RHCSA / RHCE Preparation

A Creative Commons Courseware

OpenRHCE

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Session One: Introductions

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Introductions: Your Instructor

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Qualifications

- RHCSA, RHCE #110-008-877 (RHEL6)
- Also: CTT+, CLA, CLP, CNI, LPIC1, Linux+
- Curriculum Developer and Trainer for a major computer manufacturer for 15 years
- Linux Enthusiast since 2000

Personal

- Disciple of Jesus Christ, Husband, Father, Eagle Scout, Computer Geek, Balloon Entertainer, and occasional coach of youth sports or leader of scouting units.

Fun

- Fun: Part-time Balloon Entertainer

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Introductions: Fellow Students

Please Introduce Yourselves

- Name
- Where you work or what you do.
- What Linux experience do you already have?
- What goals do you have for this class?
- Something fun about yourself.

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Introductions: The Course

Our Textbook:

> RHCSA/RHCE Red Hat Linux Certification Study Guide (Exams EX200 & EX300), 6th Edition (Certification Press) Michael Jang ISBN-10: 0071765654 | ISBN-13: 978-0071765657 Publication Date: June 17, 2011 | Edition: 6

Our classroom time will not follow it closely, but it is invaluable for your background reading, later reference, and out-of-class practice and study.

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Course Goals

Primary Goal:

Preparation to Pass the RHCE Exam (assumes passage of the RHCSA Exam)

Secondary Goal:

Preparation to Pass the RHCSA Exam

Tertiary Goal:

Acquiring high-level Enterprise-oriented Linux skills

NOT a Goal of this course:

Acquiring basic or user-oriented Linux skills. These are assumed as prerequisite for this course.

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Reasonable Expectations

- Should I be able to pass the RHCE on this class alone?

  A stunning number (estimated at 50% or more) of seasoned professionals taking Red Hat's own prep courses fail to pass on first attempt.

- Planning for more than one attempt is prudent.

  Pass rates go up substantially on 2nd attempts.

- Maximizing your out-of-class preparation time is prudent.

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Preparation Recommendations

1. Build a Practice/Study Environment

- Scenario 1 -- A single virtualization-capable system with multiple vm "guests".
    - Host must have a 64 bit CPU with HW virtualization extensions
    - 4 GB or more of RAM recommended as a minimum -- 2GB is likely an absolute minimum
    - 60 GB of HDD space recommended as a minimum -- enough for the host OS and several VMs.
- Scenario 2 -- Several Rackspace or Amazon VMs.
- Scenario 3 -- Several physical systems, networked together.
    - These can be 32-bit (i386 / i686) or 64-bit (x86_64) systems
    - Each should have 768 MB of RAM as a minimum.
    - Each should have 12-20 GB of HDD space as a minimum.

Caution!

You may be unable to practice a few of the objectives (those related to virtualization) in this scenario.

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Preparation Recommendations

2. Take initiative -- form a study group.

Find Participants:

- In class
- At work
- Linked-In groups
- Local LUGs
- MeetUps

3. Practice, practice, practice!

Take the exam objectives and work to ensure that you can configure and secure every service, and implement every feature named in the course objectives.

Highlight areas on the objectives where you need review and bring your questions to class or post them on the Google Groups site:

https://groups.google.com/d/forum/acc-ce-linux-learners

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An OS for Practice and Study

RHEL 6

https://www.redhat.com/rhel/details/eval/

CENTOS 6

https://www.centos.org/ or http://vault.centos.org/

Scientific Linux

http://www.scientificlinux.org/

Fedora 13

http://mirrors.fedoraproject.org/publiclist/Fedora/13/x86_64/

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Online Information

Red Hat docs:

https://access.redhat.com/knowledge/docs/Red_Hat_Enterprise_Linux/

RHCSA/RHCE Objectives and other information at:

https://www.redhat.com/training/certifications/

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Classroom Infrastructure

RHEL6 Server installed on virtualization-capable Dell Optiplex workstations.

We will be creating multiple virtual machines on the hosts on which the Lab Exercises will be performed.

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Red Hat Enterprise Linux

- Overview

  Well-tested Linux distro focusing on Enterprise features and stability and a long lifecycle
- Server and Desktop variants
- Add-on Functionality

  Support for high-end features such as Load Balancing, Clustering, Management, High Performance networking, etc.
- LifeCycle

  https://access.redhat.com/support/policy/updates/errata/

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The Red Hat Certification Landscape

- RHCSA

  RHCSA is new, replacing the RHCT. It is the "core" sysadmin certification from Red Hat. To earn RHCE and other system administration certs will require first earning the RHCSA.

  - RHCSA Details
  - RHCSA Objectives

- RHCE

  RHCE is a senior system administration certification. It is an eligibility requirement for taking any COE exams and is thus a requirement for the upper-level credentials as well.

  - RHCE Details
  - RHCE Objectives

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- Certificates of Expertise

  COEs are incremental credentials demonstrating skills and knowledge in specialized areas. They are worthy credentials in their own right, but also the building blocks of the upper level credentials.

  - Overview of COEs

- RHCSS, RHCDS, RHCA

  These upper level credentials recognize those who have achieved expertise in several related specialized areas. Each one requires multiple COEs.

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Exercise 1-1: Install RHEL6 on a Virtual Machine

Following the instructor, install your first virtual machine.

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RHCSA Objectives

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RHCSA Objectives: Understand & Use Essential Tools

- Access a shell prompt and issue commands with correct syntax
- Use input-output redirection (>, >>, |, 2>, etc.)
- Use grep and regular expressions to analyze text
- Access remote systems using ssh and VNC
- Log in and switch users in multi-user runlevels
- Archive, compress, unpack and uncompress files using tar, star, gzip, and bzip2
- Create and edit text files
- Create, delete, copy and move files and directories
- Create hard and soft links
- List, set and change standard ugo/rwx permissions
- Locate, read and use system documentation including man, info, and files in /usr/share/doc .

  [Note: Red Hat may use applications during the exam that are not included in Red Hat Enterprise Linux for the purpose of evaluating candidate's abilities to meet this objective.]

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RHCSA: Operate Running Systems

- Boot, reboot, and shut down a system normally
- Boot systems into different runlevels manually
- Use single-user mode to gain access to a system
- Identify CPU/memory intensive processes, adjust process priority with renice, and kill processes
- Locate and interpret system log files
- Access a virtual machine's console
- Start and stop virtual machines
- Start, stop and check the status of network services

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RHCSA: Configure Local Storage

- List, create, delete and set partition type for primary, extended, and logical partitions
- Create and remove physical volumes, assign physical volumes to volume groups, create and delete logical volumes
- Create and configure LUKS-encrypted partitions and logical volumes to prompt for password and mount a decrypted file system at boot
- Configure systems to mount file systems at boot by Universally Unique ID (UUID) or label
- Add new partitions, logical volumes and swap to a system non-destructively

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RHCSA: Create and Configure File Systems

- Create, mount, unmount and use ext2, ext3 and ext4 file systems
- Mount, unmount and use LUKS-encrypted file systems
- Mount and unmount CIFS and NFS network file systems
- Configure systems to mount ext4, LUKS-encrypted and network file systems automatically
- Extend existing unencrypted ext4-formatted logical volumes
- Create and configure set-GID directories for collaboration
- Create and manage Access Control Lists (ACLs)
- Diagnose and correct file permission problems

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RHCSA: Deploy, Configure & Maintain

- Configure networking and hostname resolution statically or dynamically
- Schedule tasks using cron
- Configure systems to boot into a specific runlevel automatically
- Install Red Hat Enterprise Linux automatically using Kickstart
- Configure a physical machine to host virtual guests
- Install Red Hat Enterprise Linux systems as virtual guests
- Configure systems to launch virtual machines at boot
- Configure network services to start automatically at boot
- Configure a system to run a default configuration HTTP server
- Configure a system to run a default configuration FTP server
- Install and update software packages from Red Hat Network, a remote repository, or from the local filesystem
- Update the kernel package appropriately to ensure a bootable system
- Modify the system bootloader

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RHCSA: Manage Users and Groups

- Create, delete, and modify local user accounts
- Change passwords and adjust password aging for local user accounts
- Create, delete and modify local groups and group memberships
- Configure a system to use an existing LDAP directory service for user and group information

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RHCSA: Manage Security

- Configure firewall settings using system-config-firewall or iptables
- Set enforcing and permissive modes for SELinux
- List and identify SELinux file and process context
- Restore default file contexts
- Use boolean settings to modify system SELinux settings
- Diagnose and address routine SELinux policy violations

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RHCE Objectives

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RHCE: System Configuration and Management

- Route IP traffic and create static routes
- Use iptables to implement packet filtering and configure network address translation (NAT)
- Use /proc/sys and sysctl to modify and set kernel run-time parameters
- Configure system to authenticate using Kerberos
- Build a simple RPM that packages a single file
- Configure a system as an iSCSI initiator that persistently mounts an iSCSI target
- Produce and deliver reports on system utilization (processor, memory, disk, and network)
- Use shell scripting to automate system maintenance tasks
- Configure a system to log to a remote system
- Configure a system to accept logging from a remote system

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RHCE: Network Services

Network services are an important subset of the exam objectives. RHCE candidates should be capable of meeting the following objectives for each of the network services listed below:

- Install the packages needed to provide the service
- Configure SELinux to support the service
- Configure the service to start when the system is booted
- Configure the service for basic operation
- Configure host-based and user-based security for the service

RHCE candidates should also be capable of meeting the following objectives associated with specific services:

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RHCE: HTTP/HTTPS

- Install the packages needed to provide the service
- Configure SELinux to support the service
- Configure the service to start when the system is booted
- Configure the service for basic operation
- Configure host-based and user-based security for the service
- Configure a virtual host
- Configure private directories
- Deploy a basic CGI application
- Configure group-managed content

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RHCE: DNS

- Install the packages needed to provide the service
- Configure SELinux to support the service
- Configure the service to start when the system is booted
- Configure the service for basic operation
- Configure host-based and user-based security for the service
- Configure a caching-only name server
- Configure a caching-only name server to forward DNS queries
- Note: Candidates are not expected to configure master or slave name servers

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RHCE: FTP

- Install the packages needed to provide the service
- Configure SELinux to support the service
- Configure the service to start when the system is booted
- Configure the service for basic operation
- Configure host-based and user-based security for the service
- Configure anonymous-only download

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RHCE: NFS

- Install the packages needed to provide the service
- Configure SELinux to support the service
- Configure the service to start when the system is booted
- Configure the service for basic operation
- Configure host-based and user-based security for the service
- Provide network shares to specific clients
- Provide network shares suitable for group collaboration

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RHCE: SMB

- Install the packages needed to provide the service
- Configure SELinux to support the service
- Configure the service to start when the system is booted
- Configure the service for basic operation
- Configure host-based and user-based security for the service
- Provide network shares to specific clients
- Provide network shares suitable for group collaboration

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RHCE: SMTP

- Install the packages needed to provide the service
- Configure SELinux to support the service
- Configure the service to start when the system is booted
- Configure the service for basic operation
- Configure host-based and user-based security for the service
- Configure a mail transfer agent (MTA) to accept inbound email from other systems
- Configure an MTA to forward (relay) email through a smart host

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RHCE: SSH

- Install the packages needed to provide the service
- Configure SELinux to support the service
- Configure the service to start when the system is booted
- Configure the service for basic operation
- Configure host-based and user-based security for the service
- Configure key-based authentication
- Configure additional options described in documentation

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RHCE: NTP

- Install the packages needed to provide the service
- Configure SELinux to support the service
- Configure the service to start when the system is booted
- Configure the service for basic operation
- Configure host-based and user-based security for the service
- Synchronize time using other NTP peers

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Operating a System

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Boot, Reboot, Shutdown

- Power On
- GRUB Menu
- Display Manager Screen
- Gnome or KDE
- Terminal commands: shutdown, halt, poweroff, reboot, init

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Runlevels

- Default
- From GRUB Menu

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Single User Mode

- Password Recovery

Note: SELinux bug prevents password changes while set to "Enforcing".

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Exercise 1-2: Use Single-user mode to recover a root password

- Reboot your virtual machine
- Activate the GRUB Menu
- Boot the system in Single User Mode
- Set SELinux to Permissive Mode
- Change the root password
- Set SELinux back to Enforcing Mode
- Activate runlevel 5
- Login as root with the new password

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Exercise 1-3: Boot into runlevel 3

- Reboot your virtual machines
- Activate the GRUB Menu
- Boot the system into runlevel 3
- Login as root
- Transition the system back to runlevel 5

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Log Files

`/var/log/*`

`/root/install.log`

`/root/anaconda-ks.cfg`

View with `cat`, `less` or other tools

Search with `grep`

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Exercise 1-4: View Logs from an x-term and a virtual terminal

- Launch a gnome-terminal session and browse the `/var/log/messages` file.
- Switch to a virtual terminal, login as root, and view `/var/log/secure`

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Start/Stop Virtual Machines

- Using virt-manager

  Select the desired VM. There are several approaches to these operations in the GUI.

- Using virsh commands:

```
# virsh list --all

# virsh start <VM ID or Name>

# virsh stop <VM ID or Name>

    # virsh destroy <VM ID or Name>
```

Note

"stop" requests a graceful shutdown. "destroy" forces a poweroff -- data loss could result.

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Virtual Machine Consoles

- virt-manager

  Double-click the Virtual Machine desired.

- virt-viewer

```
# virt-viewer <VM ID or Name>
```

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Virtual Machine Text Console

With libguestfs-tools installed and the VM in question shut-down, from the host:

```
# virt-edit {VMname} /boot/grub/menu.lst
```

There, append to the kernel line:

```
console=tty0 console=ttyS0.
```

After saving, the following commands should allow a console based view of the boot process and a console login:

```
# virsh start {VMname} ; virsh console {VMname}
```

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Virtual Machine Text Console Caveat

After this change, some messages that appear only on the default console will be visible only here. For example, the passphrase prompt to decrypt LUKS-encrypted partitions mounted in /etc/fstab will not be visible when using virt-viewer and the vm will appear to be hung. Only by using virsh console can the passphrase be entered to allow the boot process to continue.

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Start, stop, and check the status of network services

Distinguish between starting a service and configuring it to be persistently on.

- Start services with:

```
# service <servicename> start
```

or

```
# /etc/init.d/<servicescript> start
```

- Configure services to run on each reboot with:

```
# chkconfig <servicename> on
```

or with `ntsysv` or `system-config-services`

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Exercise 1-5: Manipulate the cups service

- **Check the status of the cups service**
    - Is it running now?
    - Is it configured to run on future boots? In which runlevels?
- Stop the cups service.
- Start the cups service.
- Configure cups to start only on runlevels 3 and 5

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Modify the system bootloader

- Edit the GRUB config file:

```
# vim /boot/grub/grub.conf
```

- Interactively edit the GRUB menu system.
- Directly manipulate GRUB through its shell.

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Supplemental Reading

Jang, Chapters 1-3

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Supplemental Exercises

- Setup a practice environment following instructions in Jang, Ch 1.

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Reading

Topics from this class:

Jang, Chapters 1-3

Topics for next class:

Jang 4,6,8

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Session 2 User Mgmt, Storage, and filesystems

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User Administration with Config Files

/etc/passwd

World-readable file of user information

/etc/shadow

Restricted-access file with password and expiry info.

/etc/group

World-readable file of group information

/etc/gshadow

Restricted-access group password, admin, membership info

Important

If editing directly, `vipw` and `vigr` should be used.

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Structure of /etc/passwd

`Name:Password:UID:GID:Comments:Homedir:Shell`

Sample Contents

```
$ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
sshd:x:74:74:Privilege-separated SSH:/var/empty/sshd:/sbin/nologin
ntp:x:38:38::/etc/ntp:/sbin/nologin
gdm:x:42:42::/var/gdm:/sbin/nologin
scott:x:500:500:Scott Purcell:/home/scott:/bin/bash
```

The "x" in the password field indicates that the actual password hashes have been moved to /etc/shadow in order to implement the shadow password system.

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Structure of /etc/shadow

`Name:Password:Lastchange:May:Must:Warn:Disable:Expire`

Sample Contents

```
# cat /etc/shadow
root:$1$IyApEyOS$dZ5SMuC7Yw9/PDMyWi1H11:14373:0:99999:7:::
sshd:!!:14373:0:99999:7:::
ntp:!!:14373:0:99999:7:::
gdm:!!:14373:0:99999:7:::
scott:$1${...}:14374:0:99999:7:::
bob:$1${...}:14398:7:30:7:7:14457:
```

The values in field 3 and field 8 are dates -- rendered as a count of days elapsed since the start of the "Unix Epoch" (1/1/1970).

The "{...}" marks where the actual encrypted password is stored.

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Structure of /etc/group

`Name:Password:GID:Users`

Sample Contents

```
# cat /etc/group
root:x:0:root
scott:x:500:
bob:x:501:
mary:x:502:
sales:x:503:bob,mary
training:x:504:scott
```

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Structure of /etc/gshadow

`Name:Password:Admins:Members`

Sample Contents **

```
# cat /etc/gshadow
root:::root
scott:!!::
bob:!::
mary:!::
sales:!::bob,mary
training:!::scott
```

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User Admin with CLI tools

useradd, usermod, userdel

Create, delete, and modify user accounts

groupadd, groupmod, groupdel

Create, delete, and modify group accounts

chage

Modify password aging and expiration

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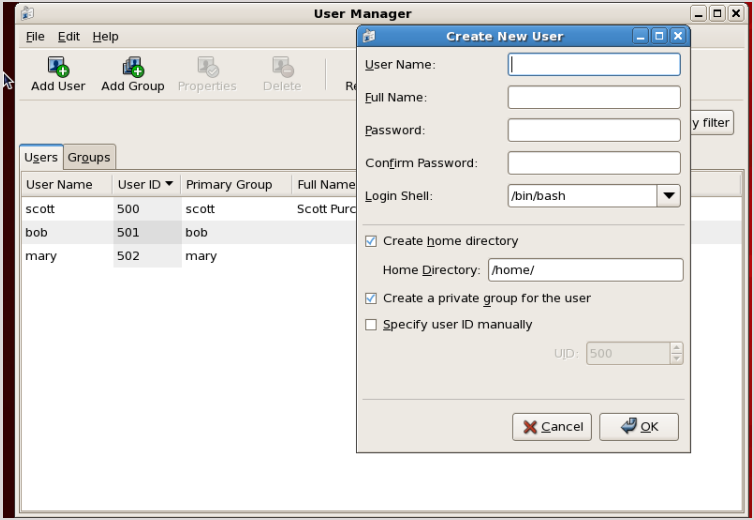
User Admin with GUI tools

The GUI tool for managing users and groups is the Red Hat User Manager. It can be launched from the menu at **System | Administration | Users and Groups** or from the CLI as `system-config-users`.



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User environment

Home directories

/home/{user}/ or /root/

/etc/skel

Contents copied to home directory of each new user.

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Common Contents:

.bashrc
.bash_logout
.bash_profile

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System-wide Shell Config Files

/etc/profile

Executed with each user login. Sets paths, variables, etc. Runs scripts in `/etc/profile.d`.

/etc/profile.d

Scripts that extend /etc/profile, usually added by applications.

/etc/bashrc

System-wide functions and aliases

Tip

In order to remember what types of content goes in which of these files, it is helpful to remember the origin of each file. /etc/profile was the config file for the Bourne shell and thus supported only the older and more limited feature set of that shell. /etc/bashrc is the newer, bash-specific config file.

Thus, the newer features such as functions and aliases can only go in bashrc, while older features such as environment variables can go in profile.

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User-configurable Environment Files

~/.bashrc

User aliases and functions

~/.bash_profile

User paths, variables, and environment settings

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Exercise 2-1: Configure Users and Groups

On your client virtual machines, perform these tasks:

1. Create Groups "goodguys" and "villains"
    - Use custom GIDs so that the automatically created GIDs for the UPG scheme remain in sync with the usernames.
2. Create Users "bugs", "tweety" and "roadrunner" and make them members of "goodguys"
3. Create Users "taz", "sam", and "wiley" and make them members of "villains"
4. Set sam's account to expire in 30 days ("wabbit season" ends!)

Tip

The following command is useful for sorting the existing GIDs in order to choose unique out-of-sequence GIDs for the instructions above:

```
# sort -t: -k3 -n /etc/group
```

The following command is useful for converting dates in /etc/shadow to calendar dates:

```
# date -d "1 January 1970 + lastchg days"
```

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"Filesystem" - Disambiguation

Several meanings for the term:

1. The way files are physically written to storage devices, as in the ext3, Fat-32, NTFS filesystems, or etc.

   Example: "Create a VFAT filesystem on a USB drive if you want a device that works for both Windows and Linux."

2. The collection of files and directories stored on a particular storage device.

   Example: "On any device using Ext 2/3/4, you should find a "lost+found" directory at the root level of the filesystem."

3. The unified directory structure which logically organizes files.

   Example: "In contrast with Windows, which accesses drives with various drive letters, on Linux all storage devices are mounted into a single filesystem."

4. The standard which defines how directories should be structured and utilized in Linux

   Example: "In a Linux filesystem, third party applications should generally be installed in /opt."

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Linux Filesystem Hierarchy

The directory structure of a Linux system is standardized through the Filesystem Hierarchy Standard (explained at http://www.pathname.com/fhs)

The Linux Manual system has an abbreviated reference:

```
$ man 7 hier
```

Red Hat has a more complete description, along with RedHat-specific implementation decisions in their **Storage Administration Guide** at https://access.redhat.com/knowledge/docs/en-US/Red_Hat_Enterprise_Linux/6/

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Disk and Filesystem tools

- `fdisk` or `parted` -- Used to partition hard disks or other block devices
- `mkfs` and variants -- Used to create filesystems on block devices (actually a front-end for a variety of FS-specific tools)
- `fsck` and variants -- Used to run filesystem checks (a front-end to FS specific tools)
- `mount` -- Used to mount a filesystem to a specific location in the directory structure
- `/etc/fstab` -- Configuration file used to describe the filesystems that should be persistently mounted
- `blkid` -- used to identify filesystems or other in-use devices by UUID or filesystem labels.
- `df` -- used to display the capacity and utilization % of mounted filesystems.
- `partx` -- used to force implementation of a new partition table on an in-use device w/o the need to reboot.
- `partprobe`

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Working with Partitions

Overview of process for using Basic Storage Devices:

- Install the device or otherwise make it available to the system.
- Partition it with `fdisk` or `parted`.
- Create a filesystem on the partition with mkfs or other tools.
- Choose or create a directory to serve as a mount point.
- Mount the partition.
- Add an entry to `/etc/fstab` to make it persistent.

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Exercise 2-2: Work with Basic Partitions

On your Host machine:

- Use `virt-manager` to create a 20 GB virtual disk for your Client VM.

On your Client virtual machine:

1. Use `fdisk -luc` to verify that it is seen after a reboot of the VM.
2. Use fdisk to create a 5 GB partition (leaving the remainder unused.
3. Create an ext4 filesystem on the new partition.
4. Create a new directory at /shared/villains and mount the new filesystem there.
5. Verify with `df -h` that the new space is seen.
6. Create an entry in `/etc/fstab` to make it persistent.

Optional Steps:

- Save a test file to `/shared/villains/`.
- Use `ls` to verify that it was saved as intended.
- Use `umount` to unmount the new partition.
- Use `ls` to verify that the file is no longer seen.
- Remount the partition.

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Working with Logical Volume Management

Overview of process for using Logical Volume Management:

- Install the device or otherwise make it available to the system.
- Create a type `8e` partition with `fdisk` or `parted`.
- Initialize the partition as a physical volume with `pvcreate`.
- Add the storage of the PV to a volume group with `vgcreate`.
- Allocate storage from the volume group to a logical volume with `lvcreate`.
- Create a filesystem on the logical volume with mkfs or other tools.
- Choose or create a directory to serve as a mount point.
- Mount the partition.
- Add an entry to `/etc/fstab` to make it persistent.

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Removing Logical Volume structures

- Unmount the lv you want to remove
- Edit /etc/fstab to remove its entry
- Remove the logical volume: `lvremove /dev/<vg>/<lv>`
- Before removing a VG, ensure there are no more LVs within it.
- Remove the volume group: `vgremove /dev/<vg>`
- Remove the LVM signature from the partitions: `pvremove /dev/<part>`

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Exercise 2-3: Work with Logical Volume Management

On your Client virtual machine:

1. From the unallocated space on the disk you added in the previous exercise, create a 5 GB partition (type 8e) for LVM
2. Initialize it with pvcreate
3. Use vgcreate to create a volume group named "shared" from the physical volume.
4. Use lvcreate to create a 2.5 GB logical volume called "goodguys" from the "shared" volume group.
5. Create an ext3 filesystem on `/dev/shared/goodguys`.
6. Create a directory `/shared/goodguys` and mount the LV there.
7. Create an entry in `/etc/fstab` for persistance.
8. Use `df -h` to verify the available space.
9. Use lvextend to add another 1 GB to `/dev/shared/goodguys`.
10. Use resize2fs to grow the filesystem on `/dev/shared/goodguys` to use the new space.
11. use `df -h` to verify the available space.

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Commands to Know

fdisk

- Always use -u and -c for best compatibility with newer storage devices
- Can't create partitions >= 2TB, use parted with GPT instead

parted

- fdisk-replacement that is GPT-aware. Required for drives > 2TB.

mkfs

- Used to create filesystems on devices
- Front-end for other filesystem-specific tools (usually named mkfs.<fstype>)

blkid

- Shows device name, Fileystem Labels, and UUID of detected block devices.
- May not show block devices until a filesystem is created on them.
- May not show block devices used in non-standard ways (for example, a filesystem on a whole disk instead of on a partition)

mount

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- used to make a new filesystem available

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Working with LUKS encrypted storage

cryptsetup-luks-1.1.2-2.el6.x86_64

Overview of process for using LUKS encryption:

- Create a new partition
- Encrypt it with `cryptsetup luksFormat /dev/<partition>`
- Open the encrypted device and assign it a name with `cryptsetup luksOpen /dev/<partition> <name>`
- Create a filesystem on the named device (/dev/mapper/<name>)
- Create a mountpoint for the device
- Mount the device

To lock the volume:

- unmount it
- Use `cryptsetup luksClose <name>` to remove the decryption mapping

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Persistent mounting of LUKS devices

To persistently mount it

- Create an entry in /etc/crypttab:

```
<name> /dev/<partition> <password (none|<blank>|<path/to/file/with/password>)>
```

- If the password field is "none" or left blank, the system will prompt for a password.
- Create an entry in /etc/fstab

> ***Note***
>
> At reboot, the password prompt goes only to the default console. If console redirection is enabled, as it might be in the case of enabling a virtual machine to accessible through `virsh console <name>`, then the only place where the prompt is seen and the passphrase can be entered is at that redirected console.

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Exercise 2-4: Create a LUKS-encrypted volume

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Working with SWAP

Overview of process for adding SWAP space using a partition:

- Create a type 82 partition
- Initialize as swap with `mkswap /dev/<partition>`
- Identify the UUID with `blkid`
- Add an `/etc/fstab` line:

```
UUID=<UUID> swap swap defaults 0 0
```

- Activate the new swap space with: `swapon -a`

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Using a file for SWAP

Overview of process for adding SWAP space using a file:

- create a pre-allocated file of the desired size:

```
dd if=/dev/zero of=/path/to/<swapfile> bs=1M count=<size in MB>
```

- Initialize as swap with `mkswap /path/to/<swapfile>`
- Add an `/etc/fstab` line:

```
/path/to/<swapfile> swap swap defaults 0 0
```

- Activate the new swap space with: `swapon -a`

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Exercise 2-5: Add a new SWAP partition

On your Client virtual machine:

1. Use `free -m` to report the amount of swap in mebibytes (MiB) [2] your system is configured to use. Note that number.
2. Create a new partition (this may be a new primary partition, or a logical partition on an extended partition, or you may need to add a new virtual disk, depending on your needs -- consult your instructor if you need help making this determination) of 512 MiB and make it a "Linux Swap" partition (type 82).
3. Initialize it with `mkswap`. Note the "UUID=..." in the output.
4. Configure `/etc/fstab` to use that device by device name or, preferably, by UUID as swap.
5. Activate the new swap partition with `swapon`.
6. Use `free -m` to confirm that the new swap space is available.

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Exercise 2-6: Add a new SWAP file

On your Client virtual machine:

1. Use `free -m` to report the amount of swap in mebibytes (MiB) [2] your system is configured to use. Note that number.
2. Create a new file for swap by using `dd` to write zeros to a file of 128 MiB.
3. Initialize it with `mkswap`.
4. Configure `/etc/fstab` to use that file (by pathname) as swap.
5. Activate the new swap partition with `swapon`.
6. Use `free -m` to confirm that the new swap space is available.

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Mounting Using UUIDs and Filesystem Labels

Configure systems to mount file systems at boot by Universally Unique ID (UUID) or label

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Local Storage: Adding New Storage

Add new partitions, logical volumes, and swap to a system non-destructively

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File systems: Working with Common Linux Filesystems

Create, mount, unmount and use ext2, ext3 and ext4 file systems
Extend existing unencrypted ext4-formatted logical volumes

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Filesystem Permissions: Basic Permissions

Linux permissions are organized around:

Three sets of permissions

- User,
- Group, and
- Other

Three types of permissions

- Read,
- Write, and
- Execute

Three extended attributes

- SUID,
- SGID, and
- Stickybit

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Three Sets of Permissions:

Any given file or directory can be owned by one (and only one) user and one (and only one) group. Three different sets of permissions can be assigned.

- User -- User permissions apply to the individual user who owns the file or directory.
- Group -- Group permissions apply to any user who is a member of the group that owns the file or directory.
- Other -- Other permissions apply to any user account with access to the system that does not fall into the previous categories.

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Three Types of Permissions:

- Read ("r")
    - On a file, allows reading
    - On a directory, allows listing
- Write ("w")
    - On a file, allows editing
    - On a directory, allows creation and deletion of files
- Execute ("x")
    - On a file, allows execution if the file is otherwise executable (script or binary)
    - On a directory, allows entry or traversal (`# cd {dirname}`)

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Three Extended Attributes:

- **SUID (Set User ID)**

  On an executable, runs a process under the UID of the file owner rather than that of the user executing it.

- **SGID (Set Group ID)**

  On a directory, causes any files created in the directory to belong to the group owning the directory. On an executable, runs a process under the GID of the group owning the file rather the logged-in group of the user executing it.

- **"Stickybit"**

  On a directory, ensures that only the owner of a file or the owner of the directory can delete it, even if all users or other members of a group have write access to the directory.

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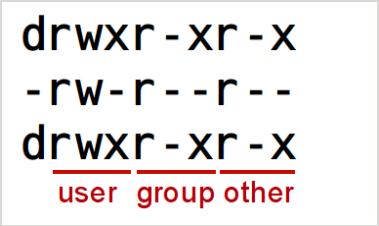
Viewing Permissions

Permissions are displayed with positions 2-10 of a "long" filelisting:



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Setting Permissions

The `chmod` command is used to set permissions on both files and directories. It has two modes -- one using symbolic options and one using octal numbers.

`chmod [option] [ugoa...][+-=][rwxst] filename`

where ugo are user, group, other, or all and rwxst are read, write, execute, s{u/g}id, stickybit.

`chmod [option] XXXX filename`

where XXXX is a number representing the complete permissions on the file.

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Setting Permissions with Symbolic Options

The following symbols are used:

Which Set?	What to do?	Which Permissions?
u user	+ add this permission	r read
g group	- remove this permission	w write
o other	= set exactly this permission	x execute
a all		

Examples:

```
$ chmod a+x /home/scott/Downloads/somescript.sh

$ chmod u=rw,g=r,o-rwx ./myfile.txt
```

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Setting Permissions with Numeric Options

Each permission is assigned a numeric value:

- 4 read
- 2 write
- 1 execute

r, w, x Permissions	Binary	Octal
---	000	0
--x	001	1
-w-	010	2
-wx	011	3
r--	100	4
r-x	101	5
rw-	110	6
rwx	111	7

Each set of permission is added separately so that a three-digit octal number fully represents the basic permissions of a file or directory:

```
$ chmod 640 ~/myfile.txt
```

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```
$ chmod 751 /shared/scripts/myscript.sh
```

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Setting Extended Attributes with Numeric Options

chmod numeric options are actually 4 digits (not three). Missing digits are assumed to be leading zeroes.

The leftmost place is for extended attributes:

Each attribute is assigned a numeric value:

- 4 SUID
- 2 SGID
- 1 Stickybit

Example:

```
$ chmod 3775 MySharedDir
```

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Setting Extended Attributes with Symbolic Values:

`chmod o+t {filename}`
Sets the sticky bit

`chmod u+s {filename}`
Sets suid

`chmod g+s {filename}`
Sets sgid

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Extended Attributes in Directory Listings

-rwxrwxrwx	Normal Permissions, All permissions granted
-rwSrwxrwx	Indicates SUID set
-rwsrwxrwx	Indicates SUID and execute permission set
-rwxrwSrwx	Indicates SGID set
-rwxrwsrwx	Indicates SGID and execute permission set
-rwxrwxrwT	Indicates Stickybit set
-rwxrwxrwt	Indicates Stickybit and execute permission set

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Umask

- The umask value determines the permissions that will be applied to newly created files and directories.
- As a "mask" it is subtractive -- representing the value of the permissions you DO NOT want to grant.
- Execute rights are automatically withheld (w/o regard for the umask) for *files* but not for *directories*.
- Extended attributes are not addressed -- even though a umask is four characters.
- The default umask value is set in /etc/bashrc and can be modified (non-persistently!) with the bash built-in command `umask`.

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Umask Examples

- Umask of 0002 yields permissions of 0775 on new directories and 0664 on new files
- Umask of 0022 yields permissions of 0755 on new directories and 0644 on new files

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SGID and Stickybit Use Case -- Collaborative Directories

- Create a Group for Collaboration
- Add users to the group
- Create a directory for collaboration
- Set its group ownership to the intended group
- Set its group permissions appropriately
- Recursively set the SGID and sticky bits on the directory

This ensures that:

1. All files created in this directory will be owned by the intended group (SGID effect)
2. All files created in this directory can only be deleted by the user who owns the file or the user who owns the directory (stickybit effect)

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File Access Control Lists

- Provide more granular control of permissions.
- Filesystem must be mounted with the 'acl' option or be configured with that option by default.
    - Use mount with a `-o acl` option to mount (non-persistently) with ACLs enabled.
    - Add "acl" in the options field of `/etc/fstab` to persistently enable ACLs
    - or use `tune2fs -o user_xattr,acl /path/to/device` to configure those attributes as default mount options

getfacl

Used to view file ACLs

setfacl

Used to set file ACLs

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getfacl

Example of "getfacl acldir"

```
# file: acldir
# owner: frank
# group: frank
user::rwx
user:bob:-wx
user:mary:rw-
group::rwx
mask::rwx
other::r-x
```

Example of `ls -l acldir`:

```
drwxrwxr-x+ 2 frank frank 4096 2009-05-27 14:15 acldir
```

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Working with CIFS network file systems

Will be covered in more detail later.

Mount and unmount CIFS network file systems

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Working with NFS file systems

Mount and unmount NFS file systems

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iSCSI Devices

Package: iscsi-initiator-utils

Allows a system to access remote storage devices with SCSI commands as though it were a local hard disk.

Terms:

- iSCSI initiator: A client requesting access to storage
- iSCSI target: Remote storage device presented from an iSCSI server or "target portal"
- iSCSI target portal: A server providing targets to the initiator
- IQN: "iSCSI Qualified Name" -- a unique name. Both the initiator and target need such a name to be assigned

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Accessing iSCSI Devices

- Install the iscsi-initiator-utils package
- Start the `iscsi` and `iscsid` services (and configure them persistently on)
- Set the initiator IQN in /etc/iscsi/initiatorname.iscsi
- Discover targets with:

```
iscsiadm -m discovery -t st -p <portal IP address>
```

- Log in to the target using the name displayed in discovery:

```
iscsiadm -m node -T <IQN> -p <portal IP address> -l
```

- Identify the SCSI device name with `dmesg`, `tail /var/log/messages` or `ls -l /dev/disk/by-path/*iscsi*`
- Use the disk as though it were a local hard disk

Important

Be certain to use UUIDs or labels for persistent mounts in `/etc/fstab`. Also, provide `_netdev` as a mount option so that this device will not be mounted until the network is already up.

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Disconnecting from iSCSI Devices

- Ensure the device is not in use
- Unmount the device
- Remove its `/etc/fstab` entry
- Logout from the target:

```
iscsiadm -m node -T <IQN> -p <portal IP> -u
```

- Delete the local record:

```
iscsiadm -m node -T <IQN> -p <portal IP> -o delete
```

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Additional References

Storage Administration Guide for RHEL6
lhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Storage_Administration_Gui
e of parted.

- Man pages for fdisk(8), fstab(5), mkfs(8), blkid(8), partprobe(8), mount(8), parted(8), cryptsetup(8), and crypttab(5)

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Reading

Topics from this class:

Jang, Chapters 4,6,8

Topics for next class:

Jang Ch 7,9,12,17

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Labs

- Add Storage
  - Add a disk to the virtual machine
    - Add Swap
    - Add a partition
    - Add space to a VG
    - Add a LUKS-encrypted filesystem
    - Enlarge an LV
  - Add an iSCSI device
- Create a partition for collaboration
  - Create File ACLs

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Session 3 Managing software, processes, kernel attributes, and users and groups

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The Red Hat Network (RHN)

The primary delivery mechanism for installable software, updates, errata and bug fixes and systems management functions for an installation of RHEL 6 is the Red Hat Network or RHN.

The "cost" of RHEL 6 is really a subscription to this support network.

These commands are using in managing an RHN subscription:

```
# man -k rhn
rhn-profile-sync     (8)  - Update system information on Red Hat Network
rhn_check            (8)  - Check for and execute queued actions on RHN
rhn_register         (8)  - Connect to Red Hat Network
rhnplugin            (8)  - Red Hat Network support for yum(8)
rhnplugin.conf [rhnplugin] (5)  - Configuration file for the rhnplugin(8) yum(8) plugin
rhnreg_ks            (8)  - A program for non interactively registering systems to Red Hat Network
rhnsd                (8)  - A program for querying the Red Hat Network for updates and information
```

RHN Subscription Activation

A new user of RHEL6 should receive information similar to this:

```
Red Hat subscription login:
    Account Number       : *******
    Contract Number      : *******
    Item Description     : Red Hat Enterprise Linux <Edition>
    RHEL Subscription Number : ******************
    Quantity             : #
    Service Dates        : 12-JUN-10 through 11-JUN-11
    Customer Name : ********************************
    Account Number: ************
    Log into the new portal here: access.redhat.com
    Login: *************
    Password: **************
    Email address: ***************************
```

That information can then be used with `rhn_register` to activate a new subscription

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3rd Party Yum Repositories

These are other repositories of installable software, updates, or bugfixes. The `yum` command can be configured to use them in addition to or instead of the RHN.

- Configuration of repositories other than the RHN is accomplished through text configuration files located in the directory: `/etc/yum.repos.d/`
- A configuration file for each repository (or group of related repos) should be created in `/etc/yum.repos.d/`
- The name of each repo config file should end in ".repo".
- This allows repos to be easily temporarily disabled simply by renaming the file to something like: `myrepo.repo.disabled`

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Yum Repository Mandatory Configuration Items

Repository ID

Short name for identifying this repository in reports

```
[MyRepo]
```

Name

Longer description of this repository

```
name=My Custom Repository
```

Baseurl

Description of protocol and location needed to locate the repo files.

```
baseurl=ftp://192.168.5.200/pub/rhel6
```

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Yum Repository Common Optional Configuration Items

gpgcheck

Defines whether yum should attempt to validate package signatures. "0" = "off", "1" = "on".

```
gpgcheck=1
```

gpgkey

Defines (via URL) where the keys for signature validation are located (typically `file:///etc/pki/rpm-gpg/<key name>`)

```
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-redhat-release
```

enabled

(Optional) Defines whether this repository should be currently active. "0" = "off", "1" = "on".

```
enabled=1
```

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Managing Software: Using yum

Common commands:

`yum help`

Displays usage information.

`yum list`

Lists all available packages and indicates which are installed.

`yum search KEYWORD`

Searches for packages with a keyword in the package metadata.

`yum info PACKAGENAME`

Displays information about a package taken from the package metadata.

`yum install PACKAGENAME`

Installs a package (obtained from the repository) and any required dependencies.

`yum localinstall RPMFILENAME`

Installs a local .rpm file, but uses the repository to satisfy dependencies.

`yum remove PACKAGENAME`

Uninstalls a package and any other packages dependent upon it.

`yum update PACKAGENAME`

Installs a newer version of the package, if available.

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`yum update`

Updates an installed package for which a newer version is available.

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Yum-related man pages

```
# man -k yum
qreposync             (1)  - synchronize yum repositories to a local directory
rhnplugin             (8)  - Red Hat Network support for yum(8)
rhnplugin.conf [rhnplugin] (5)  - Configuration file for the rhnplugin(8) yum(8) plugin
yum                   (8)  - Yellowdog Updater Modified
yum [yum-shell]       (8)  - Yellowdog Updater Modified shell
yum-groups-manager    (1)  - create and edit yum's group metadata
yum-utils             (1)  - tools for manipulating repositories and extended package management
yum.conf [yum]        (5)  - Configuration file for yum(8)
```

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RPM Architecture

`rpm` executable

RPM packages -- Files to install + SPEC file (metadata)

Local RPM database -- retains metadata from all installed packages

Database is kept in /var/lib/rpm

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RPM Package Naming

- name-version-release.architecture*.rpm
- Version is the version of the "upstream" open source code
- Release refers to Red Hat internal patches to the source code
- Architecture is one of:
    - i386,i686 -- 32 bit x86 compatible
    - x86_64 -- Intel/AMD 64 bit
    - ppc64 -- Power PC 64 bit
    - ia64 -- Intel Itanium 64 bit
    - noarch -- Arch-independent code (scripts, docs, images, etc)
    - src -- Source code

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Package Naming Example

bash-4.1.2-8.el6.x86_64

Name	Project Version	RH Release	Arch
bash	4.1.2	8.el6	x86_64

This package starts with version 4.1.2 of bash (from ftp.gnu.org/gnu/bash), applies a RH patch identified as 8.el6 to it, and is then built to run on an Intel/AMD 64 bit processor.

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Installing and Upgrading Packages

`# rpm -i[v,h] name-ver-rel.arch.rpm`

Installs a package

`# rpm -U[v,h] name-ver-rel.arch.rpm`

Upgrades a package if an older version was previously installed. Otherwise, simply installs the new version.

`# rpm -F[v,h] name-ver-rel.arch.rpm`

Upgrades a package if an older version is installed. Otherwise, does nothing -- **does not install new packages if no older version was installed.**

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Upgrading a Kernel

- Always use `#rpm -i ...`
- This leaves the previously installed kernel on the system and in the GRUB menu as a fall-back in case the new version has problems.

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RPM and Modified Config Files

Scenario: niftyapp-1.0-1.el5.rpm uses a config file, `/etc/nifty.conf`. You tweaked `/etc/nifty.conf` to fit your system. Now niftyapp-2.0-1.el5.rpm is available with new features that require changes in the .conf file and provides a new default config file. What to do?

- If the previous version provided a default config file, the changes are detected. Your modified version of the .conf file is saved as `/etc/nifty.conf.rpmsave` and the new default config is installed. You can compare the files and modify as needed.
- If the previous version did NOT provide a default config file, your version of the .conf file is saved as `/etc/nifty.conf.rpmorig` and the new default config is installed. You can compare the files and modify as needed.

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Uninstalling

```
# rpm -e name[-ver][-rel]
```

- Package removal is never verbose, never shows progress (-v, -h have not effect)
- Package removal only needs the name (or when multiple versions of the same package are installed, sometimes the version or release) but not the architecture or the .rpm extension.

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RPM over a Network

```
# rpm -ivh
ftp://{Host}/path/to/packagename-ver-rel.arch.rpm
# rpm -ivh
http://{Host}/path/to/packagename-ver-rel.arch.rpm
```

And wildcard "globbing" is allowed:

```
# rpm -ivh http://{Host}/path/to/packagename*
```

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Common RPM Queries

Query	Result
rpm -qa	lists all installed packages.
rpm -q pkg	Reports the version of the package.
rpm -qf /path/file	Reports which package provided the file.
rpm -qc pkg	Lists all configuration files of the package.
rpm -qd pkg	Lists all documentation of the package.
rpm -qi pkg	Reports a description of the package.
rpm -ql pkg	Lists all files contained in the package.
rpm -qR pkg	Lists all dependencies.
rpm -q --scripts	Lists the scripts that run when installing/removing.

rpm -q{c|d|i|l|R}p /path/to/packagename-ver-rel-arch.rpm

Reports the same info as above, but pulls info from the .rpm file instead of the rpm database.

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RPM Verification

The RPM system satisfies two types of security concerns:

1. Is this package *authentic*? How do I know it came from Red Hat?
2. Has this package retained *integrity*? How do I know they haven't been modified?

Authenticity and integrity of packages can be confirmed prior to installation with GPG signing and MD5 checksums of the RPM packages.

Integrity of files can be confirmed after installation with verification of installed files against the recorded metadata in the package.

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Validate Package Signatures

1. Import the Red Hat GPG public key (It can be found on the installation CD or in the /etc/pki/rpm-gpg/ directory):

```
# rpm --import /media/disk/RPM-GPG-KEY-redhat-release
```

or:

```
# rpm --import /etc/pki/rpm-gpg/RPM-GPG-KEY-redhat-release
```

2. Check the signature of the package in question:

```
# rpm --checksig /path/to/package-ver-rel.arch.rpm
```

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RPM Checksig Sample Output

```
$ rpm --checksig ftp://linuxlib.us.dell.com/pub/Distros/RedHat/RHEL5/5.3/Server/x86_64/
install-x86_64/Server/ImageMagick-6.2.8.0-4.el5_1.1.i386.rpm

ftp://linuxlib.us.dell.com/pub/Distros/RedHat/RHEL5/5.3/Server/x86_64/install-x86_64/Server
/ImageMagick-6.2.8.0-4.el5_1.1.i386.rpm: (sha1) dsa sha1 md5 gpg OK
```

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Verify Installed Files

`rpm -V` (or `--verify`) will compare existing files on the system to their pristine state in the packages they came from.

There are 8 points of comparison as shown in the following table, in the Michael Jang book and in the rpm man page:

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Change Codes from rpm --verify

Change Code	Meaning
5	MD5 checksum
S	File size
L	Symbolic Link
T	Modification time
D	Device
U	User
G	Group
M	Mode

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RPM Verify Sample Output

```
#rpm -Va
...

S.5....T  c /etc/ntp.conf
..?.....  c /etc/ntp/keys
S.5....T    /usr/bin/aspell
.......T    /usr/share/ImageMagick-6.2.8/config/magic.xml
.......T  d /usr/share/doc/ImageMagick-6.2.8/images/arc.png
.......T  d /usr/share/doc/ImageMagick-6.2.8/images/background.jpg

...
```

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Identifying Installed Packages

View a list of the packages originally installed on the system:

```
# less /root/install.log
```

View a list of the packages installed through yum:

```
# less /var/log/yum.log
```

Query the RPM database for the packages installed right now:

```
# rpm -qa
```

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Managing Software: Building RPMs

As of this writing, Red Hat provides little documentation on their own site about RPM creation. Instead, they provide pointers to the following resources:

- The RPM.org site
- The Fedora RMP Guide

The RPM.org site, in turn, links to a PDF available from Gurulabs:

- GuruLabs RPM Guide

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Inside an RPM package

- files
- scripts
- metadata

The package is defined by a "build specification file" or *spec file*.

A good example of a spec file can be obtained from the source rpm for redhat-release.

ftp://ftp.redhat.com/pub/redhat/linux/enterprise/6Server/en/os/SRPMS/redhat

> ***Tip***
>
> Open .spec files in vim for color highlighting

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Main contents of a .spec file

- Introduction or preamble: Contains metadata about the package
- Build instructions on how to compile the source code or otherwise prepare the package payload.
- Scriptlets that perform the installation, uninstallation, or upgrade.
- Manifest of files to be installed, along with their permissions.
- Changelog recording the changes made to the package with each revision.

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Format of the .spec file

Preamble (aka "Header")

Optional macro definitions and directives that define the package

Stanzas

Sections that perform specific functions, identified by tokens like `%prep` and `%build`.

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Preamble directives

Name

Name of the package. Should not include whitespace.

Version

Version identifier. Should not include dashes.

Release

Indicates incremental changes within a version.

Group

The package group that should include this package. This can come from the list at `/usr/share/doc/rpm-*/GROUPS` or can be unique to you. Not related to yum package groups.

License

Short License Identifier as described at http://fedoraproject.org/wiki/Packaging/LicensingGuidelines

Summary

Short (<=50 chars) one-line description.

Source

The file to be used as the source code. Add'l sources can be specified as Source0, Source1, etc.

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BuildArch

Arch to use when building. Defaults to the existing system arch. May also be "noarch" for arch-independent packages.

Requires

Requirements that this package needs to run. Can be in the form of files or other packages

BuildRequires

Requirements needed to build this package.

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Required Spec file sections

%description

Longer description. Lines starting flush-left will be automatically wrapped when displayed. Lines starting with leading whitespace are treated as pre-formatted text and not wrapped. Blank Lines separate paragraphs.

%prep

Prepares the environment for the build. May need no more than the macro: `%setup -q`.

%build

Builds the binaries from source. This section must include the commands that would be used to manually build the software.

%install

"Installs" the compiled application -- but into the build environment instead of on your working filesystem.

%clean

Removes the contents of the build environment.

%files

Lists, and sets attibutes for, all the files and directories to be placed on the target system by your finished RPM

%changelog

Time-stamps and describes the changes in each revision of the RPM.

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Package Building Tools

These packages will provide tools for setting up a build environment and the ability to create your own packages.

- rpm-build
- rpmdevtools
- rpmlint

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Setting up a Build Environment

As a non-privileged user, run:

```
$ rpmdev-setuptree
```

This should create the following directory structure in your home directory:

```
~/rpmbuild
  |-- BUILD
  |-- RPMS
  |-- SOURCES
  |-- SPECS
  \-- SRPMS
```

In that structure, your source files (in a tarball) should be placed ~/rpmbuild/SOURCES/ and your .spec file in ~/rpmbuild/SPECS/. The ~/rpmbuild/BUILD/ directory will be a temporary working directory for the build process. And, after the rpmbuild process is complete, the finished binary and source RPMs will be placed in ~/rpmbuild/RPMS/ and ~/rpmbuild/SRPMS/, respectively.

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Viewing the Build Environment

When diagnosing build problems, it is sometimes useful to see what files are actually being created in the build environment in order to identify deviations of actual behavior from expected behavior. The tree utility is useful for that.

Install tree with `# yum install tree`.

Invoke tree with `$ tree ~/rpmbuild` to show the contents of the build environment.

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Building the RPM

With the source files in place and a properly configured `.spec` file written, the `rpmbuild` command can be used to build the rpm either at once, or (for troubleshooting) in stages

`$ rpmbuild -bp <spec file>`

Builds through the `%prep` section -- unpacks sources and applies patches.

`$ rpmbuild -bc <spec file>`

Builds through compile -- processes the `%prep` and `%build` sections.

`$ rpmbuild -bi <spec file>`

Builds through `%install` -- processes `%prep`, `%build`, and `%install`.

`$ rpmbuild -bb <spec file>`

Builds only the binary rpm file.

`$ rpmbuild -bs <spec file>`

Builds only the source rpm file.

`$ rpmbuild -ba <spec file>`

Builds both the binary and source rpm files.

Use `rpmbuild --help` or `man rpmbuild` for other options.

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Exercise: Building a Custom RPM

As root, install rpm-build, rpmlint, rpmdevtools:

```
# yum -y install rpmbuild rpmdevtools rpmlint
```

As a non-privileged user, create a project directory, named according to the convention: <projname>-<majorver>.<minorver>:

```
$ mkdir ~/hello-1.0
```

Create bash script: ~/hello-1.0/hello.sh

```
#!/bin/bash
# hello.sh
echo 'hello'
exit 0
```

Create a tarball of the project directory:

```
$ tar cvzf hello-1.0.tar.gz ~/hello-1.0/
```

Create an rpm development environment:

OpenRHCE

```
$ rpmdev-setuptree
```

Move the tarball to the SOURCES directory:

```
$ mv hello-1.0 rpmbuild/SOURCES/
```

Create a .spec file in the SPECS directory:

```
$ vim rpmbuild/SPECS/hello-1.0.spec
```

or:

```
$ rpmdev-newspec -o rpmbuild/SPECS/hello-1.0.spec
```

Insert a name (Match the pkgname on the tarball and directory):

```
Name:           hello
```

Insert a version (Match the version):

```
Version:        1.0
```

Leave the release alone

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Insert a summary (one line):

```
Summary:        Simple Hello script created as a test package
```

Insert a group (package group):

```
Group:          Applications/Text
```

Insert a license:

```
License:        Public Domain
```

Insert a URL or delete the line:

```
URL:            http://www.example.com/hello-1.0/
```

Insert on the Source0 line, the name of your tarball:

```
Source0:        hello-1.0.tar.gz
```

Leave the BuildRoot line alone

Unless your package has prerequisites needed before it can be compiled, delete the BuildRequires line

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Unless your package has prerequisites needed before it can work, delete the Requires line

On a blank line below %description, insert a brief description of your package

Leave the %prep and %setup lines alone

If your package does not need to be "built" (compiled), delete the %build, %configure, and make lines.

Leave the %install section header alone.

Under the %install section, leave the rm line alone.

If your package does not need to be built, modify the make install line to something like this:

```
install -D hello.sh $RPM_BUILD_ROOT/usr/local/bin/hello.sh
```

Leave the %clean and the rm -rf lines alone.

Under %files, use the following syntax to list each of the files your package will place on the target system:

```
%attr(777,root,root)/usr/local/bin/hello.sh
```

Use the following syntax to list each of the directories your package will place on the target system:

```
%dir /usr/local/bin
```

The changelog section can be deleted or left alone.

Save and exit the .spec file and then test your build with:

```
$ rpmbuild -ba rpmbuild/SPECS/hello-1.0.spec
```

If it fails, troubleshoot using the various partial invocations of rpmbuild (described on a previous page) and using the tree command to see what is actually being placed on your system.

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Signing Your RPMs

Your RPMs can be digitally signed to protect users from the possibility of forged packages (any RPM package can execute scripts w/ root privileges when installed!). To implement this, first generate and identify a gpg key:

```
$ gpg --gen-key
gpg (GnuPG) 2.0.14; Copyright (C) 2009 Free Software Foundation, Inc.
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.

Please select what kind of key you want:
   (1) RSA and RSA (default)
   (2) DSA and Elgamal
   (3) DSA (sign only)
   (4) RSA (sign only)
Your selection?
RSA keys may be between 1024 and 4096 bits long.
What keysize do you want? (2048)
Requested keysize is 2048 bits
Please specify how long the key should be valid.
         0 = key does not expire
      <n>  = key expires in n days
      <n>w = key expires in n weeks
      <n>m = key expires in n months
      <n>y = key expires in n years
```

```
Key is valid for? (0)
Key does not expire at all
Is this correct? (y/N) y
```

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```
GnuPG needs to construct a user ID to identify your key.

Real name: Scott Purcell
Email address: scott@texastwister.info
Comment:
You selected this USER-ID:
    "Scott Purcell <scott@texastwister.info>"

Change (N)ame, (C)omment, (E)mail or (O)kay/(Q)uit? O
You need a Passphrase to protect your secret key.

We need to generate a lot of random bytes. It is a good idea to perform
some other action (type on the keyboard, move the mouse, utilize the
disks) during the prime generation; this gives the random number
generator a better chance to gain enough entropy.
gpg: key B9AED1DE marked as ultimately trusted
public and secret key created and signed.

gpg: checking the trustdb
gpg: 3 marginal(s) needed, 1 complete(s) needed, PGP trust model
gpg: depth: 0  valid:   1  signed:   0  trust: 0-, 0q, 0n, 0m, 0f, 1u
pub   2048R/B9AED1DE 2011-02-22
      Key fingerprint = 9987 B276 A24A 1210 13A7  4D05 9F3F 8934 B9AE D1DE
uid                  Scott Purcell <scott@texastwister.info>
sub   2048R/0DA4CCE9 2011-02-22

[scott@Client1 rhel6]$
```

The key ID can be seen in the output above, or can be found with gpg --fingerprint

Export the key to a file:

```
$ gpg --armor --output ~/RPM-GPG-KEY-ScottPurcell --export B9AED1DE
```

[scott@Client1 ~]$ cat RPM-GPG-KEY-ScottPurcell -----BEGIN PGP PUBLIC KEY BLOCK----- Version: GnuPG v2.0.14 (GNU/Linux)

mQENBE1jVagBCADVDTOvRl3Z5xPZb6AAl2D3bM/H4kEhyJ+yk1pbVPmu8yu0Cbsl
. . . R+J9rjvN8rNpQwm40Gx6RpM7qtP/LodzD46dNfbr87lJ4F+4A3U= =f4Gq
-----END PGP PUBLIC KEY BLOCK-----

Configure rpm-related tools to use your signature:

```
$ echo '%_gpg_name Scott Purcell'>> ~/.rpmmacros
```

or:

```
$ echo '%_gpg_name B9AED1DE'>> ~/.rpmmacros
```

Now packages can be created and signed at the same time with rpmbuild using the --sign option. Or existing packages can be retroactively signed with rpm using the --addsign or --resign options.

With a signed package in place, the user intending to install it now needs to import the key:

```
# rpm --import /home/scott/RPM-GPG-KEY-ScottPurcell
```

And with the key imported, the package can be verified:

```
$ rpm -K rpmbuild/RPMS/x86_64/rhel6rhce-0.5-1.el6.x86_64.rpm
rpmbuild/RPMS/x86_64/rhel6rhce-0.5-1.el6.x86_64.rpm: rsa sha1 (md5) pgp md5 OK
```

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Create a Repo with your files

(Assumes httpd already installed)

```
# yum -y install createrepo
# mkdir -p /var/www/html/repo/Packages
# cp MyPackage.rpm /var/www/html/repo/Packages
# createrepo -v /var/www/html/repo
# cp /home/me/RPM-GPG-KEY-me /var/www/html/repo
```

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RPM Packaging, Other Documentation:

Red Hat Enterprise Linux Deployment Guide, section on "Querying RPM"

Man Pages:

- rpm (8)
- rpm2cpio (8)
- cpio (1)

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Manage Processes and Services

Start a service:

- `service <servicename> start`
- `/etc/init.d/<servicescript> start`

Stop a service:

- `service <servicename> stop`
- `/etc/init.d/<servicescript> stop`

Check status of a service:

- `service <servicename> status`
- `/etc/init.d/<servicescript> status`

Reload a service's config:

- `service <servicename> reload`
- `/etc/init.d/<servicescript> reload`

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Persistent Configuration of Services

Configure a service to start at boot:

- `chkconfig <servicename> on`
- `system-config-services`
- `ntsysv`

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Manage Processes and Services: Configure systems to boot into a specific runlevel automatically

`/etc/inittab`

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Monitoring Processes

`ps`

Highly configurable command to list running processes

`top`

Command to provide realtime reports of the most active running processes

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Killing Processes

`kill`

kills a process by PID. Optionally sends "signals" other than "kill".

`kill-all`

Kills a process by name. Use care not to match names you don't intend to kill.

`pkill`

Also kills processes by name. Use care not to match names you don't intend to kill.

`pgrep`

Searches processes by name. Useful for verifying which processes would be killed by pkill.

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Prioritizing Processes

The kernel calculates the priority of each process through a variety of factors. One input into that calculation is a user-modifiable value called "niceness".

- A process with higher niceness has lower priority and is thus more willing to share resources with other processes.
- niceness can range from -20 (highest priority) to 19 (lowest priority).

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`nice` and `renice` commands

`nice`

Launches commands with a specified "niceness" value affecting process priority.

- Default niceness is "0".
- Root can set any value.
- Non-privileged users can only use positive values.

`renice`

Modifies the niceness of an already-running process.

- Root can modify the niceness of any process in either direction.
- Non-privileged users can only modify their own processes and by increasing niceness (lowering priority)

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Manage system performance

- Use /proc/sys and sysctl to modify and set kernel run-time parameters
- Produce and deliver reports on system utilization (processor, memory, disk, and network)
- Use iostat and vmstat to report on system performance
- Use shell scripting to automate system maintenance tasks

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Session 4 Networking and Routing

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Network Configuration and Troubleshooting

Class discussion -- Populate a table explaining for each of the following aspects of network configuration: 1) How to view or verify the existing configuration, and 2) How to change the configuration.

- IP Address and Subnet Mask
- Routing and Default Gateway
- Hostname
- Name Resolution

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IP Address and Subnet Mask

- Verifying configuration

  `ip a`, `ifconfig`

- Changing configuration

  `nm_applet`, `system-config-network`, manual editing of interface config files

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Routing and Default Gateway

- Verifying configuration

  `route`, `ip r`
- Changing configuration

  `route`, `ip r`, manual editing of route config files,

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Hostname

- Verifying configuration
- Changing configuration

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Name Resolution

- Verifying configuration
- Changing configuration

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Two Controlling Services

NetworkManager

- RHEL6 default
- Ideal for client systems and systems with dynamic network conditions
- No support for bonding/bridging/aliases, etc.

network

- RHEL5 and earlier default
- Ideal for systems with static network conditions
- Bonding/bridging/aliases supported.

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Switching between Controlling Services

To disable NetworkManager and enable network:

```
# service NetworkManager stop; chkconfig NetworkManager off
# service network start; chkconfig network on
```

To disable network and enable NetworkManager:

```
# service network stop; chkconfig network off
# service NetworkManager start; chkconfig NetworkManager on
```

To exempt a particular interface from control by NetworkManager, but leave it in control of other interfaces:

- In the interface configuration file of the interface to be exempted, insert the line:

```
NM_CONTROLLED=no
```

- Ensure both services are configured on and running.
- Configured interfaces can be brought up with `ifup eth<x>` or down with `ifdown eth<x>` regardless of whether they are managed by NetworkManager or not.

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Network Configuration Files

/etc/hosts

Static hostname-to-IP resolution.

/etc/resolv.conf

Client configuration for DNS.

/etc/sysconfig/network

Main system networking config file. Enables/disables networking in general, sets the hostname, and configures routing.

/etc/sysconfig/network-scripts/ifcfg-<ifname>

Config file for each configured interface.

/etc/sysconfig/network-scripts/route-<name>

Config file for static routes (where needed)

Note

/etc/sysconfig/networking/ is used by system-config-network and should not be manually edited.

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Reference

/usr/share/doc/initscripts-9.03.17/sysconfig.txt

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Future (Near!) Network Device Naming Scheme

http://linux.dell.com/files/whitepapers/consistent_network_device_naming_in_L

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Session 5 Firewalls and SELinux

OpenRHCE

Firewalling in RHEL6

RHEL6 implements a packet filtering firewall called iptables. You should know several key terms:

rule

A one-line rule defining a packet type and how it should be handled.

chain

A list of rules.

table

A list of rules aggregating all of the chains and rules taking a particular path through the network stack.

policy

A default rule that applies in the absence of other rules.

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iptables Built-in Chains

INPUT

Applies to traffic with your server as the destination.

OUTPUT

Applies to traffic origination on your server as the source.

FORWARD

Applies to traffic being routed by your system from one network to another

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iptables Targets

ACCEPT

Allows the packet to proceed to its destination.

DROP

Silently drop the packet.

REJECT

Drop the packet with a rejection message

LOG

Log the packet and move to next rule in the chain (which may then accept, drop, or reject)

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Connection Tracking States

Iptables can filter packets based on their relationship with previous traffic.

NEW

The packet has started a new connection.

ESTABLISHED

Applies to packets that are part of an established TCP connection (packets have already been delivered in both directions).

RELATED

The packet is starting a new connection, but associated with an existing connection.

INVALID

The packet is associated with no known connection.

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Iptables Command Options

`-vnl --line-numbers`
List all rules with line numbering

`-A <chain> <rule> -j <target>`
Adds a rule to the end of the chain

`-D <chain> <rule#>`
Deletes a rule by number

`-F <chain>`
Flushes all rules from the chain

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Matching packets

A source IP or network:

```
-s 192.0.2.0/24
```

A destination IP or network:

```
-d 10.0.0.1
```

UDP/TCP and ports:

```
-p udp --sport 68 --dport 67
```

ICMP and types:

```
-p icmp --icmp-type echo-reply
```

Inbound network interface:

```
-i ETH0
```

Outbound network interface:

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```
-o ETH0
```

State tracking:

```
-m state --state ESTABLISHED,RELATED
```

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Iptables Tips

Use `system-config-firewall` to enable and select FTP and SSH to generate a sample set of rules and load the connection tracking module.

Show connections being accepted or rejected in realtime:

```
# watch -d -n 2 `iptables -nvL`
```

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SELinux

SELinux is a set of security rules that determine which processes can access which files, directories, ports, and other system resources.

Purposes:

- Provide another method of securing a system.
- Implement Mandatory Access Control policies (required in some institutional contexts).
- Protect the system and its data from system services that have been compromised.

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SELinux in Action

- httpd allows remote anonymous access.
- This allows the possibility of attempts to compromise the httpd daemon with security exploits.
- httpd runs with the identity of the user "apache" and the group "apache" -- a successful exploit gains system access with the permissions granted to that user and group.
- In addition to the filesystem areas needed to run a webserver, the apache user and group also have access to other "world-readable" and "world-writeable" location such as `/tmp`.
- SELinux ensures that a compromised service cannot gain access to these filesystem location where it should not need access in the normal course of events.

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SELinux Enforcement Modes

Disabled

No rules are enforced and the SELinux filesystem contexts are stripped away. Moving to or from this mode to one of the others requires a reboot -- during which the entire filesystem will be processed to add or remove the SELinux filesystem context labels.

Permissive

Rules are in place, violations are logged, but access is permitted (rules not enforced). Useful for troubleshooting.

Enforcing

Rules are in place and enforced. Attempted violations are logged and access is denied.

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Important SELinux Filesystem locations

`/etc/sysconfig/selinux`

Used to set enforcement mode and policy set.

`/var/log/audit/audit.log`

Extensive log of SELinux messages

`/var/log/messages`

Contains short summaries of SELinux messages when `setroubleshoot-server` is installed and active

- Watch for "AVC" (Access Vector Cache) in log messages.

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Related Packages

coreutils

Always installed. Provides some default elements of SELinux.

policycoreutils

Provides `restorecon`, `secon`, `setfiles`, et al.

libselinux-utils

Provides `getenforce`, `setenforce`, `getsebool`, `setsebool`, et al.

policycoreutils-gui

Provides `system-config-selinux` and `sepolgen`, et al.

policycoreutils-python

Provides `semanage`, `audit2allow`, `audit2why`, et al.

setroubleshoot

Provides `seapplet`

setroubleshoot-server

Provides `sealert`, `sedispatch`, `setroubleshootd`, et al.

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Useful Commands

`sestatus`

Displays information about the current SELinux parameters.

`chcon`

Changes context labels on files (but non-persistently! Use with `semanage` for persistent changes.

`semanage`

Modifies SELinux contexts persistently.

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Additional Documentation

http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Security-

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Setting the SELinux Enforcement Mode

View the current setting:

```
# getenforce
Enforcing
```

Change the current setting:

```
# setenforce <mode>
```

To make persistent changes, edit `/etc/sysconfig/selinux`

OpenRHCE

SELinux Policy Types

Targeted (default)

Default policy set that aims to protect the most high-risk system services.

Strict

(Deprecated? Unable to find RHEL6 information about this policy type. Replaced by MLS?)

MLS

Implements Multi-Level Security policies -- a much stricter policy set than the default

Minimum

A less intrusive implementation of minimal aspects of SELinux

The RHCE exam will likely only be concerned with the default "Targeted" policy set.

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SELinux Contexts

When SELinux is not disabled, every file, directory, and process has an SELinux context label. These labels are used to determine which protected service(s) can operate in this location.

View SELinux contexts of processes:

`ps -eZ`, `ps -axZ`, `ps -Zc <process name>`, etc.

View SELinux contexts of files and directories:

`ls -Zd /path/to/dir/`, `ls -Z /path/to/file`, etc.

View SELinux contexts of users:

`id -Z`

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Setting SELinux file contexts

The initial contexts are created based on a set of rules, which are also used by `restorecon` to restore contexts to the default. When using the default "targeted" policy, these rules are stored in `/etc/selinux/targeted/contexts/files/file_contexts`. New customized rules are stored in `/etc/selinux/targeted/contexts/files/file_contexts.local`.

View these rules with:

```
# semanage fcontext -l
```

Or search for a specific service or path:

```
# semanage fcontext -l | grep "/var/ftp"
/var/ftp(/.*)?                                     all files          system_u:object_r:public_content_t:s0
/var/ftp/bin(/.*)?                                 all files          system_u:object_r:bin_t:s0
/var/ftp/etc(/.*)?                                 all files          system_u:object_r:etc_t:s0
/var/ftp/lib(64)?(/.*)?                            all files          system_u:object_r:lib_t:s0
/var/ftp/lib(64)?/ld[^/]*\.so(\.[^/]*)*            regular file       system_u:object_r:ld_so_t:s0
```

In these rules the regular expression `(/.*)?` is a match for the preceding directory and everything within it, recursively.

Add/delete/modify rules with:

```
#semanage fcontext -[a|d|m] -f <ftype> -t <context> '<regex>'
```

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SELinux Booleans

SELinux uses a collection of boolean variables to allow users to change SELinux policy in pre-defined ways without the need to reload or recompile SELinux policies.

Show all booleans and their current values:

```
# getsebool -a
```

Show all booleans with current values and meanings:

```
# semanage boolean -l
```

Show a specific boolean value:

```
# getsebool <boolean-name>
```

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Modifying SELinux Booleans

Modify a boolean non-persistently (for testing, or temporary use):

```
# setsebool <variablename> <value>
```

Modify a boolean persistently:

```
# setsebool -P <variablename> <value>
```

Use the graphical tool: `system-config-selinux`

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Help for SELinux with regard to specific services

Many targeted services have specialised man pages dealing with SELinux configuration.

Display these pages with:

```
# man -k '_selinux'
ftpd_selinux          (8)  - Security-Enhanced Linux policy for ftp daemons
httpd_selinux         (8)  - Security Enhanced Linux Policy for the httpd daemon
kerberos_selinux      (8)  - Security Enhanced Linux Policy for Kerberos
named_selinux         (8)  - Security Enhanced Linux Policy for the Internet Name server (named) daemon
nfs_selinux           (8)  - Security Enhanced Linux Policy for NFS
pam_selinux           (8)  - PAM module to set the default security context
rsync_selinux         (8)  - Security Enhanced Linux Policy for the rsync daemon
samba_selinux         (8)  - Security Enhanced Linux Policy for Samba
ypbind_selinux        (8)  - Security Enhanced Linux Policy for NIS
```

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Monitor SELinux Violations

Installing `setroubleshoot-server` sends SELinux error messages to `/var/log/messages`. These can be further parsed with `sealert`.

`audit2why` and `audit2allow` can be used to parse the messages in /var/log/audit/audit.log and explain why access was denied, and how to modify your configuration to allow it.

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Session 6 Virtualization

OpenRHCE

Virtualization Terms

Physical Machine

The actual physical machine with RAM, disk space, etc.

Virtual Machine

A logical construct provided by hardware and/or software capabilities that can run an independent OS and perform work as though it were a physical machine.

Hypervisor

A specialized OS that provides virtual machines.

Xen

A hypervisor previously available on Red Hat operating systems that was implemented as a modified version of the Linux kernel.

KVM

Kernel Virtual Machine, the hypervisor Red Hat currently supports on RHEL6. It is implemented within (as a set of kernel modules) the mainstream Linux kernel.

Guest

The operating system that runs on a virtual machine.

Host

The operating system that runs on a physical machine hosting virtual machines (i.e. the hypervisor).

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RHEL6 KVM requirements

- 64-bit Intel or AMD processor

  To confirm, search `/proc/cpuinfo` for the string `lm` on the flags line.

- CPU Hardware assisted virtualization extensions (enabled in BIOS)

  To confirm, search `/proc/cpuinfo` for the string `vmx` (for Intel) or `svm` (for AMD)

- 64-bit version of RHEL6

  To confirm, look for `x86_64` in the output of `uname -m`.

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KVM Virtualization Components

- KVM kernel modules
- libvirt
- `virsh` virtualization shell
- `virt-manager`

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Installing Virtualization Capabilities

At OS Installation:

Select the `Virtual Host` server role --or-- customize packages and select the `Virtualization` package group. In a kickstart file, these packages can be installed as a group with the `@kvm` group name.

After Installation:

With entitlement to the Virtualization packages, or access to them through a 3rd party repository,: `yum install kvm`

Other recommended packages:

- python-virtinst
- libvirt
- libvirt-python
- virt-manager
- libvirt-client

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Virsh Commands

Power on a virtual machine:

```
virsh start <vm name>
```

Gracefully shut down a virtual machine:

```
virsh shutdown <vm name or id>
```

Power off a virtual machine:

```
virsh destroy <vm name or id>
```

Connect to a virtual machine console (requires guest configuration):

```
virsh console <vm name or id>
```

Disconnect from a console of a virtual machine:

```
^]  ( "ctrl + ]" )
```

Set a VM to start at boot:

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```
virsh autostart <vm name or id>
```

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Creating Virtual Machines with Virt-Manager

Demonstrated and practiced in the classroom.

OpenRHCE

Creating Virtual Machines with virt-install

`virt-install` is a command-line tool used to create virtual machines.

See the syntax with `man virt-install` or `virt-install --help`.

Sample command:

```
# virt-install --name StXVM3 --ram 768 \
--disk path=/var/lib/libvirt/images/StXVM3disk1.img,size=8\
--network network=default --cdrom /dev/cdrom
```

OpenRHCE

SELinux considerations

- SELinux expects file-based guest images to be stored in `/var/lib/libvirt/images/`. Use of other locations with SELinux enforcing will require adding the location to the SELinux policies.

1. Find the context applied to the expected location:

```
# ll -Z /var/lib/libvirt/

drwx--x--x. root root system_u:object_r:virt_image_t:s0 images
```

2. Add a new context policy:

```
# semanage fcontext -a -t virt_image_t "/virtstorage(/.*)?"
```

3. Set the context to match the newly created policy:

```
# restorecon -R -v /virtstorage/
restorecon reset /virtstorage context unconfined_u:object_r:
default_t:s0->system_u:object_r:virt_image_t:s0
```

OpenRHCE

Session 7 Logging and remote access

OpenRHCE

RHEL 6 Logging with Rsyslog

Red Hat uses `rsyslog` for its logging facility. `rsyslog` can be configured to for local logging only, to send log messages to a remote destination as well, and to recieve log messages from other systems as well.

Terms

facility

A name that indicates what the message concerns or from what service it originates.

priority

A name that indicates the importance of the messages in that category.

The man pages for logger(1) and syslog(3) have more information.

`rsyslog` is configured in `/etc/rsyslog.conf` and defaults to using port 514 (TCP or UDP) to send and receive messages.

OpenRHCE

Accepting Remote Logs

By default, `rsyslog` is configured for only local logging. To enable it to receive log messages from other systems, uncomment one of the following groups of lines in the config file (depending on which transport protocol, tcp or udp, you prefer to use):

For UDP (more widely supported but less reliable):

```
# Provides UDP syslog reception
#$ModLoad imudp.so
#$UDPServerRun 514
```

For TCP (less widely supported but more reliable):

```
# Provides TCP syslog reception
#$ModLoad imtcp.so
#$InputTCPServerRun 514
```

After changing the appropriate lines, restart the service.

OpenRHCE

Rsyslog Configuration: Message Selection

In `/etc/rsyslog.conf` in the "RULES" section, ensure that a rule exists (or write one) for the kind of messages you want to send. The format is:

```
<facility>.<priority>        <action>
```

facility

One of: auth, authpriv, cron, daemon, kern, lpr, mail, news, syslog, user, uucp, local0-7, or "*"

priority

One of (in ascending priority): debug, info, notice, warning (warn), err (error), crit, alert, emerg (panic), none, or "*"

- Multiple facilities can be specified with the same priority with the use of a comma.

```
uucp,news.crit        /var/log/spooler
```

- Multiple selectors (facility/priority pairs) can be specified for the same action with the use of a semicolon.

```
*.info;mail.none;authpriv.none;cron.none   /var/log/messages
```

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Rsyslog Configuration: Actions

action

One of the following:

- A file, specified with a full path name.
- A named pipe (fifo)
- A terminal (tty) or console
- A remote machine's IP or hostname, prefaced with "@" (for UDP), "@@" (for TCP), or ":omrelp:" for the RELP protocol.
- A list of users (comma-delimited). This notifies them via console message if they are logged in. An asterisk (*) includes all logged-in users
- A tilde, to indicate that these messages should be discarded.
- See the documentation for others.

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Practice

Configure one system to receive remote log messages. Configure the other to log only a particular facility or priority to the remote syslog server.

Use `logger` to generate test messages.

Remember to investigate firewall and SELinux considerations.

OpenRHCE

Remote Access via SSH

RedHat installs by default both the OpenSSH client package (openssh) and the server package (openssh-server)

Client behavior is configured in `/etc/ssh/ssh_config`

Server behavior is configured in `/etc/ssh/sshd_config`

Start the service:

```
# service sshd start
```

Configure it persistently on:

```
# chkconfig sshd on
```

OpenRHCE

Investigate SELinux implications for SSH

Find SELinux Filesystem contexts that might affect ssh:

```
semanage fcontext -l | grep "ssh"
```

Find SELinux port contexts that might affect ssh:

```
semanage port -l | grep "ssh"
```

Find SELinux booleans that might affect ssh:

```
getsebool -a | grep ssh
```

OpenRHCE

SSH key-based authentication

Generate a key with `ssh-keygen`

Transmit a key to a remote system with `ssh-copy-id`

- The key you want is usually named `~/.ssh/id_rsa.pub`. Be certain to use the .pub version of the key instead of the private key!

OpenRHCE

SSH Security Considerations

Allow root logins?

Disallow with `PermitRootLogin no` in `/etc/ssh/sshd_config`

Listen on specific interfaces?

Specify with `ListenAddress x.x.x.x` in `/etc/ssh/sshd_config`

Allow legacy versions?

Specify allowed versions of the protocol in `/etc/ssh/sshd_config` (read comments).

Allow X11 forwarding?

Configure with `X11Forwarding yes|no` in `/etc/ssh/sshd_config`

Specify alternate port?

Configure with `Port xx` in `/etc/ssh/sshd_config`. Multiple ports on multiple lines accepted. Don't forget firewall and SELinux implications though!

OpenRHCE

Remote Access via VNC

For remote management when a GUI is desired or required, Red Hat provides VNC services through tigervnc.

Install the package with `yum -y install tigervnc-server`.

Configure the service at /etc/sysconfig/vncservers

Start the service:

```
# service vncserver start
```

Configure it persistently on:

```
# chkconfig vncserver on
```

OpenRHCE

Configuring a VNC remote display

In `/etc/sysconfig/vncservers` uncomment and modify the lines below:

```
# VNCSERVERS="2:myusername"
# VNCSERVERARGS[2]="-geometry 800x600 -nolisten tcp -localhost"
```

As the user who will connect, set a VNC password with `vncpasswd`.

Start or restart the service.

Connect to the remote system using a vnc client with the `-via` option:

```
vncviewer localhost:<x> -via y.y.y.y
```

Where X is the display number and y.y.y.y is the IP address of the remote machine.

OpenRHCE

Investigate SELinux implications for VNC

Find SELinux Filesystem contexts that might affect vnc:

```
# semanage fcontext -l | grep "vnc"
```

Find SELinux port contexts that might affect vnc:

```
# semanage port -l | grep "vnc"
```

Find SELinux booleans that might affect vnc:

```
# getsebool -a | grep vnc
```

OpenRHCE

Session 8 Network Time Protocol and System Performance Reports

OpenRHCE

NTP Overview

NTP (Network Time Protocol) provides a standardized way for systems to provide and obtain correct time over the network.

This service is increasingly critical for today's networking environments. Synchronized time information is required for accurate handling of email, for clustering, for cloud computing, and for virtualization (just to name a few).

OpenRHCE

NTP Packages

ntp

Provides the daemon and utilities

system-config-date

Provides a graphical interface for changing the time and configuring an NTP client.

ntpdate

Provides a command line utility for setting the date and time with NTP

OpenRHCE

NTP Documentation

Many man pages:

- ntp.conf (5)
- ntp_misc (5)
- ntp_acc (5)
- ntp_auth (5)
- ntp_clock (5)
- ntp_mon (5)
- ntpd (8)

OpenRHCE

Installing, Starting, and Configuring Persistence

Install the service (likely already installed):

```
# yum -y install ntp
```

Starting the service:

```
# service ntpd start
```

Configuring it to be on persistently:

```
# chkconfig ntpd on
```

OpenRHCE

Defining NTP Terms

Stratum0

A clock device such as an atomic, radio, or GPS clock device. Not usually attached to the network but connected to a server.

Stratum1

A server attached to a high accuracy time device that also allows queries for its time information.

Stratum{2..16}

Servers that acquire time information from servers above them in the hierarchy and share that information with peers or clients.

Server (in ntp.conf)

A time server that is a more authoritative time-source (higher stratum) than the system being configured, and from which this system obtains time information.

Peer (in ntp.conf)

A time server that is considered equally authoritative (same stratum) with the system being configured, and with which this system shares time information.

OpenRHCE

Configuration of NTP

Configured in `/etc/ntp.conf`

`restrict` lines

Define the access to be allowed or restricted for other hosts that communicate with this service. Each server or peer configured must be included in a `restrict` line.

`server` lines

Define a host to be queried as a more authoritative time source.

`peer` lines

Define a host to be queried as an equally authoritative time source.

`broadcast` or `multicast` lines

Define ways to obtain or provide time information apart from unicast queries.

OpenRHCE

NTP "restrict" options

```
restrict <address> [mask <subnet mask> ] [flag] [flag] ...
```

address and optional mask

The address, in dotted-quad notation, of the host or network to be restricted. Alternatively, the address can be a valid DNS name.

ignore (flag)

Disallows all packets

kod (flag)

Sends a "kiss of death" packet to misbehaving (usually fire-walled) clients.

nomodify (flag)

Allows queries for information, but denies attempts to modify the time.

noquery (flag)

Deny ntpq and ntpdc queries. The time service is unaffected.

nopeer (flag)

Deny packets related to peering

notrap (flag)

Deny "trap" messages (used in logging).

OpenRHCE

Configure as a Client

1. Include at least one server (three are preferred) in `/etc/ntp.conf`:

```
server <server1 IP> iburst
server <server2 IP> iburst
```

2. With the ntp service stopped, synchronize time with ntpdate:

```
# ntpdate -v <IP of ntp server>
```

3. Start the ntp service.
4. Verify that the service sees the configured servers (this may take a few minutes):

```
# ntpq -p
```

OpenRHCE

Configure as a Server

1. Follow the steps for Client Configuration.
2. Add one or more restrict lines to allow appropriate access from those systems that will be clients (or peers):

```
restrict 10.37.112.0 mask 255.255.240.0 nomodify notrap
restrict 10.37.112.13
```

3. Restart the service after making changes.

OpenRHCE

Configure as a Peer

1. Follow the steps for Client Configuration
2. Add one or more restrict lines to allow appropriate access from those systems that will be clients (or peers):

```
restrict 10.37.112.0 mask 255.255.240.0 nomodify notrap
restrict 10.37.112.13
```

3. Add one or more peer lines:

```
peer <peer IP or hostname> [options]
```

4. Restart the service after making changes.
5. Verify that the service sees the configured peers and servers (this may take a few minutes):

```
# ntpq -p
```

OpenRHCE

Investigate SELinux implications for NTP

Find SELinux Filesystem contexts that might affect NTP:

```
# semanage fcontext -l | grep "ntp"
```

Find SELinux port contexts that might affect NTP:

```
# semanage port -l | grep "ntp"
```

Find SELinux booleans that might affect NTP:

```
# semanage boolean -l | grep ntp
```

OpenRHCE

Investigate Firewall Implications for NTP

Find ports that may need to be opened for NTP:

```
# grep ntp /etc/services
```

Rules to open up the required ports:

```
-A INPUT -m state --state NEW -m tcp -p tcp --dport 123 -j ACCEPT
-A INPUT -m state --state NEW -m udp -p udp --dport 123 -j ACCEPT
```

OpenRHCE

Reporting on System Performance

One of the more vague of the RHCE Objectives says: "Produce and deliver reports on system utilization (processor, memory, disk, and network)."

This loosely defined objective can be very wide-ranging -- this section will cover some of the tools that might be useful in meeting it.

OpenRHCE

Tools for System Utilization Reporting

df

"diskfree", reports on disk space utilization for all mounted filesystems. Part of the coreutils package.

iostat

Provided by the sysstat package.

vmstat

Provided by the procps package.

top

Provided by the procps package.

Explore the man pages for these utilities and be prepared to use them with scripting to write reports to a file.

OpenRHCE

Session 9 HTTP and FTP

OpenRHCE

Apache Web Server

Service name: httpd
Package name: httpd-{ver}.{arch}.rpm
Main config: /etc/httpd/conf/httpd.conf
Module config: /etc/httpd/conf.d
Default DocRoot: /var/www/html

OpenRHCE

Installation and Basic Configuration

1. Install the `web-server` package group:

```
# yum groupinstall web-server
```

   Note that this install several packages including the Apache Manual which is then locally accessible at http://localhost/manual

2. Install the `mod_ssl` package:

```
# yum install mod_ssl
```

3. Start and configure persistence:

```
# service httpd start; chkconfig httpd on
```

   In this default configuration, you can create an `index.html` page in `/var/www/html/` and it will be served out as your home page. Additionally, you can use `https://` to connect securely to your webserver, but you will have to manually accept a self-signed certificate.

OpenRHCE

Installing a Signed SSL Certificate

1. Place the certificate and private key in the appropriate locations in `/etc/pki/tls/`.
2. Ensure that both files have the `cert_t` SELinux file context and that the private key is readable only by root.
3. Modify `/etc/httpd/conf.d/ssl.conf`:
   - `SSLCertificateFile` points to your newly installed certificate.
   - `SSLCertificateKeyFile` points to the corresponding private key.
4. Restart the service.

   Now your website will present a certificate signed by an accepted CA.

OpenRHCE

Virtual Host Configuration

"Virtual Hosts" come in two forms:

Standard Virtual Hosts

Exist on hosts that have been assigned multiple IP addresses. Queries for each separate IP address are served pages from a particular virtual host.

Name Virtual Hosts

Exist on hosts with multiple names aliased to one IP address (usually through DNS aliases, but can also be accomplished with `/etc/hosts`). Queries for each separate name (regardless of IP address) are served as different virtual hosts.

OpenRHCE

Name Virtual Host Configuration

Near the end of httpd.conf, uncomment the line:

```
#NameVirtualHost *:80
```

Create a section for each vhost:

```
#<VirtualHost *:80>
#    ServerAdmin webmaster@dummy-host.example.com
#    DocumentRoot /www/docs/dummy-host.example.com
#    ServerName dummy-host.example.com
#    ErrorLog logs/dummy-host.example.com-error_log
#    CustomLog logs/dummy-host.example.com-access_log common
#</VirtualHost>
```

- Uncomment the first and last lines in that block. Uncomment and modify the lines for ServerName, DocumentRoot, and others that you want to customize.
- Include a Vhost stanza for your default server instance and for each alternate name.

OpenRHCE

Example Virtual Host Configuration

```
#NameVirtualHost *:80
#
# NOTE: NameVirtualHost cannot be used without a port specifier
# (e.g. :80) if mod_ssl is being used, due to the nature of the
# SSL protocol.
#

#
# VirtualHost example:
# Almost any Apache directive may go into a VirtualHost container.
# The first VirtualHost section is used for requests without a known
# server name.
#
#<VirtualHost
<VirtualHost *:80>
#     ServerAdmin webmaster@dummy-host.example.com
#     DocumentRoot /www/docs/dummy-host.example.com
#     ServerName dummy-host.example.com
#     ErrorLog logs/dummy-host.example.com-error_log
#     CustomLog logs/dummy-host.example.com-access_log common
#</VirtualHost>
</VirtualHost>

<VirtualHost *:80>
    DocumentRoot /var/www/virtual/Blade7/
    ServerName Blade7
</VirtualHost>

<VirtualHost *:80>
    DocumentRoot /var/www/virtual/www7/
    ServerName www7
</VirtualHost>
```

OpenRHCE

Configuring for CGI-BIN scripts

Refer to the Apache Manual (package: httpd-manual) for full details and a tutorial on *CGI: Dynamic Content*.

The `ScriptAlias` line in `httpd.conf` designates the directory in which Apache expects to find CGI scripts.

CGI scripts can be implemented in directories **outside** of the `DocumentRoot` path -- but this will require modification of the `ScriptAlias` line and the fcontext rules for SELinux.

OpenRHCE

Apache Access Control

Per-directory options (example):

```
<Directory /var/www/>
    Order Deny,Allow
    Deny from all
    Allow from dev.example.com
</Directory>
```

- Three-pass access control:
    1. Parse all statements of type specified first.
    2. Parse all statements of type specified second. Matches overrides matches of previous type.
    3. Process requests which matched nothing.
- In `Order` statements, whichever directive comes **last** is the default in case of no match.

OpenRHCE

Host Based Security directive formats

```
Deny from example.com
Allow from 192.168.0.15
Deny from 192.168.0.0/255.255.255.0
Deny from 192.168.1.0/24
```

OpenRHCE

Access Control with .htaccess files

If permitted by httpd.conf, access may be controlled on a per-directory basis with `.htaccess` files in the directories where the content needs to be protected:

```
<Files ~ "^\.ht">
    Order allow,deny
    Allow from 192.168.5.200
    Deny from all
</Files>
```

OpenRHCE

User Based Security with htpasswd flat file

```
<Directory "/var/www/html/site">
  AuthType Basic
  AuthName "Password Protected"
  AuthUserFile /etc/httpd/.htpasswd
  Require valid-user
</Directory>
```

OpenRHCE

Configuring Passwords

- `htpasswd -cm /etc/httpd/.htpasswd good_user`
- `htpasswd -m /etc/httpd/.htpasswd another_user`

OpenRHCE

User Based Security with LDAP authentication

1. Obtain the LDAP certificate.
2. Add a line to your http.conf (usually in your Vhost definition):

```
LDAPTrustedGlobalCert CA_BASE64 /path/to/cert
```

3. Configure a Directory Block:

```
<Directory /var/www/html/private>
    AuthName "Private with LDAP access"
    AuthType  basic
    AuthBasicProvider ldap
    AuthLDAPUrl "ldap://fqdn/prefix" TLS
    Require valid-user
</Directory>
```

Modify the cert path, and the FQDN and prefix of the LDAP Server to match your infrastructure.

OpenRHCE

SELinux Implications for HTTP

Find SELinux Filesystem contexts that might affect HTTP:

```
# semanage fcontext -l | grep "http"
```

Find SELinux port contexts that might affect HTTP:

```
# semanage port -l | grep "http"
```

Find SELinux booleans that might affect HTTP:

```
# semanage boolean -l | grep http
```

Read the man page `httpd_selinux (8)`

Make SELinux more verbose:

```
# semanage dontaudit off
```

This disables setroubleshoot-server, sealert, and the issuing of SELinux messages into `/var/log/messages` -- so you'll need to view the messages in `/var/log/audit/audit.log`.

OpenRHCE

Important SELinux Contexts

httpd_sys_content_t

For general files and directories to be served by httpd.

httpd_sys_script_exec_t

For scripts (CGI) to be executed by the web server.

public_content_t

For files that are to be shared with other SELinux protected services

OpenRHCE

Firewall and SELinux for httpd

OpenRHCE

Very Secure File Transfer Protocol Daemon

`vsftpd` is Red Hat's preferred FTP daemon. The "Very Secure" descriptor refers to the daemon and not to the protocol!

The only mention of FTP in the RHCSA objectives is concerned with enabling a default configuration

The only mention of FTP in the RHCE objectives is concerned with securely configuring anonymous access.

OpenRHCE

Installation and Basic Configuration

Package: vsftpd

Install:

```
# yum -y install vsftpd
```

Start and Configure Persistence:

```
# service vsftpd start; chkconfig vsftpd on
```

In this default configuration, anonymous downloads are allowed from `/pub` (as shown to the client) and are placed in `/var/ftp/pub/` (as viewed on the server). Additionally, system users are able to login by username and password and access their home directories with read/write permissions. No anonymous uploads are permitted by default.

OpenRHCE

FTP Documentation

Man Pages:

- vsftpd.conf (5)
- ftpd_selinux (8)

OpenRHCE

Investigate SELinux implications for FTP

Find SELinux Filesystem contexts that might affect FTP:

```
# semanage fcontext -l | grep "ftp"
```

Find SELinux port contexts that might affect FTP:

```
# semanage port -l | grep "ftp"
```

Find SELinux booleans that might affect FTP:

```
# semanage boolean -l | grep ftp
```

OpenRHCE

Investigate Firewall Implications for FTP

Find ports that may need to be opened for FTP:

```
# grep ftp /etc/services
```

OpenRHCE

Configuring a Secure "Drop-box" for Anon Upload

1. Create an upload directory owned by `root.ftp` and with 730 permissions:

```
cd /var/ftp
mkdir incoming
chgrp ftp incoming
chmod 730 incoming
```

2. Modify SELinux

   - Set context of `public_content_rw_t` on the upload directory:

```
semanage fcontext -a -t public_content_rw_t '/var/ftp/incoming(/.*)?'
restorecon -rvv /var/ftp/
```

   - Enable the `allow_ftp_anon_write` boolean:

```
setsebool -P allow_ftpd_anon_write on
```

3. Modify `/etc/vsftpd/vsftpd.conf` as follows:

```
anonymous_enable=YES
local_enable=NO
```

OpenRHCE

```
write_enable=YES
anon_upload_enable=YES
chown_uploads=YES
chown_username=daemon
anon_umask = 077
```

4. Modify iptables for inbound ftp

- in /etc/sysconfig/iptables-config:

```
IPTABLES_MODULES="nf_conntrack_ftp nf_nat_ftp"
```

- Set rules:

```
# iptables -A INPUT -p tcp --dport 21 -j ALLOW
# iptables -A INPUT -m state --state ESTABLISHED,RELATED -j ALLOW
```

OpenRHCE

Session 10 NFS and Samba

OpenRHCE

Network File System (NFS)

Three available versions:

- NFS v2 -- Original public NFS.
- NFS v3 -- Extensions and enhancements to v2.
- NFS v4 -- Complete redesign, Red Hat default, preferred except where backward compatibility is required.

OpenRHCE

Packages

Group: nfs-file-server

Packages:

- nfs-utils
- nfs4-acl-tools

OpenRHCE

Configuration

/etc/sysconfig/nfs

/etc/exports

OpenRHCE

Configuring an NFS server (Network File System)

service nfs start
chkconfig nfs on

OpenRHCE

/etc/exports

```
/home 192.168.0.0/24(rw,root_squash) server1.example.com(rw,no_root_squash)
/pub  *(ro,root_squash)
```

- Note: There is no space between the host or subnet and the options defined between the parentheses ().
- If you put a space between them, then you will get a global export.

OpenRHCE

Commands

exportfs -a

exportfs -r

exportfs -u

showmount -e server

OpenRHCE

SELinux

OpenRHCE

Mounting

mount nfsserv:/home /mnt/homes

OpenRHCE

Automounter

Automatically mounts a directory when it is accessed.

Unmounts the directory after a specified idle time.

Autofs service controls this behavior.

A master configuration file called.

/etc/auto.master

Sub configuration files

Usually called /etc/auto.*

OpenRHCE

Auto.master

Specifies directories to mount under when accessed.

Specifies the auto.* file to use for the directories.

Example:

/etc/auto.master

```
/misc                    /etc/auto.misc
/data                    /etc/auto.data
```

When a directory under /misc is accessed, the /etc/auto.misc file indicates how to mount it.
When a directory under /data is accessed, the /etc/auto.data file indicates how to mount it.

OpenRHCE

Auto.*

Specifies directory name.

Specifies options to use when mounting.

Specifies what to mount.

Example:

/etc/auto.data

```
pictures -rw,soft,intr nfs.example.com:/export/pics mp3s -ro
/dev/sdd1
```

When the /data/pictures directory is accessed, the system will mount the nfs export /export/pics on nfs.example.com.

When the /data/mp3s directory is accessed, the system will mount the local partition /dev/sdd1.

OpenRHCE

Understanding Automount

You must access the destination directory in order for it to automount.

> If nothing is automounted and you run "ls /data" then you will get no files listed.
> If you run "ls /data/mpp3", you will get a listing. You can now run "ls /data" and you will see the mp3s directory listed. At least until the idle timeout is reached.

Some commands will cause the directory to be mounted when ran but they do not produce any results. In this case, you may need to run the command a second time.

OpenRHCE

Samba

Samba is a project providing software capable of utilizing the SMB (Server Message Block) and CIFS (Common Internet File System) protocols to interoperate with systems using MS-Windows-style file and printer sharing.

Linux systems can use Samba to:

- Act as a client to SMB/CIFS servers
- Provide file and printer sharing services to clients
- Provide domain controller functionality in a limited subset of possible configurations.

OpenRHCE

Accessing SMB/CIFS Shares

- Graphically, using Nautilus:

  Use **Places | Connect to Server**, choose `Windows share` as the **Service Type** and provide the required credentials.

- Occasional, FTP-like access from the command line:

```
# smbclient //server/share/ -U username \
-W [domain or workgroup]
```

- Through filesystem mounts:

```
# mount -t cifs //server1/tmp /mnt/share \
-o credentials=/root/credentials``
```

- `/etc/fstab` entry:

```
# //server/share /mnt/point cifs \
credentials=/root/credentials 0 0``
```

- Credentials File contents:

```
user=<username>
pass=<password>
domain=<domainname>
```

OpenRHCE

OpenRHCE

Samba Packages:

- samba
- samba-client
- samba-common
- samba-windbind
- samba-domainjoin-gui (Optional Repository)

OpenRHCE

SELinux

SELinux notes are at the top of the config file (`/etc/samba/smb.conf`) and the man page samba_selinux (8).

SELinux Port Settings for Samba:

```
# semanage port -l  |grep smb
smbd_port_t                    tcp      137-139, 445
```

SELinux Booleans for Samba:

```
# semanage boolean -l  |grep "smb\|samba"
```

SELinux fcontexts for Samba:

```
# semanage fcontext -l  |grep "smb\|samba"
```

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Services

service smb start
chkconfig smb on

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/etc/samba/smb.conf (Global)

workgroup

Specifies a shared Windows Workgroup or Domain name.

server string

Provides a description of the server.

netbios name

Specifies a name for the server for in implementations where NetBIOS is still used.

Interfaces

Used to bind the service only to particular network adapters or IP addresses.

Hosts Allow

Used for host-based access control.

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/etc/samba/smb.conf Security Types

The security line establishes the security model for the server. This would be one of the following:

user

Indicates that user credentials are held on the local server.

share

Indicates that credentials are not kept globally on an individual basis. All who report membership in the same workgroup are permitted access to the server and user authentication in configured in the share settings.

domain

Used when the Samba Server has been added to a Windows NT Domain. User access is authenticated through a primary or secondary domain controller.

server

User access is authenticated through a peer server that is not a domain controller.

ads

User access is authenticated through an Active Directory controller. Kerberos must be installed and configured to authenticate this machine's membership in the Domain.

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Samba Users and Passwords

When the security model set to `user`, local Samba users and passwords must be created. Typically, these accounts use the same user names as those configured on the local system. `smbpasswd` is the command used:

```
# smbpasswd -a winuser
```

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/etc/samba/smb.conf (Shares)

```
[public]
  comment = Public Share
  path = /var/ftp/public
  browsable = yes
  writable = yes
```

Path must have appropriate filesystem permissions.

OpenRHCE

Testing Configuration

Syntax of the smb.conf file can be tested before restarting the service:

```
# testparm
```

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Samba Firewalling Considerations

Samba, in its latest version, uses TCP port 445.

For backwards compatibility, UDP ports 137 and 138 and TCP port 139 may also need to be opened in some instances.

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HowTo: Enable Home Directory sharing via Samba

1. Install the appropriate packages.
2. Start and enable the service.
3. Configure the workgroup name in smb.conf.
4. Create the required Samba users and passwords.
5. Enable the SELinux boolean permitting home directory access.
6. Configure the firewall.
7. Restart the service.
8. Test from another system.

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HowTo: Configure a Group Share

1. Create the appropriate group if required.
2. Create a collaborative directory.
3. Set the SELinux contexts on the shared directory.
4. Define the share in smb.conf.

   Set the following values:

```
valid users = @groupname
writeable = yes
```

   (Ensure that the directory permissions are 2770.)

   or, to allow broader read-only permission:

```
writeable = no
write list = @groupname
```

   (And relax the directory permissions to 2775.)

5. Restart the service.
6. Test from another system.

OpenRHCE

Session 11 DNS and SMTP

OpenRHCE

Types of DNS servers

Authoritative

- Master (primary)
- Slave (secondary)

Non-authoritative

- Caching-only

Current RHCE Objectives only require ability to configure a few behaviors of a caching-only name server. The default configuration is now a caching-only nameserver listening only to localhost.

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Included DNS Servers

BIND

Berkely Internet Name Daemon

Dnsmasq

Lightweight Caching DNS server designed for small networks behind NAT routing.

We'll focus on BIND, but if you have existing familiarity with dnsmasq, you may be able to satisfy the RHCE requirements using it instead.

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BIND Packages

bind

The Berkeley Internet Name Domain (BIND) DNS (Domain Name System)

bind-utils

Utilities for querying DNS name servers

bind-chroot

A chroot runtime environment for the ISC BIND DNS server,

bind-devel

Header files and libraries needed for BIND DNS development

bind-libs

Libraries used by the BIND DNS packages

bind-sdb

BIND server with database backends and DLZ support

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Installing and enabling Bind

```
# yum -y install bind

# service named start

# chkconfig named on
```

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Useful Commands

rndc

Interface to BIND.

host

Queries for DNS resolution. Uses /etc/nsswitch and /etc/resolv.conf.

dig

Queries a DNS server directly. By-passing local config files if you want.

dig www.dell.com

Gets dns server from resolv.conf

dig @dns_server www.dell.com

Queries DNS server directly.

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Configuration Files

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Enabling caching-only for localhost

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Allowing queries from other systems

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Enabling Forwarding

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Firewall Considerations

Port 53 must be open for both UDP and TCP

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SELinux Considerations

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Email TLAs: MTA, MUA, MDA

MTA - Mail Transfer Agent

Conveys mail from Server to Server (ex: sendmail, postfix)

MUA - Mail User Agent

Conveys mail between Client and Server (ex: Evolution, Thunderbird, mutt, mail, elm)

MDA - Mail Delivery Agent

Conveys mail from Server to local mail spools

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Red Hat's New Default MTA: Postfix

Packages

postfix

/etc/postfix/main.cf

Important Directives:

inet_interfaces

Controls which interfaces the mailserver listens on (by default, only localhost!)

myhostname

provides the hostname for this server

mydomain

provides the mail domain for this server (often different than a DNS domain)

myorigin

provides the host/domain that should be shown as the origin for outbound mail from my system.

mynetworks

Comma-separated list of IP addresses and networks that can relay through this mailserver (ex: 92.168.0.0/16, 10.0.0.0/8)

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Postfix configuration tool

postconf

Applies configuration changes on the fly (not persistent). Can also display available directives and default directives.

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Reading Mail

mail

mutt

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Firewall Considerations

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SELinux Considerations

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Session 12 Finish uncompleted topics, Review, or Practice Exam

OpenRHCE

Supplemental Topics

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Manage Processes and Services: Schedule tasks using cron

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Cron

Scheduler
man 5 crontab
anacron
crond
/etc/cron.*
/var/spool/cron

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Format of a crontab file

variable=value variable2=value

minute hour dayofmonth month dayofweek command

example:

`*/5 * * * * cleanup`

Runs cleanup every 5 minutes

`1 23 * * 0 cleanup`

Runs cleanup 11:01 pm every Sunday

`1 23 5 * 0 cleanup`

Runs cleanup at 11:01 on the 5th of each month, but only if it falls on a Sunday.

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Controlling Cron

cron -u username

cron -l

cron -r

cron -e

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at Jobs

Runs job once at specified time.

Understands now, midnight, noon, teatime, minutes, hours, day, week

Examples:

```
echo "/sbin/init 6" | at now + 10 minutes
```

or

```
at now + 10 minutes
at> /sbin/init 6
at> <CTRL-D>
```

atq

atrm

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Securing cron and at

/etc/cron.allow
/etc/cron.deny
/etc/at.allow
/etc/at.deny

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User Admin with Config Files

/etc/passwd

World-readable file of user information

/etc/shadow

Restricted-access file with password and expiry info.

/etc/group

World-readable file of group information

/etc/gshadow

Restricted-access group password, admin, membership info

If editing directly, `vipw` and `vigr` should be used.

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Structure of /etc/passwd

Name:Password:UID:GID:Comments:Homedir:Shell

Sample Contents _____-

```
$ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
sshd:x:74:74:Privilege-separated SSH:/var/empty/sshd:/sbin/nologin
ntp:x:38:38::/etc/ntp:/sbin/nologin
gdm:x:42:42::/var/gdm:/sbin/nologin
scott:x:500:500:Scott Purcell:/home/scott:/bin/bash
```

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Structure of /etc/shadow

```
Name:Password:Lstchg:May:Must:Warn:Disable:Expire
```

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Sample Contents

```
# cat /etc/shadow
root:$1$IyApEyOS$dZ5SMuC7Yw9/PDMyWi1H11:14373:0:99999:7:::
sshd:!!:14373:0:99999:7:::
ntp:!!:14373:0:99999:7:::
gdm:!!:14373:0:99999:7:::
scott:$1${...}:14374:0:99999:7:::
bob:$1${...}:14398:7:30:7:7:14457:
```

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Structure of /etc/group

```
Name:Password:GID:Users
```

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Sample Contents

```
# cat /etc/group
root:x:0:root
scott:x:500:
bob:x:501:
mary:x:502:
sales:x:503:bob,mary
training:x:504:scott
```

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Structure of /etc/gshadow

```
Name:Password:Admins:Members
```

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Sample Contents

```
# cat /etc/gshadow
root:::root
scott:!!::
bob:!::
mary:!::
sales:!::bob,mary
training:!::scott
```

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User Admin with CLI tools

useradd, usermod, userdel

Create, delete, and modify user accounts

groupadd, groupmod, groupdel

Create, delete, and modify group accounts

chage

Modify password aging and expiration

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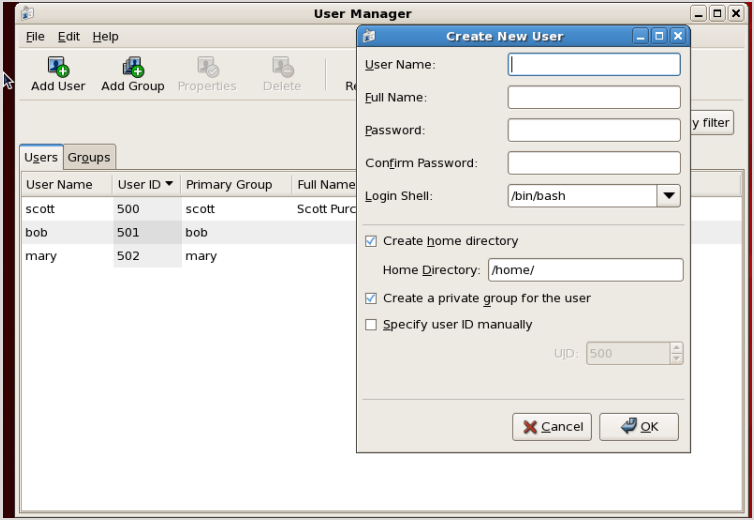
User Admin with GUI tools

The GUI tool for managing users and groups is the Red Hat User Manager. It can be launched from the menu at **System | Administration | Users and Groups** or from the CLI as `system-config-users`.



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User environment

Home directories

/home/{user}/ or /root/

/etc/skel

Contents copied to home directory of each new user.

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Common Contents:

.bashrc
.bash_logout
.bash_profile

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System-wide Shell Config Files

/etc/profile

Executed with each user login. Sets paths, variables, etc. Runs scripts in `/etc/profile.d`.

/etc/profile.d

Scripts that extend /etc/profile, usually added by applications.

/etc/bashrc

System-wide functions and aliases

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User-configurable Environment Files

~/.bashrc

User aliases and functions

~/.bash_profile

User paths, variables, and environment settings

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CUPS Printing System

uses IPP

Do not firewall port 631 udp/tcp from localhost or you will not print even to local printers.

system-config-printer

Use it. Requires X.

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Controlling Jobs from the Command Line

lpr

send a job to a printer

lpq

See what is in the print queue.

lprm

Remove a job from the print queue.

lpc

Check the status of the queues. "lpc status"

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CUPS Web-Based Interface

http://localhost:631

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Troubleshooting

Read the entire error or message and read it carefully.

- Pay attention to what it says.

Look at the logs.

- /var/log/messages
- /var/log/secure

Look for typos in the command line or configuration file.

- A simple missing semicolon (;) or a dot (.) instead of a dash (-) could be the issue.

Break the problem down into smaller parts and troubleshoot them.

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Booting

Think about the boot process and at which point you are failing.

- MBR (GRUB Stage 1)
- GRUB Stage 1.5 (Driver to read filesystem)
- GRUB Stage 2 (Menu)
  - Kernel
  - initrd (initial ramdisk)
- init process
  - inittab
- rc.sysinit
- services

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Booting - (MBR)

The MBR boots the system and loads the next GRUB Stage.

If MBR is on a partition, is it marked bootable according to fdisk ?

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Booting - GRUB Stage 1.5 (Driver to read filesystem)

If this does not exist or is corrupt, then Stage 2 may not be able to be loaded.

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Booting - GRUB Stage 2 (Menu)

This stage reads the grub.conf and displays the grub menu.

Tells GRUB where and which kernel and initial ramdisk to load.

Passes extra boot optons to the kernel.

root (hd0,0) indicates the files from /boot are located on the first partition of the first drive.

- The kernel and initial ramdisk are loaded from this partition.
- The paths should begin / and not /boot.

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Booting - Kernel

Be careful to not create a typo when specifying the kernel.

- A common typo is a dash instead of a period.
- Make sure the "root=" specifies the correct locatation of the device containing root (/).

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Booting - initrd (initial ramdisk)

Be careful to not create a typo when specifying the kernel.

- A common typo is a dash instead of a period.

The initial ramdisk NEEDS ALL DRIVERS needed for loading the filesystem.

- That means storage drivers must be in it.
- That means network drivers must be in it for booting across the network.

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Booting - init process

/sbin/init needs to exist and be executable.

Its the parent of all processes.

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Booting - inittab

This is inits configuration file.

It calls rc.sysinit.

It runs services for the appropriate run levels.

This is a very important and very easy file to corrupt.

If you get "Process spawning too rapidly" during boot, check this file or check to see if the commands it calls are there.

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Booting - rc.sysinit

Sets hostname
Runs filesystem checks if needed
Mounts file systems in fstab
remounts / as read/write

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Booting - services

Maybe the boot issue is caused by a service.

Boot into run level 1 and see if it boots.

- Run level 1 runs rc.sysinit and a couple of services.

Boot into runlevel S.

- Run level S does not start any services and does not run rc.sysinit.

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Networking

/etc/resolv.conf

- dns resolution

/etc/nsswitch

/etc/sysconfig/network

/etc/sysconfig/network-scripts/ifcfg-eth*

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X

system-config-display --reconfig --noui

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TCP_Wrappers

tcp_wrappers is an easy-to-configure security mechanism that protects some (but not all!) services using the hosts access files, /etc/hosts.allow and /etc/hosts.deny.

- hosts.allow is processed first, then hosts.deny.
- Each file is read from top down and the first matching rule is applied -- all subsequent rules are ignored.
- If no matching rule is found, **access is granted!**
- Changes take immediate effect -- no services need restarting.

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Which Services are Protected?

- **ALL** services managed by xinetd
    - telnetd
    - tftpd
- Other services compiled against the libwrap.a library
    - sshd
    - sendmail
    - vsftpd
- Notably **NOT** included: httpd

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Identifying Protected Services

- Identify the binary used by the service in question:

```
# which sendmail
/usr/sbin/sendmail
```

- Run `ldd` and `strings` against the binary and examine the output for "libwrap":

```
# strings `which sendmail` |grep libwrap
# ldd `which sendmail` |grep libwrap
libwrap.so.0 => /lib64/libwrap.so.0 ...
```

- Nul output confirms the service does NOT use tcp_wrappers:

```
# ldd `which httpd` |grep libwrap
#
```

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Hosts Access Files Syntax

Basic format: `<daemon list>: <client list> [: <option>: <option>: ...]`

- Lists are comma-separated.
- The daemon list uses process names -- not always the same as the name of the service or daemon. Wild cards and operators are available.
- The client list is hostnames, IP addresses, patterns or wildcards
- More details in `man hosts_options`

OpenRHCE

Source Repository

Info: See <https://github.com/texastwister/OpenRHCE> for the latest version of this doc.

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Date: November 26, 2012

2(1, 2) A mebibyte (MiB) is the *proper* term for the unit containing 1024 units (kibibytes or KiB) of 1024 bytes. This is in contrast to the term "megabyte" which properly refers to a unit containing 1000 units (kilobytes or kB) of 1000 bytes. For more information, see the short summary by The National Institute of Standards and Technology (NIST) or the reference article on Wikipedia

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