Recovery Utilities *(continued)*

Task	Backup Utility				
	`fbackup` `frecover`	`cpio`	`tar`	`dump` `restore`[1]	`vxdump` `vxrestore`[2]
Do an incremental backup	Has a powerful multilevel backup.	Use `find` to locate new or modified files.	Use the `-u` option to add any new or modified files to the end of archive.	Possible on a single file system only.	Possible on a single file system only.
List files as they are backed up or restored	Possible. Use `-v` option.[16]	Possible. Use `-v` option.[17]	Possible. Use the `-v` option.[18]	Possible (on a restore only).[19]	Possible (on a restore only).[20]
Do a backup based on selected criteria (such as group)	Not possible.	Possible. Use `find`.	Not possible.	Not possible.	Not possible.
Cross disk or file system boundaries	Use `fbackup -n` to cross NFS boundaries.	Possible. Use `find`.	Possible.	Not possible.	Not possible.
Restore absolute path names to relative location	Relative to the current directory. Use `-X` option.	Limited. Can specify path name on each file with `cpio -ir`.	Not possible.	Relative to the current directory. Use `restore -r`.	Relative to the current directory. Use `vxrestore -r`.
Interactively decide on files to restore	Not possible.[21]	Can specify path or name on each file with `cpio -ir`.	"Yes" or "no" answer possible using `tar -w`.	In interactive mode, can specify which files.	In interactive mode, can specify which files.
Use wildcards when restoring	Not possible.	Possible.	Not possible.	Only in interactive mode.	Only in interactive mode.
Ease of selecting files for backup from numerous directories	High.	Medium.	Low.	Not possible.	Not possible.
Back up a snapshot file system	Not possible.	Possible.[22]	Possible.[22]	Not possible.	Possible.
Backup/ restore extent attributes	Possible.	Not possible.	Not possible.	Not possible.	Possible.

1 For High Performance File Systems (HFS) only. For remote systems, use `rdump/rrestore`
2 For Journaled File Systems (JFS or VxFS). For remote systems, use `rvxdump/rvxrestore`
3 Use the "`-f remote_system:remote_device_file`" option on `fbackup`
4 Use `find | cpio -o | remsh host "dd of=/dev/tape obs=blocksize"`
5 Use `find | tar cvf - | remsh host "dd of=/dev/tape obs=blocksize"`
6 Use `rdump -f remote_system:remote_device_file`
7 Use `rvxdump -f remote_system:remote_device_file`
8 Separate backups will be on one tape.
9 Use `frecover -f device_or_file -I index or frecover -rNvf device_or_file 2> index`
10 Use `cpio -it < device_or_file > index`
11 Use `tar -tvf device_or_file > index`
12 Use `restore -tf device_or_file > index`
13 Use `vxrestore -tf device_or_file > index`
14 Use `restore -i -f device_or_file`
15 Use `vxrestore -i -f device_or_file`
16 Use `fbackup -i path -f device_or_file -v 2 >index`
17 Use `find . | cpio -ov > device_or_file 2 > index`
18 Use `tar -cvf device_or_file * 2 > index`
19 Use `restore -t` or `restore -trv`.
20 Use `vxrestore -t` or `vxrestore -trv`.
21 However, you can use `frecover -x -ipath` to specify individual files.
22 If the snapshot file system has extent attributes, you will need to use `vxdump filesystem`.

Author's Note: fbackup and frecover in the above table need to be replaced with pax, but I did not have time at AR0809 to complete this. Because fbackup/frecover are still supported (though they are in the process of being phased out), I chose to leave them in this table for this release. —pv

Determining What Data to Back Up

To restore your system after a complete loss of data, you will need copies of the following:

- all user files
- system files that you have customized (such as `/etc/passwd`)
- system files that you have added since your original installation (for example, printer configurations)
- any additional products that were installed since your original installation

Defining What Files and Directories to Back Up

If you are backing up using the `fbackup` command, you must define which directories and files you want to back up:

- Included Files

  Included files are directories and files to include in your backup. When you specify a directory, all of the files and subdirectories are included in the backup. Identify includes files with the `-i` option of the `fbackup` command or with a graph file (see the following definition).

- Excluded files

  Excluded files are files within your included directories to excluded from the backup. In other words, they are the exceptions. Identify excluded files with the `-e` option to the `fbackup` command or with a graph file (described below).

- Graph files

  Graph files are text files that contain a list of directories and files to back up. If you us HP SMH to back up your system, HP SMH creates the graph files for you (in `/etc/sam/br`) usinmg the included and excluded files. Graph files contain one entry per line. Entries that begin with the character `i` indicate included files; those that begin with the character `e` indicate excluded files. For example:

  ```
  i /home
  e /home/deptD
  ```

  The above file will cause all of the directory `/home` with the exception of `/home/deptD` to be backed up.

  You can identify a graph file with the `-g` option of the `fbackup` command.

Determining How Often to Back Up Data

Evaluate the applications running on your system and the needs of your users to determine how critical the data on your system is to them. Consider the following:

- How often do the contents of files change?
- How critical is it that files' contents be up-to-date?
- Can the files be recreated or recovered from an alternate source?

Full Backups vs. Incremental Backups

Once you have identified a list of files to include and exclude, decide whether you want all of the files represented by your list to be backed up (a full backup) or only those files that have changed or that have been created since the last time you backed up this set of files (incremental backup).

Incremental backups can save you a lot of time if only a small percentage of files in a backup set have changed since the last time a backup was performed. Full backups ensure that each file in a backup set is captured at the time the backup is performed (regardless of when or how often it was previously backed up).

NOTE: A full backup does *not* mean a backup of every file on your system. It means a backup of every file on your include list, regardless of when it was last backed up.

To ensure consistency, do not modify or use different graph files between full and incremental backups.

Other backup utilities, such as `tar`, `cpio`, and `pax`, do not support the concept of incremental backups, but can maintain timestamp data for files in the archives they make. When using these utilities to restore files from archives, you can chose whether to overwrite a newer file on disk with an older version of that file from an archive.

Backup Levels

A backup level is a level you define that identifies the different degrees of incremental backups. Each backup level has a date associated with it that indicates when the last backup at that level was created. You can have up to ten backup levels (0 through 9). For example, level 0 is a full backup; level 1 backs up files that changed since the last level 0 backup; level 2 backs up files that changed since the last level 1 backup, and so on.

This brings up the question, "how does `fbackup` know when the previous backup was created?" This information is contained in the file `/var/adm/fbackupfiles/dates`, a file that is updated only when all of the following conditions are true:

- The `-u` option is used with `fbackup`.
- A graph file is used to indicate which files should be included/excluded when a backup is performed.
- Neither the `-i` nor the `-e` option is used (graph file used instead).
- The backup completed successfully.

Backup levels are a way of specifying varying degrees of incremental backup. For example, suppose you wanted to set up the following backup schedule:

- On the first day of the month, back up an entire set of selected files (a monthly, full backup).
- Every Friday, back up all files in the selected set that have changed since the previous Friday (a weekly, incremental backup so that you can back up and restore files that have been active within the month, relatively quickly).
- Every day except Friday (or the first of the month), back up all of the files in the selected set that have changed since the previous day (a daily, incremental backup, so that you can quickly back up and restore files that have been active within the last week).

There are three "layers" (levels) associated with the above schedule (the once per month level, the once per week level, and the once per day level). The once per month level is a full backup. The other two are incremental backups. The problem is how to

distinguish between the two types of incremental backup. This is accomplished with backup levels.

The file `/var/adm/fbackupfiles/dates` contains information about when the last backup at each backup level was performed. This information is used by `fbackup`, along with the modification date stamps on the files themselves, to determine when files in the specified set are to be included with the backup that is currently being created.

As previously stated, you can have up to 10 backup levels. When you run `fbackup`, you can tell it which level to use. `fbackup` will use the level you give it as follows:

- Level 0 is always considered full backup.
- Higher levels are generally used to perform incremental backups.
- When doing an incremental backup of a particular graph (specified by a graph file name), at a particular level, `fbackup` will search the file `/var/adm/fbackupfiles/dates` to find the date of the most recent backup of the same graph that was done at a lower level. If no such entry is found, the beginning of time is assumed. All files in the specified graph that have been modified since this date are back up.

Example of Setting Backup Levels

Assume you want the following three backup levels:

- Level 0 — full monthly backup
- Level 1 — weekly backup on Friday
- Level 2 — daily backup, except Friday

There are three ways you can implement these levels: use HP SMH, enter the `fbackup` command and specify a backup level on the command line, or automate the commands (see "Setting Up an Automated Backup Schedule" (page 132)).

The figure below illustrates the level numbers for implementing this example:

```
Date:             1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  ...  1
Day:             Su  M  T  W  Th  Fr  Sa  Su  M  T  W  Th  F  Sa  Su  ...

Backup level      0   2  2  2  2   1   2   2   2  2  2  2   1  2  2    ...  0
```

If your data becomes corrupt on Thursday the 12th, do the following to restore your system to its Wedneday the 11th state:

- Restore the monthly full backup tape from Sunday the 1st.
- Restore the weekly incremental backup tape from Friday the 6th.
- Restore the incremental backup tape from Wednesday the 11th.

For information about the actual method and commands to restore these tapes, see "Restoring Your Data Using HP-UX Commands " (page 138).

Backing Up Your Data Using the fbackup Command

The /usr/sbin/fbackup command is the recommended HP-UX backup utility. The fbackup command can do the following:

- indicate specific files or directories to include or exclude from a backup
- specify different levels of backup on a daily, weekly, or monthly basis
- create an online index file
- when used in conjunction with the crontab utility, can automate backups

NOTE: As fbackup does its work, it will not back up files that are active (open) when it encounters them. For this reason, it is best to back up your system when there are few or no users logged in. If you can do so, you should change your system's run-level to the system administration state (singe-user mode) before using fbackup. This will insure that you are the only one logged in when the backup is run. As a result, a minimum number of files will be active, thereby reducing the number of files that are intended for, but not include in, the backup.

When changing to the single-use state, all the subdirectories are unmounted. Therefore, you must remount them if necessary before backup up. For information about changing to the single-user state, see *shutdown*(1M). If you shut down the system to single-user state, mount the file systems (other than root (/) that you want backup up.

General Procedure for Using the fbackup Command

To use the fbackup command:

1. Ensure that you have superuser capabilities.
2. Ensure that files you want to back up are not being accessed. The fbackup command will not back up files that are active (opened) or locked.
3. Verify that the backup device is properly connected.
4. Verify that the backup device is turned on.
5. Load the backup device with write-enabled media. If the backup required additional media, fbackup will prompt you when to load or change media.
6. If possible, change to a single-user state. Then mount any directories you want to back up.
7. Create the backup using fbackup. For example, the command:

   ```
   fbackup -f /dev/rmt/0m -i /home
   ```

   can be used to back up the entire contents of /home to the device file /dev/rmt/0m. For more information on fbackup, see *fbackup*(1M). For more information about the /dev file formats, see the *Configuring HP-UX for Peripherals* manual and see *mt*(7).

Creating the Index File on the Local Device

If you use the `fbackup` command, an index is written at the beginning of each tape listing all files in the graph file being backed up. However, since this index is written before the files are actually backed up, if a file is removed after the index is written but before the file is backed up to tape (or something else happens that prevents the file from being backed up), the index will not be completely accurate.

If you tell `fbackup` to make an online index file (using the —`I` option),it will create the file after the backup is complete. Therefore, the only index that will be accurate is the online index, which is produced after the last volume has been written (the index created using the `fbackup -I` option).

Also, `fbackup` assumes all files remaining to be backed up will fit on the current tape for the index contained on that media. Therefore, if you did not use the `-I` option on `fbackup` or removed the index file, extract an index from the last media of the set.

Use the `/usr/sbin/frecover` utility to list the contents of the index at the beginning of a backup volume made with `fbackup`. For example, the command

```
fev/rmt/0mrecover -I /tmp/index2 -f
```

specifies that the device file for the magnetic tape drive is `/dev/rmt/0m` and you want to put the listing of the index in the file `/tmp/index2`.

Backing Up NFS Mounted Files with fbackup

When backing up files that are NFS mounted to your system, `fbackup` can only back up those files having other user read permission unless you have superuser capability. (To recover the files, you will need other user write permission.) To ensure the correct permissions, log in as superuser on the NFS file server and use the root= option to the /usr/sbin/share command to share the permissions, then back up as root. For more information, see*share*(1M) and the *NFS Administrator's Guide*.

Examples of fbackup Commands

Here are a series of examples showing a variety of ways that fbackup can be used.

Example: Backing Up to a DDS (DAT) Tape

For this example, we want to do a full backup and do not care about doing future incremental backups. Therefore, we do not need to specify a backup level (nor do we need to use the `-u` option to update the dates file). We could also specify "level 0" to indicate a full backup.**`fbackup -i /home`**

Example: Backup Up to a DLT Tape

(You plan to do a future incremental backup.)

This example will back up the entire structure except the invoices directory. The device file for this example is `/dev/rmt/1h`, specified using the `-f` option. For this example, we need to plan for the incremental backup (next example), so we must do three things:

1. Use a graph file to specify which files will be included/excluded.
2. Specify the `-u` option to update the file `/var/adm/fbackupfiles/dates`.
3. Specify a backup level.

Because this will be a full backup, we'll use the backup level 0. Any backup level would do as long as it is the lowest backup level in use. See Backup Levels for details about how backup levels are interpreted by fbackup.

The graph file for this example will be /var/adm/fbackupfiles/graphs/g1 and the contents will look like:

```
i /home
e /home/text/invoices
```

The fbackup command to accomplish the above is:

```
fbackup -f /dev/rmt/1h -0 -u -g /var/adm/fbackupfiles/graphs/g1
```

Example: Incremental Backup to a DLT Tape

This example is an extension of the previous one. All characteristics of the previous example will remain the same except that this will be an incremental backup at a point in time following the previous example's backup.

We'll use the backup level 5. The exact number is not critical as long as it is higher than the level used in the previous example. See Backup Levels for details about how backup levels are interpreted by `fbackup`.

```
fbackup -f /dev/rmt/1h  -5 -u -g /var/adm/fbackupfiles/graphs/g1
```

Example: Backing Up to Two Devices

This example will show how it is possible to specify more than one device to receive the output from `fbackup`. When more than one device is specified, the second one is written to when the media on the first device has filled up. If the media on the first device fills up and the remaining data to be backed up will fit on the media on the second device, an unattended backup possible. With only one device, a media change would be required in this situation.

Also, in this example, an index file will be created called `/tmp/index`. An index is written to the beginning of each tape, listing all files in the specified graph being backed up. However, if a file is removed after the index is written but before the file is backed up to tape (or something else happens that prevents the file from being backed up), the index will not be completely accurate. If you tell `fbackup` to make an online index file (using the `-I` option), it will create the file after the backup is complete. Therefore, the online index file will be completely accurate with respect to which files are on each volume of the backup.

For ecample, to back up every file on the entire system to the two magnetic tape drives represented by device files, /dev/rmt/0m and /dev/rmt/2,m, enter:

```
fbackup -f /dev/rmt/0m -f /dev/rmt/1m -i / -I /tmp/index
```

You would typically use both tape drives in the same tape density mode.

Backing Up Files on a Remote System

If you are administering a workgroup, it is likely that only some of the systems in the workgroup will have storage devices such as tape drives or optical disk drives attached locally. In this situation, you will need to perform remote backups.

Remote Backup Using fbackup

To perform a remote backup using `fbackup` — a utility that *does* support network backups — enter a command such as:

```
fbackup -f othersystem.company.com:/dev/rmt/c0t0d0BEST -v -i /home/matt/project1
```

Of course, you will need to substitute your system name, tape device file name, and directory tree information.

For information on recovering files remotely using the `frecover` command, see "Restoring Your Data" (page 137).

Remote Backup Using cpio

```
cd relative-path
find . -hidden -depth -fsonly hfs -xdev \
  | cpio \ -ovxcB 2>/tmp/index \
  | remsh system-name -l user \
  "cat - | dd of=/dev/rmt/0m obs=5k"
```

If the relative path is root (/), then you will perform a full backup. The `/tmp/index` file is an index file of the backup. The `-v` option causes the output to be written to standard error.

Note that `cpio` via network does not support multiple tapes.

Remote Backup Using tar

To perform a remote backup using `tar`, enter:

```
cd relative-path
tar cvf - . | remsh remote-system dd of=/dev/rmt/0m
```

For information on restoring files remotely using the `tar` command, "Restoring Your Data" (page 137).

Setting Up an Automated Backup Schedule

If possible, use HP SMH to set up an automated backup schedule.

If you use HP-UX commands, you can automate your backup procedure using the `crontab` utility, which uses with `cron`, the HP-UX process scheduling facility. For details, see *cron*(1M) and see *crontab*(1).

Creating an Automated Backup Schedule

Use the `crontab` utility to specify an input file containing information about the backup procedures you want to automate. The `crontab` utility allows you to specify an input file containing the date, time, and run-strings of the backup procedures (processes) that you want to automate. This file (the input to the `crontab` utility) contains lines that have six required fields each. The fields are separated by spaces or tabs. Each entry in this file has the following format:

`minutes hours dates months days runstring`

where:

`minutes`	Specifies the minutes of the hour (0-59)
`hours`	Specifies the hours of the day (0-23)
`dates`	Specifies particular dates of the month (1-31)
`months`	Specifies particular months of the year (1-12)
`days`	Specifies particular days of the week (0-6 with 0 representing Sunday)
`runstring`	Specifies the command line or script file to execute

NOTE: Specify multiple values in a field by separating them with commas (no spaces), as in `10,20,30`.

The value `*` in any field represents all legal values.

Therefore, to schedule the `ps` command (see *ps*(1)) to execute at 5:10 p.m. (17:10) on every Friday and Monday during June, July, and August, you would make an entry in your `crontab` input file that looks like this:

```
10 17 * 6,7,8 1,5 ps >> /tmp/psfile 2>&1
```

When using `crontab`, redirect any output that is normally sent to the terminal to a file. In this example, `2>&1` redirects any error messages to the file `psfile`.

An example backup strategy may consist of a full backup (performed once per week) and an incremental daily backup. Assume that the backups are to be performed at 4:03am and the media is DDS (DAT) tape. The following `crontab` file implements the example backup strategy:

```
3 4 * * 1 incrback >> monbackup
3 4 * * 2 incrback >> tuebackup
3 4 * * 3 incrback >> wedbackup
3 4 * * 4 incrback >> thubackup
3 4 * * 5 incrback >> fribackup
3 4 * * 6 fullback >> satbackupfull
```

In the above example `incrback` and `fullback` are example shell scripts. Be sure to set the `PATH` variable appropriately or use complete paths to any scripts that you include in the `crontab` input file. Scripts like these may be used to:

- Warn any users who are logged in that the system is going down (for backup purposes).
- Shutdown the system (to single user mode).
- Mount any file systems that you wish to back up.
- Run `fbackup` to perform the actual backup.
- Return the system to multiuser operating mode.

The output redirection can be specified in the `crontab` input file or within the script contained in the `crontab` input file.

TIP: To edit the `crontab` input file directly, use the `crontab -e` option.

Displaying an Automated Backup Schedule

To list your currently scheduled processes, enter:

```
crontab -l
```

This displays the contents of your activated `crontab` input file.

Activating an Automated Backup Schedule

Before you activate a new `crontab` input file, you should view the currently scheduled processes (see "Displaying an Automated Backup Schedule" (page 134)). Consider adding these processes to your `crontab` input file.

To activate all of the processes defined in your `crontab` input file and cancel any previously scheduled processes not defined in your `crontab` input file, enter:

```
crontab your_crontab_file
```

After your `crontab` backup has been activated, make sure that:

- The system clock is set properly.
- The backup device is properly connected and the HP-UX I/O system recognizes the device file specified in the `fbackup` run string.
- Adequate media has been loaded in the backup device.
- The backup device is connected to your system and is turned on.
- The NFS mounted files you want backed up have the correct permissions.

Backing Up If You Are Using LVM

If you are running LVM, you must maintain the backup configuration files for each volume group. After making changes to the configuration of the disks or the logical volumes within a given volume group, the `vgcfgbackup` command is run automatically

to record the group's configuration (`vgcfgbackup` saves the configuration of each volume group in `/etc/lvmconf/volume_group_name.conf`).

To ensure recovery of LVM information following disk corruption, you *must* back up both the `/dev` and `/usr` directories. Include the `/usr` directory in the root volume group during your backup. If, however, the `/usr` directory was not originally part of the root volume group, you can still create a new logical volume in the root volume group and move the `/usr` directory within it.

For information on saving volume group configuration information using `vgcfgbackup`, see *HP-UX System Administrator's Guide: Logical Volume Management*.

Backing Up Large Files

A large file is defined as one whose size is greater than 2 GB. See the *HP-UX Large Files White Paper Version 1.4* for more information.

Backup Utilities that Support Large Files

The following backup utilities will back up large files.

- `dd`
- `fbackup`, `frecover`

Neither of the preceding commands require any user intervention to backup large files.

Backup Utilities that Do Not (fully) Support Large Files

The following backup utilities do *not* support large files:

`tar`	Supports files <8GB in size
`cpio`	Does not support large files (>2GB) and cannot process cpio archives containing large files written by `pax`)
`pax`	Supports files <8GB in size for `ustar` and `cpio` formats, (but will support any size file in `pax` format).
`ftio`	Does not support large files (>2GB)

Attempts to back up any files greater than 2 GB using the preceding utilities will fail.

Restoring Large Files

If you use `fbackup` to back up large files (> 2 GB), then those files can only be restored on a large file system. For instance, suppose that you back up a file system containing large files; you cannot restore those files to a file system that is not enabled for large files.

If a backup contains large files and an attempt is made to restore the files on a file system that does not support large files, the large files will be skipped.

Backing Up a VxFS Snapshot File System

NOTE: Creating and backing up a VxFS snapshot file system requires that you have the optional Veritas File System (HP OnLineJFS) product installed on your system.

The Journaled File System (JFS) enables you to perform backups without putting the file system off-line. You do this by making a snapshot of the file system, a read-only image of the file system at a moment in time. The primary file system remains online and continues to change. Once you create the snapshot, you back it up with any backup utility except dump.

How to Create and Back Up a VxFS Snapshot File System

1. Determine how large the snapshot file system needs to be, and create a logical volume to contain it.
   a. Use `bdf` to assess the primary file system size and consider the following:
      - Block size of the file system (1024 bytes per block by default)
      - How much the data in this file system is likely to change (15 to 20% of total file system size is recommended)

      For example, to determine how large to make a snapshot of `lvol4`, mounted on `/home`, examine its `bdf` output:

      ```
      # bdf /home
      Filesystem            kbytes    used   avail  %used Mounted on
      /dev/vg00/lvol4       40960   38121    2400   94%   /home
      ```

      Allowing for 20% change to this 40 MB file system, you would want to create a logical volume of 8 blocks (8 MB).

   b. Use `lvcreate` to create a logical volume to contain the snapshot file system.

      For example,

      ```
      lvcreate -L 8 -n lvol1 /dev/vg02
      ```

      creates an 8 MB logical volume called `/dev/vg02/lvol1`, which should be sufficient to contain a snapshot file system of `lvol4`.

      See *lvcreate*(1M) for syntax.

2. Make a directory for the mount point of the snapshot file system.

   For example,

   ```
   mkdir /tmp/house
   ```

3. Make and mount the snapshot file system.

   In the following example, a snapshot is taken of logical volume `/dev/vg00/lvol4`, contained in logical volume `/dev/vg02/lvol1`, and mounted on `/tmp/house:`

```
mount -F vxfs -o snapof=/dev/vg00/lvol4 \
  /dev/vg02/lvol1 /tmp/house
```

See *mount_vxfs*(1M) for syntax.

4. Back up the snapshot file system with any backup utility except `dump`.

   For example, to use *tar*(1) to archive the snapshot file system `/tmp/house`, ensuring that the files on the tape will have relative path names:

   ```
   cd tmp; tar cf /dev/rmt/0m house
   ```

   Alternatively, the following *vxdump*(1M) command backs up a snapshot file system `/tmp/house`, which has extent attributes:

   ```
   vxdump -0 -f /dev/rmt/0m /tmp/house
   ```

Restoring Your Data

HP-UX has a number of utilities for backup and recovery. This discussion focuses on the `fbackup` and `frecover` commands used by HP SMH. See the HP-UX Reference for information on the other backup and restore utilities: `cpio`, `dump`, `ftio`, `pax`, `restore`, `rrestore`, `tar`, `vxdump`, and `vxrestore`.

The following topics are covered:

- "Determining What Data to Restore" (page 137)
- "Before Restoring Your Data " (page 138)
- restordata
- "Restoring Your Data Using HP-UX Commands " (page 138)
- "Recovering From a System Crash " (page 140)

Determining What Data to Restore

There are two scenarios you will likely encounter for restoring files:

1. You need to recover one or a few files, usually as a result of an accidental deletion or because the file has been overwritten.
2. You need to recover *all* of your files. This is usually part of the system crash recovery process. If you have experienced a file system failure and you suspect that you have corrupt data, see System Recovery. If your root disk failed and all the data on the disk is lost, you need to re-install HP-UX; see the HP-UX installation guide for your version of HP-UX for details. After you have repaired the file system or replaced the hardware, you can restore your data from your most recent backups.

Ensure that your system can access the device from which you will restore the backup files. You might need to add a disk or tape drive to your system.

Before Restoring Your Data

Gather the following information and materials before you begin:

- A list of files you need to restore
- The media on which the data resides
- The location on your system to restore the files (original location or relative to some other location)
- The device file corresponding to the backup device used for restoring the files

Restoring Your Data Using HP SMH

You can use HP SMH or HP-UX commands to restore data. Generally, HP SMH is simpler than HP-UX commands. If your backup was created by the `fbackup` command (which HP SMH uses), you can use HP SMH or the `frecover` command to restore the files from your backup.

Restoring Your Data Using HP-UX Commands

The command restores backup files made using the fbackup utility. If your files were not created with fbackup, you will need to use another utility. See "Choosing a Backup/Recovery Utility" (page 122).

To restore files from backups using `frecover`:

1. Ensure that you have superuser capabilities.
2. Ensure that files you intend to restore are not being accessed. The `frecover` command will not restore files that are active (open) or locked.
3. Verify that the backup device is properly connected.
4. Verify that the device is turned on.
5. Ensure that the device is loaded with the appropriate backup tape.
6. Restore files using the `frecover` command.

The `-r` option to the `frecover` command is generally used for recovering *all* files from your backup; the `-x` option is used for restoring *individual* files to your system. For complete details, see *frecover*(1M).

Restoring Files that are NFS Mounted

When restoring files that are NFS mounted to your system, `frecover` can only restore those files having "other user" write permission. To ensure the correct permissions, log in as superuser on the NFS file server and use the `/usr/sbin/share` command to export the appropriate permissions. For more information, see *share*(1M) and *NFS Administrator's Guide*.

Restoring Large Files

If you use a utility such as `fbackup` to back up large files (> 2 GB), then those files can only be restored on a large file system. For instance, suppose that you back up a 64-bit

file system containing large files; you cannot restore those files to a 32-bit file system that is not enabled for large files.

If a backup contains large files and an attempt is made to restore the files on a file system that does not support large files, the large files will be skipped.

Examples of Restoring Data

Here are some examples of restoring data:

- To restore the files using `frecover` in the directory `/home/deptA` from a DDS format (DAT) tape:

  ```
  frecover -x -i /home/deptA
  ```

  If files are currently in a directory on the disk that is newer than the corresponding files on the tape, `frecover` will *not* overwrite the newer version on disk because the `-o` option is not specified.

- To restore the files using `frecover` from all of the directories under `/home/text` from a DDS format (DAT) tape into the `/tmp` directory on the system:

  ```
  cd /tmp
  frecover -x -oF -i /home/text
  ```

  The `-F` option removes leading path names from all files on the tape that meet the include criteria. If there are files in the directory `/tmp` whose names match those coming from tape, specifying the `-o` option overwrites the version on disk, even if the copy on disk is newer. The `/tmp` directory now contains all of the files that were backed up from `/home/text` without the leading directories.

Examples of Restoring Data Remotely

Here are some examples of restoring data remotely (across the network):

- To use `frecover` to restore files across the network, enter:

  ```
  frecover -r -vf remote-system:/dev/rmt/0m
  ```

- To use the `tar` command to restore files across the network, enter:

  ```
  remsh remote-system -l user dd if=/dev/rmt/0m bs=7k \
    | tar -xvf -
  ```

  If the `tar` backup used relative paths, the files will be restored relative to the current directory. If absolute paths were used, the files will be restored to their original paths.

Recovering From a System Crash

IMPORTANT: To protect your data, you should create a recovery plan to be used in the event of a system crash.

You can create a recovery archive of an existing system using Ignite-UX.. To obtain the system recovery features and manpages, install Ignite-UX from the Application Release media and choose the bundle that matches your release.

For detailed information, see the *Installing and Updating Ignite-UX* and *HP-UX 11i v3 Installation and Update Guide*.

Backing Up and Recovering Directories: Quick Reference for tar

The following examples may be useful for users wanting to make a quick backup to tape or disk. For information on system backup, see "Backing Up Data" (page 120).

- To create a tar backup to tape:

  `tar cv /home/me/mystuff /work/project5/mystuff`

  This can include files and directories.

NOTE: This overwrites anything already on the tape.

- `v` (verbose) is optional throughout.
- `tar` assumes the system default tape device file `/dev/rmt/0m`; this is implicit in all the tape examples that follow. You can specify a different device file (or a disk file; see the next example) by means of the `f` option.

- To add files to the tape only if they are not already there, or have been modified since they were last written to the tape:

  `tar uv /home/me`

  New and changed files in the directory `/home/me` are added to the end of the tape (old versions of the files are not overwritten on the tape).

- To find out what's already on the tape:

  `tar tv`

- To write out the tape table of contents to a file:

  `tar tv > /home/me/backup.12.26.2007`

- To print out the tape table of contents:

  `tar tv | lp` *`lp_options`*

- To extract a file (get it back off the tape):

  `tar x /users/me/mystuff/needed`

- To extract a directory (and any of its sub-directories)

  `tar x /users/me/mystuff`

- To restore all the files on the tape (write them back to disk):

  `tar x`

NOTE: `tar` recreates the directories on the tape if they aren't already on the system.

How To:

Determining What Version of the HP-UX Operating System is Running

To determine what version of operating system you are running and on which platform, use the `uname` command with the `-a` option:

`uname -a`

```
HP-UX tavi B.11.31 A 9000/800 1920004321 two-user license
```

In the example above, the system returned the following information:

`HP-UX`	Operating system name
`tavi`	System name
`B.11.31`	Operating system release identifier
`A`	Operating system version identifier
`9000/800`	Machine and model numbers
`1290005321`	Machine identification number
`two-user license`	Operating system license level

For more information about `uname`, see *uname*(1).

NOTE: The system release identifier B.11.31 corresponds with HP-UX 11i Version 3.

Checking the System's Run Level

To find out what run level the system is in (for example if you want to check that you are in single-user mode) enter:

`who -r`

The run level is the number in the third field from the right.

For example, this output

```
run-level 4 Apr 23 16:37 4 0 S
```

means that the system is in run-level 4.

Scheduling a cron Job

To schedule a job in `cron` (as `root`):

1. Run the command: `crontab -e root` (you can replace `root` with a different user name to edit the respective user's `crontab` file). This will open an editor, allowing you to create or change `crontab` entries.
2. Edit the entries as appropriate:

   Add an entry; for example,

   ```
   0 12 * * * tar cv /work /home >/tarlog 2>&1
   ```

   takes a `tar` backup of `/work` and `/home` every day at noon.

   Here's how this works (the letters under the first five fields of the example are keyed to the explanations that follow):

   ```
   0 12 * * * tar cv /work /home 1>/tarlog 2>&1A B C D E
   ```

   - A = minute
   - B = hour
   - C = day of the month
   - D = month of the year
   - E = day of the week (0 = Sunday)
   - An asterisk (`*`) means all legal values, so the asterisks in fields C, D, and E mean do it every day of the year. Note that standard output and standard error are redirected to `/tarlog`.

   See "Creating an Automated Backup Schedule" (page 133) for additional information and examples on how to format cron file entries.

3. When you exit the editor, `crontab` will automatically copy the entries to the user's `crontab` file.

See *cron*(1M) and *crontab*(1) for more information.

Adding Users to a Workgroup

This section includes the following topics:

- "Accessing Multiple Systems" (page 142)
- "Sharing Remote Work Directories" (page 143)
- "Local versus Remote Home Directories" (page 143)
- "Adding a User to Several Systems: A Case Study" (page 144)
- "Exporting a Local Home Directory" (page 146)

Accessing Multiple Systems

If a user has an account with the same login on more than one system, (for example, if the user's `$HOME` directory is NFS-mounted from a file server) the UID number should be the same on all of these systems.

For example, suppose user `thomas` has a UID of 200 on system `tmsystem1` and imports files to `tmsystem2` where he has a UID of 330. If the files created on `tmsystem1` have permissions of `-rw-------`, then they will not be accessible to him from `tmsystem2`. HP-UX determines file ownership by the UID, not by the user name.

As system administrator, you should ensure that each new user login name has a corresponding UID that is unique within the workgroup, site, or network that the user needs to reach.

See *HP-UX System Administrator's Guide: Configuration Management*.

To allow a user to access a remote system using`rcp` or `remsh` or to use `rlogin` without supplying a password, set up `$HOME/.rhosts`file on the remote system.

$HOME/.rhosts file

Users listed in the `$HOME/.rhosts` file are allowed access to the local system, from the remote systems and accounts named in the file, without supplying a password. This file should be owned by the local user.

In the following example, `/home/evan/.rhosts` resides on system `et6700`. Users `zac` and `matthew` can log in to `evan`'s account on `et6700`, from `zship` and `checker` respectively, without supplying a password.

```
zship zac
checker matthew
```

NOTE: Your site security policies might not allow you to use a `$HOME/.rhosts` file or allow the use of `remsh` or `rcp`. If this is the case, consider using the secure shell (`ssh`) and secure copy (`scp`) commands instead.

Sharing Remote Work Directories

After you have created a new user's account, you must decide which directories within the workgroup the user needs to access. NFS allows users to use their own systems to work on files residing on other file servers. The server or remote system **shares** the user's system and the user's system **imports** from the remote system.

The topic "Adding a User to Several Systems: A Case Study" (page 144) illustrates how you might set up your users.

Local versus Remote Home Directories

Users can have their home directory on their own local system or on a remote file server. The advantage of keeping all users' home directories on one file server is that you can back up all the accounts at one time.

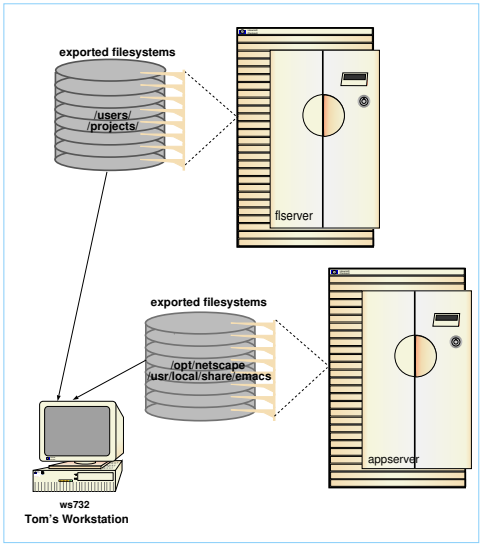
If a user's home directory is on a remote server, you may want to create a minimal home directory on the local system so that a user can still log into the local system if the server is down. See *HP-UX System Administrator's Guide: Configuration Management*.

See "Adding a User to Several Systems: A Case Study" (page 144) for steps to create a home directory on a remote system.

Adding a User to Several Systems: A Case Study

The following example shows how to import Tom's home directory and work directory from the file server, `flserver`, and import Emacs and Netscape from the application server, `appserver`.

Figure 3-1 Adding a User to Several Systems



Before beginning, make sure Tom's login name has a UID number that is unique across the systems he is going to use. (Your network administrator may have a program to ensure uniqueness of UID numbers.)

Then create an account for Tom on the file server, `flserver`. See *HP-UX System Administrator's Guide: Configuration Management*.

Then do the following procedure:

1. On the file server, `flserver`, share Tom's `home` directory (`/home/tom`) and the `projects` directory where he does his work (`/projects/work`):
   a. Add an entry to the `/etc/dfs/dfstab` file to share Tom's `home` directory:

      ```
      share -F nfs -o -async,anon=65534 -d "home dir" /home/tom
      ```

      If the directory is already shared, simply add the user's system to the access list.

   b. Add an entry to the `/etc/dfs/dfstab` file to share the `/projects/work` directory:

      ```
      share -F nfs -o -async,anon=65534 -d "work" /projects/work
      ```

      This contains the files and directories Tom will share with other members of his project team.

   c. Force the server to re-read `/etc/dfs/dfstab` and activate the new shares for `/projects/work` and `/home/tom`:

      ```
      shareall -F nfs
      ```

2. On the application server, share the directories (`emacs` and `netscape`) that Tom needs:
   a. Add entries to the `/etc/dfs/dfstab` file:

      ```
      share -F nfs -o async,anon=65534 -d "emacs" /usr/local/share/emacs
      share -F nfs -o async,anon=65534 -d "emacs" /opt/hp/gnu/bin700/emacs
      share -F nfs -o async,anon=65534 -d "netscape" /opt/netscape
      ```

   b. Export the directories for `emacs` and `netscape`:

      ```
      sharall -F nfs
      ```

3. On Tom's system, wsb2600, do the following:
   a. Create Tom's account. See *HP-UX System Administrator's Guide: Configuration Management*. If Tom's login has already been set up on another system (for example on flserver) you may want to cut the line from flserver's /etc/passwd file and paste it into the /etc/passwd file on wsb2600 to ensure that Tom's account has the same UID number on both systems.
   b. Create empty directories for the file systems to be imported.

      ```
      mkdir /home/tom
      mkdir /projects/work
      mkdir /usr/local/share/emacs
      mkdir /opt/hp/gnu/bin700/emacs
      mkdir /opt/netscape
      ```

   c. Add entries to /etc/fstab.

      ```
      flsserver:/home/tom /home/tom nfs rw,suid 0 0
      flserver:/work /work nfs rw,suid 0 0
      appserver:/opt/netscape opt/netscape nfs rw,suid 0 0
      appserver:/usr/share/emacs/ /usr/share/emacs nfs rw,suid 0 0
      appserver:/opt/hp/gnu/bin700/emacs nfs rw,suid 0 0
      ```

   d. Mount all the directories:

      ```
      mount -a
      ```

See "Exporting a File System (HP-UX to HP-UX)" (page 147) for more information.

Exporting a Local Home Directory

Assume you are setting up an account on the system named wsj6700 for the user lisa. In this example, lisa's home directory will reside on her local disk and will be shared with the other systems she logs in on.

1. On the local system, do the following:
   a. Create the user's account. See *HP-UX System Administrator's Guide: Configuration Management*.
   b. Export the user's home directory to other systems that the user needs to log in to:
      - Add an entry, such as flserver, to /etc/dfs/dfstab:

        ```
        share -F -o async,anon=65534 -d "lisa home" /home/lisa
        ```

      - Export the home directory/home/lisa:

        ```
        shareall -F nfs
        ```

2. On the remote system, do the following:
   a. Create an empty directory:
      ```
      mkdir /home/lisa
      ```
   b. Add entry to `/etc/fstab`:
      ```
      mailserver:wsj6700:/home/lisa /home/lisa nfs rw,suid 0 0
      ```
   c. Mount all directories:
      ```
      mount -a
      ```

See "Exporting a File System (HP-UX to HP-UX)" (page 147) for more information.

Exporting a File System (HP-UX to HP-UX)

Use either of the following procedures to set up NFS shares on the server.

- "Using HP SMH to Export a File System" (page 147)
- "Using the Command Line to Export a File System" (page 147)

Using HP SMH to Export a File System

1. Log in *to the server* as root.
2. Access the HP SMH homepage. Select **Tools**, **Network Services Configuration**, **Networked File Systems**, **Share/Unshare File Systems (Export FS)**.
3. Enable NFS if necessary:
4. Choose **Share (Export) a File System ...**
5. Fill in the fields identifying the file systems to be shared, their access privileges, and the systems that can import them. Use the online help if necessary.

The shared file system should now be listed in the `/etc/dfs/sharetab` file. Additional information is contained in help.

Using the Command Line to Export a File System

1. Log into the server as root.
2. If the system is not already configured as an NFS server:
   a. Edit `/etc/rc.config.d/nfsconf`, changing the values for `NFS_SERVER` and `START_MOUNTD` to 1.
   b. Run the `nfs.server` script:
      ```
      /sbin/init.d/nfs.server start
      ```
3. Edit `/etc/dfs/sharetab`, adding an entry for each directory that is to be shared. The entry identifies the directory and (optionally) the systems that can import it. The entry should look something like this:
   ```
   /opt/netscape async,anon=65534,access=wsb2600:appserver:wsb2600:wszx6
   ```

NOTE: If *no* systems are specified for a particular file system, then *all* systems have permission to import the file system; if *any* systems are listed, then *only* those systems can import the file system.

See *dfstab*(4) for more information.

4. Share the directories:.

   ```
   shareall -F nfs
   ```

Moving Resources

Moving a System

This is a cookbook for moving a system from one subnet to another, changing the system's host name, IP address, and Domain Name Server.

NOTE: Do steps 1-10 *before* moving the system.

1. Run `set_parms`:

   ```
   /sbin/set_parms hostname
   ```

2. Change the system name when prompted.
3. Answer "no" to the "`reboot?`" question.
4. Run `set_parms` again:

   ```
   /sbin/set_parms ip_address
   ```

5. Change the system IP address when prompted.
6. Answer "no" to the "`reboot?`" question.
7. Run `set_parms` again:

   ```
   /sbin/set_parms addl_netwrk
   ```

8. Change the name and IP address of the Domain Name Server.
9. Answer "no" to the "reboot?" question.
10. When you are ready to move the system, shut it down:

    ```
    shutdown -h
    ```

11. Unplug and move the system.

NOTE: Do steps 12-13 *after* moving the system.

12. Connect and plug in the system components.
13. Boot the system.

Moving a Directory (within a File System)

From time to time, a user needs to move a directory, say from `/home/user` to `/work/project5`. The following may be helpful as a cookbook.

1. **`cp -r /home/user/subdir /work/project5/subdir`**

   Do not create `/work/project5/subdir` first.

2. **`ll -R /home/user/subdir`**
3. **`ll -R /work/project5/subdir`**
4. Compare the output of the last two commands; if they match, proceed to the next step.
5. **`rm -r /home/user/subdir`**
6. Change permissions if necessary.

   The above operation should leave the ownership intact, but if you have to invoke the root user for some reason, the new files will all be owned by root. There is an elegant way to change permissions throughout a subtree:

   `cd /work/project5/subdir`

   `find . -print | xargs chgrp usergroup`

   `find . -print | xargs chown user`

Popping the Directory Stack

You can avoid retyping long path names when moving back and forth between directories by using the hyphen (`-`) to indicate the last directory you were in; for example:

```
$pwd
/home/patrick
$cd /projects
$cd -/home/patrick
```

Continuing to Work During a Scheduled Downtime

If your file server is down and you share files from that system, those files are inaccessible to you. If you are able to use your system and the necessary software is available, copy the data files into your local directory tree and work on them there while the file server is down. You can also copy any other files or executables you need.

It is *very important* that you copy any modified files back to the appropriate location on the file server as soon as it is available again.

Also, while the file server is down, *do not* save files in the shared directory or any other mount point. Such files will be hidden when you remount the file system from the file server.

Diagramming a System's Disk Usage

It's useful (and in some circumstances essential) to have a hardcopy diagram of a system's disks and how they are used. You should create such a diagram at least for each server in the workgroup, and keep it up to date as you add and replace disks and modify the configuration.

1. Access the HP SMH Homepage.
2. Select **Tools** → **Disks and File Systems** → **Disks**. This will display a list of the disks in the system.
3. For each disk this screen shows you:
   - Hardware path (e.g., `1/0/0/3/0.6.0`).
   - Usage (e.g., `LVM`).
   - Volume group (e.g., `vg00`).
   - The disk's total capacity.

     (The usable space will be somewhat less than this, probably about 15% less altogether; see "Setting Up Logical Volumes for File Systems" in *HP-UX System Administrator's Guide: Logical Volume Management*.)

   - The disk's model number and in some cases the name of its device driver, for example, `HP C3010 SCSI Disk Drive`.
4. Select each disk, one at a time. This will display more information for the selected disk at the bottom of the page. You can then select from **Properties, LUN Attributes**, **LUN Paths**, and **Physical Volumes** tabs to display detailed information for each selected disk.
   - The device file name(s) of the logical volume(s) that occupy the disk.
   - How each logical volume is being used (e.g., `HFS`, `Swap/Dump`).
   - The amount of space, in megabytes, being used on this disk by each logical volume.

     If a logical volume is spread over more than one disk, you can use this screen to see how the space is shared among the disks.

     For example, on the system shown in the diagram, logical volume `lvol1` of volume group `vg02` is distributed across two disks, `c0t2d0` and `c0t5d0`.

   - The file system the logical volume is mounted to, if any.

     You can see how a file system is distributed across LVM disks; for example, the `/home` directory on the system shown in the diagram is mounted to `/dev/vg02/lvol1`, which occupies all of `c0t2d0` and 356 MB of `c0t5d0`.

It's useful to know the mapping of physical disk space to logical volumes and file systems, so you may want to record it on your own diagram.

Use the detailed information to begin the diagram: group the disks into their volume groups and fill in their hardware addresses and sizes; you may also want

to add the model number (e.g., `HP C3010`) and device driver name (for example, `SCSI`).

5. You can get information on the logical volumes by clicking on the **Logical Volumes** tab at the top of the page. This will display a list of logical volumes. You can then select the logical volumes one at a time to obtain similar detailed information for each logical volume.
6. Clicking on the **Volume Groups** or **File Systems** tabs at the top of the page will display additional information such as overall storage available and file system distribution.

Finding Large Files

As a preliminary to getting your users to clean up unneeded files from an overfull volume, it's useful to identify the largest files (often core files users are unaware of, postscript files they have long ago printed and been forgotten about, folders containing ancient mail, and so on). The following commands are examples of how you might look for these files:

Example 3-1 Producing a directory listing sorted by size

```
ll dirname | sort -n -k5,6
```

Example 3-2 Finding files larger than a specific size

This command pipe will provide a listing of files found within a directory tree, rooted at *dirname*, greater than 2 million characters in size:

```
find  dirname -size +2000000c|xargs ll -d
```

You can adjust the value for the size to whatever you like. You can also use other options to the `find` command to further refine your search. For example, the above command pipe can be adjusted to only look for files owned by the user `skibby`:

```
find  dirname -user skibby -size +2000000c|xargs ll -d
```

Examining File System Characteristics

To see what characteristics a file system was built with, use the `-m` option of `mkfs`. This works particularly well for VxFS:

```
#bdf | grep /work
/dev/vg01/lvol8      73728    7856   61648   11% /work
#mkfs -m /dev/vg01/lvol8
mkfs -F vxfs -o ninode=unlimited,bsize=8192,version=6,inosize=256,logsize=2048,largefiles0
#
```

NOTE: `bsize` in the resulting output is the configured block size, in bytes, of the file system `/work`. But in VxFS file systems, the configured block size determines only the block size of the **direct blocks** , typically the first blocks written out to a new file. **Indirect blocks**, typically those added to a file as it is updated over time, all have a block size of 8 kilobytes.

See *mkfs_vxfs*(1M) for an explanation of each field in the output.

You can also run `mkfs -m` on an HFS file system, but the output is less friendly, lacking the labels. `dumpfs`, with `grep` for the parameter you're interested in, is better; see "Checking NFS Server/Client Block Size" (page 192) for an example.

Managing Groups of Distributed Systems or Serviceguard Clusters

You can also use Distributed Systems Administration Utilities (DSAU) to monitor your distributed cluster or network. DSAU can apply rules to each machine in the distributed configuration. Using DSAU tools you can perform several tasks across groups of systems or in a Serviceguard cluster. For additional information, see *Distributed Systems Administration Utilities (DSAU) User's Guide*.

Adding Peripherals

To add peripherals to your system, consult the following documentation:

- The hardware installation manual that came with the peripheral.
- For PCI OL* information, see the manual *Interface Card OL* Support Guide*. For PCI OL* information on nPartition-able systems, see the manual *nPartition Administrator's Guide*.

  PCI OL*, previously known as OLAR, is the ability to add or remove a PCI card without needing to completely shutdown the entire system. The system hardware combined with operating system support allows per-slot power control. Instead of turning off the entire system, you can turn off and on power to a specific PCI slot.

  PCI latches and doorbells refer to physical latches and buttons on the system itself that allows for enabling and disabling power to a PCI slot.

  The procedures for PCI OL* can be performed through a GUI, such as `pdweb` or the Partition Manager, or through HP-UX commands, such as `rad` (`olrad` as of 11i v2). All are documented in the preceding manuals.

CAUTION: Before attempting these procedures, please read the manuals mentioned above. Turning off power to certain PCI slots can have disastrous effects; for example if the PCI slot connects to an unmirrored root or swap disk, the system will crash. Further, the I/O card itself needs to be checked for OL* functional compatibility as well as compatibility to the specific PCI slot; for example, you cannot insert a 33 MHz card to a slot running a 66 MHz bus.

- See the *HP-UX 11i Release Notes* for the titles of documents that may be relevant to installing peripherals. Such documents may contain specific information on the software driver and the device special file for communication with particular peripherals.

The easiest way to add peripherals is to run HP SMH or Partition Manager for nPartition-able systems. However, you can also add peripherals using HP-UX commands.

For HP-UX to communicate with a new peripheral device, you may need to reconfigure your system's kernel to add a new driver. If using HP-UX commands, use the `/usr/sbin/mk_kernel` command (which HP SMH uses). For details, see *mk_kernel*(1M), HP SMH online help, and *HP-UX System Administrator's Guide: Configuration Management*.

Setting Up Non-HP Terminals

To set up a user with a non-HP terminal, do the following:

1. Make sure the fileset `NONHPTERM` is on the system by using either of these methods:
   - **`swlist -l fileset NonHP-Terminfo`**

     If the fileset exists, the entry for `NonHP-Terminfo.NONHPTERM` will be displayed.
   - **`ll /var/adm/sw/products/NonHP-Terminfo`**

     If the fileset exists, the directory `/var/adm/sw/products/NonHP-Terminfo/NONHPTERM` will exist.

   If the fileset is not on the system, you will need to load it from your latest HP-UX media. See "Managing Software" (page 177) or the manual, *Software Distributor Administration Guide*, for details.
2. Look in the directory `/usr/share/lib/terminfo` for a file that corresponds to the terminal you want to set up. For example, suppose you want to set up a user with a Wyse™ 100 terminal. All supported terminals whose names begin with `w` are contained in the `/usr/share/lib/terminfo/w` directory. Because this directory contains an entry `wy100`, you have probably found the correct file. To be sure, examine the contents of the file with `more`. You will see a screen full of special characters, but near the beginning you will see `wy100|100|wyse 100`.

This verifies the correct file and shows that you can refer to the Wyse 100 by any of the names `wy100`, `100`, or `wyse 100`.

If there is a `terminfo` file for the terminal you want to add, skip the next step and go to Step 4.

If there is no `terminfo` file for the terminal you want to add, you will need to create one. See the next step for details.

3. To create a `terminfo` file, follow the directions in *terminfo*(4).

   To adapt an existing file, follow these steps:

   a. Log in as superuser.
   b. Make an ASCII copy of an existing `terminfo` file. For example, make a copy of the file `/usr/share/lib/terminfo/w/wy100` by entering:

      `untic /usr/share/lib/terminfo/w/wy100> new_file`

   c. Edit the new file to reflect the capabilities of the new terminal. Make sure you change the name(s) of the terminal in the first line.
   d. Compile the new `terminfo` file:

      `tic new_file`

      For more further information, see *tic*(1M) and *untic*(1M)

4. Set the user's `TERM` variable in the appropriate login script (either `.profile` for Korn and POSIX shell users or `.login` for C shell users in their home directory) to any of the names you uncovered in Step 2. For example:

   `export TERM=wy100` *`(Korn or POSIX shell)`*

   `setenv TERM wy100` *`(C shell)`*

   The default versions of these scripts prompt the user for the terminal type upon log in, so rather than editing the script, you could simply tell the user to respond with the terminal name. For example:

   `TERM = (hp)` **`wy100`**

   You can also set the `TERM` variable with the `/sbin/ttytype` command.

Troubleshooting Problems with Terminals

There are a number of terminal related problems that can occur. Many of these result in a terminal that appears not to communicate with the computer. Other problems cause "garbage" to appear on the screen (either instead of the data you expected or intermixed with your data).

This section primarily addresses problems with alpha-numeric display terminals; however, many of the steps discussed here can also be applied to problems with terminal emulators such as HP AdvanceLink (running on a Vectra PC) or X Window terminal processes (such as hpterm and xterm). Also see "Other Terminal Problems" (page 159).

Unresponsive Terminals

There are many things that can cause a terminal not to respond (no characters are displayed except, perhaps, those which are displayed by the terminal's local echo setting). Here is a procedure you can use to find many of them.

1. Check the status of the system.

   Is the system still up? If not, you've probably found your problem. You will need to reboot the system.

   Is the system in single user state? If so, the only active terminal will be the system console. Other terminals will not respond. You will need to switch to a multiuser state. See the *init*(1M) manpage for more information on changing run states.

NOTE: To check what run state your system is in (from a working terminal) type:

```
who -r
```

The output will look something like:

```
.       system boot   Feb 10 07:10    2    0    S
```

The current state of the machine is in the field immediately to the right of the time (third field from the right). For complete information on each of the fields, consult the *who*(1) manpage.

2. Check to see if an editor is running on the terminal.

   This is best done from another terminal. Issue the command:

   ```
   ps -ef
   ```

   Look in the column marked TTY for *all* processes associated with the terminal with which you are having problems. For each entry, check in the column marked COMMAND to see if the process represented by that entry is an editor.

   If you find that an editor *is* running at the terminal, it is probably in a text-entry mode. You will need to save the work and exit the editor. For directions on how to do this, consult the manpage for the appropriate editor.

CAUTION: If you are not sure of the status of the work being edited, *DO NOT* simply save the file and exit. You will overwrite the previous contents of the file with unknown text. Save the work in progress to a temporary file so that both the original and edited versions of the file are accessible.

3. Enter **ctrl**-**q** at the terminal keyboard.

   Terminals frequently use the XON/XOFF protocol to start and stop output to them. If output to the terminal was stopped because an XOFF signal (**ctrl**-**s**) was sent from the terminal to the computer, it can be restarted by sending the computer an

XON signal (type **ctrl**-**q** from the problem terminal's keyboard). Sending the XON signal does not harm anything even if no XOFF signal was previously sent.

If the problem is an application program that's looping or not functioning properly, try pressing the **break** key and then try **ctrl**-**C** to see if you can get a shell prompt back (**ctrl**-**C** is the default interrupt character; you might use a different one). If you need to find out what the interrupt character for the affected terminal is, go to a working terminal and enter the command:

```
stty < /dev/device_filename_for_the_problem_terminal
```

CAUTION: The `stty` command, above, should only be used with device file names for **currently active** terminal device files (use the `who` command to see which device files are active). If you attempt to execute `stty` with a non-active device file, you will hang the terminal where you entered the commands.

4. Reset the terminal.

   The terminal itself may be stuck in an unusable state. Try resetting it. Consult your terminal owner's manual for information on how to do this. Powering the terminal off, waiting for a few seconds and powering it back on will also reset the terminal.

5. Check the terminal configuration.

   The terminal might not be configured correctly. You should check the following:

   - Is the terminal in Remote * mode? *It should be*.
   - Is Block * mode turned ON? *It shouldn't be*.
   - Is Line * mode turned ON? *It shouldn't be*.
   - Is Modify * mode turned ON? *It shouldn't be*.

6. Check the physical connection.

   Check to make sure that:

   - All cables are firmly attached and in their proper locations.
   - All interface cards are firmly seated in their slots.
   - The power cord to the terminal is firmly connected.
   - The power switch is turned on.

7. Kill processes associated with the problem terminal.

CAUTION: Use *extreme caution* when killing processes. The processes will be immediately and unconditionally terminated. Some valid processes might take a long time to complete. Be sure to type carefully when entering the PID numbers for the `kill`command to avoid killing the wrong process.

If you have another terminal that is still working, go to that terminal and log in (you will need to be superuser). Execute the command:

```
ps -ef
```

The output will look similar to this:

```
UID        PID  PPID  C     STIME   TTY      TIME COMMAND
root        95     1  0   Jul 20    ?        0:00  /usr/sbin/getty -h ttyd1p0 9600
root        94     0  0   Jul 20    tty0p5   0:00  /usr/sbin/getty -h tty0p5  9600
root     22095     1  0   13:29:17  ?        0:00  /usr/sbin/getty -h ttyd2p1 9600
root     22977     1  0   14:42:28  ?        0:00  /usr/sbin/getty -h ttyd2p0 9600
root     14517     1  0   Jul 21    ttyd1p4  0:01  -csh [csh]
root       107     1  0   Jul 20    ?        0:00  /usr/sbin/getty -h ttyd3p0 9600
stevem   20133     1  0   11:20:24  ttyd2p5  0:00  -csh [csh]
```

Look in the column marked `TTY` for those processes that are associated with the terminal with which you are having problems. Look at the column marked `PID` for those entries (these are the process IDs for the processes associated with that terminal). Execute the following command, listing each process ID associated with the problem terminal:

`kill -9` *`process-id`* [*`process-id`*]...

If, in the example above, we wanted to kill the process associated with terminal *ttyd2p5*, we would execute the command:

```
kill -9 20133
```

This should kill all processes associated with that terminal. The `init` process will then respawn a `getty` process for that terminal (if it has been set up to do that, in the `/etc/inittab` file) and you should once again be able to log in.

8. Attempt to log in to the previously hung terminal again.

   If you are successful, you've fixed the problem. If not, continue to the next step.

9. Use `cat` to send an ASCII file to the hung terminal's device file.

   HP-UX communicates with peripherals through device files. These special files are typically located in the directory `/dev` and are used by HP-UX to determine which driver should be used to talk to the device (by referencing the **major number**) and to determine the address and certain characteristics of the device with which HP-UX is communicating (by referencing the **minor number**).

   Try using the `cat` command to send an ASCII file (such as `/etc/motd` or `/etc/issue`) to the device file associated with the problem terminal. For example, if your problem terminal is associated with the device file `ttyd1p4`:

   ```
   cat /etc/motd > /dev/ttyd1p4
   ```

   You should expect to see the contents of the file `/etc/motd`displayed on the terminal associated with the device file `/dev/ttyd1p4`. If you do not, continue to the next step.

10. Check the parameters of the device file for the problem terminal.

    Device files have access permissions associated with them, just as other files do. The file's access permissions must be set so that you have access to the file. If you set the files permissions mode to 622 (`crw--w--w-`), you should be safe.

If the file's permissions are set to allow write access and the file isn't displayed on the terminal, check the major and minor numbers of the device file. You can list them with the `ll` command. You can use the `lssf` command to interpret the major and minor numbers and display the results.

11. Other things to check.
    - Make sure your `inittab` entries are active

      If you are just adding this terminal and have made a new entry in the `/etc/inittab` file by editing it, remember that this doesn't automatically make your new entry active. To do that you need to, enter the command:

      ```
      init -q
      ```

      This tells the `init` process to scan the `/etc/inittab` file to update the information in its internal tables.

    - Check for functioning hardware.

      Now is the time to check the hardware. To do this, check the following items:

      — If your terminal has a self-test feature, activate it. If not, power the terminal off, wait several seconds, and power the terminal back on. This will test (at least to some degree) your terminal hardware.

      — An alternate method to test the terminal hardware is to swap the suspect terminal with a known good one. This will help identify problems within the terminal that are *not* caught by the terminal self-test.

      NOTE: Be sure to swap only the terminal (along with its keyboard and mouse). You want the known good terminal at the end of the SAME cable that the suspect terminal was plugged into). Also, plug the suspect terminal (with its keyboard and mouse) into the same cable that the known good terminal was plugged into and see if it functions there.

      — If the known good terminal doesn't function on the suspect terminal's cable, and the suspect terminal is working fine in its new location, you can be confident that the terminal itself is functioning properly and the problem is elsewhere.

      — The next thing to check is the cable connecting the terminal to the computer. Swap the suspect cable with a known good one.

      NOTE: Since you know the terminal at the end of each cable is working, you only have to swap the ends of the cables where they connect to the computer. If the problem remains with the terminal it was associated with prior to the cable swap, you probably have a broken or miswired cable. If the problem transfers to the other terminal (and the previously bad terminal/cable combination works in its new location), then the problem is most likely with your MUX, port, or interface card.

Other Terminal Problems

The other type of problem you're likely to run into with terminals is that of garbage

on the screen. Garbage on the screen comes in two types: garbage intermixed with valid data characters and complete garbage.

What to check for when garbage is mixed with valid data

The following is a list of possible reasons for garbage characters intermixed with your valid data:

- Noise on the data line:
  - RS-232 Cable too long (maximum recommended length is 50 feet)
  - Data cable near electrically noisy equipment (motors, etc.)
  - Partially shorted or broken wires within the cable
  - Noisy connection (if using phone lines)
- Hardware problem with a modem, interface card, or the terminal itself
- The program performing I/O could be sending the garbage
- The Display Functns* feature of your terminal is enabled (which displays characters that would not normally print)

What to check for when everything printed is garbage

One of the most common reasons for total garbage on the screen (and certainly the *first* thing you should check) is a Baud-rate mismatch. If your terminal's speed setting is different than that of the line (as set with the `stty` command), you will get garbage on your screen (if anything at all).

Here is a list of other possible reasons for total garbage on your screen.

If you have not yet logged in, try pressing the **break** key. This tells `getty` to try the next entry in the `/etc/gettydefs` file. The `gettydefs` file can be set up so that, as `getty` tries various entries, it will also be trying various speed settings (this is usually how it's set up). `getty` will then try various speeds (with each press of the **break** key). When the correct speed is matched, you will get a login prompt that is readable.

- The shell environment variable called `TERM` isn't set to a value appropriate to your terminal. If you have an HP terminal, try setting the value of `TERM` to `hp` (lowercase) using your shell's `set` command.
- A running process is producing garbage output
- A miswired cable
- Excessive noise on the data line
- A hardware failure (bad interface card, modem, MUX, etc.)

4 Managing Printers

NOTE: The term “plotter” can be used interchangeably with the term “printer” throughout this section. Thus, all features ascribed to printers can be performed with plotters.

- For conceptual information about print management, see *HP-UX System Administrator’s Guide: Overview*.
- For procedures to configure a print management system, see *HP-UX System Administrator’s Guide: Configuration Management*.

This chapter deals with the tasks you need to do to configure a new system into the network and the workgroup, and to set up shared access to resources such as files and printers and services such as mail and backups:

Administering the LP Spooler

The following procedures are used to administer the LP Spooler:

- “Stopping and Restarting the LP Spooler ” (page 161)
- “Controlling the Flow of Print Requests” (page 162)
- “Enabling or Disabling a Printer” (page 163)
- “Setting a Printer’s Fence Priority ” (page 163)
- “Changing a Printer’s Default Request Priority” (page 164)

Table 4-1 in “Summary of Additional Printer Tasks” (page 164) gives further system-administration instructions for common management tasks.

Table 4-2 in “Solving Common Printer Problems ” (page 165) provides troubleshooting information for potential print-management difficulties.

Table 4-3 (page 166) and Table 4-4 (page 167) list HP-UX commands that may be used to handle print requests.

Stopping and Restarting the LP Spooler

Typically, the LP spooler is started during the boot process. (To change the boot-up procedure to not start the scheduler, edit the file `/etc/rc.config.d/lp` and set the shell environment variable `LP` to `0`.)

The spooler must be stopped whenever the spooling system is modified (such as when adding or removing a printer) and then restarted after the modification is made. You can use either the HP System Management Homepage or HP-UX commands to stop or start the LP spooler.

Using HP SMH

1. Access the HP SMH homepage as root.
2. Select **Tools**, **Printer Management**, **Save or Restore Print Spooler Configuration**. This will display a tool launching page.

NOTE: If your client console is a PC, you must have an X Window Server running before executing this function.

3. Click on the Run button. This will display a printer management X Window.

   From the `Actions` pull-down menu,

   - Choose `Stop Print Spooler` to stop the LP spooler.

     HP SMH asks for confirmation before stopping the LP spooler.

   - Choose `Start LP Spooler` to start or restart the LP spooler.

     HP SMH asks whether you want it started with or without logging. If yes, logging information is kept in `/var/adm/lp/log`.

Using HP-UX Commands

1. Ensure that you have superuser capabilities.
2. Check for active print requests. Ideally, it is best to wait until there are no requests printing before stopping the LP spooler.

   `/usr/bin/lpstat -o -i`

   In the above command, the `-o` option prints the output of all output requests; the `-i` option inhibits the reporting of remote requests (that is, `lpstat` shows local requests only).

3. Stop the LP spooler.

   `/usr/sbin/lpshut`

   All active print requests will stop, but remain in the print queue.

4. Restart the LP spooler.

   `/usr/sbin/lpsched`

When the spooler is restarted, any print request actively being printed at the time the `lpshut` command was issued will be completely reprinted, regardless of how much of the request was previously printed.

Controlling the Flow of Print Requests

As superuser, you can use HP SMH or HP-UX commands to control the flow of print requests to the queues of named printers or printer classes.

Using HP-UX Commands

To allow print requests to be sent to a printer or to a printer class, use the `accept` command. For example:

```
/usr/sbin/accept laser1 jet2 lj
```

See *accept*(1M) for details.

To prevent print requests from being sent to a printer or printer class, use the `reject` command. For example:

```
/usr/sbin/reject lj
```

NOTE: If the `reject` command is executed on a printer class, but not on members of the class, users can still specify *a specific printer* (not the class) in subsequent print requests until an `accept` command on the class is reissued.

If, however, you execute `reject` for all individual printers in a class, but not for the class itself, the print requests will remain in the class request directory until at least one of the printers in the class is permitted to process print requests by the `accept` command. See *reject*(1M) for details.

Enabling or Disabling a Printer

You can use HP SMH or the HP-UX commands `enable` and `disable` to activate or deactivate a printer for printing. You do not need superuser capabilities for these commands.

You can issue individual `enable` and `disable` commands for each printer or issue one command separating each printer by blank spaces. For example:

```
/usr/bin/enable laser1 laser2 laser3
```

You can enable or disable individual printers only, not printer classes. By default, any requests printing when a printer is disabled are reprinted in their entirety when the printer is reactivated. A printer that has been disabled can still accept new print requests to be printed at a later time unless it has been prevented from doing so by the `reject` command.

See *enable*(1) and *disable*(1) for details.

Setting a Printer's Fence Priority

A **fence priority** is a value (0 to 7) associated with a printer and used to control access by print requests. A print request must have a value equal to or greater than the printer's fence priority or it will remain on the print queue.

You can assign the fence priority using HP SMH or HP-UX commands.

To use HP-UX commands, follow these steps:

1. Ensure that you have superuser capabilities.
2. Stop the LP spooler:

```
/usr/sbin/lpshut
```

For more information, see "Stopping and Restarting the LP Spooler " (page 161).

3. Set the printer's fence priority (use a value from 0 to 7). For example:

```
/usr/sbin/lpfence myprinter 5
```

4. Restart the LP spooler:

```
/usr/sbin/lpsched
```

Changing a Printer's Default Request Priority

1. Ensure that you have superuser capabilities.
2. Stop the LP spooler:

```
/usr/sbin/lpshut
```

For more information, see "Stopping and Restarting the LP Spooler " (page 161).

3. Change the priority. For example:

```
/usr/sbin/lpadmin -pmyprinter -g7
```

If you do not specify the `-g` option, the default request priority is set to zero.

4. Restart the LP spooler:

```
/usr/sbin/lpsched
```

Summary of Additional Printer Tasks

Table 4-1 summarizes additional printer tasks. See the command's manpage for details. In this table, `LJ-1234` and `LJ-1829` represent sample print requests; `lj1` and `lj2` represent printers.

Table 4-1 Additional Printing Tasks

Task	Example	Additional Information
Move a print request to another location.	`lpalt LJ-1234 -dlj2`	`lj2` is a destination printer or printer class. See *lpalt*(1).
Cancel a print request.	`cancel LJ-1234`	`LJ-1234` is a unique request ID number returned by `lp` or `lpalt`. See *cancel*(1), *lp*(1), and *lpalt*(1).
Change the priority of print requests.	`lpalt LJ-1829 -p3`	This changes `LJ-1829`'s priority to 3. See *lpalt*(1).
Display statistics about LP spooler activity.	`lpana`	To log spooler activity, start the spooler by entering `lpsched` with the `-a` option. Such data is useful for configuring the spooler system for optimum operation. See *lpana*(1M).
List request id numbers.	`lpstat -o`	See *lpstat*(1).

Table 4-1 Additional Printing Tasks *(continued)*

Task	Example	Additional Information

Move all print requests from one printer destination to another.	`lpshut`
	`lpmove lj1 lj2`
	`lpsched`
		`lj1` and `lj2` are source and destination printers or printer classes. You must issue `lpshut` and `lpsched`. See *lpmove*(1M) and *lpsched*(1M).

View the status of printers and print requests.	`lpstat`	For detailed status information on the spooler, print requests, and printers, use the `-t` option to `lpstat`. See *lpstat*(1).

Solving Common Printer Problems

Table 4-2 summarizes printer problems and possible solutions.

Table 4-2 Printer Problems and Solutions

Problem	Solution
Printer will not print.	Check to see if the printer is enabled, is accepting requests, the scheduler is running, and the device file is correct. For example, specify `lpstat -t` Make sure the printer is plugged in and turned on. Check to see whether the printer is out of paper or has a paper jam. If the printer supports both serial (RS232) and parallel interfaces, verify that the cable is properly connected to the printer and the computer, and that the printer is configured for the correct interface. If the printer is a remote printer, verify that the remote system and its spooler are running, verify that the printer is enabled and accepting requests on both local and remote systems, verify that the remote spooler daemon is running on the remote system. Check other entries in the procedure "Adding a Remote Printer to the LP Spooler " (page 169). If LP spooler was started with logging enabled, consult `/var/adm/lp/log` for possible clues about the problem.
Output being printed is not what you want.	Cancel the job. For example: `cancel laserjet-1194`

Table 4-2 Printer Problems and Solutions *(continued)*

Problem	Solution
Printing does not resume after paper jam or paper out.	To restart a listing from the beginning: 1. Take printer offline 2. Issue the `disable` command 3. Clear jam or reload paper 4. Put printer online 5. Issue the `enable` command To restart a listing from the stopping point: 1. Take printer offline. 2. Clear jam or reload paper 3. Put printer online. 4. If printing does not resume, issue the `enable` command
The LP spooler configuration needs to be restored.	Use the "`Save/Restore Print Configuration`" menu item in HP SMH.
The LP spooler will not start when using `lpsched`.	Enter **`rm /var/spool/lp/SCHEDLOCK`** and try again (you must be superuser).
The LP spooler will not stop when using `lpshut`.	Enter **`kill -15 process_id`** where *`process_id`* can be found with the **`ps -ef | grep lpsched`** command (see *ps*(1)).

Typical LP Commands for Users and LP Administrators

Any user can queue files to printers, get status of the LP system, cancel any print job, and mark printers in and out of service.

The following LP commands can be issued by any user. Consult the HP-UX manpage for options and usage.

Table 4-3 LP Spooler User Commands

Command	Description
lp(1)	Sends a print request to a printer or plotter
lpstat(1)	Prints information about the status of the LP spooler. Reports status of the scheduler, printers, printer classes, and default system printer.
cancel(1)	Cancels print requests of spooled files, specified by request IDs.
enable(1)	Changes the status of the named printer to activate it and enable it to print spooled requests.

Table 4-3 LP Spooler User Commands *(continued)*

Command	Description
disable(1)	Changes the status of a named printer to deactivate it and disable it from printing spooled requests.
lpalt(1)	Alters a printer request; issues a new request ID.

LP administrators can change the configuration of the system, mark printers in and out of service, start and stop the system.

Table 4-4 LP Administrator Commands

Command	Description
lpshut(1M)	Shuts down the printer scheduler.
lpadmin(1M)	Multifaceted command used to manage the LP spooler. Capabilities include adding/removing printers, changing class members, associating a device file with a printer, assigning an interface for a printer, setting a system default destination.
accept(1M)	Allow a print destination to accept requests.
reject(1M)	Prevent a print destination from accepting requests.
lpsched(1M)	Schedules print requests for printing to destinations; typically invoked at system startup.
lpmove(1M)	Moves requests from one printer to another.
lpfence(1M)	Defines the minimum priority for which a spooled file can be printed.

Configuring Printers to Use the LP Spooler

This section provides information on performing the following procedures:

- “Initializing the LP Spooler ” (page 168)
- “Adding a Local Printer to the LP Spooler ” (page 168)
- “Adding a Remote Printer to the LP Spooler ” (page 169)
- “Adding a Network-Based Printer” (page 172)
- “Creating a Printer Class ” (page 172)
- “Removing a Printer from the LP Spooler” (page 173)
- “Removing a Printer from a Printer Class” (page 174)
- “Removing a Printer Class” (page 175)

Initializing the LP Spooler

Before you can use the LP spooler, you must initialize it.

Using HP SMH

If you use HP SMH to add a printer, it will prompt you to initialize the LP spooler.

Using HP-UX Commands

You can use HP-UX commands to initialize the LP spooler by following these steps:

1. **Add at least one printer to the LP spooler.**

   See "Adding a Local Printer to the LP Spooler " (page 168).

2. **Tell the LP spooler to accept print requests for this printer.**

   Using the plumbing system analogy in *HP-UX System Administrator's Guide: Overview*, this is equivalent to opening the accept/reject valves `above` the holding tanks. See also"Controlling the Flow of Print Requests" (page 162).

3. **Tell the LP spooler to enable the printer for printing.**

   In the plumbing system analogy, this is equivalent to opening the enable/disable valves `below` the holding tanks. See *HP-UX System Administrator's Guide: Overview*.

4. **Turn on the LP spooler.**

   See "Stopping and Restarting the LP Spooler " (page 161).

Adding a Local Printer to the LP Spooler

NOTE: Do not confuse adding a printer to the LP spooler with adding a printer to your system: adding a printer to the LP spooler involves configuring the LP spooler, whereas adding a printer to your system involves connecting the printer to your computer and configuring the needed drivers in the kernel.

Using HP SMH

The easiest way to add a local printer to the LP spooler is to run HP SMH. HP SMH will also do some of the CDE configuration (if CDE is being used) and some of the SharedPrint configuration (if you are using a SharedPrint printer model).

Using HP-UX Commands

1. Ensure that you have superuser capabilities.
2. Stop the LP spooler:

   ```
   /usr/sbin/lpshut
   ```

   For more information, see "Stopping and Restarting the LP Spooler " (page 161).

3. Add the printer to the LP spooler. For example:

```
/usr/sbin/lpadmin -plocal_printer -v/dev/lp -mHP_model -g7
```

See *lpadmin*(1M) for details on the options. See *HP-UX System Administrator's Guide: Overview* for choices for the `-m` option.

4. If the printer being added will be the default printer, execute the following:

   ```
   /usr/sbin/lpadmin -dlocal_printer
   ```

   Allow print requests to be accepted for the newly added printer. For example:

   ```
   /usr/sbin/accept local_printer
   ```

   See "Controlling the Flow of Print Requests" (page 162) for information on `accept`.

5. Enable the newly added printer to process print requests. For example:

   ```
   /usr/bin/enable local_printer
   ```

   See "Enabling or Disabling a Printer" (page 163) for details.

6. Restart the LP spooler:

   ```
   /usr/sbin/lpsched
   ```

7. Test the printer using the LP spooler, then check the LP spooler's status. For example:

   ```
   lp -dlocal_printer /etc/passwd
   lpstat -t
   ```

Adding a Remote Printer to the LP Spooler

To familiarize yourself with remote spooling concepts, see *HP-UX System Administrator's Guide: Overview*.

The easiest way to add a printer to a remote system is to use HP SMH. If you elect to use HP-UX commands, review the HP SMH procedure, Step 4, as this information will also be required when performing the task manually.

Using HP SMH

NOTE: HP SMH does not verify that an actual printer exists on a remote system. Be sure the printer is installed and configured, and if necessary, use HP SMH to configure it on the remote system before adding it as a remote printer.

1. Access the HP SMH homepage as root.

2. Select **Tools**, **Printer Management**, **Configure Printers or Plotters**. This will display a Tool Launch page.

NOTE: If your client console is a PC, you must have an X Window Server running before executing this function.

3. If needed, enter the address of the target display console. Click on the **Run** button. An X Window is displayed showing the printer configuration page.
4. From the **Action** pulldown menu, choose **AddRemotePrinter/Plotter ...**.
5. Depending on the type of printer or plotter provide detailed configuration information such as:
   - `Printer Name`
   - `Remote System Name`
   - `Remote Printer Name`
   - `Whether Remote Printer is on a BSD system`
   - `Remote Cancel Name`
   - `Remote Status Name`
   - `Default Request Priority`
   - Whether to `Allow Anyone to Cancel a Request`
   - Whether to `Make this Printer the Default Destination`
6. When all fields are filled in, select **OK**. HP SMH returns with troubleshooting information, in case configuration was unsuccessful. Most likely problems will be related to the remote system configuration. Check as follows:
   a. Edit `/etc/services` (on remote system), and if necessary, uncomment the line beginning with `printer` by removing the#.
   b. Ensure no systems are restricted from access by `/var/adm/inetd.sec`.
   c. Make sure `rlpdaemon` is running.

Using HP-UX Commands

1. Ensure that you have superuser capabilities.
2. Stop the LP spooler:

   ```
   /usr/sbin/lpshut
   ```

   For more information, see "Stopping and Restarting the LP Spooler " (page 161).
3. Add the remote printer.
   - If the remote printer is on an HP-UX system, enter:

     ```
     lpadmin -plocal_printer -v /dev/null -mrmodel \
       -ormremote_machine -orpremote_dest -ocmrcmodel \
      -osmrsmodel
     ```

   - If the remote printer is *not* on an HP-UX system, enter:

```
lpadmin -plocal_printer -v /dev/null -mrmodel \
  -ormremote_machine -orpremote_dest -ocmrcmodel \
  -osmrsmodel -ob3
```

See *lpadmin*(1M) for details on the options. Also see *HP-UX System Administrator's Guide: Overview* for information to provide to the `-m` option.

4. Allow print requests to be accepted for the newly added remote printer. For example:

   /usr/sbin/accept *local_printer*

5. If the printer being added will be the default printer, execute the following:

   /usr/sbin/lpadmin -d*local_printer*

6. Enable the newly added printer to process print requests. For example:

   /usr/bin/enable *local_printer*

7. Restart the LP spooler to process print requests.

   /usr/sbin/lpsched

8. Send a sample print job to the printer.
   - If it prints, the remote printing daemon (`rlpdaemon`) is active on the system and your task is completed.
   - If your print job does not print, the remote printing daemon (`rlpdaemon`) is not active yet on the remote machine. Activate the `rlpdaemon` on the host system where the remote printer resides, as follows in the next step.

9. Examine the file `/etc/inetd.conf` and look for the following line:

   ```
   # printer stream tcp nowait root /usr/sbin/rlpdaemon rlpdaemon -i
   ```

   If a # sign appears at the beginning of the line, the `rlpdaemon` line is commented out, preventing the printer from printing remotely.

   Edit the file `/etc/inetd.conf` to remove the # sign. Save the file.

10. Check `/etc/services` and look for:

    ```
    # printer 515/tcp spooler #remote print spooling
    ```

    If a # sign appears at the beginning of the line, the service is commented out, preventing the remote print spooler from serving the printer.

    Edit the file to remove the # sign in the first column. Save the file.

11. Reconfigure the Internet daemon `inetd`, forcing it to reread the `/etc/inetd.conf` file. Invoke the following command:

    /usr/sbin/inetd -c

    Also, check entries in `/var/adm/inetd.sec` that restrict which systems can send remote print requests.

12. Test the printer using the LP spooler, then check the LP spooler's status. For example:

```
lp -dlocal_printer /etc/passwd
lpstat -t
```

Adding a Network-Based Printer

Using HP SMH

You can use HP SMH to add a network-based printer that uses the HP JetDirect Network Interface. The HP JetDirect software must be installed on your system and you must be prepared to provide SMH with the following:

- the printer's node name (the name associated with an Internet address)
- the local name that the LP spooler will use to refer to the printer.

With HP JetDirect, printers can connect directly to the network. The printer uses a LAN connection and the HP JetDirect software transmits prints requests. For more information, see *HP JetDirect Network Interface Configuration Guide*.

Using HP-UX Commands

If you do not use HP SMH, follow the instructions shipped with your printer or the network interface card for the printer.

Creating a Printer Class

For conceptual information, read *HP-UX System Administrator's Guide: Overview*.

You can use HP SMH to add a printer to a printer class when the printer is being added to the spooler; otherwise, you must use HP-UX commands. To use HP-UX commands, follow these steps after several printers have been added to the LP spooler:

1. Ensure that you have superuser capabilities.
2. Stop the LP spooler:

   ```
   /usr/sbin/lpshut
   ```

   For more information, see "Stopping and Restarting the LP Spooler " (page 161).
3. Create the printer class, specifying the printer you want to add to the class of printers.

   For example, to add a printer named `laser1` to the class of printers named `laser`, enter:

   ```
   /usr/sbin/lpadmin -plaser1 -claser
   ```

   Only one printer can be added to a class at a time. If you have more than one printer to add, repeat this command.
4. Allow print requests to be accepted for the newly added printer class. For example:

   ```
   /usr/sbin/accept laser
   ```

5. Restart the LP spooler:

   ```
   /usr/sbin/lpsched
   ```

Removing a Printer from the LP Spooler

Using HP SMH

1. Access the HP SMH homepage as root.
2. Select **Tools**, **Printer Management**, **Configure Printers or Plotters**. This will display a Tool Launch page.

NOTE: If your client console is a PC, you must have an X Window Server running before executing this function.

3. If needed, enter the address of the target display console. Click on the **Run** button. An X Window is displayed showing the printer configuration page.
4. From the **Action** pulldown menu, choose **Remove ...**. A dialog is displayed asking that you confirm the removal.

NOTE: HP SMH asks for confirmation before removing the printer from the LP spooler. If print jobs remain in the printer's queue or if the printer is the system default destination, HP SMH notifies you. If you choose to remove a printer with jobs in its queue, HP SMH cancels them.

5. Confirm the removal, Click **YES**.

Using HP-UX commands

1. Ensure that you have superuser capabilities.
2. (Optional): Notify users that you are removing the printer from the system.
3. Remove the printer from the configuration file of any software application through which the device is accessed. (See the documentation accompanying the software application for instructions.)
4. Stop the LP spooler:

   ```
   /usr/sbin/lpshut
   ```

   For more information, see "Stopping and Restarting the LP Spooler " (page 161).

5. (Optional): Deny any further print requests for the printer. For example:

   ```
   /usr/sbin/reject -r"Use alternate printer." laser1
   ```

   By doing this step, you can be assured that no new jobs will appear before you remove the printer.

   Users will see the message "`Use alternate printer`" when they direct requests to a rejected destination if the printer has not been removed. Once the printer has

been removed and users try to send a request, they will see the message "`Destination printer_name non-existent`". See "Controlling the Flow of Print Requests" (page 162).

6. (Optional): Determine if there are any jobs in the printer's queue. For example:

   ```
   /usr/bin/lpstat -o laser1
   ```

7. (Optional): Disable the printer to be removed. For example:

   ```
   /usr/bin/disable -r"Printer laser1 is disabled." laser1
   ```

   You would issue the above `disable` command if there are jobs in the printer's queue and you do not want to wait for them to print before removing the printer. Issuing the `disable` command shuts the printer down in an orderly manner.

   For more information, see "Enabling or Disabling a Printer" (page 163). Note that you can also specify the `-c` option to the `disable` command to cancel all print requests for the printer.

8. (Optional): If there are no jobs in the printer's queue, go on to Step 9. If there are jobs, decide whether to move all pending print requests in the request directory to another printer request directory or to cancel any requests. For example, to move print requests:

   ```
   /usr/sbin/lpmove laser1 laser2
   ```

   To cancel any requests:

   ```
   /usr/bin/cancel laser1
   ```

9. Remove the printer from the LP spooler. For example:

   ```
   /usr/sbin/lpadmin -xlaser1
   ```

10. Restart the LP spooler:

    ```
    /usr/sbin/lpsched
    ```

    See *lpshut*(1M), *lpadmin*(1M), and *lpsched*(1M) for details on the command options.

Removing a Printer from a Printer Class

Read *HP-UX System Administrator's Guide: Overview* to familiarize yourself with this concept.

NOTE: You cannot use HP SMH to remove a printer from a class.

Using HP-UX commands

1. Ensure that you have superuser capabilities.
2. Stop the LP spooler:

   ```
   /usr/sbin/lpshut
   ```

For more information, see “Stopping and Restarting the LP Spooler ” (page 161).

3. Remove the printer from the class. For example:

   ```
   /usr/sbin/lpadmin -plaser1 -rclass
   ```

4. Restart the LP spooler:

   ```
   /usr/sbin/lpsched
   ```

See *lpshut*(1M), *lpadmin*(1M), and *lpsched*(1M) for details on the command options.

Removing a Printer Class

See *HP-UX System Administrator's Guide: Overview* to familiarize yourself with this concept.

NOTE: You cannot use HP SMH to remove a printer class.

Using HP-UX commands

1. Ensure that you have superuser capabilities.
2. Stop the LP spooler:

   ```
   /usr/sbin/lpshut
   ```

   For more information, see “Stopping and Restarting the LP Spooler ” (page 161).

3. (Optional): Deny any further print requests for the printer. For example:

   ```
   /usr/sbin/reject -r"Use alternate printer." laser1
   ```

4. (Optional): Determine if there are any jobs in the printer's queue. For example:

   ```
   /usr/bin/lpstat -o laser1
   ```

5. (Optional): Move all pending print requests in the request directory for the printer class to another printer or printer class. For example:

   ```
   /usr/sbin/lpmove laser1 laser2
   ```

6. Remove the printer class. For example:

   ```
   /usr/sbin/lpadmin -xlaser
   ```

7. Restart the LP spooler:

   ```
   /usr/sbin/lpsched
   ```

   See *lpshut*(1M), *reject*(1M), *lpmove*(1M), *lpadmin*(1M), and *lpsched*(1M) for details on the command options.

NOTE: When you remove a printer class, the printers in the class are not removed — you may still use them as individual printers. If you remove all printers from a class, that printer class is automatically removed.

5 Managing Software

The following applications help you manage your applications and operating system software:

- Software Distributor enables you to manage and distribute both operating system software and application software. See "Software Distributor (SD-UX)" below.
- Software Package Builder provides a visual method to create and edit software packages using the HP-UX Software Distributor (SD) package format. See "Software Package Builder (SPB)" (page 184).
- Ignite-UX is a tool used for installing new systems. Ignite-UX will help create a golden disk, distribute it, customize it and reinstall it to local or remote systems with a minimum of administrator intervention.

  See *Ignite-UX Administration Guide* for details.

Software Distributor (SD-UX)

You can manage and distribute both operating system software and application software on a local system with Software Distributor (SD-UX). SD-UX consists of a set of commands and is part of the HP-UX operating system.

Some basics of SD-UX are presented here. For information about SD-UX, see *Software Distributor Administration Guide*.

With SD-UX, you can do the following tasks:

- Install update software on local system. See "Adding Software" (page 180).
- List software that is installed on a system or on various media. See "Listing Software" (page 182).
- Remove software from a system. See "Removing Software" (page 183).
- Build a network host (distribution depot). See "SD-UX Roles" (page 183) and "Setting up a Network Host (Building a Depot)" (page 185)
- Copy software from a distribution source or media onto a system.
- Verify compatibility of software products with your system.
- Create software packages that make later software installations quicker and easier.
- Configure installed software.

For a list of SD-UX commands, see Table 5-1: "SD-UX Command Summary" (page 180).

SD-UX Software Structure

SD-UX commands work on a hierarchy of software objects. Here are the terms used to describe the SD-UX objects.

Bundles	Collections of filesets, possibly from several different products, encapsulated by HP for a specific purpose. All HP-UX 11.x operating system software is packaged in bundles. Example of a bundle is: `HPUXMinRuntime B.11.31 English HP-UX Minimum Runtime Environment`
Products	Collections of subproducts (optional) and filesets. The SD-UX commands focus on products but still allow you to specify subproducts and filesets. Example of a product is: `Networking HP-UX_LanLink_Product`

Subproducts	Groups of logically related filesets within a product if the product contains several filesets.
	Examples of subproducts are:
	`Networking.Runtime`
	`Networking.MinimumRuntime`

Filesets	Files and control scripts that make up a product. This is the smallest manageable (selectable) SD-UX software object. Filesets are only part of a single product but could be included in several different HP-UX bundles, and more than one subproduct.
	The Runtime subproduct contains all the filesets in the MinimumRuntime subproduct as well as some additional filesets.
	Examples of filesets are:
	`Networking.LAN-KRN`
	`Networking.LAN-PRG`
	`Networking.LAN-RUN`
	The `Networking.LAN-KRN` and `Networking.LAN-RUN` filesets are part of bundle `HPUXMinRuntime`.
	The first three are included in both the subproducts,
	`Networking.Runtime` and `Networking.MinimumRuntime`
	The `Networking.LAN-PRG` fileset is also part of the `HPUXMinRuntime` bundle and is included in the `Networking.Development` subproduct.

SD-UX commands refer to this product structure in the form:

`bundle[.]` or `product[.[subproduct.]fileset]`

Location of Software

Software, packaged in SD-format, is stored in a **depot**. Any system can store one or more depots. A depot is a repository which holds all the needed pieces for installation of the software. You create a depot by copying software directly to it (using the SD-UX`swcopy` command) from either a tape or CD/DVD or by creating a software package within it (using the `swpackage` command). Before you can use the depot you must register it (using the `swreg` command). It can then be used as the source for installation tasks with the `swinstall` command which is executed on the target machine.

There are two types of depots:

Directory Depot	Software in a directory depot is stored under a normal directory on your file system (by default `/var/spool/sw`). When using the SD-UX commands, refer to a directory depot via its top most directory. In a CD/DVD depot, the directory would be the media's mount point.
Tape Depot	Software in a tape depot is formatted as a tar archive. Tape depots such as cartridge tapes, DAT and 9-track tape are referred to by the file system path to the tape drive's device file. A tape depot can only be created by using`swpackage` and it cannot be verified or modified with SD-UX commands. You cannot copy software (using `swcopy`) directly to a tape; use `swpackage` for this operation. Software in a tape depot may be installed directly on a local host, but must first be transferred to a directory depot before it can be "pulled" by other hosts on the network. A tape depot can be accessed by only one command at a time.

NOTE: If you administer software for systems, you should create separate depots for each.

SD-UX Tasks

SD-UX commands can be executed from the command line. However, SD-UX provides a graphical and terminal user interface for the commonly used commands: `swinstall`, `swcopy`, `swremove`, and on 11.x, `swlist -i`.

The most common SD-UX tasks are:

- `swinstall`. See "Adding Software" (page 180)
- `swlist`. See "Listing Software" (page 182)
- `swremove`. See "Removing Software" (page 183)

The following table shows lists some of the other SD-UX functions.

Table 5-1 SD-UX Command Summary

Command	Purpose
`swinstall`	Install software
`swremove`	Remove software
`swpackage`	Package software into a depot
`swcopy`	Copy software from one depot to another
`swlist`	List software in a depot or installed on a system
`swreg`	Make a depot visible to other systems
`swverify`	Verify the integrity of installed software and depot software
`swconfig`	Configure and unconfigure installed software
`swacl`	Change access to SD-UX software objects
`swagentd`	Serve local or remote SD software management tasks, including invoking a `swagent` command
`swask`	Run interactive request scripts
`swmodify`	Modify software products
`sd`	Start the Job Browser GUI

For information about SD-UX, see *Software Distributor Administration Guide*.

Adding Software

1. Type `/usr/sbin/swinstall`.

   If you have the DISPLAY variable set, `swinstall` will run using a graphical user interface; otherwise a terminal interface is presented.

2. Click on `Source Host Name` and choose the system from which to install.
3. Click on `Source Depot Path` and choose a registered depot from which to install.
4. Select the bundle/product/fileset to be installed.

   You may select:

   - bundles
   - products
   - filesets

   To select an item, move the cursor to the bundle and press **Return** or **Space**. You can select one or more items and mark them for installation.

To see all subsets belonging to a bundle or product, choose`Open`. You can do this when only one item is selected.

To see a description of the item (if there is one), select the item and choose `Show Description Of Software`.

To update all parts of your operating system with new software found on the update media, select `Match What Target Has`.

NOTE: By default, `swinstall` does not reinstall filesets if the same revision already exists on your system. If you want to reinstall the same revision (for example if some files are lost), you can change the installation options by choosing`Options/Change Option`.

Installing a product or a fileset may automatically install dependent filesets necessary to run the selected item(s).

5. Choose `Action/Install (analysis)` to start the installation process.

   The installation process is divided into four phases:

Install Analysis	Checks dependencies, verifies that all files can be installed correctly and defines the sequence of installation so that, for example, only one kernel rebuild should be necessary even if there are more filesets which require a new kernel.
Execution Phase	Performs pre-install tasks if necessary and installs filesets.
Post_install	Performs post-installation activities, such as rebuilding of kernel and system reboot.
Configuration Phase	Configures installed filesets for your system. In some cases this must be done after the system is rebooted. This is done with the script `/sbin/rc2.d/S120swconfig` which is a link to `/sbin/init.d/swconfig`.

   Information about the installation is logged in `/var/adm/sw/swinstall.log` and `/var/adm/sw/swagent.log`. You open the `swagent.log` log file during the installation process by pressing `Logfile...`. Check the log file for errors.

Installing Protected Software

Most HP software products are shipped to you on DVD optical media as “protected” products. That is, they cannot be installed or copied unless a “codeword” and “customer ID” are provided by you. Software that is unlocked by a codeword may only be used on computers for which you have a valid license to use that software. *It is your responsibility to ensure that the codeword and software are used in this manner*.

The codeword for a particular software product is found on the DVD certificate which you receive from HP. It shows the codeword along with the customer ID for which the codeword is valid. One codeword usually unlocks all the products on a DVD which you have purchased. When an additional HP software product is purchased, an additional codeword will be provided by HP. Just enter the new codeword and customer ID and they will be merged with any previously entered codewords.

A codeword for a particular customer ID and DVD only needs to be entered once per target system. The codeword and customer ID are stored for future reference in `/var/adm/sw/.codewords`. SD-UX will prompt you for these codewords or numbers prior to the installation of protected software. You can enter or change the numbers via the SD-UX graphical user interface (using `Add New Codeword` from the `Actions` menu) or by using the appropriate default (`-x codeword=`*xxxx* and `-x customer_id=`*xxx*) on the command line.

Here is a sample DVD certificate.

Figure 5-1 Sample DVD Certificate

HP Sales Order Number: 12345678-90123C
Date:16Nov97

DISC PART#:B3108-31083
CUSTOMER ID:12345678-90123C
CODEWORD:
1234 5678 9012 3456 7890 1234 5678

PRODUCT NUMBER	PRODUCT DESCRIPTION
B2491A	MirrorDisk/UX
B3701AA	GlancePlus Pak

Listing Software

With `swlist` you can do the following:

- Specify the “level” (bundles, products, subproducts, filesets or files) to show in your list.
- Show the product structure of software selections.
- Show software attributes, such as size, revision, and vendor.
- Display the depots on a specified system.

Some examples follow:

Table 5-2 Example Tasks and Commands

Example Task	Command
To list the software installed at root (/) on your local system	`swlist`
To list the software in the depot named `/mydepot`	`swlist -d @ /mydepot`
To list the depots on `appserver`	`swlist -l depot @ appserver`
To list all files that are part of the LVM product	`swlist -l file LVM`
To list files using the SD-UX graphical user interface on 11.x	`swlist -i`

You can use HP SMH to list software:

1. Access the HP SMH Homepage.
2. Select **Tools**, **Software Management**, and **List Depot Software** (or **List Installed Software)**. This will display the **List Depot Software** page.

NOTE: If your client console is a PC, you must have an X Window Server running before executing these functions.

3. If needed, enter the address of the target display console. Click on the **Run** button. An X Window is displayed showing a list of software bundles available in the depot. If the default location for the software bundles is not correct or if you wish to list software bundles on a different system or directory, you can enter the new address.

See the *swlist*(1M) manpage for additional information.

Removing Software

To remove software, use `/usr/sbin/swremove`. You select the software to remove and the system checks dependencies between selected and remaining software. If a fileset is required by another bundle, that fileset is not removed. See the *swremove*(1M) manpage.

SD-UX Roles

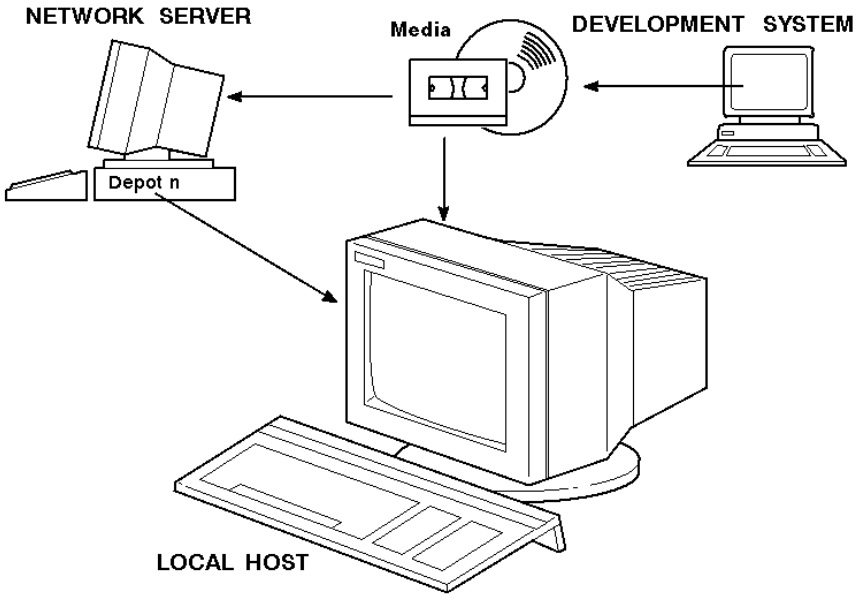
Within your environment, an individual system can play one or more SD-UX roles: development host, local host, or network host (distribution depot). The SD-UX command determines the specific role a host plays and therefore its role can change at any time.

Software is created on the development environment and individual filesets are “packaged” for further distribution. The SD-UX `swpackage` command prepares software products and filesets so they can be easily distributed and managed by other SD-UX commands.

A local host is any system where software is to be installed or managed.

A network host contains one or more depots and is connected to a network. It can act as a common software installation source for other network clients. You copy software from a depot to the network host. From the network host, you can copy software to systems as needed.

Figure 5-2 SD-UX Roles



Software Package Builder (SPB)

Software Package Builder (SPB) provides a visual method to create and edit software packages using the HP-UX Software Distributor (SD) package format. Once software is packaged, it can easily be transferred to a distribution medium, mass produced, and installed by administrators.

The SPB graphical user interface (GUI) provides a window into the software package structure, showing attributes that can be set for each package element. SPB dynamically loads packaging policies and validates software package attributes against these policies. The SPB command line interface can also perform validation of software package attributes against policies.

Using SPB you can do the following:

- Create a product specification file (PSF) to organize files into products, filesets, and optionally, into bundles and subproducts.
- Set attribute values to define the software package characteristics such as revision, architecture, file permissions, and dependencies.

- With control scripts, further customize how the software is handled when installing or removing it on the destination system.
- Validate the PSF against packaging policies to ensure successful installation with the `swpackage` command and creation of an SD depot.
- Edit and validate the PSF automatically as part of the nightly build process using SPB's command line interface.

See *Getting Started with Software Package Builder* for more information.

Setting up a Network Host (Building a Depot)

Installation from a network host is faster than from tape or DVD, and it is more convenient for users than having to transport tapes or disks.

A system connected to a network can act as a common software installation source for other network clients and can contain one or more depots. To set up a network source for software, do the following:

1. Copy software from a depot, DVD, or tape to the network server.

   By default, the `swcopy` command "registers" newly created depots. A registered depot makes software visible to other applications such as `swinstall`. Therefore, one system can be the central repository where your users can obtain software. See the *swreg*(1M) manpage.

   - See "Copying Software From a Depot with the SD User Interface" (page 185)
   - See "Copying Software From DVD" (page 185)
   - See "Copying Software From Tape" (page 186)
2. Copy software from the network host to the systems as needed.

Copying Software From a Depot with the SD User Interface

To copy software from a depot, start the SD-UX graphical or terminal user interface. Type:

`/usr/sbin/swinstall`

or

`/usr/sbin/swcopy`

`swinstall` automatically configures your system to run the software when it is installed; configuration is not done with `swcopy`.

Copying Software From DVD

1. Make sure the DVD drive is mounted. You can use HP SMH or the *mount*(1M) command to do this.
2. Register the DVD drive.

   For example to register a DVD mounted at `/cdrom`, type:

```
/usr/sbin/swreg -l depot /cdrom
```

3. Copy all or part of the contents of the DVD to hard disk and use that as a network software depot. (It is better to copy too much than too little.)

For example, to copy all the software on a DVD into a depot at `/usr/main_depot` and automatically register it:

```
/usr/sbin/swcopy -s /cdrom "*" @ /usr/main_depot
```

Or, using `swcopy` in interactive mode (using screens like those you see in `snoop`):

```
/usr/sbin/swcopy -i -s /cdrom
```

Copying Software From Tape

To copy software on tape at `/dev/rmt/0m` to a depot at `/usr/main_depot`:

```
/usr/sbin/swcopy -i -s /dev/rmt/0m @ /usr/main_depot
```

The program will pause if you need to change tapes. Bring up the "Logfile" while in `swcopy` to see the tape-change messages.

More Examples

The first command in the example that follows copies all software ("`*`") from the path `/release/11.31/wszx6` at the network source `appserver` to the target `/mnt1/depot`. The second command does the same thing except that it copies only the software specified in the file `/tmp/langJ`.

```
swcopy -s appserver.cup.hp.com:/release/11.31/wszx6 \
  "*"  @:/mnt1/depot
swcopy -f /tmp/langJ -s hpclpep:/languages/gsJ @:/mnt1/depot
```

The following example builds a tape from the depot created in the previous example:

```
swpackage -x target_type=tape -s /mnt1/depot -d /dev/rmt/0m "*"
```

NOTE: Building a depot on tape or disk is a good use of the capabilities of SD, but you are taking on some extra responsibility: if you build the depot incorrectly, or incompletely, and the upgrade fails as a result, HP will not treat this as an SD defect.

About Patches

You can find information about patches at:

- In the US, Canada, Asia Pacific, and Latin America, use:

  http://us-support.external.hp.com

- In Europe, use:

  http://europe-support.external.hp.com

From there you can obtain a list of patches and their descriptions. You can also search for and download available patches.

Other useful information about patches can be found at the following URLs:

- **http://devresource.hp.com/drc/STK**
- **http://software.hp.com**
- **http://itresourcecenter.hp.com** (This URL requires a free registration.)

Additionally, *Patch Management User Guide for HP-UX 11.x Systems*, a guide to patching HP-UX 11.x systems, can be found at **HP-UX Core Docs**.

Recommended Patches - Extension Software

HP recommends that you install the patches from `Extension Software`. `Extension Software` is a DVD that contains HP-UX core patches for each version of HP-UX. The patches in the bundle have been tested as a single unit and therefore the possibility of conflicting patches is minimized.

Installing Extension Software

1. Put the "HP-UX Extension Software" DVD into the DVD drive.
2. Make sure the DVD drive is mounted:

   `/usr/sbin/mount`

   If there is no entry for the DVD drive, mount it:

   `/usr/sbin/mount /dev/dsk/`*`devicefile /your_mount_directory`*
3. Read (or print) the `READMEFIRST` on the DVD prior to installing the patch bundles:

   `cd /`*`your_mount_directory`*

   `more READMEFIRST`

   This file contains warnings, installation instructions, and the list of patch bundles.

Removing Patches

On a standalone system, type the following command to remove individual or multiple patches:

`/usr/sbin/swremove -x auto_reboot=true \`
`PHxx_yyyy.PHxx_yyy`...[***`PHxx_yyyy.PHxx_yyy`***...]

6 Managing System Performance

This chapter provides some guidelines and suggestions for improving the performance of a system or workgroup.

- "Performance Bottlenecks" (page 189)
- "Guidelines" (page 190)
- "Measuring Performance" (page 192)
- "Making Changes" (page 195)

Performance Bottlenecks

A system may perform slowly or sluggishly for a variety of reasons, and you may need to do considerable investigation to determine the source of bottlenecks on a given system. You need to consider the interrelationships between the different components of the system, not just its individual components. Start with the tools described under "Measuring Performance" (page 192).

Once you have isolated a performance problem and you decide how to address it, change only one thing at a time. If you change more than one thing, you will not know which change helped performance. It's also possible that one change will improve performance while another makes it worse, but you won't know that unless you implement them separately and measure performance in between.

The following shows some possible system bottlenecks:

CPU Bottlenecks:

- Many background processes running at a high priority consuming a lot of CPU time, or a "runaway" process. If response time is unacceptable, lower the priority of some processes, and kill any unwanted processes.

Memory Bottlenecks:

- high deactivations
- high paging activity
- little or no free memory available
- high CPU usage in System mode

Disk Bottlenecks:

- high disk activity
- high idle CPU time waiting for I/O requests to finish
- long disk queues

NOTE: Put your most frequently accessed information on your fastest disks, and distribute the workload evenly among identical, mounted disks so as to prevent overload on a disk while another is under-utilized. This can often be accomplished by moving swap areas and heavily accessed file systems off the root disk, or by using disk striping, LVM, and/or disk mirroring to spread I/Os over multiple disks. See also "Checking Disk Load with sar and iostat" (page 192).

Network Bottlenecks:

- Excessive demand on an NFS server.
- LAN bandwidth limitations

Guidelines

Performance is a notoriously difficult topic on which to provide definite advice; these guidelines should not be taken as formal recommendations from HP, but merely as the closest the authors could come to distilling a consensus from the observations of the experts they consulted.

- Keep NFS servers and their clients on the same LAN segment or subnet. If this is not practical, and you have control over the network hardware, use switches, rather than hubs, bridges and routers, to connect the workgroup.
- As far as possible, dedicate a given server to one type of task.

  For example, in our sample network (see *HP-UX System Administrator's Guide: Overview*) `flserver` acts as a *file server*, sharing directories to the systems, whereas `appserver` is running applications.

  If the workgroup needed a web server, it would be wise to configure it on a third, high-powered system that was not doing other heavy work.
- On file servers, use your fastest disks for the shared file systems, and for swap.
  - Distribute the workload evenly across these disks.

    For example, if two teams are doing I/O intensive work, put their files on different disks or volume groups. See "Checking Disk Load with sar and iostat" (page 192).
  - Distribute the disks evenly among the system's I/O controllers.
- For shared HFS file systems, make sure the NFS read and write buffer size on the client match the block size on the server.

  You can set these values when you import the file system onto the NFS client; see the **New NFS File System** menu on HP SMH. See "Checking NFS Server/Client Block Size" (page 192) for directions for checking and changing the values.

- Enable asynchronous writes on shared file systems.

  See "Checking for Asynchronous Writes" (page 193).

- Make sure enough `nfsd` daemons are running on the servers.

  As a rule, the number of `nfsd`s running should be twice the number of disk spindles available to NFS clients.

  For example, if a server is sharing one file system, and it resides on a volume group comprising three disks, you should probably be running six `nfsd`s on the server.

  For more detail, see "Checking for Socket Overflows with netstat -s" (page 194) and "Increasing the Number of nfsd Daemons" (page 195).

- Make sure servers have ample memory.

  Efforts to optimize disk performance will be wasted if the server has insufficient memory.

  Monitor server memory frequently (see "Measuring Memory Usage with vmstat" (page 194); and never prepare a hardware budget that doesn't include additional memory!

- Defragment servers' VxFS file systems regularly.

  Fragmentation means that files are scattered haphazardly across a disk or disks, the result of growth over time. Multiple disk-head movements are needed to read and update such files, theoretically slowing response time.

  In practice, though, a server is dealing with many I/O requests at a time, and intelligence is designed into the drivers to take account of the current head location and direction when deciding on the next seek.

  This means that defragmenting an HFS file system on HP-UX may never be necessary; VxFS file systems, however, do need to be defragmented regularly.

  See "Defragmenting an HFS File System" (page 196) and "To defragment a VxFS file system using fsadm " (page 197).

- Keep shared files and directories as small as possible.

  Large files require more NFS operations than small ones, and large directories take longer to search.

  Encourage your users to weed out large, unnecessary files regularly (see "Finding Large Files" (page 151)).

- Monitor server and client performance regularly.

  See "Measuring Performance" (page 192).

Resource Hogs

To get an idea of your top CPU hogs, run HP SMH and select **Home**, **Operating System**, **Process Information**. (Or run `/usr/bin/top` from the command line.)

To compare memory use by the processes currently running, run `ps -efl`. Look under the `SZ` column of the resulting display.

Measuring Performance

The saying, "you can't manage what you don't measure," is especially true of system and workgroup performance. Here are some ways to gauge your workgroup's performance against the "Guidelines" (page 190) earlier in this section.

Checking Disk Load with sar and iostat

To see how disk activity is distributed across your disks, run `sar -d` with a time interval and frequency, for example:

```
sar -d 5 10
```

This runs `sar -d` ten times with a five-second sampling interval. The `%busy` column shows the percentage of time the disk (`device`) was busy during the sampling interval.

Compare the numbers for each of the disks the shared file systems occupy (note the `Average` at the end of the report).

Another way to sample disk activity is to run `iostat` with a time interval, for example:

```
iostat 5
```

This will report activity every five seconds. Look at the `bps` and `sps` columns for the disks (`device`) that hold shared file systems. `bps` shows the number of kilobytes transferred per second during the period; `sps` shows the number of seeks per second (ignore `msps`).

If some disks with shared file systems are consistently much busier than others, you should consider redistributing the load. See *HP-UX System Administrator's Guide: Logical Volume Management*.

NOTE: On disks managed by the Logical Volume Manager (LVM), it can be hard to keep track of what file systems reside on what disks. It's a good idea to create hardcopy diagrams of your servers' disks; see *HP-UX System Administrator's Guide: Logical Volume Management*.

Checking NFS Server/Client Block Size

In the case of an HFS file system, the client's NFS read/write block size should match the block size for that file system on the server.

- On the NFS server, you can use `dumpfs` to check the block size for an HFS file system; for example:

  ```
  dumpfs /work | grep bsize
  ```

  In the resulting output, `bsize` is the block size, in bytes, of the file system `/work`.

NOTE: For a VxFS file system, you can use `mkfs -m` to see the parameters the file system was created with. But adjusting the client's read/write buffer size to match is probably not worthwhile because the configured block size does not govern all of the blocks. See "Examining File System Characteristics" (page 151).

- On the NFS client, use HP SMH to check read/write block size.

  Go to **Tools**, **Disks and File Systems**, **File Systems** and select each imported file system in turn to view read and write buffer sizes. See the Detailed View at the bottom of the page under *Mount Options*.

  `Read Buffer Size` and `Write Buffer Size` should match the file system's block size on the server.

  If it does not, you can use HP SMH to change it.

Modify NFS Server/Client Block Size

1. Access the HP SMH Homepage as root.
2. Select **Tools**, **Disks and File Systems**, **File Systems**.
3. Unmount the file system by clicking on the **Unmount/Remove...** action on the right side of the page.
4. Check the *Unmount* box and click on the **Unmount/Remove** button at the bottom of the page. The file system will be unmounted.
5. Click on the **Done** button to return to the **File Systems** page.
6. Your file system should still be selected. Click on the **ModifyNFS...** action on the right side of the page. This will display the *Modify NFS File System* page.
7. Enter the desired Read and Write buffer sizes, select **Mount now and save configuration in /etc/fstab** , and click on the **Modify NFS** button.
8. Click on the **Done** button. You will be returned to the *File Systems* page. The selected file system will be remounted with the new buffer sizes

Checking for Asynchronous Writes

Enabling asynchronous writes tells the NFS server to send the client an immediate acknowledgment of a write request, before writing the data to disk. This improves NFS throughput, allowing the client to post a second write request while the server is still writing out the first.

This involves some risk to data integrity, but in most cases the performance improvement is worth the risk.

You can use HP SMH to see whether asynchronous writes are enabled on a server's shared file systems.

1. Access the HP SMH Homepage as root.

2. Select **Tools** → **Network Services Configuration** → **Networked File Systems** → **Share/Unshare File Systems (Export FS)**. The Share page will be displayed.
3. Select the desired file system and a table of shared file properties will be displayed. Check to see that *Asynchornous Writes* are allowed.

If needed you can change the setting of the `Asynchronous Writes` flag, while the file system is still mounted and shared.

- Select **View/Modify Shared (exported) File System...** to display the setting for the selected file system. Check the **Allow Asynchronous Writes** box and click on **OK**.

Checking for Server Overload with nfsstat -rc

Run `nfsstat -rc` *on an NFS client* to get an idea of how the server is performing.

You'll get a report that looks like this:

```
Client rpc:
calls      badcalls   retrans    badxid     timeout    wait       newcred
43467543   848        6          3868       27942      0          0
```

`badxid` should be small in relation to `timeout`. If these numbers are nearly the same, it may mean the server is overloaded and generating duplicate replies to RPC requests that have timed out and been retransmitted. Check the server's memory, disk and NFS configuration; see the "Guidelines" (page 190) in the previous section.

NOTE: A `badxid` that is close to zero and a large number for `timeout` may indicate packets are being dropped; that is, the client's requests are timing out because they never reach the server. In this case the problem is likely to be a network card on the server or client, or the network hardware.

Measuring Memory Usage with vmstat

`vmstat` displays a wealth of information; use the `-n` option to make it more readable on an 80-column display.

The column to watch most closely is `po`. If it is not zero, the system is paging. If the system is paging consistently, you probably need more RAM.

Checking for Socket Overflows with netstat -s

Although many different processes use sockets, and can contribute to socket overflows, regular socket overflows on an NFS server may indicate that you need to run more `nfsd` processes. The command,

```
netstat -s | grep overflow
```

will show you a cumulative number for socket overflows (since the last boot). If you see this number rising significantly, and NFS clients are seeing poor response from this

server, try starting more nfsds; see “Increasing the Number of nfsd Daemons” (page 195).

Checking for Network Overload with netstat -i

If you have followed all the “Guidelines” (page 190) and are still seeing poor response time, the problem may be with the network itself - either with a particular piece of hardware or with the configuration of the network.

To see cumulative statistics on a server, run

```
netstat -i
```

If your system has been running for a long time, the numbers will be large and may not reliably reflect the present state of things. You can run netstat iteratively; for example

```
netstat -I lan0 -i 5
```

In this case (after the first line), netstat reports activity every five seconds.

Input and output errors should be very low in relation to input and output packets - much less than 1%. A higher rate of output errors on only one server may indicate a hardware problem affecting the server’s connection to the network.

Collisions (colls) should be less than 5%; a higher rate indicates heavy network use which your users are probably experiencing as poor performance. Network traffic and configuration may be beyond your control, but you can at least raise a flag with your network administrator.

Making Changes

- “Increasing the Number of nfsd Daemons” (page 195)
- “Defragmenting an HFS File System” (page 196)
- “Defragmenting a VxFS File System” (page 197)
- “Configurable Kernel Parameters” (page 197)

Increasing the Number of nfsd Daemons

To increase the number of nfsds running on a server, do the following steps:

1. Edit /etc/rc.config.d/nfsconf, raising the value of NUM_NFSD; for example:

   ```
   NUM_NFSD=8
   ```

2. Stop and restart the nfs.server script:

   ```
   /sbin/init.d/nfs.server stop
   /sbin/init.d/nfs.server start
   ```

Defragmenting an HFS File System

Defragmenting an HFS file system could improve throughput by reducing disk seek time. In practice, though, most experts believe it will usually make little or no difference to performance. You should do it only if you have good reason to believe, or have received expert advice, that your system will really benefit.

NOTE: This applies only to HFS file systems. VxFS file systems *do* need to be defragmented regularly. See "Defragmenting a VxFS File System" (page 197).

You can defragment an HFS file system by backing it up to tape, removing and recreating it, then recovering the data from the tape.

The example that follows shows an alternative method, using `dcopy`, and assumes you have enough disk space to create a new logical volume at least as large as `/dev/vg01/lvol8`. We'll operate on the `/work` file system, which resides on the logical volume `/dev/vg01/lvol8`.

1. Back up the file system; for example,

   `tar cv /work`

   backs up `/work` to the system default tape device, `/dev/rmt/0m`.

2. Create a new logical volume (see HP-UX System Administrator) but do not mount it to any file system.

   We'll assume this new logical volume is `/dev/vg01/lvol9`.

3. Make sure no one has files open in `/work` and that it is no one's current working directory, for example:

   `fuser -cu /work`

4. Unmount `/work`:

   `umount /work`

5. Write out the contents of `/work` to `/dev/vg01/lvol9`:

   `dcopy -v /dev/vg01/rlvol8 /dev/vg01/lvol9`

NOTE: The source file system should be a raw device (`/dev/vg01/rlvol8`) and the destination file system should be a block device (`/dev/vg01/lvol9`).

6. Mount the new logical volume to the mount point of the original file system, `/work`:

   `mount /dev/vg01/lvol9 /work`

   You can now reuse the original logical volume `/dev/vg01/lvol8`) or remove it (see "Removing a Logical Volume" (page 106)).

Defragmenting a VxFS File System

- "To defragment a VxFS file system using HP SMH" (page 197)
- "To defragment a VxFS file system using fsadm " (page 197)
- "Daily Defragmentation " (page 197)
- *HP-UX System Administrator's Guide: Configuration Management*

To maintain performance, particularly on file systems with very large files, VxFS provides the means to reorder disk space to regain contiguous areas on which to write files. This process of defragmentation should be performed periodically.

To defragment a VxFS file system using HP SMH

1. Access the HP SMH Homepage as root.
2. Select **Tools**, **Disks and File Systems**, **File Systems**. This will display a list of file systems.
3. Select the desired VxFS file system. You can now display extent or directory fragmentation for the file system, or click on the **Defragment Extents...** or **Defragment Directories...** actions on the right side of the page.

For more information, see the HP SMH online help.

To defragment a VxFS file system using fsadm

Execute the following to perform both directory and extent reorganization and to generate reports before and after reorganization:

```
fsadm -d -D -e -E /mount_point
```

For detailed information, consult *fsadm_vxfs*(1M).

Daily Defragmentation

To maintain optimal performance on busy file systems, it may be necessary to defragment them *nightly*.

For example, to defragment every evening at 9 p.m. all the extents and directories within the file system mounted at `/home`, include the following entry in a file used by *cron*(1M):

```
0 21 * * * fsadm -d -e /home
```

Configurable Kernel Parameters

In some cases, you may be able to get the results you need by resetting kernel parameters. For example, if a user frequently runs out of processes (symptom `no more processes`), raising the value of `maxuprc` might be the answer.

NOTE: Tunable kernel parameters can be static or dynamic (not requiring a system reboot or kernel rebuild). The list of dynamic tunables is continually growing. To determine which tunables are dynamic on your system, use the `kmtune` command (see the *kmtune*(1M) manpage), or see the **Kernel Configuration** portion of HP SMH. In HP SMH's **Tunables** screen. You can tell at a glance whether or not the value of a particular tunable can be changed without a reboot.

Use the `kctune` command or the `kcweb` web interface. See *kctune*(1M) and *kcweb*(1M).

Configuring Kernel Tunable Parameters Using HP SMH

1. Access the HP System Management Homepage (HP SMH) as root.
2. Select **Tools**, **Kernel Configuration**, **Tunables**. This will display the **Kernel Configuration** page with the **Tunables** tab displayed.
3. Click on the **Modify Tunable** action on the right side of the page. This will display the **Modify Tunable** page.
4. You can now reset the tunable default, enter a new value, or log comments.
5. Click on **Modify** to complete the change.

For more information on dynamic tunables, see *HP-UX System Administrator's Guide: Configuration Management* at the BSC website: HP-UX Core Docs*Dynamically Tunable Kernel Parameters in HP-UX 11i* white paper.

CAUTION: Make sure you read the help for all the parameters related to any parameter you are considering changing. In the case of `maxuprc`, you would need to read the help on `nproc` as well as `maxuprc`.

Other Performance Management Tools

Some of the tools that HP provides are:

- "HP System Management Homepage (HP SMH)" (page 199)
- "The top Command" (page 199)
- "HP Operation Center" (page 199)
- "Kernel Resource Monitor (KRM)" (page 200)

HP also provides several sources for tools and support for HP-UX. See http://www.software.hp.com. This webpage has links to:

- HP-UX 3rd party and public domain software

  This catalog contains over 1000 packages in binary and source format. Each package is placed into a single category on the archive. These categories can be viewed in alphabetical or chronological order.

- HP-UX application demos, shareware, and freeware

- HP patches
- On-demand support

HP System Management Homepage (HP SMH)

The HP System Management Homepage (HP SMH) tool allows you to perform many system administration tasks without having to know all the HP-UX commands involved.

For more information on the HP SMH's capabilities, use HP SMH's online help or see the manpage *smh*(1M). See also "System Management Homepage (Web-Based)" (page 23).

To start HP SMH, launch a browser and enter the following **`http://system:2301/`**. A login screen will be displayed. Log in as root or a user with root privilege.

The top Command

Use the `top` command to see processes ranked by CPU usage. See the manpage *top*(1).

To run top, enter:

```
/usr/bin/top
```

HP Operation Center

The HP Operations Center offers a comprehensive, modular, service-oriented approach to IT operations management. It helps you improve the availability and performance of your physical and virtual servers, applications and application components. At the same time, it helps you achieve greater operational efficiency by enabling you to correlate management information from multiple domain managers. The HP Operation Center products helps your organization to:

- Reduce IT operations cost by increasing IT staff efficiency
- Enable IT tool consolidation initiatives by centralizing event, performance and re-mediation tools and processes
- Correlate, identify and correct root cause of infrastructure faults and performance degradations
- Monitor and visualize the health of heterogeneous IT environments, including applications

and a lot more. Some of the products are:

- "HP GlancePlus Pak Software" (page 200)
- HP Operations Manager software
- HP Performance Manager software
- Storage Management
- Openspool
- PerfView
- Software Distributor

- VantagePoint
- Network Management
- Security Management

For complete and current information on HP Operation Center products go to the following website:**http://www.operations.com**.

HP GlancePlus Pak Software

HP GlancePlus Pak is a diagnostic performance tool which provides detailed immediate performance information about your system. It has built-in bottleneck alarms and zoom-in capabilities to make performance troubleshooting easier.

The HP GlancePlus Pak provides both detailed immediate diagnostic and long-term analysis for performance data. These software products are available on multi-vendor platforms as well as for HP-UX.

Kernel Resource Monitor (KRM)

The Kernel Resource Monitor is included with Event Monitoring Systems (EMS) Hardware Monitors. The KRM checks HP-UX resources such as *nproc* (number of processes) which are controlled by the kernel parameters. KRM continually checks the actual usage of these resources. If the amount of the usage meets or exceeds a preset value, you are notified by e-mail, console message, system log, or other means.

This can be useful for tuning the kernel parameters for your particular system and avoiding panics and performance problems caused when usage of HP-UX resources approaches too high a level.

The EMS Monitors can be integrated with applications responsible for maintaining system availability, such as MC/ServiceGuard. If configured to do so, they can provide event notification to system management applications such as HP Operations Manager and HP Network Management Center.

The EMS Hardware Monitors use the same EMS framework as the EMS High Availability (HA) monitors. The HA EMS monitors are a separate set of monitors available at additional cost.

Some of the hardware monitors for fibre channel products write event information to text logs read by a new Predictive scanner, emsscan, which in turn may send events to the Response Center by way of the On-line Predictive.

The EMS Hardware Monitors (including the Kernel Resource Monitor) are distributed on the Support Plus CD media and available to download from **http://software.hp.com**.

Select “Enhancement Releases” and then “Support Tools for the HP 9000.”

For more information about Support Plus and EMS hardware monitors, see the documentation on the Instant Information DVD and the BSC website: HP Event Monitoring Service and HA Monitors Software .

A Using High Availability Strategies

High availability is the term used to describe computer systems that have been configured so as to minimize the percentage of time that they will be down or otherwise unavailable, and as a result, allow for the greatest degree of usefulness. High system availability is achieved by minimizing the possibility that a hardware failure or a software defect will result in a loss of the use of the system or in a loss of its data. Improved system and data availability can therefore result from advantageous use of either hardware and/or software components which serve to reduce the impact of errors by making use of redundant and isolated components such as dual busses, I/O devices, and duplicate copies of data.

Some of the various means of implementing high availability that should be considered in administering HP-UX systems are reviewed here.

NOTE: High availability is a complex topic that can only be briefly summarized here. For a more complete technical discussion, see the white paper, ***Choosing the Right Disk Technology in a High Availability Enviroment***.

HP References

- *HP-UX System Administrator's Guide: Logical Volume Management*
- *Configuring OPS Clusters with ServiceGuard OPS Edition*
- *Managing Serviceguard*
- *Designing Disaster Tolerant High Availability Clusters*
- *HP-UX ServiceControl User's Guide*
- *Using Advanced Tape Services*
- *Using High Availability Monitors*
- *Clusters for High Availability: A Primer of HP Solutions*, HP Press, published by Prentice Hall PTR, 1996
- *Disk and File Management Tasks on HP-UX*, HP Press, published by Prentice Hall PTR, 1997

Using Software Mirroring as a Disk Protection Strategy

Data redundancy is necessary to prevent instances in which a single disk failure can cause a system to go down until the problem is located and corrected. There are two methods of providing data redundancy: software mirroring and hardware mirroring. Each represents RAID Level 1. (See "Using Disk Arrays" (page 202) for more information on the meaning of the various RAID levels.)

Software mirroring allows you to maintain identical copies of your data (except for the root disk), so that each set of data has, in effect, a perfect clone of itself. In the event a disk fails, the system can use the mirrored copy of the data, thus allowing users to continue to work without interruption. The bad disk can be replaced at a more convenient time when the system can be brought down without causing problems.

Once the system is rebooted, the mirroring software will cause the mirrored data to be copied back to the replacement disk and the process of mirroring will begin again.

With three-way disk mirroring, *two* copies of each disk's data are maintained. This strategy is even more robust than two-way mirroring which is described above and it eliminates the need to bring the system down at all in order to replace a bad disk.

NOTE: Using Version 1 LVM Volume Groups, you can have up to three copies of your data (the original plus two mirror copies). Using Version 2 LVM Volume Groups you can have up to six copies of your data (the original plus five mirror copies).

To use disk mirroring, you will need to use LVM or VxVM as your disk management strategy and (if you are using LVM) have available the MirrorDisk/UX software product. MirrorDisk/UX causes every write to the original volume to also be written to the copy or copies of the original volume. Note that the original data and its copied data may be spread over more than one disk.

The main advantage of software mirroring over hardware mirroring, which is discussed in "Using Disk Arrays" (page 202), is that the cost of implementation is lower. The main disadvantage of software mirroring relates to its increased complexity of management. That is, it will probably be significantly more difficult to manage a system with a large number of disks as compared to a system with a single disk array.

Using Disk Arrays

A **disk array** consists of multiple disk drives under the command of an array controller. The disk array incorporates features that differentiate it from traditional disk storage devices.

Most types of disk arrays provide for one of two possible options for protecting data in the event of a disk failure. This becomes more and more important as the number of disks on a system increases, since the chance of a disk failure also increases. Normally, a disk crash brings the system down or prevents access to data, removing it from service until the problem is located and repaired, and the data is reloaded.

The first kind of data protection is called **data encoding**. When a disk drive fails, the array controller generates encoded data, which is similar to parity or checksum calculations. This allows missing user data to be reconstructed using a mathematical formula to rebuild lost data. As a result, the data remains accessible and the system remains up and running without suffering any downtime.

The second method of data protection utilizes **hardware mirroring** as a means of providing high data availability by duplicating data on redundant disk drives. As a result, failure in one disk still allows access to the data on an alternate disk.

Disk Arrays Using RAID Data Protection Strategies

RAID stands for Redundant Arrays of Independent Disks. Various configurations or RAID levels are available. We will mention several.

Mirroring (RAID Level 1)

In a RAID 1 configuration, all data is duplicated on two or more disks.

In hardware mirroring, each disk has a "twin," a backup disk containing an exact copy of its data. Some RAID 1 implementations duplicate not only the disks but the array controller and the power supply as well.

In the case of software mirroring (discussed in "Using Software Mirroring as a Disk Protection Strategy" (page 201)), the original data and its copied data may be spread over more than one disk as a result of using LVM or VxVM software to manage your disk storage.

Pros and Cons

If a disk fails, the array controller will automatically switch all system I/O activity to the drive containing the copy. This prevents the system from going down in the event a drive fails. The disadvantage of hardware mirroring is the expense of duplicating your hardware.

Recommended Uses and Performance Considerations

Use when high data availability is required. Can provide up to twice the read I/0 rate although writes are similar to using single disks. The data transfer rate is similar to using single disks.

Disk Striping (RAID Level 0)

This configuration interleaves data in blocks across multiple disks.

Pros and Cons

RAID 0 offers increased performance because several I/O transfers can be done at the same time. However, it does not provide data redundancy in the event of disk failure.

Recommended Uses and Performance Considerations

Effective for high performance I/O environments using noncritical data.

Data striping can also prevent "hot spots," which are caused by constant hits on a single drive; a specific drive may be accessed so often that it will slow down I/O traffic, or shorten the life of the drive.

RAID 3

This type of array uses a separate data protection disk to store encoded data. RAID 3 is designed to provide a high transfer rate.

RAID 3 organizes data by segmenting a user data record into either bit- or byte-sized chunks and evenly spreading the data across *N* drives in parallel. One of the drives acts as a parity drive. In this manner, every record that is accessed is delivered at the full media rate of the *N* drives that comprise the stripe group. The drawback is that every record I/O stripe accesses every drive in the group.

Pros and Cons

You may not write to a RAID 3 array, except in full data stripe logical blocks. This limits application design flexibility and also the user's ability to have different arrays run at different RAID levels on the same system.

RAID 3 is not well suited for multiple process I/O (long or short) and is especially not suited for any application that requires a high I/O per second rate with any degree of randomness. On the other hand, RAID 3 will deliver excellent performance for single process/single stream long sequential I/O requests.

Recommended Uses and Performance Considerations

RAID 3 provides consistently lower I/O performance when compared to standalone disks except when the I/O size is less than or equal to 64 KB.

RAID 3 architecture should only be chosen in a case where the user is virtually guaranteed that there will be only a single, long process accessing sequential data. A video server and a graphics server would be good examples of proper RAID 3 applications. RAID 3 is so limited that it becomes a poor choice in most other cases.

RAID 5

With this RAID level, both data and encoded data protection information are spread across all the drives in the array. Level 5 is designed to provide a high transfer rate (a one-way transmission of data) and a moderate I/O rate (a two-way transmission of data).

In RAID 5 technology, the hardware reads and writes parity information to each module in the array. If a module fails, the system processor can reconstruct all user data from the user data and parity information on the other disk modules. When a failed disk module is replaced, the system processor automatically rebuilds the disk array using the information stored on the remaining modules. The rebuilt disk array contains an exact replica of the information it would have contained had the original disk module never failed.

Pros and Cons

RAID 5 requires fewer drives than RAID 1 or RAID 1/0 which is a combination of RAID 1 and RAID 0. Disk striping is used and parity data is distributed for optimum performance. In RAID 5, three to sixteen drives can be configured per group. Five drives to a group are typical. The data are distributed across multiple drives preventing the I/O slowdown caused by constant hits on a single drive.

RAID 5 is not quite as robust as RAID 1/0 and can only sustain the loss of one disk per group.

Recommended Uses and Performance Considerations

RAID 5 is the most versatile RAID level for most applications.

RAID 5 is a good choice where multitasking applications require a large history database with a high read rate, or a database that uses a normal or less-than-normal percentage of write operations, where writes are 33% or less of all I/O operations.

RAID 5 provides consistently high performance for large input/output operations, greater or equal to 64 KB, but poor for smaller I/O sizes.

HP SureStore E Disk Array

HP SureStore E Disk Arrays provide high capacity and high speed mass storage with continuous data availability, ease of service, scalability and connectivity. They are designed to handle very large databases as well as data warehousing and data mining applications since they have a huge data capacity, often measured in terabytes. They are ideal for clustered configurations of HP-UX servers.

These disk arrays have no active single point of component failure. They utilize component and function redundancy to provide full fault-tolerance for all microprocessors, control storage, control and data busses, power supplies, and cooling fans. Thus, they can sustain multiple component failures and still continue to provide full access to stored data. However, a failure of a key component can degrade disk array performance.

Using Hot Spared Disks

A **hot spared disk** drive is a disk that is reserved for swapping with a bad disk that has no mirrored or parity data. It is simply a spare disk that is online and waiting for a disk failure in a disk array. Use a hot spare if, in RAID 5, RAID 1/0, or RAID 1 groups, high availability is so important that you want to regain data redundancy as soon as possible if a disk module fails. A hot spare provides no data storage but enhances the availability of each RAID 5, RAID 1, and RAID 1/0 group in a disk array. Disk arrays keep hot spares in use all of the time.

NOTE: For disks managed by LVM, there is a similar feature called automatic sparing. See *HP-UX System Administrator's Guide: Logical Volume Management* for details.

An **active hot spare** is differentiated from traditional hot spares in that rebuild space is distributed across all disks in the array for those disk arrays that provide active spares. This allows user data to be stored on a "spare disk," which improves I/O performance. It also increases the amount of high performing RAID 1 space. In other words, the active hot spare disk is constantly undergoing writes and reads in order to verify that it is working properly.

In a traditional hot spare array, a defective hot spare disk may not be detected until it is actually needed. The integrity of the active hot spare is assured because it is kept in use at all times. Note that some disk arrays provide active hot spares although others do not.

Using High Available Storage Systems (HASS)

High Available Storage Systems (HASS) provide two internal SCSI busses, each with their own connectors, power cords, power supplies, and fans. This hardware redundancy, when combined with software mirroring, can prevent most single point of failure problems. HASS do not provide any RAID support on their own.

Pros and Cons of HASS

There are many advantages of systems protected by HASS. These include disk storage modules that are **hot-pluggable** which means that the bus and connectors are made so that the disk module can be inserted or removed without removing the terminator for the array. All hardware modules are easily removed from the front of the chassis. HASS do not have the problems of previous disk configurations that required extra-long F/W SCSI cables, the removal of the chassis from the cabinet, and the removal of the cover before individual disk mechanisms can be replaced.

The negative side of HASS is that operating system cooperation is still required when removing a disk module from the HASS since the HASS does *not* provide any data protection or regeneration of data on a newly replaced disk module. HASS is primarily a hardware protection strategy and software mirroring is required to implement a mirroring scheme on HASS.

Recommended Uses of HASS

The HASS protection system is an excellent step in preventing single points of failure and is recommended for systems that must be available as much of the time as possible. Serviceguard can employ HASS for additional data storage. See"Using Serviceguard" (page 206).

Using Serviceguard

An Serviceguard cluster is a networked grouping of HP 9000 servers (nodes) having sufficient redundancy of software and hardware that a single point of failure will not significantly disrupt service. Applications and services are grouped together in packages. In the event of a service, node, or network failure, Serviceguard can automatically transfer control of all system resources in a designated package to another node within the cluster, allowing the applications to remain available with minimal system interruption.

Serviceguard replaces the earlier SwitchOver product which also allowed for redundant computer systems. Serviceguard first became available with HP-UX 10.0.

Pros and Cons of Serviceguard

To provide a high level of availability, a typical cluster uses redundant system components, for example, two or more processing cores and two or more independent disks. This redundancy eliminates any single point of failure. In general, the more redundancy, the greater access you will have to applications, data, and supportive services in the event of failure. In addition to hardware redundancy, the system must

have the software support that enables and controls the transfer of applications to another server or network after a failure. Serviceguard provides the following support:

- In the case of LAN failure, Serviceguard transparently switches to a standby LAN.
- In the case of a node failure, an application is automatically transferred from a failed processor to a functioning processor and in a minimum amount of time.
- For software failures, an application can be restarted on the same node or another node with minimum disruption of service.

The primary disadvantages for Serviceguard are the additional cost of software and hardware redundancy and the added complexity of administration. Also, hardware failures on shared components may adversely affect all systems that are jointly connected.

Serviceguard is an excellent choice for high availability data protection. It may be used in conjunction with other high availability products.

HP References

Managing Serviceguard

http://www.hp.com/go/enterprise

Serviceguard Features

Serviceguard Automatic Rotating Standby

Using a feature called **automatic rotating standby**, you can configure a cluster that lets you use one node as a substitute in the event a failure occurs. Any package would fail over to the node containing the fewest running packages.

HP Reference

Managing Serviceguard, Chapter 3.

Serviceguard Rolling Upgrades

To reduce the amount of time needed for HP-UX operating system upgrades as well as application upgrades and patches, you can provide what is called a **rolling upgrade**. For a system with many components, the typical scenario is to bring down the entire cluster, upgrade every node to the new version of the software, and then restart the application on all the affected nodes. For large systems, this could result in a long downtime. An alternative is to provide for a rolling upgrade. A rolling upgrade rolls out the new software in a phased approach by upgrading only one component at a time without bringing down your clusters. This process can also be used any time one system needs to be taken offline for hardware maintenance.

HP Reference

Managing Serviceguard, Appendix E.

Serviceguard Advanced Tape Services (ATS)

You can use shared tape devices in an Serviceguard cluster allowing high availability backups using tape libraries and tools such as . The ATS facility allows a two-node to four-node cluster to share standalone magnetic tape devices and/or tape library robotic devices. As a result, even after a package fails on one node, a backup of the package data continues or restarts on an alternate node. Device files corresponding to each tape or library robotic mechanism are created and written to an ATS ASCII configuration file. ATS uses this file to keep track of the devices configured in the cluster.

HP Reference

Using Advanced Tape Services

Other High Availability Products and Features

Dynamic Root Disk

Dynamic Root Disk is an HP-UX system administration tool set used to clone an HP-UX system image to a disk other than that from which the system is currently booted, for purposes of software maintenance and recovery. In this way, you can install software and patches to a clone of your current system *without affecting the running system*. Then, when an opportunity to reboot the system is available, the patched or updated clone can be booted. This reduces system downtime to just the time it takes to reboot to the clone. Also, if necessary, the changes can be quickly backed out by simply rebooting to the original clone.

High Availability Monitors

High availability monitors allow you to check up on your system's resources and to be informed if problems develop. They can be used in conjunction with Serviceguard. Monitors are available for disk resources, cluster resources, network interfaces, system resources, and database resources. When a monitor detects a problem, an alert is sent, allowing an operator or administrator to correct the problem.

HP Reference

Using High Availability Monitors

Enterprise Cluster Master Toolkit

The Enterprise Cluster Master Toolkit is a set of templates and scripts that allow you to configure ServiceGuard packages for the HP Domain Internet servers as well as for

several third-party database management systems. The master toolkit is a collection of specific product toolkits, which include the following:

- HA Foundation Monitor toolkit, designed to monitor the status of an entire mission critical environment.
- HA Internet toolkits for use with HP Domain server products.
- Database toolkits for Oracle, Informix, Sybase, and Progress database management systems.

HP Reference

Enterprise Cluster Master Toolkit Version B.01.03 Release Notes for HP-UX 11i

MetroCluster

MetroCluster is a Hewlett-Packard high availability product for Serviceguard customers requiring integrated disaster recovery solutions. MetroCluster provides automated failover of ServiceGuard packages on local and remote high availability disk arrays. Integrating MetroCluster with Serviceguard allows application packages to fail over:

- Between one system that is attached locally to an array frame and another remote node that is attached locally to another array frame.
- Among local nodes that are attached to the same array.

Two versions of MetroCluster are available:

- MetroCluster with Continuous Access XP provides a special package-control script template to implement physical replication between HP SureStore XP256 or XP512 disk arrays.
- MetroCluster with EMC SRDF provides a special package-control script template to implement physical replication between EMC Symmetrix disk arrays.

HP Reference

Designing Disaster Tolerant High Availability Clusters

Continental Clusters

Continental Clusters is a Hewlett-Packard high availability solution that provides disaster tolerant clustering over long distances. Continental Clusters employs semi-automatic failover of Serviceguard packages from a primary cluster to a recovery cluster following a cluster event that indicates serious disruption of service on the primary cluster.

The product consists of a set of configuration tools, a monitor that sends notification of cluster-down events, and a command that moves packages from one cluster to another. In addition, Continental Clusters includes the following components:

- Cluster Object Manager, which provides the ability to query ServiceGuard cluster status.
- A special package control script template to implement physical data replication between HP SureStore XP256 or HP512 disk arrays.
- A special package control script template to implement physical data replication between EMC Symmetrix disk arrays.

HP Reference

Designing Disaster Tolerant High Availability Clusters

HP ServiceControl

HP ServiceControl is a system management environment including high capacity HP HyperPlex clusters. It provides a consolidated point for managing your workload, applications, and resources on your system from a single management station. High availability products, such as Serviceguard and HA Monitors, reside physically on the HyperPlex cluster nodes.

HP ServiceControl organizes nodes into HyperPlex clusters. Within these clusters, Serviceguard minimizes and eliminates application downtime by

- Protecting mission-critical applications from a variety of hardware and software failures by monitoring the health of each node.
- Balancing the workload on a system by responding quickly to changes and workload demands.

HP Reference

HP-UX ServiceControl User's Guide

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