

# OpenRHCE

## A Creative Commons Courseware for RHCE Preparation

```
# tail -f /var/log/messages
$
# fdisk -l
$ df -h
# ifconfig eth0
# yum install gnome-applet-vm
$ ssh scott@192.168.1.100
# lvcreate -L 12G -n SRV01 vmstore
# service network restart
```

# Course Outline

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## Session One: Introduction

## Introductions: Your Instructor

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## Introductions: Your Instructor

## **Qualifications:**

- RHCSA, RHCE #110-008-877 (RHEL6)
- Also: CTT+, CLA, CLP, CNI, LPIC1, Linux+
- Curriculum Developer and Trainer for a major computer manufacturer for going on 11 years
- Linux Enthusiast since 2000

**Personal:**

- Husband, father, disciple and
- Fun: Part-time Balloon Entertainer



## Introductions: Fellow Students

## ***Please Introduce Yourself***

- 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.

## Introductions: The Course

## ***Expectations***

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

A stunning number of seasoned professionals taking Red Hat's own prep courses fail to pass on first attempt.

- Planning for more than one attempt is prudent.
- Maximizing your out-of-class preparation time is prudent.

## ***Preparation Recommendations***

- Practice/Study Environment

- 2 or 3 systems or VMs, networked together. Virtualized hosting providers may be an alternative.
- RHEL 6 (eval), CENTOS 6 (when available), or Fedora (Fedora 13 will be closest to RHEL 6)
- Red Hat docs at:

[http://docs.redhat.com/docs/en-US/Red\\_Hat\\_Enterprise\\_Linux/index.html](http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/index.html)

- RHCE Objectives and other information at:

<http://www.redhat.com/certification/>

- Take initiative -- form a study group.
- Practice, practice, practice!



# 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.

- 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.

- 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.

- RHCSS, RHCDS, RHCA

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

## RHCSA Objectives

## ***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

## ***RHCSA: ...Essential Tools... (cont)***

- 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.]

## ***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



## ***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

## ***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

## ***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

## ***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

## ***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



## RHCE Objectives

## ***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

## ***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:

## ***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

## ***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



## ***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

## ***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

## ***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

## ***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

## ***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



## ***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

## Operating a System: Boot, Reboot, Shutdown

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

## Operating a System: Runlevels

- Default
- From GRUB Menu

## Operating a System: Single User Mode

- Password Recovery

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

## Operating a System: Log Files

`/var/log/*`

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

Search with `grep`



## Operating a System: Start/Stop Virtual Machines

- Using virt-manager
- Using virsh commands

## Operating a System: Virtual Machine Consoles

- virt-manager
- virt-viewer

## Operating a System: 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}
```

## **Operating a System: Start, stop, and check the status of network services**

## Operating a System: Modify the system bootloader

```
# fdisk -l
```

```
$ df -h
```

```
# ifconfig eth0
```

```
# yum install gnome-applet-vm
```

```
$ ssh scott@192.168.1.100
```

```
# lvcreate -L 12G -n SRV01 vmstore
```

```
# service network restart
```



## Session 2 Storage and filesystems

```
# fdisk -l
```

```
$ df -h
```

```
# ifconfig eth0
```

```
# yum install gnome-applet-vm
```

```
$ ssh scott@192.168.1.100
```

```
# lvcreate -L 12G -n SRV01 vmstore
```

```
# service network restart
```

## Local Storage: 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.

# Local Storage: 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.

## Local Storage: Working with LUKS encrypted storage

Create and configure LUKS-encrypted partitions and logical volumes to prompt for password and mount a decrypted file system at boot

## Local Storage: Using UUIDs and Filesystem Labels

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



## Local Storage: Adding New Storage

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

## **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

## File systems: Working with LUKS-encrypted filesystems

Mount, unmount and use LUKS-encrypted file systems

## Filesystem Permissions: Basic Permsions

## Filesystem Permissions: Extended Attributes



## Filesystem Permissions: Use case -- Collaborative Directories

## Filesystems Permissions: File Access Control Lists

Create and manage File Access Control Lists

## Network Storage: Working with CIFS network file systems

Mount and unmount CIFS network file systems

## Network Storage: Working with NFS file systems

Mount and unmount NFS file systems

## Network Storage: Working with iSCSI devices

Configure a system as an iSCSI initiator that persistently mounts an iSCSI target



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

## Managing Software: 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
```

## Managing Software: 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](http://access.redhat.com)

Login: \*\*\*\*\*

Password: \*\*\*\*\*

Email address: \*\*\*\*\*

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

## Managing Software: 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/`

# Managing Software: Repo Configuration

- 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"`.
- Tip: This allows repos to be easily temporarily disabled simply by renaming the file to something like: `myrepo.repo.disabled`

Mandatory options:

```
[repositoryid]
name=Some name for this repository
baseurl=url://path/to/repository/
```

Related man pages:

```
# man -k yum
grepsync          (1) - synchronize yum repositories to a local directory
rhnpugin          (8) - Red Hat Network support for yum(8)
rhnpugin.conf [rhnpugin] (5) - Configuration file for the rhnpugin(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)
```



```
# tail -f /var/log/messages
$
# fdisk -l
$ df -h
# ifconfig eth0
# yum install gnome-applet-vm
$ ssh scott@192.168.1.100
# lvcreate -L 12G -n SRV01 vmstore
# service network restart
```

## Managing Software: Using yum

Common commands:

- yum help
- yum list
- yum search KEYWORD
- yum info PACKAGENAME

## Managing Software: Using rpm

## Managing Software: Building RPMs

## Managing Software: Signing and Publishing RPMs



## Managing Software: Updating the kernel package

```
# fdisk -l
```

```
$ df -h
```

```
# ifconfig eth0
```

```
# yum install gnome-applet-vm
```

```
$ ssh scott@192.168.1.100
```

```
# lvcreate -L 12G -n SRV01 vmstore
```

```
# service network restart
```

## **Manage Processes and Services: Configure network services to start automatically at boot**

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

## **Manage Processes and Services: Monitoring, prioritizing, and controlling processes**

## Manage Processes and Services: Schedule tasks using cron



## 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 shell scripting to automate system maintenance tasks

## 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
- Configure system to authenticate using Kerberos

## Session 4 Networking and routing

- o Networking & Routing + \* Configure networking and hostname resolution statically or dynamically + \* Route IP traffic and create static routes

## Session 5 Firewalls and SELinux

- o IPTables + \* Configure firewall settings using system-config-firewall or iptables
- o SELinux + \* 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

## Session 6 Virtualization

- o KVM Virtualization + \* 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 + \*
- Install Red Hat Enterprise Linux automatically using Kickstart



## Session 7 Logging and remote access

o + - Remote Logging + \* Configure a system to log to a remote system + \*  
Configure a system to accept logging from a remote system o + - Remote Access +  
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 SSH options described in documentation + VNC # \* 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

## Session 8 Network Time Protocol

- o 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

## Session 9 HTTP and FTP

## Session 10 NFS and Samba

## Session 11 DNS and SMTP



## Session 12 Finish uncompleted topics, Review, or Practice Exam