RH133 - Red Hat Linux System Administration

Introduction - RH133 Red Hat Enterprise Linux Administration

Copyright

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Introduction

RH133 Red Hat Enterprise Linux Administration

RH133-RH133-RHEL5-en-1-20070321

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Welcome

Please let us know if you have any special needs while at our training facility.

Participant Introductions

Please introduce yourself to the rest of the class!

Red Hat Enterprise Linux

- Enterprise-targeted operating system
- Focused on mature open source technology
- 18-24 month release cycle
  - Certified with leading OEM and ISV products
- Purchased with one year Red Hat Network subscription and support contract
  - Support available for seven years after release
  - Up to 24x7 coverage plans available

Red Hat Enterprise Linux Variants

- Two Install Sets available
- Server Spin
  - Red Hat Enterprise Linux
  - Red Hat Enterprise Linux Advanced Platform
- Client Spin
  - Red Hat Enterprise Linux Desktop
  - Workstation Option
  - Multi-OS Option

Red Hat Network

- A comprehensive software delivery, system management, and monitoring framework
  - *Update Module* : Provides software updates
    - Included with all Red Hat Enterprise Linux subscriptions
  - *Management Module* : Extended capabilities for large deployments
  - *Provisioning Module* : Bare-metal installation, configuration management, and multi-state configuration rollback capabilities
  - *Monitoring Module* provides infrastructure health monitoring of networks, systems, applications, etc.

Other Red Hat Supported Software

- Global Filesystem
- Directory Server
- Certificate Server
- Red Hat Application Stack
- JBoss Middleware Application Suite

Notes on Internationalization

- Red Hat Enterprise Linux supports nineteen languages
- Default language can be selected:
  - During installation
  - With **system-config-language**
    - System->Administration->Language
- Alternate languages can be used on a per-command basis:

```
$ LANG=en_US.UTF8 date
```

- Language settings are stored in `/etc/sysconfig/i18n`

The Fedora Project

- Red Hat sponsored open source project
- Focused on latest open source technology
  - Rapid four to six month release cycle
  - Available as free download from the Internet
- An open, community-supported proving ground for technologies which may be used in upcoming enterprise products
- Red Hat does not provide formal support

Classroom Network

	Names	IP Addresses
Our Network	example.com	192.168.0.0/24
Our Server	server1.example.com	192.168.0.254
Our Stations	station*X*.example.com	192.168.0.*X*
Hostile Network	cracker.org	192.168.1.0/24
Hostile Server	server1.cracker.org	192.168.1.254
Hostile Stations	station*X*.cracker.org	192.168.1.*X*
Trusted Station	trusted.cracker.org	192.168.1.21

Objectives

- Understand system and service initialization
- Integrate new filesystems
- Understand advanced partitioning schemes
- Perform filesystem management tasks
- Set up networking
- Perform user and group administration
- Automate tasks with at, cron, and anacron
- Set up core services: Logging, Printing, X Window system
- Manage software packages with **yum** and **rpm**
- Install the system interactively and with Kickstart
- Perform basic troubleshooting

Audience and Prerequisites

- Audience: Linux or UNIX users, who understand the basics of Red Hat Linux, that desire further technical training to begin the process of becoming a system administrator.
- Prerequisites: RH033 Red Hat Linux Essentials or equivalent experience with Red Hat Enterprise Linux.

Unit 1

System Initialization

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Objectives

Upon completion of this unit, you should be able to:

- Discuss the boot sequence
- Understand GRUB's role
- Understand init's role
- Control System V services

Boot Sequence Overview

- BIOS Initialization
- Boot Loader
- Kernel initialization
- **init** starts and enters desired run level by executing:
  - `/etc/rc.d/rc.sysinit`
  - `/etc/rc.d/rc` and `/etc/rc.d/rc?.d/`
  - `/etc/rc.d/rc.local`
  - X Display Manager if appropriate

Boot Loader Components

- Boot Loader
  - 1st Stage - small, resides in MBR or boot sector
  - 2nd Stage - loaded from boot partition
- Minimum specifications for Linux:
  - Label, kernel location, OS root filesystem and location of the initial ramdisk (*initrd*)
- Minimum specification for other OS:
  - boot device, label

GRUB and grub.conf

- GRUB "the GRand Unified Bootloader"
  - Command-line interface available at boot prompt
  - Boot from ext2/ext3, ReiserFS, JFS, FAT, minix, or FFS file systems
  - Supports MD5 password protection
- `/boot/grub/grub.conf`
- Changes to `grub.conf` take effect immediately
- If MBR on `/dev/hda` is corrupted, reinstall the first stage bootloader with:
  - `/sbin/grub-install /dev/hda`

Starting the Boot Process: GRUB

- Image selection
  - Select with space followed by up/down arrows on the boot splash screen
- Argument passing
  - Change an existing stanza in menu editing mode
  - Issue boot commands interactively on the GRUB command line

Kernel Initialization

- Kernel boot time functions
  - Device detection
  - Device driver initialization
  - Mounts root filesystem read only
  - Loads initial process (**init**)

init Initialization

- **init** reads its config: `/etc/inittab`
  - initial run level
  - system initialization scripts
  - run level specific script directories
  - trap certain key sequences
  - define UPS power fail / restore scripts
  - spawn gettys on virtual consoles
  - initialize X in run level 5

Run Levels

- **init** defines run levels 0-6, S, emergency
- The run level is selected by either
  - the default in `/etc/inittab` at boot
  - passing an argument from the boot loader
  - using the command **init** ***new_runlevel***
- Show current and previous run levels
  - **/sbin/runlevel**

/etc/rc.d/rc.sysinit

- Important tasks include:
  - Activate **udev** and `selinux`
  - Sets kernel parameters in `/etc/sysctl.conf`
  - Sets the system clock
  - Loads keymaps
  - Enables swap partitions
  - Sets hostname
  - Root filesystem check and remount
  - Activate RAID and LVM devices
  - Enable disk quotas
  - Check and mount other filesystems
  - Cleans up stale locks and PID files

/etc/rc.d/rc

- Initializes the default run level per the `/etc/inittab` file `initdefault` line such as `id:3:initdefault:`

- `l0:0:wait:/etc/rc.d/rc 0`

```
l1:1:wait:/etc/rc.d/rc 1
l2:2:wait:/etc/rc.d/rc 2
l3:3:wait:/etc/rc.d/rc 3 (default)
l4:4:wait:/etc/rc.d/rc 4
l5:5:wait:/etc/rc.d/rc 5
l6:6:wait:/etc/rc.d/rc 6
```

System V run levels

- Run level defines which services to start
  - Each run level has a corresponding directory:
    - `/etc/rc.d/rc`*X*`.d`
  - The System V init scripts reside in:
    - `/etc/rc.d/init.d`
  - Symbolic links in the run level directories call the `init.d` scripts with a start or stop argument

/etc/rc.d/rc.local

- Run after the run level specific scripts
- Common place for custom modification
- In most cases it is recommended that you create a System V *init* script in
- `/etc/rc.d/init.d` unless the service you are starting is so trivial it doesn't warrant it. Existing scripts can be used as a starting point.

Controlling Services

- Utilities to control default service startup
  - **system-config-services**: graphical utility that requires an X interface
  - **ntsysv**: ncurses based utility usable in virtual consoles
  - **chkconfig**: a fast, versatile command line utility that works well and is usable with scripts and Kickstart installations
- Utilities to control services manually
  - **service**: immediately start or stop a standalone service
  - **chkconfig** immediately starts and stops **xinetd**-managed services

End of Unit 1

- Questions and Answers
- Summary
  - System BIOS
  - GRUB
  - init
  - chkconfig and service

Unit 2

Package Management

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redhat

Objectives

Upon completion of this unit, you should be able to:

- Install and remove RPM packages
- Query packages and verify their state
- Manage packages using **yum**
- Understand the relationship between **yum** and **rpm**
- Configure **yum** to connect to a RHN Satellite Server
- Create a private **yum** repository
- Configure **yum** to connect to a private repository
- Configure and use Red Hat Network

RPM Package Manager

- RPM Components
  - local database
  - **rpm** and related executables
  - RPM frontends such as yum
  - package files
- Primary Functions
  - install/remove
  - query
  - verify

Installing and Removing Software

- Primary RPM options:
  - Install: **rpm -i**, **--install**
  - Upgrade: **rpm -U**, **--upgrade**
  - Freshen: **rpm -F**, **--freshen**
  - Erase: **rpm -e**, **--erase**
- Output Options: **-v**, **-h**
- URL support: `ftp://` (with globbing), `http://`
- Many other install-options are available to address special cases.

Updating a Kernel RPM

- Make sure to install kernel updates
- Do not use **rpm -U** or **rpm -F** !
  - **rpm -ivh kernel-version.arch.rpm**
  - Boot new kernel to test
  - Revert to old kernel if a problem arises
  - **rpm -e kernel-oldversion** if no problems

rpm Queries

- Syntax:
  - **rpm -q what_packages what_information**
- Installed Package Options:
  - **rpm -qa** lists installed packages
  - **rpm -qf filename** shows owning package
  - **rpm -qi package_name** general information
  - **rpm -ql package_name** lists files in package
- Uninstalled Package Options:
  - **rpm -qip package_file.i386.rpm**
  - **rpm -qlp package_file.i686.rpm**

rpm Verification

- Installed RPM File Verification:
  - **rpm -V <package_name>**
  - **rpm -Vp <package_file>.i386.rpm**
  - **rpm -Va**
- Signature verification BEFORE package install:
  - **rpm --import RPM-GPG-KEY**
  - **rpm -K <package_file>.i386.rpm**

About yum

- Front-end to **rpm**
  - Designed to resolve package dependencies
  - Can locate packages across multiple repositories
- Replacement for **up2date**

Using yum

- Install/Remove/Update
  - **yum install** *package...*
  - **yum remove** *package...*
  - **yum update** *[package...]*

Searching packages/files

- Searching packages
  - **yum search** *searchterm*
  - **yum list** *(all|available|extras|installed|recent|updates)*
  - **yum info** *packagename*
- Searching files
  - **yum whatprovides** *filename*

Configuring Additional Repositories

- Create a file in `/etc/yum.repos.d` for your repository
- Required information
  - [*repo-name*]
  - name=*A nice description*
  - baseurl=*http://yourserver.com/path/to/repo*
  - enabled=*1*
  - gpgcheck=*1*

Creating a private repository

- Create a directory to hold your packages
- Make this directory available by **http**/**ftp**
- Install the **createrepo** RPM
- Run **createrepo -v /package/directory**
- This will create a `repodata` subdirectory

and the needed support files

Red Hat Network

- Centralized platform for systems mangement
  - provides Red Hat software packages
  - shows if errata are available for systems
  - can update many systems at once
  - allows full life cycle management
- Webbased management interface
- Uses HTTPS for all transactions

Red Hat Network Server

- `rhn.redhat.com` or local Satellite/Proxy
  - Web based management of machines
  - RHN Proxy caches RHN traffic
  - RHN Satellite provides an autonomous RHN
- RHN Accounts
  - RHN Users for registration of machines and web based management
  - System ID for automatic authentication of systems

Entitlements

- Grant access to software channels
  - Base Channel
  - Child Channel(s)
- Define level of service
  - Update
  - Management
  - Provisioning
  - Monitoring

Red Hat Network Client

- Registration
  - Run **rhn_register**
  - Select the updates location (RHN or local satellite/ proxy)
  - Enter Account information
- Interactive usage
  - **yum** plugin for downloading packages from RHN
  - Configuration in `/etc/yum/pluginconf.d/rhn-plugin.conf`
- Remote management
  - **rhnsd** polls RHN every four hours
  - **rhn_check** polls imediately

End of Unit 2

- Questions and Answers
- Summary
  - What are the primary functions of RPM?
  - What **rpm** options should be used to install a kernel RPM?
  - Package-management with yum
  - Relationship between **yum** and **rpm**
  - Using **yum** with RHN
  - Creating a private repository
  - Configuring repositories
  - How does Red Hat Network work?

Unit 3

Kernel Services

Objectives

Upon completion of this unit, you should be able to:

- Understand the purpose and organization of the kernel
- Understand how to load and configure kernel modules.
- Know how to configure the kernel using /proc and sysctl
- Explore hardware devices available on the system

The Linux Kernel

- The kernel constitutes the core part of the Linux operating system.
- Kernel duties:
  - System initialization: detects hardware resources and boots up the system.
  - Process scheduling: determines when processes should run and for how long.
  - Memory Management: allocates memory on behalf of running processes.
  - Security: Constantly verifies filesystem permissions, SELinux contexts and firewall rules.
  - Provides buffers and caches to speed up hardware access.
  - Implements standard network protocols and filesystem formats.
- Documentation available in the `kernel-doc` RPM package

Kernel Images and Variants

- Architectures supported: x86, x86_64, IA64/ Itanium, PowerPC64, s390x.
- Three kernel versions available for x86:
  - Regular: one or more processors but 4GB of RAM or less
  - PAE: multiple processors and up to 64G of RAM
  - Xen: needed for virtualization
- Kernels always installed under `/boot/vmlinuz-*`

Kernel Modules

- Modules are small kernel extensions that may be loaded and unloaded at will
- Can implement drivers, filesystems, firewall, and more
- Are located under `/lib/modules/$(uname -r)/`
- Compiled for a specific kernel version and are provided with the kernel RPM.
- Third party modules may be added

Kernel Module Utilities

- **lsmod** provides a list of loaded modules
- **modprobe** can load and unload modules
- **modinfo** displays information about any available module
- `/etc/modprobe.conf` used for module configuration:
  - Parameters to pass to a module whenever it is loaded
  - Aliases to represent a module name
  - Commands to execute when a module is loaded or unloaded

Managing the initrd Image

- The initial RAM disk provides modules loaded early in the boot process.
- This file is located under `/boot/initrd-$(uname -r).img`
- Extra modules sometimes need to be added due to:
  - New hardware added to the system. i.e. SCSI controller
  - New features needed such as USB devices.
  - Module needs to load automatically at boot time.
- Use **mkinitrd** and the **--with** option to rebuild with an extra module:

```
mkinitrd --with=module_name /boot/initrd-$(uname -r).img \
$(uname -r)
```

Accessing Drivers Through /dev

- Files under /dev used to access drivers
- Reading from and writing to those files are valid operations:
  - Read from serial port: **cat /dev/ttyS0**
  - Write to serial port: **echo "Message" > /dev/ttyS0**
- Three file attributes determine which driver to access:
  - Device type (character or block)
  - Major number
  - Minor number

Device Node Examples

- Block Devices
  - `/dev/hda`, `/dev/hdc` - IDE hard disk, CDROM
  - `/dev/sda`, `/dev/sdb` - SCSI, SATA, or USB Storage
  - `/dev/md0`, `/dev/md1` - Software RAID
- Character Devices
  - `/dev/tty[0-6]` - virtual consoles
  - `/dev/null`, `/dev/zero` - software Devices
  - `/dev/random`, `/dev/urandom` - random Numbers

Managing /dev With udev

- udev manages files stored under /dev/
- Files only created if corresponding device is plugged in
- Files are automatically removed when device is disconnected
- udev statements under /etc/udev/rules.d/ determine:
  - Filenames
  - Permissions
  - Owners and groups
  - Commands to execute when a new device shows up

Adding Files Under /dev

- The right way to add a /dev entry involves udev:
  - Create a new file under /etc/udev/rules.d/
  - Insert a statement such as:

```
KERNEL=="sda", NAME="usbkey" , SYMLINK="usbstorage"
```

  - This creates a device file named usbkey and a symlink named usbstorage next time /dev/sda gets plugged.
- Files can be added manually with **mknod**:

```
mknod /dev/usbdevice b 8 0
```

- **mknod** not persistent!

Kernel Configuration With /proc

- /proc used to get or set kernel configuration
- Virtual filesystem: files not stored on hard disk
- Entries not persistent: modifications get reinitialized after a reboot
- Used to display process information, memory resources, hardware devices, kernel memory, etc.
- Can be used to modify network and memory subsystems or modify kernel features
- Modifications apply immediately

/proc Examples

- Read-only files:
  - /proc/cpuinfo
  - /proc/1/*
  - /proc/partitions
  - /proc/meminfo
- Read-Write entries under `/proc/sys/`:
  - `/proc/sys/kernel/hostname`
  - `/proc/sys/net/ipv4/ip_forward`
  - `/proc/sys/vm/drop_caches`
  - `/proc/sys/vm/swappiness`

sysctl : Persistent Kernel Configuration

- **sysctl** adds persistence to `/proc/sys` settings
- Statements added to `/etc/sysctl.conf` automatically reflected under `/proc` after a reboot.
- Configuration maintained or monitored using the **sysctl** command:
  - List all current settings: **sysctl -a**
  - Reload settings from `sysctl.conf`: **sysctl -p**
  - Set a `/proc` value dynamically: **sysctl -w net.ipv4.ip_forward=1**

Exploring Hardware Devices

- A snapshot of all connected devices is maintained by HAL: Hardware Abstraction Layer
- **hal-device** lists all devices in text mode.
- **hal-device-manager** displays all devices on a graphical window.
- **lspci** and **lsusb** list devices connected to the PCI and USB buses, respectively.
- The `/proc` and `/sys` filesystems also contain bus and device specific information.

Monitoring Processes and Resources

- Information available under `/proc/` can be hard to understand.
- Interfaces are available to format the data and make it more accessible:
  - Memory: **free**, **vmstat**, **swapon -s**, **pmap**
  - Processes: **ps**, **top**, **gnome-system-monitor**
  - Kernel state: **uname**, **uptime**, **tload**

Unit 4

System Services

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Objectives

Upon completion of this unit, you should be able to:

- Understand the importance of time syncronization
- Configure System Logging
- Setup the X Window System
- remotely administer the system
- Automate tasks with cron
- Configure printing

Network Time Protocol

- Workstation hardware clocks tend to drift over time without correction
- Many application require accurate timing
- Time synchronization makes system logs easier to analyze
- NTP counters the drift by manipulating the length of a second
- NTP clients should use three time servers
- Config file: `/etc/ntp.conf`
- Config tool: **system-config-date**

System Logging

- Centralized logging daemons: **syslogd**, **klogd**
- Log file examples:
  - `/var/log/dmesg`: Kernel boot messages
  - `/var/log/messages`: Standard system error messages
  - `/var/log/maillog`: Mail system messages
  - `/var/log/secure`: Security, authentication, and xinetd messages
- Application log files and directories also reside in `/var/log`

syslog Configuration

- **syslog** System V initialization script in `/etc/rc.d/init.d` controls both the syslogd and the klogd daemons
- `/etc/syslog.conf`
  - Configures system logging
- `/etc/sysconfig/syslog`
  - Sets switches used when starting syslogd and klogd from the System V initialization script

XOrg: The X11 Server

- Foundation for the Red Hat Enterprise Linux graphical user interface(GUI)
- Open Source implementation of X11
- Client / Server Architecture
- Core server with dynamically loaded modules
  - drivers: ati, nv, mouse, keyboard, etc.
  - extensions: dri, glx, and extmod
- Font Rendering
  - Native server: **xfs**
  - Fontconfig/Xft libraries

XOrg Server Configuration

- Typically configured after installation
- Post-install configuration:
  - Best results while in runlevel 3!
  - **system-config-display**
    - options:
      - **--noui**
      - **--reconfig**
  - stored in `/etc/X11/xorg.conf`

XOrg in runlevel 3

- Two methods to establish the environment
  - `/usr/X11R6/bin/xinit`
  - `/usr/X11R6/bin/startx`
- Environment configuration
  - `/etc/X11/xinit/xinitrc` and `~/.xinitrc`
  - `/etc/X11/xinit/Xclients` and `~/.Xclients`
  - `/etc/sysconfig/desktop`

XOrg in runlevel 5

- Environment established by **/sbin/init**
- Environment configuration
  - `/etc/inittab`
    - `/etc/X11/prefdm`
  - `/etc/sysconfig/desktop`
    - DESKTOP defines the window manager
    - DISPLAYMANAGER defines the display manager
  - `/etc/X11/xdm/Xsession`
    - `/etc/X11/xinit/xinitrc.d/*`
    - `~/.xsession` or `~/.Xclients`

Remote X Sessions

- X protocol communication is unencrypted
- Host-based sessions implemented through the **xhost** command
- User-based sessions implemented through the Xauthority mechanism
- **sshd** may automatically install **xauth** keys on remote machine
  - Tunnels X protocol over secure encrypted **ssh** connection

SSH: Secure Shell

- encrypted remote shell
- frequently used for remote system administration
- can copy files securely
- can execute commands remotely

```
# ssh root@host 'ifconfig eth0'
```

- can tunnel X11 and other TCP based network traffic
- supports key based authentication

VNC: Virtual Network Computing

- Allows to access or share a complete desktop over the network
- Uses significantly less bandwidth as pure remote X connections
- Server
  - Individual users can start a VNC server with the command: **vncserver**
  - Runs `$HOME/.vnc/xstartup` upon startup
  - Requires a VNC password which should not be identical to the system password
  - Servers can automatically be started via `/etc/init.d/vncserver`
- Client
  - connects to a remote VNC server with **vncviewer *host*:*screen***
  - Unique screen numbers distinguish between multiple VNC servers running on the same host
  - supports tunneling through SSH: **vncviewer -via user@host localhost:1**

cron

- Used to schedule recurring events
- Use crontab to edit, install, and view job schedules
- Syntax
  - **`crontab [-u user] file`**
  - **`crontab [-l|-r|-e]`**
    - **-l** lists crontab
    - **-r** removes crontab
    - **-e** edits crontab using `$EDITOR`

Controlling Access to cron

- Restrict / allow user access to cron
  - `/etc/cron.allow`
  - `/etc/cron.deny`
- Contains usernames to allow / deny access

System crontab Files

- Different format than user crontab files
- Master crontab file `/etc/crontab` runs executables in
  - `/etc/cron.hourly`
  - `/etc/cron.daily`
  - `/etc/cron.weekly`
  - `/etc/cron.monthly`
- `/etc/cron.d/` directory contains additional system crontab files

Daily Cron Jobs

- **tmpwatch**
  - Cleans old files in specific directories
  - Keeps `/tmp` from filling up
- **logrotate**
  - Keeps log files from getting to large
  - Highly configurable in `/etc/logrotate.conf`
- **logwatch**
  - provides a summary about system activity
  - reports suspicious messages
  - Configuration file: `/etc/log.d/conf/logwatch.conf`

The anacron System

- **anacron** runs **cron** jobs that did not run when the computer is down
  - Assumes computers are not up continually
  - Vital for laptops, desktops, workstations, and other systems that are not up continually
  - Useful for servers that need to be taken down temporarily
- Configuration file: `/etc/anacrontab`
  - Field 1: If the job has not been run in this many days...
  - Field 2: wait this number of minutes after reboot and then run it
  - Field 3: job identifier
  - Field 4: the job to run

CUPS

- uses the Internet Printing Protocol (IPP)
  - allows remote browsing of printer queues
  - based on HTTP/1.1
  - Uses PPD files to describe printers
  - Configuration files
    - `/etc/cups/cupsd.conf`
    - `/etc/cups/printers.conf`
  - Configuration tools
    - **system-config-printer**
    - Web based on `http://localhost:631`
    - Commandline management with **lpadmin**

End of Unit 4

- Questions and Answers
- Summary
  - System Logging
  - system-config-display
  - Remote Administration tools: **ssh** and **vnc**
  - Task Automation
  - What are the tools to configure **cups**?

Unit 5

User Administration

RH133-RH133-RHEL5-en-1-20070321

Objectives

Upon completion of this unit, you should be able to:

- Configure user and group accounts
- Modify File ownership and permissions
- Use "Special" permissions SUID / SGID / Sticky
- Configure Network Users with NIS and LDAP
- Set ACLs

Adding a New User Account

- Most common method is **useradd**:
  - **useradd [*options*] *username***
- Running **useradd** is equivalent to:
  - editing `/etc/passwd`, `/etc/shadow`, `/etc/group`, `/etc/gshadow`
  - creating and populating home directory
  - setting permissions and ownership
- Set account password using **passwd**
- Accounts may be added in a batch with **newusers**

User Private Groups

- When user accounts are created, a private group is also created with the same name
  - Users are assigned to this private group
  - User's new files affiliated with this group
- Advantage: Prevents new files from belonging to a "public" group
- Disadvantage: May encourage making files "world-accessible"

Modifying / Deleting User Accounts

- To change fields in a user's `/etc/passwd` entry you can:
  - Edit the file by hand
  - Use **usermod [*options*] *username***
- To remove a user either:
  - Manually remove the user from `/etc/passwd`, `/etc/shadow`, `/etc/group`, `/etc/gshadow`, `/var/spool/mail`, etc.
  - Use **userdel [-r] *username***

Group Administration

- Entries added to `/etc/group` and `/etc/gshadow`
  - **groupadd**
  - **groupmod**
  - **groupdel**

Password Aging Policies

- By default, passwords do not expire
- Forcing passwords to expire is part of a strong security policy
- Modify default expiration settings in `/etc/login.defs`
- To modify password aging for existing users, use the **chage** command
  - **chage [*options*] *username***

Switching Accounts

- Syntax
  - **su [-] [user]**
  - **su [-] [user] -c *command***
- Allows the user to temporarily become another user
  - Default user is root
- The "**-**" option makes the new shell a login shell

sudo

- Users listed in `/etc/sudoers` execute commands with:
  - an effective user id of 0
  - group id of root's group
- An administrator will be contacted if a user not listed in `/etc/sudoers` attempts to use **sudo**

Network Users

- Information about users may be centrally stored and managed on a remote server
- Two types of information must always be provided for each user account
  - Account information: UID number, default shell, home directory, group memberships, and so on
  - Authentication: a way to tell that the password provided on login for an account is correct

Authentication Configuration

- **system-config-authentication**
  - GUI tool to configure authentication
  - For text-based tool, use **authconfig-tui**
  - Load `authconfig-gtk` RPM
- Supported account information services:
  - (local files), NIS, LDAP, Hesiod, Winbind
- Supported authentication mechanisms:
  - (NSS), Kerberos, LDAP, SmartCard, SMB, Winbind

Example: NIS Configuration

- Must install `ypbind` and `portmap` RPMs
- Run **system-config-authentication**
  - Enable NIS to provide User Information
  - Specify NIS server and NIS domain name
  - Keep default authentication (through NSS)
- What does this actually do?
  - Five text-based configuration files are changed

Example: LDAP Configuration

- Must install `nss-ldap` and `openldap` RPMs
- Run **system-config-authentication**
  - Enable LDAP to provide User Information
  - Specify server, the search base DN, and TLS
  - Enable LDAP to provide Authentication
- What does this actually do?
  - Five text-based configuration files are changed

SUID and SGID Executables

- Normally processes started by a user run under the user and group security context of that user
- SUID and/or SGID bits set on an executable file cause it to run under the user and/or group security context of the file's owner and/or group

SGID Directories

- Used to create a collaborative directory
- Normally, files created in a directory belong to the user's the default group
- When a file is created in a directory with the SGID bit set, it belongs to the same group as the directory

The Sticky Bit

- Normally users with write permissions to a directory can delete any file in that directory regardless of that file's permissions or ownership
- With the sticky bit set on a directory, only the owner of a file can delete the file
- Example:

```
ls -ld /tmp
drwxrwxrwt  12 root  root  4096 Nov 2 15:44 /tmp
          ^
```

Default File Permissions

- Read and write (not execute) for all is the default for files
- Read, write and execute is the default for directories
- **umask** can be used to withhold permissions on file creation
- Users' umask is 022
  - Files will have permissions of 644
  - Directories will have permissions of 755
  - May need to change to 002 for group colaboration

Access Control Lists (ACLs)

- Grant rwx access to files and directories for multiple users or groups
  - **mount -o acl *`/directory`***
  - **getfacl *`file`*|*`directory`***
  - **setfacl -m u:gandolf:rwx *`file`*|*`directory`***
  - **setfacl -m g:nazgul:rw *`file`*|*`directory`***
  - **setfacl -m d:u:frodo:rw *`directory`***
  - **setfacl -x u:samwise *`file`*|*`directory`***

SELinux

- Mandatory Access Control (MAC) -vs- Discretionary Access Control (DAC)
- A rule set called the *policy* determines how strict the control
- Processes are either restricted or unconfined
- The policy defines what resources restricted processes are allowed to access
- Any action that is not explicitly allowed is, by default, denied

SELinux, continued

- All files and processes have a *security context*
- The context has several elements, depending on the security needs
  - user:role:type:sensitivity:category
  - `user_u:object_r:tmp_t:s0:c0`
  - Not all systems will display s0:c0
- **ls -Z**
- **ps -Z**
  - Usually paired with other options, such as **-e**

SELinux: Targeted Policy

- The targeted policy is loaded at install time
- Most local processes are *unconfined*
- Principally uses the type element for *type enforcement*
- The security context can be changed with **chcon**
  - **chcon -t tmp_t /etc/hosts**
- Safer to use **restorecon**
  - **restorecon /etc/hosts**

SELinux: Management

- Modes: Enforcing, Permissive, Disabled
  - Changing enforcement is allowed in the Targeted policy
  - **getenforce**
  - **setenforce 0 | 1**
  - Disable from GRUB with **selinux=0**
- `/etc/sysconfig/selinux`
- **system-config-securitylevel**
  - Change mode, Disabling requires reboot
- **system-config-selinux**
  - Booleans
- **setroubleshootd**
  - Advises on how to avoid errors, not ensure security!

End of Unit 5

- Questions and Answers
- Summary
  - User and Group accounts
  - File ownership and permissions
  - Extended file modes: SUID / SGID / Sticky
  - Switching accounts with su
  - **umask** and the UPG scheme
  - Shell environment
  - Setup NIS and LDAP
  - Use ACLs
  - Configure and troubleshoot SELinux

Unit 6

Filesystem Management

RH133-RH133-RHEL5-en-1-20070321

Objectives

Upon completion of this unit, you should be able to:

- Understand filesystem hierarchy
- Manage virtual memory
- Add new drives and partitions
- Mount NFS filesystems

Overview: Adding New Filesystems to the Filesystem Tree

- Identify Device
- Partition Device
- Make Filesystem
- Label Filesystem
- Create entry in `/etc/fstab`
- Mount New Filesystem

Device Recognition

- Master Boot Record (MBR) contains:
  - Executable code to load operating system
  - Space for partition table information, including:
    - Partition id or type
    - Starting cylinder for partition
    - Number of cylinders for partition

Disk Partitioning

- An extended partition points to additional partition descriptors
- Total maximum number of partitions supported by the kernel:
  - 63 for IDE drives
  - 15 for SCSI drives
- Why partition drives?
  - containment, performance, quotas, recovery

Managing Partitions

- Create partitions using:
  - **fdisk**
  - **sfdisk**
  - GNU **parted** - advanced partition manipulation (create, copy, resize, etc.)
- **partprobe** - reinitializes the kernel's in-memory version of the partition table

Making Filesystems

- **mkfs**
- **mkfs.ext2**, **mkfs.ext3**, **mkfs.msdos**
- Specific filesystem utilities can be called directly
  - **mke2fs [*options*] *device***

Filesystem Labels

- Alternate way to refer to devices
- Device independent
  - **e2label** ***special_dev_file [fslabel]***
  - **mount** ***[options]*** **LABEL=*fslabel* *mount_point***
- **blkid** can be used to see labels and filesystem type of all devices.

tune2fs

- adjusts filesystem parameters
  - reserved blocks
  - default mount options
  - **fsck** frequency
- View current settings with **dumpe2fs**

Mount Points and /etc/fstab

- Configuration of the filesystem hierarchy
- Used by **mount**, **fsck**, and other programs
- Maintains the hierarchy between system reboots
- May use filesystem volume labels in the device field
- The **mount -a** command can be used to mount all filesystems listed in the /etc/fstab

Mounting Filesystems with mount

- **mount [options] *device mount_point***
  - `-t` *`vfstype`* (normally not needed)
  - `-o options`
  - Default options: `rw`, `suid`, `dev`, `exec`, `acl`, and `async`

Unmounting Filesystems

- **umount [*options*] *device* | *mount_point***
- You cannot unmount a filesystem that is in use
  - Use **fuser** to check and/or kill processes
- Use the **remount** option to change a mounted filesystem's options atomically
  - **mount -o remount,ro /data**

mount By Example

- Sample filesystem requirements met using options:
  - Disabling execute access
  - Mounting a filesystem image
  - Mounting a PC-compatible filesystem
  - Disabling access time updates
  - Setting up a **mount** alias

Handling Swap Files and Partitions

- Swap space is a supplement to system RAM
- Basic setup involves:
  - Create swap partition or file
  - Write special signature using **mkswap**
  - Add appropriate entries to `/etc/fstab`
  - Activate swap space with **swapon -a**

Mounting NFS Filesystems

- Makes a remote NFS filesystem work as though it were a local filesystem
- `/etc/fstab` can be used to specify persistent network mounts
- NFS shares are mounted at boot time by **/etc/init.d/netfs**
- Exports can be mounted manually with the **mount** command.

```
# mkdir /mnt/server1
# mount -t nfs server1:/var/ftp/pub /mnt/server1
```

Automounter

- System administrator specifies mount points controlled by automounter daemon process in `/etc/auto.master`
- The automounter monitors access to these directories and mounts the filesystem on demand
- Filesystems automatically unmounted after a specified interval of inactivity
- Enable the special map `-host` to "browse" all NFS exports on the network
- Supports wildcard directory names

Direct Maps

- Direct maps include absolute path names
- Does not obscure local directory structure
- Example:

```
/etc/auto.master:
/-  /etc/auto.direct

/etc/auto.direct:
/foo            server1:/export/foo
/usr/local/  server1:/usr/local
```

gnome-mount

- automatically mounts removable devices
- integrated with the HAL (Hardware Abstraction Layer)
- replaces fstab-sync

End of Unit 6

- Questions and Answers
- Summary
  - What tools are available for partitioning?
  - What two ways can swap space be implemented?
  - Mount NFS

Unit 7

Advanced Filesystem Management

RH133-RH133-RHEL5-en-1-20070321

Objectives

Upon completion of this unit, you should be able to:

- Setup filesystem quotas
- Setup and manage software Raid devices
- Configure Logical Volumes
- setup LVM Snapshots
- perform backups

Configuring the Quota System

- Overview
  - Implemented within the kernel
  - Enabled on a per-filesystem basis
  - Individual policies for groups or users
    - Limit by the number of blocks or inodes
    - Implement both soft and hard limits
- Initialization
  - Partition mount options: `usrquota, grpquota`
  - Initialize database: **quotacheck**

Setting Quotas for Users

- Implementation
  - Start or stop quotas: **quotaon**, **quotaoff**
  - Edit quotas directly: **edquota** ***username***
  - From a shell:

    setquota ***username*** **4096 5120 40 50** ***/foo***

  - Define prototypical users:

    edquota -p ***user1 user2***

Reporting Quota Status

- Reporting
  - User inspection: **quota**
  - Quota overviews: **repquota**
  - Miscellaneous utilities: **warnquota**

What is Software RAID?

- Multiple disks grouped together into "arrays" to provide better performance, redundancy or both.
- **mdadm** - provides the administration interface to software RAID.
- Many "RAID Levels" supported, including RAID O, 1 and 5.
- Spare disks add extra redundancy
- RAID devices are named, `/dev/md0`, `/dev/md1`, `/dev/md2`, `/dev/md3` and so on.

Software RAID Configuration

- Create and define RAID devices using **mdadm**

```
mdadm -C /dev/md0 -a yes -l 1 -n 2 -x 1 /dev/sda1 /dev/sdb1 /dev/sdc1
```

- Format each RAID device with a filesystem

```
mke2fs -j /dev/md0
```

- Test the RAID devices
- **mdadm** allows you to check the status of your RAID devices

```
mdadm --detail /dev/md0
```

Software RAID Testing and Recovery

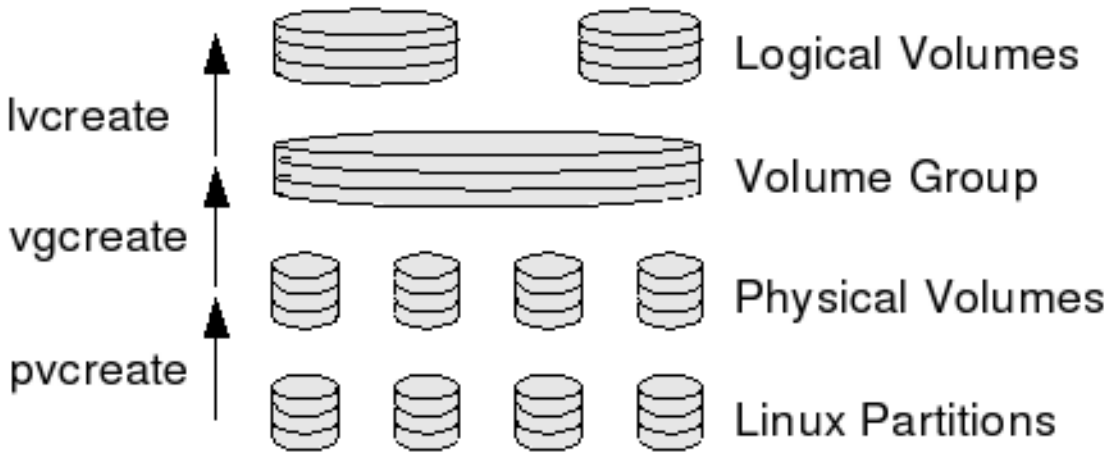
- Simulating disk failures

```
mdadm /dev/md0 -f /dev/sda1
```

- Recovering from a software RAID disk failure
  - replace the failed hard drive and power on
  - reconstruct partitions on the replacement drive
  - **`mdadm /dev/md0 -a /dev/sda1`**
- **mdadm**, `/proc/mdstat`, and syslog messages

What is Logical Volume Manager (LVM)?

- A layer of abstraction that allows easy manipulation of volumes. Including resizing of filesystems
- Allows reorganization of filesystems across multiple physical devices
  - Devices are designated as Physical Volumes
  - One or more Physical Volumes are used to create a Volume Group
  - Physical Volumes are defined with Phyisical Extents of a fixed size
  - Logical Volumes are created on Physical Volumes and are composed of Physical Extents
  - Filesystems may be created on Logical Volumes



Creating Logical Volumes

- Create physical volumes

```
pvcreate /dev/hda3
```

- Assign physical volumes to volume groups

```
vgcreate vg0 /dev/hda3
```

- Create logical volumes from volume groups

```
lvcreate -L 256M -n data vg0
mke2fs -j /dev/vg0/data
```

Resizing Logical Volumes

- Growing Volumes
  - **lvextend** can grow logical volumes
  - **resize2fs** can grow EXT3 filesystems online
  - **vgextend** adds new physical volumes to an existing volume group.
- Shrinking volumes
  - Filesystem must be reduced first
  - Requires a filesystem check and cannot be performed online
  - **lvreduce** can then reduce the volume.
  - Volume Groups can be reduced with:

```
pvmove /dev/hda3
vgreduce vg0 /dev/hda3
```

Logical Volume Manager Snapshots

- *Snapshots* are special Logical Volumes that are an exact copy of an existing Logical Volume at the time the snapshot is created
- Snapshots are perfect for backups and other operations where a temporary copy of an existing dataset is needed
- Snapshots only consume space where they are *different* from the original Logical Volume
  - Snapshots are allocated space at creation but do not use it until changes are made to the original Logical Volume or the Snapshot
  - When data is changed on the original Logical Volume the older data is copied to the Snapshot
  - Snapshots contain only data that has changed on the original Logical Volume or the Snapshot since the Snapshot was created.

Using LVM Snapshots

- Create Snapshot of existing Logical Volume

```
# lvcreate -l 64 -s -n databackup /dev/vg0/data
```

- Mount Snapshot

```
#  mkdir -p /mnt/databackup
# mount -o ro /dev/vg0/databackup /mnt/databackup
```

- Remove Snapshot

```
# umount /mnt/databackup
# lvremove /dev/vg0/databackup
```

Archiving tools: tar

- **tar** can backup to a file or tape device
- supports GZIP and BZIP2 compression
- can preserve file permissions, ownership and timestamps
- supports extended attributes
- uses **rmt** to write to a remote tape device

Archiving Tools: dump/restore

- Back up and restore ext2/3 filesystems
  - Does not work with other filesystems
  - dump should only be used on unmounted filesystems or filesystems that are read-only.
- Can do full or incremental backups
- Examples:

```
dump -0u -f /dev/nst0 /dev/hda2
restore -rf /dev/nst0
```

Archiving Tools: rsync:

- Efficiently copies files to or from remote systems
- Uses secure **ssh** connections for transport
  - **rsync *.conf barney:/home/joe/configs/**
- Faster than **scp** - copies differences in like files

End of Unit 7

- Questions and Answers
- Summary
  - Filesystem quotas
  - Configuration of Software RAID
  - Software RAID recovery
  - Configuration of Logical Volumes
  - LVM Snapshots
  - Backup Tools

Unit 8

Network Configuration

Objectives

Upon completion of this unit, you should be able to:

- configure IP interfaces
- setup routes
- understand name resolution
- setup IPv6

Network Inferfaces

- Networking scripts refer to logical interface names:
  - Ethernet: `eth0, eth1 ...`
  - Dial-up: `ppp0, ppp1 ...`
  - Loopback: `lo`
- Display network interfaces by using:
  - **ifconfig -a**
  - **ip link [show]**

Driver Selection

- All drivers for network interface cards are built as modules
- `/etc/modprobe.conf` maps logical names to specific modules:
  - `alias eth0 3c59x`
- Secondary "card selection" can be specified in the interface configuration file, `/etc/sysconfig/network-scripts/ifcfg-eth0`
  - `HWADDR=00:0D:60:FB:CA:61`

Speed and Duplex Settings

- Modules are configured to autonegotiate, by default
- Mismatches can cause intermittent to no communcation
- Manually overridden using:
  - **ethtool**
  - `ETHTOOL_OPTS` in `ifcfg-`*`ethX`*
  - `options` or `install` in `/etc/modprobe.conf` for older interface modules

IPv4 Addresses

- View configuration with:
  - **ifconfig**
  - **ip addr [show]**

Dynamic IPv4 Configuration

- Interface configuration defined in:
  - `/etc/sysconfig/network-scripts/ifcfg-`*`ethX`*
  - Dynamic with line of: `BOOTPROTO=dhcp`
- Zero Configuration Networking
  - Uses `169.254.0.0/16`
  - Disabled with line of: `NOZEROCONF=yes` in `/etc/sysconfig/network-scripts/ifcfg-`*`ethX`*
- Use **ifdown *`device`*; ifup *`device`*** to apply configuration changes

Static IPv4 Configuration

- Interface configuration defined in:
  - `/etc/sysconfig/network-scripts/ifcfg-`*`ethX`*
- Static with lines of:
  - `BOOTPROTO=none`
  - `IPADDR=`*`10.0.0.1`*
  - `NETMASK=`*`255.255.255.0`*

Device Aliases

- Useful for virtual hosting
- Bind multiple IP addresses to a single NIC
  - `eth1:1`
  - `eth1:2`
  - `eth1:3`
- Create a separate interface configuration file for each device alias:
  - `ifcfg-ethX:xxx`
  - Must use static networking

Routing Table

- Defines path to all systems
- View table with:
  - **route**
  - **netstat -r**
  - **ip route [show]**

Default Gateway

- Used when no route entry is matched
- Might be obtained dynamically with DHCP
- Can be statically configured:
  - With a line of: `GATEWAY=`*`10.53.0.254`*
  - Globally in: `/etc/sysconfig/network`
  - OR, per interface in the interface configuration file: `/etc/sysconfig/network-scripts/ifcfg-`*`ethX`*

Configuring Routes

- To control traffic flow when there is more than one router
- Static routes defined per interface
  - `/etc/sysconfig/network-scripts/route-`*`ethX`*
  - Uses **ip route add** syntax
- Dynamic routes learned via daemon(s)
  - **quagga**
  - Support for various forms of `RIP`, `OSPF`, and `BGP`

Verify IP Connectivity

- **ping**
  - Network packet loss and latency measurement tool
- **traceroute**
  - Displays network path to a destination
- **mtr**

Defining the Local Host Name

- View/Set local hostname with **hostname**
- Initially defined in `/etc/sysconfig/network`:
  - `HOSTNAME=`*`stationX.example.com`*
- Might "pull" name from network
  - **dhclient** daemon
  - "Reverse DNS Lookup"

Local Resolver

- Resolver performs forward and reverse lookups
- `/etc/hosts`
  - Local database of hostname to IP address mappings
  - Useful for small isolated networks
  - Normally, checked before DNS

Remote Resolvers

- `/etc/resolv.conf`
  - Domains to search
  - Strict order of name servers to use
  - May be updated by **dhclient**
- `/etc/nsswitch.conf`
  - Precendence of DNS versus `/etc/hosts`

Verify DNS Connectivity

- Verify name servers using:
  - **nslookup** (deprecated)
  - **host**
  - **dig**

Network Configuration Utilities

- **system-config-network**
  - **system-config-network-gui**
  - **system-config-network-tui**
- Profile Selection
  - **system-config-network-cmd**
  - `netprofile` kernel argument

Transparent Dynamic Configuration

- **NetworkManager** service
- **nm-applet**

Implementing IPv6

- Kernel **ipv6** module enables stateless autoconfiguration
- Additional configuration implemented by **/etc/rc.d/init.d/network** initialization script
  - `NETWORKING_IPV6=yes` in `/etc/sysconfig/network`
  - `IPV6INIT=yes` in `/etc/sysconfig/network-scripts/ifcfg-`*`ethX`*

IPv6: Dynamic Interface Configuration

- Two ways to dynamically configure IPv6 addresses:
  - Router Advertisement Daemon
    - Runs on (Linux) Default Gateway - **radvd**
    - Only specifies prefix and default gateway
    - Enabled with `IPV6_AUTOCONF=yes`
    - Interface ID automatically generated based on the MAC address of the system
  - DHCP version 6
    - **dhcp6s** supports more configuration options
    - Enabled with `DHCPV6C=yes`

IPv6: StaticInterface Configuration

- `/etc/sysconfig/network-scripts/ifcfg-`*`ethX`*
  - `IPV6ADDR=<ipv6_address>[/prefix_length]`
  - Device aliases unnecessary...
  - `IPV6ADDR_SECONDARIES=<ipv6_address>[/prefix_length] [...]`

IPv6: Routing Configuration

- Default Gateway
  - Dynamically from **radvd** or **dhcpv6s**
  - Manually specified in `/etc/sysconfig/network`
    - `IPV6_DEFAULTGW=<IPv6_address[%interface]>`
    - `IPV6_DEFAULTDEV=<interface>` - only valid on point-to-point interfaces
- Static Routes
  - Defined per interface in `/etc/sysconfig/network-scripts/route6-`*`ethX`*
    - Uses **ip -6 route add** syntax
    - `<ipv6_network/prefix> via <ipv6_routeaddress>`

New and Modified Utilities

- ping6
- traceroute6
- tracepath6
- ip -6
- host -t AAAA *hostname6.domain6*

End of Unit 8

- Questions and Answers
- Summary
  - Where are drivers linked to specific interfaces?
  - Where is a static IP address defined?
  - Where is the default route set?
  - Where is the list of nameservers stored?

Unit 9

Installation

Objectives

Upon completion of this unit, you should be able to:

- Know important command line switches
- Understand different installation methods
- Create advanced partition layouts
- Understand Kickstart's role
- Create Kickstart files

Anaconda, the Red Hat Enterprise Linux Installer

- Supports different modes
  - Kickstart offers automated Installation
  - Upgrade performs an update of an existing Red Hat Enterprise Linux installation
  - Rescue Mode allows troubleshooting of unbootable systems
- Consists of two stages:
  - First stage starts the installation
  - Second stage performs the installation

First Stage: Starting the Installation

- The first stage consists of a installation kernel and an `initrd.img`
- Can be started with any supported boot loader
- Tasks of the First Stage:
  - Initializes the Installer
  - Parses command line arguments
  - Autodetects hardware
  - Loads additional drivers
  - Selects language, keyboard layout and installation method
  - Sets up networking if required for installation

First Stage: Boot Media

- Supported boot media:
  - `boot.iso` or Installation CD/DVD
  - USB drive containing `bootimg.img`
  - Network boot with PXE
  - Other bootloaders such as GRUB
  - Boot floppies no longer supported
- Boot media can modified for custom installations

Accessing the Installer

- Graphical Installation
  - Default installation type
  - Useful Switches: `lowres`,`resolution`, `skipddc`
- VNC based Installation
  - Activate with **vnc** and protect the session with **vncpassword=*password***
  - Set network parameters with **ip=*IP Address*** and **netmask=*Network Mask***
- Text based Installation
  - Started with the **text** switch
  - Menu-based terminal interface
- Serial Installation
  - Used automatically when no graphic card is detected
  - Enable with: **serial=*device***

First Stage: Installation Method

- Available Installation Methods:
  - Local CDROM
  - Hard drive
  - NFS image
  - FTP
  - HTTP
- Media sets:
  - Two Sets available: Client and Server
  - Can be downloaded from Red Hat Network
  - May contain packages from additional layered products
  - An "Installation Key" must be entered to unlock additional content
  - Extra packages can also be installed after installation through RHN.

Network Installation Server

- Necessary for network-based installs
- Often faster than CDROM-based installation methods
- Provides an easy distribution platform for the enterprise
- Shares the RedHat directory via NFS, FTP and/or HTTP
- Can be used as a **yum** repository

Second Stage: Installation Overview

- Language and keyboard selection
- Installation Key
- Disk partitioning
- Bootloader configuration
- Network and time zone configuration
- Package selection

Configuring File Systems

- Must select mount points, partition sizes, and file system types in the installer
  - Can set up manually or automatically
- There are many layouts which may be used
  - `/` must include `/etc`, `/lib`, `/bin`, `/sbin`
  - Swap space is typically 2x physical RAM
  - Typical mount points: `/boot`, `/home`, `/usr`, `/var`, `/tmp`, `/usr/local`, `/opt`

Advanced Partitioning

- Software RAID
  - Create new partitions and select Software RAID as "filesystem" type
  - Combine RAID partitions into a RAID device with RAID
- LVM
  - Select Physical Volume to create physical volumes
  - LVM creates a Volume Group
  - Add creates new Logical Volumes

Package Selection

- A default set of packages is automatically installed
- Select Customize now to change the default set of packages
- Customizing is necessary to add support for additional languages
- Anaconda automatically resolves package dependencies
- Package set can easily customized after install with **yum** or **system-config-packages**

First Boot: Post-Install Configuration

- Configure X Window System if necessary
- Firewall and SELinux Setup
- Kdump setup
- Set date and time
- Register with Red Hat Network and get updated RPMs
- Setup users
- Configure sound card
- Install additional RPMs or Red Hat documentation from CDROM

Kickstart

- Scripted Installation method
- Supports all Anaconda features
- `/root/anaconda-ks.cfg` is automatically created during Install
- Configuration utility: **system-config-kickstart**
- Syntax-checker: **ksvalidator**

Starting a Kickstart Installation

- Anaconda enters Kickstart mode, when the `ks` boot option is specified
- `ks` queries DHCP for the Kickstart location
- `ks=`*`url`* gets the file via HTTP, FTP, or NFS
- From a local medium: `ks=floppy`, `ks=cdrom`, or `ks=hd:`*`device`*`:/path/to/file`

Anatomy of a Kickstart File

- Commands section
  - Configures the system
  - Ommited directives are prompted to the user
- `%packages` Section
  - Selects packages and groups for installation
  - Dependcies are always resolved
- Scripts section(s)
  - Optional section to customize the system
  - `%pre` scripts are run before installation
  - `%post` scripts are run after installation

Kickstart: Commands Section
Starting the Installation

- Installation Mode
  - `install` performs a fresh install.
  - `upgrade` upgrades an existing installation.
- Installation Method:

```
cdrom
url --url url
nfs --server host --path directory
harddrive --partition=device --dir=/path/to/install_tree
```

Kickstart: Commands section
Important Directives

- Required Directives
  - Must be specified, otherwise the installer configures them interactively
  - Localization options: `keyboard`, `lang`, `timezone`
  - Authentication: `rootpw`, `authconfig`
  - Bootloader: `bootloader`
- Optional Directives
  - Network: `network [options]`
  - Security: `firewall`, `selinux`, `services`
  - Installer behaviour: `firstboot`, `poweroff|reboot`, `interactive`, `text`

Kickstart: Packages Section

- Add single packages with `package_name` without any version number
- Add package groups with `@package_group`
- Remove packages from the list: `-package_name`
- Use wildcards to specify multiple packages
- Dependencies are always resolved
- Add support for additional languages with `@lang-support`
- Packages from layered products can be installed when an installation key is specified by with the `key` directive in the commands section.

Kickstart: %pre, %post

- %pre gives you the first word
  - executes as a bash shell script
  - executes after Kickstart file is parsed
- %post gives you the final word
  - Can specify interpreter (bash is default)
  - chrooted by default, but may be run without chroot

End of Unit 9

- Questions and Answers
- Summary
  - Steps of the installation
  - Important Anaconda switches
  - **system-config-kickstart**
  - **ksvalidator**

Unit 10

Virtualization with Xen

Objectives

Upon completion of this unit, you should be able to:

- Define Virtualization
- Understand Xen Terminology
- Xen Tools

Virtualization with Xen

- Advantages of Virtualization
  - Effective resource usage
  - Managability
  - Security
- Key Concepts of Xen
  - Small Hypervisor
  - First "Domain" manages the system
  - supports full and para virtualization

Hardware Considerations

- Minimum Requirements:
  - Processor with PAE support
  - 256 MiB RAM per domain
  - 6 GiB hard drive per domain
- Additional Considerations:
  - CPU with VT/SVM for Full Virtualization
  - Shared Storage for Live Migration
  - Actual Storage needs will vary by application

Preparing Domain-0

- Install the Domain0 as normal
- Boot the Xen hypervisor
- Start the **xend** management daemon

Virtual Resources

- CPU
  - uses VCPUs (Virtual CPUs)
  - need not map directly to real CPUs
- Storage
  - Block devices
  - Simple files
- Network Devices
  - Bridged or routed to Domain0
  - By default mapped to `xenbr0`

Domain-U Configuration

- Defined Per Domain-U
- Virtual Block Devices
- CPUs
- Networking
- `/etc/xen/`*`domain`*

Installing a new Domain-U

- **virt-manager**
  - Graphical frontend for managing domains
  - Provides a wizard for setting up new domains
  - Command line alternative: **xm**
- Define name of the domain
- Select storage type and number of CPUs
- Specify the location of the installer and optionally a kickstart file

Domain Management with xm

- Command line management tool
- Controlling domains
  - **xm <create|destroy>**
  - **xm <pause|unpause>**
  - **xm <save|restore>** ***filename***
  - **xm <shutdown|reboot>**
- Monitoring
  - **xm list**
  - **xentop**
  - **xen console**

Activating Domains on boot

- **xendomains** Sys-V init script
- Starts/stops Domain-Us
- must link domain config files to `/etc/xen/auto`

End of Unit 10

- Questions and Answers
- Summary
  - Xen Terminology
  - xm commands
  - xendomains

Unit 11

Troubleshooting

Objectives

Upon completion of this unit, you should be able to:

- Develop a strategy for troubleshooting
- Fix problems in different areas of the Linux system
- Boot the system into various runlevels
- Use the Rescue environment

Method of Fault Analysis

- Characterize the problem
- Reproduce the problem
- Find further information
- Eliminate possible causes
- Try the easy things first
- Backup config files before changing

Fault Analysis: Gathering Data

- Useful commands
  - **history**
  - **grep**
  - **diff**
  - **find -cmin -60**
  - **strace *command***
  - **tail -f *logfile***
- Generate additional information
  - `*.debug` in syslog
  - **--debug** option in application

Things to Check: X

- Never debug X while in runlevel 5!
- Try **system-config-display** first
- **X -probeonly**
- Is /home or /tmp full, or has the user reached a hard quota?
- Is **xfs** running?

Things to Check: Networking

- Hostname resolution
  - **dig www.redhat.com**
- IP configuration
  - **ifconfig**
- Default gateway
  - **route -n**
- Module specification
- Device activation

Order of the Boot Process

- Bootloader configuration
- Kernel
- **/sbin/init**
  - Starting init
- **/etc/rc.d/rc.sysinit**
- **/etc/rc.d/rc**, `/etc/rc.d/rc?.d/`
  - Entering runlevel X
- **/etc/rc.d/rc.local**
- X

Filesystem Corruption

- Common after crash or improper shutdown
- ext2 mounted for writing marked "dirty"
  - If not mounted or mounted read-only, "clean"
  - if not mounted and "dirty", may be corrupted
  - repair requires exhaustive check
- ext3 usually marked "clean"
  - journal indicates if recovery is needed
  - only need to check files recorded in journal

Filesystem Recovery

- If / has journal, kernel examines it at boot
- **/etc/rc.d/rc.sysinit** runs **fsck** on filesystems marked in /etc/fstab
- fsck is a front end to other programs
- A failed fsck must be run manually

Recovery Run-levels

- Pass run-level to init
  - on boot from GRUB splash screen
  - from shell prompt using: **init** or **telinit**
- Runlevel 1
  - Process `rc.sysinit` and `rc1.d` scripts
- Runlevel s, S, or single
  - Process only `rc.sysinit`
- emergency
  - Run **sulogin** only

Rescue Environment

- Required when root filesystem is unavailable
- Non-system specific
- Boot from CDROM (boot.iso or CD #1)
- Boot from diskboot.img on USB key

Rescue Environment Utilities

- Disk Maintenance Utilities
- Networking Utilities
- Miscellaneous Utilities
- Logging: `/tmp/syslog` or `/tmp/anaconda.log`

Rescue Environment Details

- Filesystem reconstruction
  - Anaconda will ask if filesystems should be mounted
  - `/mnt/sysimage/*`
  - `/mnt/source`
  - `$PATH` includes hard drive's directories
- Filesystem nodes
  - System-specific device files provided
  - **mknod** knows major/minor #'s

End of Unit 11

- Questions and Answers
- Summary
  - What are some things to check for
  - X problems?
  - Services problems?
  - Networking problems?
  - Boot problems?
  - How might you repair an ext2 filesystem?
  - What are some alternate boot methods?