Red Hat Enterprise Linux 6
Migration Planning Guide

Migrating to Red Hat Enterprise Linux 6
Edition 6

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Abstract

This guide documents migration of systems running Red Hat Enterprise Linux 5 to Red Hat Enterprise Linux 6.

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Preface

1. Document Conventions

This manual uses several conventions to highlight certain words and phrases and draw attention to specific pieces of information.

1.1. Typographic Conventions

Four typographic conventions are used to call attention to specific words and phrases. These conventions, and the circumstances they apply to, are as follows.

Mono-spaced Bold

Used to highlight system input, including shell commands, file names and paths. Also used to highlight keys and key combinations. For example:

> To see the contents of the file **my_next_bestselling_novel** in your current working directory, enter the **cat my_next_bestselling_novel** command at the shell prompt and press **Enter** to execute the command.

The above includes a file name, a shell command and a key, all presented in mono-spaced bold and all distinguishable thanks to context.

Key combinations can be distinguished from an individual key by the plus sign that connects each part of a key combination. For example:

> Press **Enter** to execute the command.
>
> Press **Ctrl**+**Alt**+**F2** to switch to a virtual terminal.

The first example highlights a particular key to press. The second example highlights a key combination: a set of three keys pressed simultaneously.

If source code is discussed, class names, methods, functions, variable names and returned values mentioned within a paragraph will be presented as above, in **mono-spaced bold**. For example:

> File-related classes include **filesystem** for file systems, **file** for files, and **dir** for directories. Each class has its own associated set of permissions.

Proportional Bold

This denotes words or phrases encountered on a system, including application names; dialog-box text; labeled buttons; check-box and radio-button labels; menu titles and submenu titles. For example:

> Choose **System** → **Preferences** → **Mouse** from the main menu bar to launch **Mouse Preferences**. In the **Buttons** tab, select the **Left-handed mouse** check box and click **Close** to switch the primary mouse button from the left to the right (making the mouse suitable for use in the left hand).
>
> To insert a special character into a **gedit** file, choose **Applications** → **Accessories** → **Character Map** from the main menu bar. Next, choose **Search** → **Find…** from the **Character Map** menu bar, type the name of the character in the **Search** field and click **Next**. The character you sought will be highlighted in the

> **Character Table**. Double-click this highlighted character to place it in the **Text to copy** field and then click the **Copy** button. Now switch back to your document and choose **Edit** → **Paste** from the **gedit** menu bar.

The above text includes application names; system-wide menu names and items; application-specific menu names; and buttons and text found within a GUI interface, all presented in proportional bold and all distinguishable by context.

Mono-spaced Bold Italic or ***Proportional Bold Italic***

Whether mono-spaced bold or proportional bold, the addition of italics indicates replaceable or variable text. Italics denotes text you do not input literally or displayed text that changes depending on circumstance. For example:

> To connect to a remote machine using ssh, type **ssh *username*@*domain.name*** at a shell prompt. If the remote machine is **example.com** and your username on that machine is john, type **ssh john@example.com**.
>
> The **mount -o remount *file-system*** command remounts the named file system. For example, to remount the **/home** file system, the command is **mount -o remount /home**.
>
> To see the version of a currently installed package, use the **rpm -q *package*** command. It will return a result as follows: ***package-version-release***.

Note the words in bold italics above: username, domain.name, file-system, package, version and release. Each word is a placeholder, either for text you enter when issuing a command or for text displayed by the system.

Aside from standard usage for presenting the title of a work, italics denotes the first use of a new and important term. For example:

> Publican is a *DocBook* publishing system.

1.2. Pull-quote Conventions

Terminal output and source code listings are set off visually from the surrounding text.

Output sent to a terminal is set in **mono-spaced roman** and presented thus:

```
books        Desktop   documentation  drafts  mss    photos   stuff  svn
books_tests  Desktop1  downloads      images  notes  scripts  svgs
```

Source-code listings are also set in **mono-spaced roman** but add syntax highlighting as follows:

```
static int kvm_vm_ioctl_deassign_device(struct kvm *kvm,
                 struct kvm_assigned_pci_dev *assigned_dev)
{
         int r = 0;
         struct kvm_assigned_dev_kernel *match;

         mutex_lock(&kvm->lock);

         match = kvm_find_assigned_dev(&kvm->arch.assigned_dev_head,
                                       assigned_dev->assigned_dev_id);
         if (!match) {
                 printk(KERN_INFO "%s: device hasn't been assigned
before, "
                   "so cannot be deassigned\n", __func__);
                 r = -EINVAL;
                 goto out;
         }

         kvm_deassign_device(kvm, match);

         kvm_free_assigned_device(kvm, match);

out:
         mutex_unlock(&kvm->lock);
         return r;
}
```

1.3. Notes and Warnings

Finally, we use three visual styles to draw attention to information that might otherwise be overlooked.

Note

Notes are tips, shortcuts or alternative approaches to the task at hand. Ignoring a note should have no negative consequences, but you might miss out on a trick that makes your life easier.

Important

Important boxes detail things that are easily missed: configuration changes that only apply to the current session, or services that need restarting before an update will apply. Ignoring a box labeled “Important” will not cause data loss but may cause irritation and frustration.

Warning

Warnings should not be ignored. Ignoring warnings will most likely cause data loss.

2. We Need Feedback!

If you find a typographical error in this manual, or if you have thought of a way to make this manual better, we would love to hear from you! Please submit a report in Bugzilla: http://bugzilla.redhat.com/ against the product **Red Hat Enterprise Linux.**

When submitting a bug report, be sure to mention the manual's identifier: doc-*Migration_Guide* and version number: **6**.

If you have a suggestion for improving the documentation, try to be as specific as possible when describing it. If you have found an error, please include the section number and some of the surrounding text so we can find it easily.

Chapter 1. Introduction

The Migration Planning Guide documents the migration of any minor version of a Red Hat Enterprise Linux 5 installation to Red Hat Enterprise Linux 6 by highlighting key behavioral changes worthy of note when migrating.

This guide is intended to increase ease of use of Red Hat Enterprise Linux 6 by providing guidelines for changes in the product between Red Hat Enterprise Linux 5 and Red Hat Enterprise Linux 6. This guide is however *not* designed to explain all new features: it is focused on changes to the *behavior* of applications or components which were part of Red Hat Enterprise Linux 5 and have changed in Red Hat Enterprise Linux 6 or whose functionality has been superseded by another package.

1.1. Red Hat Enterprise Linux 6

Red Hat Enterprise Linux is the leading platform for open source computing. It is sold by subscription, delivers continuous value and is certified by top enterprise hardware and software vendors. From the desktop to the datacenter, Red Hat Enterprise Linux couples the innovation of open source technology and the stability of a true enterprise-class platform.

Red Hat Enterprise Linux 6 is the next generation of Red Hat's comprehensive suite of operating systems, designed for mission-critical enterprise computing. This release is available as a single kit on the following architectures:

- i386
- AMD64/Intel64
- System z
- IBM Power (64-bit)

In this release, Red Hat brings together improvements across the server, desktop and the overall Red Hat open source experience. The following are some of the many improvements and new features that are included in this release:

Power Management

Tickless kernel and improvements through the application stack to reduce wakeups, power consumption measurement by PowerTOP, Power Management (ASPM, ALPM), and adaptive system tuning by Tuned.

next generation Networking

Comprehensive IPv6 support (NFS 4, CIFS, mobile support [RFC 3775], ISATAP support), FCoE, iSCSI, and a new and improved mac80211 wireless stack.

Reliability, Availability, and Serviceability

System level enhancements from industry collaborations to make the most of hardware RAS capabilities and NUMA architectures.

Fine-grained Control and Management

Improved scheduler and better resource management in the kernel via Completely Fair Scheduler (CFS) and Control Groups (CG).

Scalable Filesystems

ext4 is the default filesystem, and xfs offers robustness, scalability, and high-performance.

Virtualization

KVM includes performance improvements and new features, sVirt protects the host, VMs, and data from a guest breach, SRIOV and NPIV deliver high performance virtual use of physical devices, and libvirt leverages kernel CG controller functionality.

Enterprise Security Enhancement

SELinux includes improved ease of use, application sandboxing, and significantly increased coverage of system services, while SSSD provides unified access to identity and authentication services as well as caching for off-line use.

Development and Runtime Support

SystemTap (allows instrumentation of a running kernel without recompilation), ABRT (simple collection of bug information), and improvements to GCC (version 4.4.3), glibc (version 2.11.1), and GDB (version 7.0.1).

1.2. Application Compatibility

This release of Red Hat Enterprise Linux provides dependencies so applications designed to run on earlier versions of the operating system continue to run with minimum disruption. To that end, older versions of key libraries are included to preserve legacy interfaces that might have changed between this release and prior versions. These libraries serve as dependencies primarily for applications written in C/C++.

Please note that it is not necessary to re-test or re-certify applications between minor releases of Red Hat Enterprise Linux. Red Hat Enterprise Linux compatibility policies ensure that applications running on a version of the release will continue to run throughout the life of the release. For example, applications certified on Red Hat Enterprise Linux 6.0 will be fully compatible on Red Hat Enterprise Linux 6.1 and so on.

Refer to the following table for details on these compatibility packages:

Table 1.1. Compatibility Libraries

Package	Description
compat-db	The Berkeley DB database compatibility library. The Berkeley Database (Berkeley DB) is a programmatic toolkit that provides embedded database support for both traditional and client/server applications. This package contains various versions of Berkeley DB which were included in previous releases.
compat-expat1	Expat is a stream-oriented XML parser. This package provides library compatibility with previous versions.
compat-glibc	glibc is the C library used for system calls and other basic facilities. This package provides compatibility (and runtime libraries) for the compiling of binaries that require older glibc versions, and allows them to run on this release of Red Hat Enterprise Linux.

Package	Description
compat-libf2c-34	This package provides older versions of Fortran 77 shared libraries, which are needed to run dynamically-linked Fortran 77 programs.
compat-libgcc-296	Contains the 2.96 libgcc.a library and support object files to retain compatibility with older versions of GCC.
compat-libgfortran-41	This package includes a Fortran 95 runtime library for compatibility with GCC 4.1.x compiled Fortran applications.
compat-libstdc++-295	Provides compatibility with the GNU standard C++ library version 2.95.
compat-libstdc++-296	Provides compatibility with the GNU standard C++ library version 2.96.
compat-libstdc++-33	Provides compatibility with the GNU standard C++ library version 3.3.
compat-libtermcap	This package provides compatibility for older termcap-based programs.
compat-openldap	OpenLDAP is an open source suite of LDAP (Lightweight Directory Access Protocol) applications and development tools. The compat-openldap package includes older versions of the OpenLDAP shared libraries which are sometimes required by some applications.
openssl098e	This package provides OpenSSL 0.98e, which is required for some SSL applications.

Chapter 2. Installation

This section outlines the differences between Red Hat Enterprise Linux 6 and Red Hat Enterprise Linux 5 installation procedures. Depending on which release of Red Hat Enterprise Linux 5 you are migrating from, not all of the options and techniques listed here will be relevant to your environment, as they might already be present in your Red Hat Enterprise Linux 5 environment.

2.1. Kernel and Boot Options

- You can perform memory testing before you install Red Hat Enterprise Linux by entering **`memtest86`** at the **`boot:`** prompt. This option runs the *Memtest86* stand alone memory testing software in place of the *Anaconda* system installer. Once started, *Memtest86* memory testing loops continually until the **`Esc`** key is pressed.
- The **`rdloaddriver`** kernel parameter is now needed to define the order of module loading, instead of the old **`scsi_hostadapter`** option.
- Kernel Modesetting (KMS) is a feature that assigns the responsibility of graphics mode initialization to the kernel, and is enabled by default. KMS enables:
  - Improved graphical boot.
  - Faster fast user switching.
  - Seamless X server switching.
  - Graphical panic messages.

  KMS can be disabled for all drivers by appending **`nomodeset`** to the **`boot:`** line when booting the system.

2.2. Graphical Installer

This section describes what behaviors have changed in the graphical installer.

2.2.1. Devices and Disks

- Use of the /dev/hd*X* device name is deprecated on the i386 and x86_64 architecture for IDE drives, and has changed to /dev/sd*X*. This change does not apply to the PPC architecture.
- If you have difficulties with the installation not detecting a Smart Array card, enter **`linux isa`** at the installer prompt. This lets you manually select the required card.
- Whereas older IDE drivers supported up to 63 partitions per device, SCSI devices are limited to 15 partitions per device. Anaconda uses the new *libata* driver in the same fashion as the rest of Red Hat Enterprise Linux, so it is unable to detect more than 15 partitions on an IDE disk during the installation or upgrade process. If you are upgrading a system with more than 15 partitions, migrating the disk to Logical Volume Manager (LVM) is recommended.
- A change in the way that the kernel handles storage devices means that device names like /dev/hd*X* or /dev/sd*X* can differ from the values used in earlier releases. Anaconda solves this problem by relying on partition labels. If these labels are not present, then Anaconda provides a warning that these partitions need to be labeled. Systems that use Logical Volume Management (LVM) and the device mapper usually do not require relabeling.

- With the inclusion of the Linux Unified Key Setup (LUKS) specification, support is included for installation to encrypted block devices, including the root file system. Refer to the *Red Hat Enterprise Linux Installation Guide* for more information on LUKS.
- Not all IDE RAID controllers are supported. If your RAID controller is not yet supported by **dmraid**, it is possible to combine drives into RAID arrays by configuring Linux software RAID. For supported controllers, configure the RAID functions in the computer BIOS.
- The version of GRUB included in Red Hat Enterprise Linux 6 now supports ext4, so Anaconda now allows you to use the ext4 file system on any partition, including the **/boot** and root partitions.

2.2.2. Kickstart

This section describes what behaviors have changed in automated installations (Kickstart).

2.2.2.1. Behavioral Changes

- Previously, a Kickstart file that did not have a **network** line resulted in the assumption that DHCP is used to configure the network. This was inconsistent with the rest of Kickstart in that all other missing lines mean installation will halt and prompt for input. Now, having no **network** line means that installation will halt and prompt for input if network access is required. If you want to continue using DHCP without interruption, add **network --bootproto=dhcp** to your Kickstart file. Also, the **--bootproto=query** option is deprecated. If you want to prompt for network configuration in the first stage of installation, use the **asknetwork** option.
- In previous versions of Red Hat Enterprise Linux, the **next-server** DHCP option was used to specify an NFS server containing Kickstart files when the **ks** option is passed to the system without a value. This DHCP option has changed to **server-name** in Red Hat Enterprise Linux 6.
- Traditionally, disks have been referred to throughout Kickstart by a device node name (such as **sda**). The Linux kernel has moved to a more dynamic method where device names are not guaranteed to be consistent across reboots, so this can complicate usage in Kickstart scripts. To accommodate stable device naming, you can use any item from **/dev/disk** in place of a device node name. For example, instead of:

  ```
  part / --fstype=ext4 --onpart=sda1
  ```

  You could use an entry similar to one of the following:

  ```
  part / --fstype=ext4 --onpart=/dev/disk/by-path/pci-0000:00:05.0-scsi-
  0:0:0:0-part1
  part / --fstype=ext4 --onpart=/dev/disk/by-id/ata-
  ST3160815AS_6RA0C882-part1
  ```

  This provides a consistent way to refer to disks that is more meaningful than just **sda**. This is especially useful in large storage environments.
- You can also use shell-like entries to refer to multiple disks. This is primarily intended to make it easier to use the **clearpart** and **ignoredisk** commands in large storage environments. For example, instead of:

  ```
  ignoredisk --drives=sdaa,sdab,sdac
  ```

  You could use an entry similar to the following:

```
ignoredisk --drives=/dev/disk/by-path/pci-0000:00:05.0-scsi-*
```

- Kickstart will halt with an error in more cases than previous versions. For example, if you refer to a disk that does not exist, the installation will halt and inform you of the error. This is designed to help detect errors in Kickstart files before they lead to larger problems. As a side-effect, files that are designed to be generic across different machine configurations can fail more frequently. These must be dealt with on a case-by-case basis.

- The **`/tmp/netinfo`** file used for Kickstart network information has been removed. Anaconda now uses *NetworkManager* for interface configuration by default, and stores configuration in the ifcfg files in **`/etc/sysconfig/network-scripts/`**. It is possible to use this new location as a source of network settings for *%pre* and *%post* scripts.

2.2.2.2. Command Changes

This sections lists the most important changes to commands and their options:

- The **`network --device`** option can now refer to devices by MAC addresses instead of device name. Similar to disks, network device names can also change across reboots depending on the order in which devices are probed. In order to allow consistent naming in Kickstart, you could use an entry similar to the following:

  ```
  network --device=00:11:22:33:44:55 --bootproto=dhcp
  ```

- The **`langsupport`**, **`key`** and **`mouse`** commands have been removed. Any use of these commands will result in a syntax error. The **`monitor`** command has also been deprecated.

  Instead of **`langsupport`**, add the appropriate group to the **`%packages`** section of your Kickstart file. For example, to include French support, add **`@french-support`**.

  There is no replacement for the **`key`** option, as an installation key is no longer requested during install. Simply remove this option from your file.

  The **`mouse`** and **`monitor`** commands are not required as X.Org can detect and configure settings automatically. For the same reason, the **`xconfig --resolution=`** command is no longer valid, and these can all be safely removed from the file.

- The **`part --start`** and **`part --end`** commands have been deprecated and have no effect. Anaconda no longer allows creating partitions at specific sector boundaries. If you require a more strict level of partitioning, use an external tool in **`%pre`** and then tell Anaconda to use existing partitions with the **`part --onpart`** command. Otherwise, create partitions with a certain size or use **`--grow`**.

- Instead of creating groups manually in **`%post`**, you can now use the **`group`** command to create them for you. Please refer to the complete Kickstart documentation for more details.

- The **`rescue`** command automatically enters the installer's rescue mode for recovery and repair. You can optionally use the **`--nomount`** (to not mount any file systems) or the **`--romount`** (mount in read-only mode) options to the **`rescue`** command.

- The **`sshpw`** command has been added. It is used to control the accounts created in the installation environment that are remotely logged into while installation is taking place.

- The **`updates`** command has been added, allowing you to specify the location of any **`updates.img`** file to be used during installation.

- The **`fcoe`** command will enable the installer to activate any FCoE locations attached to the specified network interface.
- The default autopart algorithm has changed. For all machines, autopart will create a **`/boot`** (or other special bootloader partitions as required by the architecture) and swap. For machines with at least 50 GB of free disk space, autopart will create a reasonably sized root partition (**`/`**) and the rest will be assigned to **`/home`**. For those machines with less space, only root (**`/`**) will be created.

  If you do not want a **`/home`** volume created for you, do not use autopart. Instead, specify **`/boot`**, swap and **`/`**, making sure to allow the root volume to grow as necessary.
- Anaconda now includes a new storage filtering interface to control which devices are visible during installation. This interface corresponds to the existing **`ignoredisk`**, **`clearpart`** and **`zerombr`** commands. Because **`ignoredisk`** is optional, excluding it from the Kickstart file will not cause the filter UI to appear during installation. If you wish to use this interface, add:

  ```
  ignoredisk --interactive
  ```
- The **`--size=1 --grow`** option from the **`/tmp/partition-include`** file can no longer be used. You must specify a reasonable default size and partitions will grow accordingly.

2.2.2.3. Packages Changes

These changes affect the **`%packages`** section:

- The **`--ignoreDeps`** and **`--resolveDeps`** arguments have been removed. Anaconda automatically resolves dependencies, but will skip installation of packages that have unmet dependencies.
- If you want to get the exact same set of packages via Kickstart that you would in a default GUI install accepting all of the defaults, add the following:

  ```
  %packages --default
  %end
  ```
- You can also optionally specify the architecture of packages that you want installed for multi-arch installs. For instance:

  ```
  %packages
  glibc.i686
  %end
  ```

  This would add the x86 *glibc* package to the set, which can be useful on an x86-64 system that requires the x86 packages for compatibility reasons.
- It is not possible to audit and migrate all of the packages and groups in the **`%packages`** section. Some packages and groups have been removed, some added, and some have had their name changed. Please refer to the Release Notes for more details.

2.2.2.4. Script Changes

These changes affect the use of **`%pre`**, **`%post`** and **`%traceback`** scripts.

- Logging of errors while running scripts has been improved. Scripts are no longer removed after they are run, so they can be inspected. This is most useful on systems where the scripts are dynamically generated so you can see what was run. In addition, the stderr and stdout output is always logged for every script. This has one important side effect: if your scripts use an interactive program, you must pass **--logfile=/dev/tty3** to the header of your scripts. Otherwise, you will not be able to interact with the program.

2.2.2.5. Syntax Changes

Changes to the core Kickstart syntax are quite rare. However, there are two important syntax changes to be aware of:

- The **%include** option can now accept a URL as an argument, in addition to a file name.
- The **%packages**, **%post**, **%pre** and **%traceback** sections do not require an **%end** section. A deprecation warning will appear if **%end** sections are not included, but the script will continue to run.

2.2.2.6. Summary of Differences

This section lists the difference in commands and options in Red Hat Enterprise Linux 6:

Commands removed:

- **key**
- **langsupport**
- **mouse**

Commands deprecated:

- **monitor**
- **xconfig --resolution**

Commands added:

- **fcoe**
- **group**
- **rescue**
- **sshpw**
- **updates**

2.2.2.7. pykickstart

The *pykickstart* package contains utilities that can be used to make migration easier. Make sure you have the latest package installed. The **ksverdiff** command takes a starting and ending syntax version, and reports differences in commands and options for the two given versions. It states the new, deprecated and removed commands and options. For example:

```
$ ksverdiff --from RHEL5 --to RHEL6

The following commands were removed in RHEL6:
langsupport mouse key

The following commands were deprecated in RHEL6:
monitor
```

```
The following commands were added in RHEL6:
sshpw group rescue updates fcoe
...
```

You can also check the validity of your Kickstart file with the **`ksvalidator`** command. This command checks the validity of the file against any Kickstart syntax version that you specify. However, it can not inform you about problems that would only happen at install time, for example if you specify **`part --ondisk=sdr`** and no such device exists. Example usage:

```
$ ksvalidator --version RHEL6 my-rhel5-ks.cfg
```

2.2.3. Networking

This section describes what behaviors have changed in the graphical installer, relating to networking.

- Anaconda is now using *NetworkManager* for configuration of network interfaces during installation. The main network interface configuration screen in Anaconda has been removed. Users are only prompted for network configuration details if they are necessary during installation. The settings used during installation are then written to the system for later use.

- When PXE booting and using an .iso file mounted via NFS for the installation media, add **`repo=nfs:server:/path/`** to the command line. The **`install.img`** and **`product.img`** files also need to be extracted and/or placed into the **`nfs:server:/path/images/`** directory. The **`product.img`** file contains variant definitions and various install classes.

- Some systems with multiple network interfaces do not assign *eth0* to the first network interface as recognized by the system BIOS. This can cause the installer to attempt to use a different network interface than was initially used by PXE. To change this behavior, use the following in **`pxelinux.cfg/*`** configuration files:

  ```
  IPAPPEND 2
  APPEND ksdevice=bootif
  ```

  This configuration option causes the installer to use the same network interface as the system BIOS and PXE use. You can also use the following option, which will cause the installer to use the first network device it finds that is linked to a network switch:

  ```
  ksdevice=link
  ```

2.2.4. Product Subscriptions and Content Updates

Red Hat Enterprise Linux 6 introduces an updated and more flexible service for content delivery and subscription management. This section describes the changes to the content service.

- The Red Hat Network hosted environment is updated from using channel-based subscriptions to product-and-quantity based subscriptions. The new Certificate-Based RHN has redesigned client tools for managing subscriptions and systems and works with the new Subscription and Content Delivery Network (CDN).

  The traditional channel-based RHN is still available as *RHN Classic*.

  These two subscription services are available on the same platform, just with parallel technologies, so all subscriptions can be registered and managed either way.

Environments using a Satellite or proxy server will continue to use the traditional channel-based subscription system and will register systems with RHN Classic.

- A new content server option, Red Hat Network Classic, has been added to the firstboot wizard. This uses the traditional channel-based RHN rather than the updated RHN and CDN. The default Red Hat Network option uses the new Certificate-based Red Hat Network management platform.

- Certificate-Based RHN and RHN Classic are interoperable; if a system is registered using one service, the other service recognizes it and will not issue any warnings. However, these services do not work simultaneously. A system must be registered with one, and only one, subscription service; it cannot be registered with both.

  There is currently no direct migration path from a system using RHN Classic to the new Certificate-based Red Hat Network. To move a system from one service to the other, there are two options:

  - Update the system to Red Hat Enterprise Linux 6.1 or later using a boot ISO rather than **`yum`**.

  - Manually remove the system from RHN Classic and delete the host record, then register the system to Certificate-based Red Hat Network using the Red Hat Subscription Manager tools.

- A new set of client tools, the Red Hat Subscription Manager GUI and CLI, are provided with Red Hat Enterprise Linux 6.1 and newer to manage subscriptions through Certificate-Based RHN. The existing **`rhn_*`** tools are still available to handle systems managed through RHN Classic.

2.3. Text-Based Installer

The text-mode installation option in Red Hat Enterprise Linux 6 is significantly more streamlined than it was in earlier versions. Text-mode installation now omits the more complicated steps that were previously part of the process, and provides you with an uncluttered and straightforward experience. This section describes the changes in behavior when using the text-based installer:

- Anaconda now automatically selects packages only from the base and core groups. These packages are sufficient to ensure that the system is operational at the end of the installation process, ready to install updates and new packages.

- Anaconda still presents you with the initial screen from previous versions that allows you to specify where Anaconda will install Red Hat Enterprise Linux on your system. You can choose to use a whole drive, to remove existing Linux partitions, or to use the free space on the drive. However, Anaconda now automatically sets the layout of the partitions and does not ask you to add or delete partitions or file systems from this basic layout. If you require a customized layout at installation time, you must perform a graphical installation over a VNC connection or a Kickstart installation. More advanced options, such as logical volume management (LVM), encrypted filesystems, and resizable filesystems are still only available in graphical mode and Kickstart. Refer to the *Red Hat Enterprise Linux Installation Guide* for more information on performing a graphical (VNC) installation.

- Anaconda now performs bootloader configuration automatically in the text-based installer.

- Text-mode installations using Kickstart are carried out in the same way that they were in previous versions. However, because package selection, advanced partitioning, and bootloader configuration are now automated in text mode, Anaconda cannot prompt you for information that it requires during these steps. You must therefore ensure that the Kickstart file includes the packaging, partitioning, and bootloader configurations. If any of this information is missing, Anaconda will exit with an error message.

Chapter 3. Storage and File Systems

3.1. kdump

It is now possible to use ext4, XFS and btrfs file systems as dump targets during kdump operations. For more information regarding these file systems, please refer to the Red Hat Enterprise Linux 6 *Storage Administration Guide*.

3.2. RAID

3.2.1. Upgrades

Performing an upgrade from a **`dmraid`** set to an **`mdraid`** set is not supported. A warning will be displayed when an upgrade of this type is attempted. Upgrades from existing **`mdraid`** sets and creation of new **`mdraid`** sets are possible.

The new default superblock can cause problems when upgrading sets. This new superblock format (used on all devices except when creating a RAID1 **`/boot`** partition) is now at the beginning of the array, and any file system or LVM data is offset from the beginning of the partition. When the array is not running, LVM and file system **`mount`** commands might not detect the device as having a valid volume or file system data. This is intentional, and means that if you want to mount a single disk in a RAID1 array, you need to start the array having only that single disk in it, then mount the array. You can not mount the bare disk directly. This change has been made as mounting a bare disk directly can silently corrupt the array if a resync is not forced.

On subsequent reboots, the RAID system can then consider the disk that was not included in the array as being incompatible, and will disconnect that device from the array. This is also normal. When you are ready to re-add the other disk back into the array, use the **`mdadm`** command to hot add the disk into the array, at which point a resync of the changed parts of the disk (if you have write intent bitmaps) or the whole disk (if you have no bitmap) will be performed, and the array will once again be synchronized. From this point, devices will not be disconnected from the array, as the array is considered to be properly assembled.

The new superblock supports the concept of named **`mdraid`** arrays. Dependency on the old method of array enumeration (for instance, **`/dev/md0`** then **`/dev/md1`**, etc.) for distinguishing between arrays has been dropped. You can now choose an arbitrary name for the array (such as **`home`**, **`data`**, or **`opt`**). Create the array with your chosen name using the **`--name=opt`** option. Whatever name is given to the array, that name will be created in **`/dev/md/`** (unless a full path is given as a name, in which case that path will be created; or unless you specify a single number, such as 0, and **`mdadm`** will start the array using the old **`/dev/md`***x* scheme). The Anaconda installer does not currently allow for the selection of array names, and instead uses the simple number scheme as a way to emulate how arrays were created in the past.

The new **`mdraid`** arrays support the use of write intent bitmaps. These help the system identify problematic parts of an array, so that in the event of an unclean shutdown, only the problematic parts need to be resynchronized, and not the entire disk. This drastically reduces the time required to resynchronize. Newly created arrays will automatically have a write intent bitmap added when suitable. For instance, arrays used for swap and very small arrays (such as **`/boot`** arrays) do not benefit from having write intent bitmaps. It is possible to add a write intent bitmap to your previously existing arrays after the upgrade is complete via the **`mdadm --grow`** command on the device, however write intent bitmaps do incur a modest performance hit (about 3-5% at a bitmap chunk size of 65536, but can increase to 10% or more at small bitmap chunk sizes such as 8192). This means that if a write intent bitmap is added to an array, it is best to keep the chunk size reasonably large. The recommended size is 65536.

3.3. ext4

3.3.1. Migration from ext3

Moving to ext4 must be done with a freshly formatted ext4 file system. Migrating in place from ext3 to ext4 is not supported and will not produce many of the benefits ext4 offers, since the data currently residing on the partition will not make use of the extents features and other changes.

Red Hat recommends that customers who cannot migrate to a cleanly formatted ext4 file system remain on their existing ext3 file system.

3.3.2. Behavioral changes

Red Hat Enterprise Linux 6 provides full support for ext4 and it is the default file system for new installations. This section explains the major changes in behavior that this new file system introduces.

- The included version of the *GRUB* bootloader provides full support for ext4 partitions. The installer also allows you to place any **`/boot`** file system on an ext4 partition.
- The included version of the *e2fsprogs* package is fully compatible with ext4.
- In some cases, ext4 file systems created under Red Hat Enterprise Linux 5.3 with the *e4fsprogs* package created an **`ext4dev`** file system type. The **`test_fs`** feature flag identifying these file systems as a development version can be removed with the following command: **`tune2fs -E ^test_fs`**. This is done so that these file systems will be recognized as regular ext4 file systems.

3.4. blockdev

The **`blockdev --rmpart`** command option is no longer supported. The **`partx(8)`** and **`delpart(8)`** commands now provide this functionality.

3.5. Tape devices

As of Red Hat Enterprise Linux 6.4, the number of tape drives supported on a system has increased from 128 to 512.

Chapter 4. Networking and Services

4.1. Interfaces and Configuration

NetworkManager

Red Hat Enterprise Linux 6 uses NetworkManager by default when configuring network interfaces; however, the network configuration tools, **`system-config-network`**, **`system-config-network-tui`** and **`system-config-network-cmd`** are still included.

Infiniband

Infiniband support (specifically the **`openib`** start script and the **`openib.conf`** file) was provided by the *openib* package in Red Hat Enterprise Linux 5. The package name has changed in Red Hat Enterprise Linux 6 to reflect its functionality more accurately. The Infiniband functionality is now distributed in the *rdma* package. The service is now called **`rdma`**, and the configuration file is located at **`/etc/rdma/rdma.conf`**.

biosdevname

biosdevname accepts a kernel device name as an argument, and returns the BIOS-assigned name for that device. This is useful on systems where the BIOS name for a device does not directly or clearly map to the kernel name. The use of biosdevname is only recommended on systems and architectures that provide such information in their BIOS. Pass **`biosdevname=1`** at installation time to activate biosdevname based naming.

4.2. Service Initialization

4.2.1. xinetd

Xinetd is a daemon used to start network services on demand. The changes in xinetd are related to the allowed limit of open file descriptors:

- The listening mechanism has changed from **`select()`** to **`poll()`**. With this change, the limit of open file descriptors used by xinetd can be changed.
- File descriptor limit can also now be changed on a per-service basis. This can be done in the configuration file for the service via the **`rlimit_files`** directive. The value can be a positive integer or UNLIMITED.

4.2.2. Runlevels

In Red Hat Enterprise Linux 6, the custom runlevels 7, 8 and 9 are no longer supported and can not be used.

4.2.3. Upstart

In Red Hat Enterprise Linux 6, *init* from the *sysvinit* package has been replaced with *Upstart*, an event-based init system. This system handles the starting of tasks and services during boot, stopping them during shutdown and supervising them while the system is running. For more information on Upstart itself, refer to the **`init(8)`** man page.

Processes are known to Upstart as jobs and are defined by files in the **/etc/init** directory. Upstart is very well documented via man pages. Command overview is in **init(8)** and job syntax is described in **init(5)**.

Upstart provides the following behavioral changes in Red Hat Enterprise Linux 6:

- The **/etc/inittab** file is deprecated, and is now used *only* for setting up the default runlevel via the *initdefault* line. Other configuration is done via **upstart** jobs in the **/etc/init** directory.

- The number of active tty consoles is now set by the *ACTIVE_CONSOLES* variable in **/etc/sysconfig/init**, which is read by the **/etc/init/start-ttys.conf** job. The default value is *ACTIVE_CONSOLES=/dev/tty[1-6]*, which starts a getty on tty1 through tty6.

- A serial getty is still automatically configured if the serial console is the primary system console. In prior releases, this was done by **kudzu**, which would edit **/etc/inittab**. In Red Hat Enterprise Linux 6, configuration of the primary serial console is handled by **/etc/init/serial.conf**.

- To configure a getty running on a non-default serial console, you must now write an Upstart job instead of editing **/etc/inittab**. For example, if a getty on ttyS1 is desired, the following job file (**/etc/init/serial-ttyS1.conf**) would work:

```
# This service maintains a getty on /dev/ttyS1.

start on stopped rc RUNLEVEL=[2345]
stop on starting runlevel [016]

respawn
exec /sbin/agetty /dev/ttyS1 115200 vt100-nav
```

As in prior releases, ttyS1 is required in **/etc/securetty** if you wish to allow root logins on this getty.

Because of the move to Upstart, using **/etc/shutdown.allow** for defining who can shut the machine down is no longer supported.

4.3. IPTables/Firewalls

IPTables includes a **SECMARK** target module. This is used to set the security mark value associated with the packet for use by security subsystems such as SELinux. It is only valid in the mangle table. Refer to the following for example usage:

```
iptables -t mangle -A INPUT -p tcp --dport 80 -j SECMARK --selctx \
system_u:object_r:httpd_packet_t:s0
```

4.4. Apache HTTP Server

Below is a list of changes for the Apache HTTP Server that are noteworthy when migrating to Red Hat Enterprise Linux 6:

- The **mod_file_cache**, **mod_mem_cache**, and **mod_imagemap** modules are no longer supported.

- The **Charset=UTF-8** option has been added to the default **IndexOptions** directive. If directory listings with a non UTF-8 character set are required (such as those produced by **mod_autoindex**), this option must be changed.

- The **distcache** distributed session cache is no longer supported in **mod_ssl**.
- The default location of the process ID (pid) file has moved from **/var/run** to **/var/run/httpd**.
- The *mod_python* package is no longer included as upstream development has ceased. Red Hat Enterprise Linux 6 provides *mod_wsgi* as an alternative, with support for Python scripting via the WSGI interface.

4.5. Samba

Samba 3.6 is packaged with Red Hat Enterprise Linux 6.4. Major changes include:

- SMB2 support
- ID mapping re-write
- SMB Traffic Analyzer

For full details refer to the Samba release notes available here: http://www.samba.org/samba/history/samba-3.6.0.html.

4.6. PHP

PHP changes are listed below:

- PHP has been upgraded to version 5.3. Compatibility issues require some scripts to be updated. For further details, refer to the following URLs:
  - http://php.net/manual/migration52.php
  - http://php.net/manual/migration53.php
- The following changes have been made to the default configuration (**/etc/php.ini**):
  - **error_reporting** is now set to **E_ALL & ~E_DEPRECATED** (previously **E_ALL**)
  - **short_open_tag** is now set to **Off** (previously **On**)
  - **variables_order** is now set to **GPCS** (previously **EGPCS**)
  - **enable_dl** is now to set to **Off** (previously **On**)
- The **mime_magic**, **dbase**, and **ncurses** extensions are no longer distributed.

4.7. BIND

There are several major changes in BIND configuration:

Default ACL configuration

In Red Hat Enterprise Linux 5, the default ACL configuration allowed queries and offered recursion for all hosts. By default in Red Hat Enterprise Linux 6, all hosts can make queries for authoritative data but only hosts from the local network can make recursive queries.

New allow-query-cache option

The **allow-recursion** option has been deprecated in favor of this option. It is used to control access to server caches, which include all non-authoritative data (like recursive lookups and root nameserver hints).

Chroot environment management

The **`bind-chroot-admin`** script, which was used to create symlinks from a non-chroot environment to a chroot environment, is deprecated and no longer exists. Instead, configuration can be managed directly in a non-chroot environment and init scripts automatically mount needed files to the chroot environment during **`named`** startup in the case that files are not already present in the chroot.

`/var/named` directory permissions

The **`/var/named`** directory is no longer writable. All zone files that need to be writable (such as dynamic DNS zones, DDNS) must be placed in the new writable directory: **`/var/named/dynamic`**.

`dnssec [yes|no]` option removed

The global **`dnssec [yes|no]`** options have been split into two new options: **`dnssec-enable`** and **`dnssec-validation`**. The **`dnssec-enable`** option enables DNSSEC support. The **`dnssec-validation`** option enables DNSSEC validation. Note that setting **`dnssec-enable`** to "no" on recursive server means that it cannot be used as a forwarder by another server that performs DNSSEC validation. Both options are set to yes by default.

`controls` statement not required

You no longer need to specify the **`controls`** statement in **`/etc/named.conf`** if you use the **`rndc`** management utility. The **`named`** service automatically allows control connections via the loopback device and both **`named`** and **`rndc`** use the same secret key generated during installation (located in **`/etc/rndc.key`**).

In a default installation, BIND is installed with DNSSEC validation enabled, and uses the ISC DLV register. This means all signed domains (such as gov., se., cz.), that have their key in the ISC DLV register, are cryptographically validated on the recursive server. If validation fails due to attempts at cache poisoning, then the end user will not be given this forged/spoofed data. DNSSEC deployment is fully supported in Red Hat Enterprise Linux 6. DNSSEC is an important step in making the Internet more secure for end users, and is widely implemented. As previously mentioned, DNSSEC validation is controlled with the **`dnssec-validation`** option in **`/etc/named.conf`**.

4.8. SNMP

In Red Hat Enterprise Linux 6.4 and previous, Net-SNMP shipped its configuration file readable to any user on the system. Since configuration files can contain sensitive information like passwords, as of Red Hat Enterprise Linux 6.5, the configuration file is readable only by root.

This change affects user scripts that attempt to access the SNMP configuration file, **`/etc/snmp/snmpd.conf`**.

4.9. NTP

NTP (Network Time Protocol) is used to synchronize the clocks of computer systems over the network. In Red Hat Enterprise Linux 6, the default configuration file, **`/etc/ntp.conf`**, now has the following lines commented:

```
#server 127.127.1.0 # local clock
#fudge 127.127.1.0 stratum 10
```

This configuration means that **ntpd** will only distribute time information to network clients if it is specifically synchronized to an NTP server or a reference clock. To get **ntpd** to offer this information even when not synchronized, the two lines must be uncommented.

Also, when **ntpd** is started with the **-x** option (in OPTIONS in the **/etc/sysconfig/ntpd** file), or if there are servers specified in **/etc/ntp/step-tickers**, the service no longer runs the **ntpdate** command before starting. There is now a separate **ntpdate** service which can be enabled independently from the **ntpd** service. This **ntpdate** service is disabled by default, and is only recommended for use when other services require the correct time before starting, or do not function properly when time modifications occur later by **ntpd**.

If you encounter problems running this service with the default NetworkManager configuration, a possible fix is to add **NETWORKWAIT=1** to **/etc/sysconfig/network**, as described in the Red Hat Enterprise Linux Deployment Guide.

As of Red Hat Enterprise Linux 6.5, the format used by **ntpd** for **syslog** messages has changed. This affects users attempting to parse these log messages. Additionally, users can now configure the types of message to be logged via the **logconfig** option in **ntp.conf**.

4.10. PTP

IEEE 1588 Precision Time Protocol Version 2 (PTPv2) is used to precisely synchronize clocks in an Ethernet network. When used in conjunction with hardware support, it's capable of achieving clock accuracy in the sub-microsecond range. As of Red Hat Enterprise Linux 6.5, PTP is fully supported by Red Hat and compatible with the Broadcom (bnx2x, tg3), Intel (e1000e, igb, ixgbe), and Solarflare (sfc) network drivers.

4.11. Kerberos

In Red Hat Enterprise Linux 6, Kerberos clients and servers (including KDCs) will default to not using keys for the ciphers **des-cbc-crc**, **des-cbc-md4**, **des-cbc-md5**, **des-cbc-raw**, **des3-cbc-raw**, **des-hmac-sha1**, and **arcfour-hmac-exp**. By default, clients will not be able to authenticate to services which have keys of these types.

Most services can have a new set of keys (including keys for use with stronger ciphers) added to their keytabs and experience no downtime, and the ticket granting service's keys can likewise be updated to a set which includes keys for use with stronger ciphers, using the kadmin **cpw -keepold** command.

As a temporary workaround, systems that need to continue to use the weaker ciphers require the **allow_weak_crypto** option in the *libdefaults* section of the **/etc/krb5.conf** file. This variable is set to *false* by default, and authentication will fail without having this option enabled:

```
[libdefaults]
allow_weak_crypto = yes
```

Additionally, support for Kerberos IV, both as an available shared library and as a supported authentication mechanism in applications, has been removed. Newly-added support for lockout policies requires a change to the database dump format. Master KDCs which need to dump databases in a format that older KDCs can consume must run kdb5_util's **dump** command with the **-r13** option.

4.12. Mail

4.12.1. Sendmail

In some releases of Red Hat Enterprise Linux 5, the *sendmail* Mail Transport Agent (MTA) accepted network connections from external hosts by default. In Red Hat Enterprise Linux 6, *sendmail* by default only accepts connections from the local system (localhost). To grant *sendmail* the ability to act as a server for remote hosts, perform one of the following steps:

- Edit **`/etc/mail/sendmail.mc`** and change the **`DAEMON_OPTIONS`** line to also listen on network devices
- Comment out the **`DAEMON_OPTIONS`** line in **`/etc/mail/sendmail.mc`**.

To put either of these changes into effect, install the *sendmail-cf* package, then regenerate **`/etc/mail/sendmail.cf`**. This is done by running the following commands:

```
su -c 'yum install sendmail-cf'
su -c 'make -C /etc/mail'
```

4.12.2. Exim

Exim has been removed from Red Hat Enterprise Linux 6. Postfix is the default and recommended MTA.

4.12.3. Dovecot

4.12.3.1. Dovecot configuration

The configuration for Dovecot 2.x has changed. The master configuration file **`/etc/dovecot.conf`** has moved to **`/etc/dovecot/dovecot.conf`** and other parts of Dovecot configuration have moved to **`/etc/dovecot/conf.d/*.conf`**. The majority of the configuration is the same and is compatible with this new version; however, you can test your configuration and list which options have been renamed, removed, or otherwise changed in this new version with the following command:

```
doveconf [-n] -c /old/dovecot.conf
```

4.13. MySQL®

4.13.1. DBD Driver

The MySQL DBD driver has been dual-licensed and the related licensing issues have been resolved. The resulting *apr-util-mysql* package is now included in the Red Hat Enterprise Linux 6 software repositories.

4.14. PostgreSQL

4.14.1. Upgrading Databases

If you are upgrading from an existing Red Hat Enterprise Linux 5 installation in which PostgreSQL 8.4 (*postgresql84-** packages) was in use, the Red Hat Enterprise Linux 6 PostgreSQL packages will operate as a drop-in replacement.

However, if you are upgrading from a Red Hat Enterprise Linux 5 installation in which PostgreSQL

8.1 (*postgresql-** packages) or earlier was in use, and you have existing database content that needs to be preserved, you will need to follow the dump and reload procedure here due to changes in the data format: http://www.postgresql.org/docs/8.4/interactive/install-upgrading.html. Ensure that you perform the dump step **before** upgrading to Red Hat Enterprise Linux 6.

4.14.2. Other Changes

Refer to the following URL for possible application compatibility issues associated with the transition from PostgreSQL 8.1 to 8.4: http://wiki.postgresql.org/wiki/WhatsNew84

4.15. Squid

Squid has been updated to version 3.1. This update provides native IPv6 support and significantly shortens the **/etc/squid/squid.conf** configuration file. However, it also comes with some significant change to configuration options, which are not entirely backwards compatible with some older versions of Squid. For complete details on the changes, see the Squid 3.1 release notes: http://www.squid-cache.org/Versions/v3/3.1/RELEASENOTES.html.

4.16. Bluetooth

4.16.1. Bluetooth Service On Demand

In order to support Bluetooth devices, the Bluetooth background service was started by default in previous versions of Red Hat Enterprise Linux. In this release, the Bluetooth service is started on demand when needed and automatically stops 30 seconds after the use of the device has stopped. This reduces overall initial startup time and resource consumption.

4.17. Cron

4.17.1. Vixie cron and Cronie

Red Hat Enterprise Linux 6 includes the *cronie* package as a replacement for *vixie-cron*. The main difference between these packages is how the regular jobs (daily, weekly, monthly) are done. Cronie uses the **/etc/anacrontab** file, which by default looks like the following:

```
# the maximal random delay added to the base delay of the jobs
RANDOM_DELAY=45

# the jobs will be started during the following hours only
START_HOURS_RANGE=3-22

# period in days   delay in minutes   job-identifier      command

1   5  cron.daily nice run-parts /etc/cron.daily
7   25  cron.weekly nice run-parts /etc/cron.weekly
@monthly  45  cron.monthly nice run-parts /etc/cron.monthly
```

These regular jobs will be executed once a day in the 03:00-22:00 time interval, including a random delay. For example, *cron.daily* will have a 5 minute forced delay plus a random delay of 0-45 minutes. You could also run jobs with no delays, between 4 and 5:

```
RANDOM_DELAY=0 # or do not use this option at all

START_HOURS_RANGE=4-5

# period in days   delay in minutes   job-identifier      command
1   0  cron.daily nice run-parts /etc/cron.daily
7   0  cron.weekly nice run-parts /etc/cron.weekly
@monthly  0  cron.monthly nice run-parts /etc/cron.monthly
```

Features of *cronie* include:

- Random delay for starting the job in **`/etc/anacrontab`**.
- Time range of regular jobs can be defined in **`/etc/anacrontab`**.
- Each cron table can have its own defined time zone with the CRON_TZ variable.
- By default, the cron daemon checks for changes in tables with inotify.

For further details about *cronie* and *cronie-anacron*, please refer to the Red Hat Enterprise Linux Deployment Guide.

4.18. Logging

The **`dateext`** option is now enabled by default in **`/etc/logrotate.conf`**. This option archives old versions of log files by adding an extension representing the date (in YYYYMMDD format). Previously, a number was appended to files.

Chapter 5. Command Line Tools

This section describes the behavioral changes of command-line tools in Red Hat Enterprise Linux 6.

5.1. Grep

The behavior of the **grep** command has changed with regards to searching for upper and lower case strings. Using interval searching in the [a-z] format is dependent on the *LC_COLLATE* variable.

You can set **LC_COLLATE=C** to preserve old behavior and to achieve proper results when performing interval searching with this method; however, in Red Hat Enterprise Linux 6, the recommended way of interval searching is to use the [[:lower:]],[[:upper:]] format.

This change can significantly affect output, so scripts and processes must be reviewed to continue to achieve the correct results.

5.2. Sed

The **sed** command with the **-i** option lets you delete the contents of a read-only file and lets you delete other protected files. The permissions on a file define what actions can take place to that file, while the permissions on a directory define what actions can be taken to the list of files in that directory. For this reason, **sed** does not let you use **-i** on a write-enabled file in a read-only directory, and will break symbolic or hard links when the **-i** option is used on such a file.

5.3. Pcre

The *pcre* package has been updated to 7.8. It includes the following behavioral changes:

- UTF-8 checking now references RFC 3629 instead of RFC 2279. This makes it more restrictive in the strings that it accepts. For example, the UTF-8 character ordinal value is now limited to 0x0010FFFF:

  ```
  $ echo -ne "\x00\x11\xff\xff" | recode UCS-4-BE..UTF8 | pcregrep --utf-
  8 '.'
  pcregrep: pcre_exec() error -10 while matching this line:
  ```

  Please refer to the RFC for more details: http://tools.ietf.org/html/rfc3629#section-12.

- Saved patterns that were compiled by earlier versions of PCRE must be recompiled. This affects applications that serialize pre-compiled PCRE expressions to external memory (for example, a file) and load them later. This is usually done for performance reasons, for example in large spam filters.

5.4. Shells

The location of the shell binary files has changed. For example, the **bash** and **ksh** binaries are no longer in **/usr/bin**. Both binaries are now found in **/bin**. Scripts will require updating to point to the new location of the binary.

5.5. Nautilus

The *nautilus-open-terminal* package provides a right-click **`Open Terminal`** option to open a new terminal window in the current directory. Previously, when this option was chosen from the **`Desktop`**, the new terminal window location defaulted to the user's home directory. However, in Red Hat Enterprise Linux 6, the default behavior opens the Desktop directory (i.e **`~/Desktop/`**). To enable the previous behavior, use the following command to set the **`desktop_opens_home_dir`** GConf Boolean to true:

```
gconftool-2 -s /apps/nautilus-open-terminal/desktop_opens_dir --type=bool
true
```

Chapter 6. System Configuration

6.1. ACPI

6.1.1. CPU hotplug

ACPI CPU hotplug is available as a Technology Preview in Red Hat Enterprise Linux 6.5. This is a platform-specific feature; as such, details of its use are outside the scope of this document.

Important

Technology Preview features provide early access to upcoming product innovations, enabling you to test functionality and provide feedback during the development process. However, these features are not fully supported under Red Hat Enterprise Linux Subscription Level Agreements, may not be functionally complete, and are not intended for production use. During the development of a Technology Preview feature, additional components may become available to the public for testing. Because Technology Preview features are still under development, Red Hat cannot guarantee the stability of such features. As a result, if you are using Technology Preview features, you may not be able to seamlessly upgrade to subsequent releases of that feature.

While Red Hat intends to fully support Technology Preview features in future releases, we may discover that a feature does not meet the standards for enterprise viability. If this happens, we cannot guarantee that Technology Preview features will be released in a supported manner. Some Technology Preview features may only be available for specific hardware architectures.

The **`CONFIG_ACPI_HOTPLUG_CPU`** configuration option must be enabled in order to use this feature.

Additionally, if the platform implements the optional ACPI **`_OST`** method, the following configuration options must also be enabled. There are no harmful effects associated with enabling these configuration for all platforms.

- **`CONFIG_ACPI_HOTPLUG_CPU`**
- **`CONFIG_ACPI_HOTPLUG_MEMORY`** or **`CONFIG_ACPI_HOTPLUG_MEMORY_MODULE`**
- **`CONFIG_ACPI_CONTAINER`** or **`CONFIG_ACPI_CONTAINER_MODULE`**

6.2. Logging

The **`dateext`** option is now enabled by default in **`/etc/logrotate.conf`**. This option archives old versions of log files by adding an extension representing the date (in YYYYMMDD format). Previously, a number was added to files.

Chapter 7. Desktop

In Red Hat Enterprise Linux 6, the GUI console has moved from tty7 to tty1.

7.1. GDM Configuration

A number of GDM settings are now managed within GConf.

The GDM default greeter is called the simple Greeter and is configured via GConf. Default values are stored in GConf in the *gdm-simple-greeter.schemas* file. Use **`gconftool2`** or **`gconf-editor`** to edit these values. The following options exist for the Greeter:

- /apps/gdm/simple-greeter/banner_message_enable

  ```
  false (Boolean)
  ```

  Controls whether the banner message text is displayed.

- /apps/gdm/simple-greeter/banner_message_text

  ```
  NULL (string)
  ```

  Specifies the text banner message to show on the greeter window.

- /apps/gdm/simple-greeter/logo_icon_name

  ```
  computer (string)
  ```

  Set to the themed icon name to use for the greeter logo.

- /apps/gdm/simple-greeter/disable_restart_buttons

  ```
  false (Boolean)
  ```

  Controls whether to show the restart buttons in the login window.

- /apps/gdm/simple-greeter/wm_use_compiz

  ```
  false (Booleans)
  ```

  Controls whether compiz is used as the window manager instead of metacity.

Plugins can also be disabled using GConf. For example, if you want to disable the sound plugin then unset the following key: **`/apps/gdm/simple-greeter/settings-manager-plugins/sound/active`**.

Chapter 8. Security and Authentication

This chapter covers behavioral changes for security and authentication, including SELinux, SSSD, LDAP, Checksums, and PAM.

8.1. SELinux

The **sshd** daemon is now a confined service.

8.2. SSSD

SSSD (System Security Services Daemon) offers access to remote identity and authentication mechanisms, referred to as *providers*. SSSD allows these providers to be configured as SSSD back-ends, abstracting the actual (local and network) identity and authentication sources. It also allows any kind of identity data provider to be plugged in. A *domain* is a database containing user information, which can serve as the source of a provider's identity information. Multiple identity providers are supported, allowing two or more identity servers to act as separate user namespaces. Collected information is available to applications on the front-end through standard PAM and NSS interfaces.

SSSD runs as a suite of services, independent of the applications that use it. Those applications therefore no longer need to make their own connections to remote domains, or even be aware of which is being used. Robust local caching of identity and group membership information allows operations regardless of where identity comes from (e.g., LDAP, NIS, IPA, DB, Samba, etc.), offers improved performance, and allows authentication to be performed even when operating offline and online authentication is unavailable. SSSD also allows the use of multiple providers of the same type (e.g., multiple LDAP providers) and allows domain-qualified identity requests to be resolved by those different providers. Further details can found in the Red Hat Enterprise Linux 6 Deployment Guide.

8.3. LDAP

8.3.1. OpenLDAP

The configuration required for the OpenLDAP service has changed in Red Hat Enterprise Linux 6. In previous versions, **slapd** was configured via the **/etc/openldap/slapd.conf** file. The **slapd** configuration in Red Hat Enterprise Linux 6 is now stored in a special LDAP directory (**/etc/openldap/slapd.d/**) with a pre-defined schema and Directory Information Tree (DIT). Further details of this configuration schema can be found at openldap.org. The following section details an example on how to convert the old configuration file to work with the new directory:

8.3.2. Converting slapd configuration

This example assumes that the file to convert from the old **slapd** configuration is located at **/etc/openldap/slapd.conf** and the new directory for OpenLDAP configuration is located at **/etc/openldap/slapd.d/**.

- Remove the contents of the new **/etc/openldap/slapd.d/** directory:

  ```
  # rm -rf /etc/openldap/slapd.d/*
  ```

- Run **slaptest** to check the validity of the configuration file and specify the new configuration directory:

```
slaptest -f /etc/openldap/slapd.conf -F /etc/openldap/slapd.d
```

- Configure permissions on the new directory:

```
chown -R ldap:ldap /etc/openldap/slapd.d
```

```
chmod -R 000 /etc/openldap/slapd.d
```

```
chmod -R u+rwX /etc/openldap/slapd.d
```

- Once the service is confirmed to be working in the new configuration directory, remove the old configuration file:

```
rm -rf /etc/openldap/slapd.conf
```

8.4. Checksums

Red Hat Enterprise Linux now uses the SHA-256 digest algorithm for data verification and authentication in more places than before, upgrading from the cryptographically weaker SHA-1 and MD5 algorithms.

8.5. Pluggable Authentication Modules (PAM)

Common configuration for PAM services is located in the **/etc/pam.d/system-auth-ac** file.

Authentication modules are now also written into additional PAM configuration files: **/etc/pam.d/password-auth-ac**, **/etc/pam.d/smartcard-auth-ac** and **/etc/pam.d/fingerprint-auth-ac**.

The PAM module for **sshd** and other remote services such as **ftpd** now include the **/etc/pam.d/password-auth** file in Red Hat Enterprise Linux 6 instead of **/etc/pam.d/system-auth**.

8.6. System Users

The threshold for statically assigned UID/GID numbers (defined by the *setup* package in the **/usr/share/doc/setup-*/uidgid** file) has increased from 100 (in Red Hat Enterprise Linux 3, 4, and 5) to 200 in Red Hat Enterprise Linux 6. This change can affect systems that have 100-200 dynamically or statically assigned UID/GIDs, and cause failure in the installation and running of some applications.

Dynamic UID/GID allocation now ranges from 499 downward in Red Hat Enterprise Linux 6. For static system user creation without reservations enforced by the *setup* package, it is recommended to use the UID/GID area of 300 and above.

8.7. NIST SCAP 1.2 Certification

As of Red Hat Enterprise Linux 6.6, OpenSCAP (*openscap*) is certified by the National Institute of Standards and Technology's (NIST) Security Content Automation Protocol (SCAP) 1.2. SCAP provides a standardized approach to maintaining the security of enterprise systems, allowing you to automatically verify the presence of patches, check system security configuration settings, and examine systems for signs of compromise.

Red Hat Enterprise Linux 6.6 also includes a new package, *scap-security-guide*, which provides more information on how to get the best out of OpenSCAP.

8.8. Changes to RSA and DSA Key Generation

Normal Red Hat Enterprise Linux 6 operation allows the generation of RSA and DSA keys of any size. Additional restrictions are applied if Red Hat Enterprise Linux 6 is run in FIPS mode.

As of Red Hat Enterprise Linux 6.6, the ***OPENSSL_ENFORCE_MODULUS_BITS*** environment variable determines key generation behaviour in FIPS mode.

When FIPS mode is in use and the ***OPENSSL_ENFORCE_MODULUS_BITS*** environment variable is set, only 2048 bit or 3072 bit RSA and DSA keys can be generated.

If the ***OPENSSL_ENFORCE_MODULUS_BITS*** environment variable is not set, key generation behavior does not change from previous releases of Red Hat Enterprise Linux 6: the system can generate RSA keys greater than or equal to 1024 bits, and DSA keys of 1024 bits, 2048 bits, or 3072 bits.

Chapter 9. System Monitoring and Kernel

9.1. dracut

The *dracut* tool has replaced the use of *mkinitrd*. Also, the **/etc/modprobe.conf** file is no longer used by default in the management of kernel modules, however it can still be used if manually created. Refer to the following for an example usage of the *dracut* tool:

```
# mv /boot/initramfs-$(uname -r).img /boot/initramfs-$(uname -r)-old.img
# dracut --force /boot/initramfs-$(uname -r).img $(uname -r)
```

You can find the configuration files for *dracut* in the configuration directory, **/etc/dracut.conf.d**.

9.2. IP Virtual Server (IPVS)

Red Hat Enterprise Linux 6.5 introduces a new sync message protocol format. This new format is provided to prevent interruptions to business services caused by persistent connections on backup server nodes timing out prematurely, causing inconsistent state in the case of failover to a backup server node.

This new format is not compatible with versions of Red Hat Enterprise Linux 6.4 or earlier, or kernel versions prior to kernel-2.6.32-406.el6. Upgrade backup nodes before upgrading the master node.

To continue using the old format for sync messages, for example if you need to upgrade the master node prior to the backup nodes, set the value of **/proc/sys/net/ipv4/vs/sync_version** to **0**.

9.3. Joystick support

Joystick device support is not enabled by default. The Red Hat Enterprise Linux 6 kernel no longer provides the joystick module.

9.4. Automatic Bug Reporting Tool (ABRT)

As of Red Hat Enterprise Linux 6.6, the Automatic Bug Reporting Tool (ABRT) has been updated to version 2. This update removes several limitations , but involves a number of changes to configuration and behavior.

Problem data, such as that pertaining to a crash, is no longer stored in a database. This information is now stored only as files in a problem data directory. As a result, the **/etc/abrt/abrt.conf** configuration file has been simplified, and some configuration directives are now obsolete, or specified in other locations.

- The ***OpenGPGCheck***, ***BlackList***, ***ProcessUnpackaged***, and ***BlackListedPaths*** directives are no longer specified in **/etc/abrt/abrt.conf**. Instead, they are specified in the **/etc/abrt/abrt-action-save-package-data.conf** file.
- The ***Database*** directive is no longer required or supported.
- The ***ActionsandReporters*** directive has been replaced by the **post-create** event. For further information about events in ABRT 2, see Section 9.4.1, “ABRT Events”.

- The **`[AnalyzerActionsAndReporters]`** section of the **`abrt.conf`** file is now obsolete. The directives that were previously configured in this section (***`Kerneloops`***, ***`CCpp`***, and ***`Python`***) have been replaced by the **`analyze_*`** and the **`report_*`** events. For further information about events in ABRT 2, see Section 9.4.1, “ABRT Events”.
- The functionality of the C/C++ hook has been replaced with the **`abrt-ccpp`** service, except for the ***`ReadonlyLocalDebugInfoDirs`*** directive, which has not yet been ported.
- The functionality of the Python hook has been replaced with the *abrt-addon-python* package.
- The functionality of the kernel oops hook has been replaced with the **`abrt-oops`** service and the related **`abrt-dump-oops`** and **`abrt-action-kerneloops`** commands.

ABRT provides a number of commands to provide flexible automated reporting of problem data, including the following:

reporter-bugzilla

Checks for bugs with the same ABRT hash as the specified problem data directory and comments on an existing bug, or creates a new bug, as appropriate. This command requires the *libreport-plugin-bugzilla* package in addition to the default package.

reporter-kerneloops

Reports kernel oops to an appropriate site. This command requires the *libreport-plugin-kerneloops* package in addition to the default package.

reporter-mailx

Sends the contents of a problem data directory via email. This command requires the *libreport-plugin-mailx* plugin in addition to the default package.

reporter-print

Prints problem data to standard output or a specified file. This command requires the *libreport-plugin-logger* package in addition to the default package.

reporter-rhtsupport

Reports problem data to RHT Support. This command requires the *libreport-plugin-rhtsupport* plugin in addition to the default package.

reporter-upload

Uploads a tarball of the problem data directory to a specified URL. This command requires the *libreport-plugin-reportuploader* package in addition to the default package.

9.4.1. ABRT Events

ABRT 2 adds configurable events to the ABRT workflow. Events are triggered when problem data is recorded. They specify actions to perform on problem data and can be used to modify how data is analyzed or to specify a location to which data should be uploaded. You can also have events run only on problem data with certain characteristics.

Event configuration files are stored in the **`/etc/libreport/events.d`** directory. They contain the following:

Event name

The name of the event being triggered. This is the first argument of the ***EVENT*** parameter. For example, the following event configuration file contains an event called **report_Bugzilla**.

```
EVENT=report_Bugzilla analyzer=Python
   reporter-bugzilla -c /etc/libreport/plugins/Bugzilla.conf
```

Conditions

The conditions that must be matched by the problem data for the event to be triggered on that problem data. In this case, the following event is triggered only if the problem data directory contains an **analyzer** file that contains a value of **Python**.

```
EVENT=report_Bugzilla analyzer=Python
   reporter-bugzilla -c /etc/libreport/plugins/Bugzilla.conf
```

Actions

The actions that are performed on the problem data when this event is run. In this case, the **reporter-bugzilla** command is run.

```
EVENT=report_Bugzilla analyzer=Python
   reporter-bugzilla -c /etc/libreport/plugins/Bugzilla.conf
```

For further details, see the man page:

```
$ man report_event.conf
```

Chapter 10. Package and Driver Changes

The list of included packages and system drivers undergoes regular changes in Red Hat Enterprise Linux releases. This is done for a number of reasons: packages and drivers are added or updated in the operating system to provide new functionality, or when the packages and drivers represent out-of-date hardware and are removed; the upstream project for the packages and drivers might no longer be maintained, or hardware-specific packages and drivers are no longer supported by a hardware vendor and are removed.

This chapter lists the new and updated packages and drivers in Red Hat Enterprise Linux 6, as well as those that have been deprecated and discontinued (removed).

10.1. System Configuration Tools Changes

10.1.1. system-config-bind

The *system-config-bind* tool has been deprecated and removed without replacement. Editing the name server configuration manually via the **`named.conf`** file is recommended in Red Hat Enterprise Linux 6. Comprehensive BIND documentation is installed as part of the *bind* package in **`/usr/share/doc/bind-x.y.z`**. Also, sample configurations can be found in the **`/usr/share/doc/bind-x.y.z/sample`** directory. The *system-config-bind* tool from previous versions does, however, generate standard BIND configuration, so depending on your environment it is possible to migrate to the version of BIND found in Red Hat Enterprise Linux 6 by moving old configuration files to the correct location and performing sufficient testing.

10.1.2. system-config-boot

The *system-config-boot* tool allowed graphical configuration of the GRUB bootloader. In Red Hat Enterprise Linux 6 it has been deprecated and removed without replacement. The default GRUB configuration is sufficient for many users, however if manual changes are required, the boot configuration can be accessed and changed in the **`grub.conf`** file, located in the **`/boot/grub`** directory. Red Hat Enterprise Linux 6 uses version 1 of GRUB, also known as GRUB legacy. Full documentation for configuring GRUB can be found at the GRUB homepage: http://www.gnu.org/software/grub/.

10.1.3. system-config-cluster

The *system-config-cluster* tool has been deprecated and removed without replacement. Using *ricci* and *luci* (from the *Conga* project) is recommended.

10.1.4. system-config-display

The *system-config-display* tool has been replaced by *XRandr* configuration tools as found in both supported desktops: GNOME and KDE. There is no explicit configuration file (**`xorg.conf`**) in the default X server installation as display management is now done dynamically via one of the following menu options:

GNOME: **System** → **Preferences** → **Display** (or the **`system-config-display`** command).

KDE: **System Settings** → **Computer Administration** → **Display**

The command line utility (**`xrandr`**) can be also used for display configuration. See the **`xrandr --help`** command or the manual page via the **`man xrandr`** command for further details.

10.1.5. system-config-httpd

The *system-config-httpd* tool has been deprecated and removed without replacement. Users must configure web servers manually. Configuration can be done in the **`/etc/httpd`** directory. The main configuration file is located at **`/etc/httpd/conf/httpd.conf`**. This file is well documented with detailed comments in the file for most server configurations; however if required, the complete Apache web server documentation is shipped in the *httpd-manual* package.

10.1.6. system-config-lvm

The *system-config-lvm* tool has been deprecated. Management of logical volumes can be performed via the *gnome-disk-util* or the *lvm* tools.

10.1.7. system-config-netboot

The *system-config-netboot* tool has been deprecated and removed without replacement. Using Red Hat Network Satellite is recommended.

10.1.8. system-config-nfs

The *system-config-nfs* tool has been deprecated and removed without replacement. Users must set up NFS server configuration manually.

10.1.9. system-config-rootpassword

The *system-config-rootpassword* tool has been replaced by the *system-config-users* tool - a powerful user management and configuration tool. The root password can be set in the *system-config-users* tool by unchecking the **`"Hide system users and groups"`** option in the Preferences dialog. The root user will now be shown in the main listing, and the password can be modified like any other user.

10.1.10. system-config-samba

The *system-config-samba* tool has been deprecated and removed without replacement. Users must set up SMB server configuration manually.

10.1.11. system-config-securitylevel

The *system-config-securitylevel* tool has been removed. The *system-config-firewall* tool is recommended for firewall configuration.

10.1.12. system-config-soundcard

The *system-config-soundcard* tool has been removed. Sound card detection and configuration is done automatically.

10.1.13. system-config-switchmail

The *system-config-switchmail* tool has been deprecated and removed without replacement. Postfix is the preferred and default MTA (Mail Transfer Agent) in Red Hat Enterprise Linux 6. If you are using another MTA, it must be configured manually according to its specific configuration files and techniques.

10.1.14. Preupgrade Assistant

The **Preupgrade Assistant** (**preupg**) checks for potential problems you might encounter with an upgrade from Red Hat Enterprise Linux 6 to Red Hat Enterprise Linux 7 before making any changes to your system. This helps you assess your chances of successfully upgrading to Red Hat Enterprise Linux 7 before the actual upgrade process begins.

The **Preupgrade Assistant** assesses the system for possible in-place upgrade limitations, such as package removals, incompatible obsoletes, name changes, deficiencies in some configuration file compatibilities, and so on. It then provides the following:

- System analysis report with proposed solutions for any detected migration issues.
- Data that could be used for "cloning" the system, if the in-place upgrade is not suitable.
- Post-upgrade scripts to finish more complex issues after the in-place upgrade.

Your system remains unchanged except for the information and logs stored by the **Preupgrade Assistant**.

For detailed instructions on how to obtain and use the **Preupgrade Assistant**, see https://access.redhat.com/site/node/637583/.

10.1.15. Red Hat Upgrade Tool

The new **Red Hat Upgrade Tool** is used after the **Preupgrade Assistant**, and handles the three phases of the upgrade process:

- **Red Hat Upgrade Tool** fetches packages and an upgrade image from a disk or server, prepares the system for the upgrade, and reboots the system.
- The rebooted system detects that upgrade packages are available and uses **systemd** and **yum** to upgrade packages on the system.
- **Red Hat Upgrade Tool** cleans up after the upgrade and reboots the system into the upgraded operating system.

Both network and disk based upgrades are supported. For detailed instructions on how to upgrade your Red Hat Enterprise Linux 6 system to Red Hat Enterprise Linux 7, see https://access.redhat.com/site/node/637583/.

10.2. Bash (Bourne-Again Shell)

Red Hat Enterprise Linux 6 includes version 4.1 of Bash as its default shell. This section describes the compatibility issues that this version introduces over previous versions.

- Bash-4.0 and later now allows process substitution constructs to pass unchanged through brace expansion, so any expansion of the contents will have to be separately specified, and each process substitution will have to be separately entered.
- Bash-4.0 and later now allows SIGCHLD to interrupt the wait builtin, as Posix specifies, so the SIGCHLD trap is no longer always invoked once per exiting child if you are using `wait' to wait for all children.
- Since Bash-4.0 and later now follows Posix rules for finding the closing delimiter of a $() command substitution, it will not behave as previous versions did, but will catch more syntax and parsing errors before spawning a subshell to evaluate the command substitution.

- The programmable completion code uses the same set of delimiting characters as readline when breaking the command line into words, rather than the set of shell metacharacters, so programmable completion and readline will be more consistent.
- When the read builtin times out, it attempts to assign any input read to specified variables, which also causes variables to be set to the empty string if there is not enough input. Previous versions discarded the characters read.
- In Bash-4.0 and later, when one of the commands in a pipeline is killed by a SIGINT while executing a command list, the shell acts as if it received the interrupt.
- Bash-4.0 and later versions change the handling of the **set -e** option so that the shell exits if a pipeline fails (and not just if the last command in the failing pipeline is a simple command). This is not as Posix specifies. There is work underway to update this portion of the standard; the Bash-4.0 behavior attempts to capture the consensus at the time of release.
- Bash-4.0 and later fixes a Posix mode bug that caused the **. (source)** builtin to search the current directory for its filename argument, even if **"."** is not in the system PATH. Posix says that the shell should not look in the PWD variable in this case.
- Bash-4.1 uses the current locale when comparing strings using operators to the **[[** command. This can be reverted to the previous behavior by setting one of the **compatNN** *shopt* options.

10.2.1. Regular Expressions

Further to the points already listed, quoting the pattern argument to the regular expression matching conditional operator =~ can cause regexp matching to stop working. This occurs on all architectures. In versions of *bash* prior to 3.2, the effect of quoting the regular expression argument to the **[[** command's =~ operator was not specified. The practical effect was that double-quoting the pattern argument required backslashes to quote special pattern characters, which interfered with the backslash processing performed by double-quoted word expansion and was inconsistent with how the == shell pattern matching operator treated quoted characters.

In *bash* version 3.2, the shell was changed to internally quote characters in single- and double-quoted string arguments to the =~ operator, which suppresses the special meaning of the characters that are important to regular expression processing (`.', `[', `\', `(', `), `*', `+', `?', `{', `|', `^', and `$') and forces them to be matched literally. This is consistent with how the == pattern matching operator treats quoted portions of its pattern argument.

Since the treatment of quoted string arguments was changed, several issues have arisen, chief among them the problem of white space in pattern arguments and the differing treatment of quoted strings between *bash* 3.1 and *bash* 3.2. Both problems can be solved by using a shell variable to hold the pattern. Since word splitting is not performed when expanding shell variables in all operands of the **[[** command, this provides the ability to quote patterns as you wish when assigning the variable, then expand the values to a single string that can contain whitespace. The first problem is solved by using backslashes or any other quoting mechanism to escape the white space in the patterns.

Bash 4.0 introduces the concept of a *compatibility level*, controlled by several options to the *shopt* builtin. If the *compat31* option is enabled, bash will revert to the 3.1 behavior with respect to quoting the right-hand side of the =~ operator.

10.3. Other Package Changes

10.3.1. New Packages

The following list details new packages in Red Hat Enterprise Linux 6.

java-1.8.0-openjdk

> **Important**
>
> OpenJDK 8 is provided in Red Hat Enterprise Linux 6.6 as a Technology Preview. For details about the support available to Technology Preview features, see https://access.redhat.com/site/support/offerings/techpreview/.

Red Hat Enterprise Linux 6.6 provides OpenJDK 8 as a Technology Preview. OpenJDK 8 is the open-source reference implementation of the Java SE 8 Platform Specification defined by JSR 337. This new version of the specification adds lambda expressions and default methods to the Java programming language. It also includes a new date and time API, and extends the Java programming language to allow annotations on types.

Javadoc parsing is stricter in this release, which means that some javadocs created for previous versions of OpenJDK may not compile. If you must compile prior to modifying your javadocs for these changes, you can temporarily disable javadoc generation to work around these stricter requirements.

Additionally, a number of methods are deprecated as of this release. See the specification for details.

libnl3

The *libnl3* package provides version 3 of libnl, a collection of libraries for netlink interfaces. *libnl3* provides similar functionality to *libnl*, but is not a backward compatible replacement for it. Therefore, as of Red Hat Enterprise Linux 6.6, *libnl3* can be installed in parallel with the original *libnl* package.

redhat-support-tool

Red Hat Support Tool (*redhat-support-tool*) facilitates console-based access to Red Hat's subscriber services and gives Red Hat subscribers more venues for accessing both the content and services available to them as Red Hat customers. Further, it enables our customers to integrate and automate their helpdesk services with our subscription services. The capabilities of this package include:

- Red Hat Access Knowledge Base article and solution viewing from the console (formatted as man pages).
- Viewing, creating, modifying, and commenting on customer support cases from the console.
- Attachment uploading directly to a customer support case or to ftp://dropbox.redhat.com/ from the console.
- Full proxy support (that is, FTP and HTTP proxies).
- Easy listing and downloading of attachments in customer support cases from the console.
- Red Hat Access Knowledge Base searching on query terms, log messages, and other parameters, and viewing search results in a selectable list.

- Easy uploading of log files, text files, and other sources to the Red Hat Access automatic problem determination engine for diagnosis.
- Various other support-related commands.

Detailed usage information for the tool can be found in the Red Hat Customer Portal at https://access.redhat.com/site/articles/445443.

redhat-support-lib-python

Red Hat customers can use this library to easily integrate their help desk solutions and IT infrastructure with the services provided by the Red Hat Customer Portal. Further, this library will be used by and integrated into shipped products for automatic problem determination/diagnostics.

The python library provided by this package is an abstraction layer that simplifies interactions with the Red Hat Customer Portal. Simply create an instance of the API by providing the necessary authorization credentials, then use the API object to interact with the Red Hat Customer Portal.

Some of the interactions supported by this API include, but are not limited to, automatic diagnostic services on log files, knowledge base searching, support case creation, attaching files to support cases, viewing the status of support cases, and viewing entitlements.

rsyslog7

The new *rsyslog7* package provides rsyslog version 7. The previous package, *rsyslog*, continues to provide version 5.

As of Red Hat Enterprise Linux 6.6, Red Hat will focus on maintaining the *rsyslog7* package, and only critical security issues will be fixed in the *rsyslog* package. This allows legacy projects that require version 5 to remain supported, while giving customers access to version 7, which includes performance improvements and introduces production support for structured logging.

Red Hat Access Insights

With Red Hat Enterprise Linux 6.7, the Red Hat Access Insights service is now available.

Red Hat Access Insights is a proactive service designed to enable you to identify, examine, and resolve known technical issues before they affect your deployment. Insights leverages the combined knowledge of Red Hat Support Engineers, documented solutions, and resolved issues to deliver relevant, actionable information to system administrators.

The service is hosted and delivered through the customer portal at https://access.redhat.com/insights/ or via Red Hat Satellite.

To register your systems, please follow the latest Getting Started Guide for Insights, which is available at: https://access.redhat.com/insights/getting-started/

For further information, data security and limits, please review https://access.redhat.com/insights/splash/

10.3.2. Updated Packages

The following table lists updated packages in Red Hat Enterprise Linux 6 and a description of noteworthy changes.

Table 10.1. Updated Packages

Updated Package	Description
OProfile	OProfile has been updated to 0.9.5. This newer version includes support for Intel Atom and i7 processors, AMD Family 11h processors, and the Instruction Based Sampling (IBS) feature in AMD Family 10h.
quota, edquota, setquota	Now accepts a user name or user ID as an argument. If the argument appears to be a number it will be considered a user ID, otherwise it will be translated into an ID automatically. Be aware that this can cause a problem if the user name consists solely of digits. The **quota** package has been updated. The **-x** argument, which forced user name to ID translation in utilities such as **quota**, **edquota** and **setquota** has been removed. This functionality is now provided by the **--always-resolve** option.
module-init-tools	**/etc/modprobe.conf** does not exist by default. Can still be used if manually created.
openscap	As of Red Hat Enterprise Linux 6.6, the *openscap* package has been rebased to conform to the SCAP 1.2 specification. This update includes a number of changes to component specifications. For details, see http://scap.nist.gov.

10.3.3. Discontinued Packages

The following table lists discontinued (removed) packages in Red Hat Enterprise Linux 6 and their replacements or alternatives.

Table 10.2. Discontinued Packages

Discontinued Package	Replaced By
aspell	hunspell. aspell is only provided as a build dependency. Applications that want to use spell-checking must use hunspell.
beecrypt	NSS/OpenSSL
crash-spu-commands	None. Cell-specific packages no longer included.
dhcpv6/dhcpv6-client	dhcp/dhclient binaries now have IPv6 capability built in.
elfspe2	None. Cell-specific packages no longer included.
exim	Postfix
gnbd	iSCSI recommended for use instead.
gnome-vfs	gvfs
ipsec-tools	Openswan
kmod-gnbd	iSCSI recommended for use instead.
lam	openmpi

Discontinued Package	Replaced By
libatomic	gcc-libraries, in Red Hat Enterprise Linux 6.5 and onward.
libspe2	None. Cell-specific packages no longer included.
libspe2-devel	None. Cell-specific packages no longer included.
linuxwacom	xorg-x11-drv-wacom
mod_python	mod_wsgi, which uses the WSGI interface, can be used as an alternative for Python scripting.
mkinitrd	dracut
nss_ldap	nss-pam-ldapd, pam_ldap
openmotif-2.2	openmotif-2.3
spu-tools	None. Cell-specific packages no longer included.
switchdesk	The session management performed by both supported session managers: GDM and KDM.
sysklogd	rsyslog as of Red Hat Enterprise Linux 6.0; rsyslog7 as of Red Hat Enterprise Linux 6.6
SysVinit	upstart
vixie-cron	cronie

10.3.4. Deprecated Packages

- qt3
- GFS1
- gcj continues to be included in Red Hat Enterprise Linux 6 for performance reasons, however gcj is not likely to be included in future releases.
- cryptoloop
- mingw32-qpid-cpp
- python-qmf
- python-qpid
- qpid-cpp
- qpid-qmf
- qpid-tests
- qpid-tools
- ruby-qpid
- saslwrapper

10.4. Driver Changes

This section describes the driver changes in Red Hat Enterprise Linux 6. Please note that all drivers are now loaded to initramfs by default.

10.4.1. Discontinued Drivers

- aic7xxx_old
- atp870u
- cpqarray
- DAC960
- dc395x
- gdth
- hfs
- hfsplus
- megaraid
- net/tokenring/
- paride
- qla1280
- sound/core/oss
- sound/drivers/opl3/*
- sound/pci/nm256

10.4.2. Deprecated Drivers

- aacraid
- aic7xxx
- i2o
- ips
- megaraid_mbox
- mptlan
- mptfc
- sym53c8xx

10.4.3. Discontinued Kernel Components

- NBD - Network Block Device supplanted by iSCSI in Red Hat Enterprise Linux 6.
- HFS - Apple filesystem support discontinued in Red Hat Enterprise Linux 6.
- Tux - Web Server accelerator discontinued in Red Hat Enterprise Linux 6.
- Non-PAE x86 kernel - Previous versions of Red Hat Enterprise Linux contained multiple kernels for the i686 architecture: a kernel with, and a kernel without PAE. It has been many years since non-PAE hardware was sold in volume. Hence in Red Hat Enterprise Linux 6, there is only a single

kernel, one that includes PAE.

- The Anticipatory I/O scheduler is deprecated and is not present in Red Hat Enterprise Linux 6. It is replaced by the CFQ (Completely Fair Queueing) I/O scheduler, which has been the default I/O scheduler in the Linux kernel since 2006. Customers using the Anticipatory I/O scheduler are encouraged to test their workload using CFQ and file bugs for any performance issues observed. While the goal is to make CFQ perform on par with the Anticipatory I/O scheduler in all tested workloads, Red Hat cannot guarantee that there will be no outliers.

10.5. Library Changes

32-bit libraries are not installed by default on Red Hat Enterprise Linux 6. You can change this behavior by setting **`multilib_policy=all`** in **`/etc/yum.conf`**, which will enable multilib policy as a system-wide policy.

Appendix A. Revision History

Revision 6.7-6 Wed Aug 05 2015 Laura Bailey

Correcting typographical error.

Revision 6.7-5 Tue Jul 30 2015 Mark Flitter

Updated to include Red Hat Access Insights

Revision 6.7-2 Tue Jul 28 2015 Mark Flitter

Publishing for RHEL 6.7

Revision 6.7-1 Tue Jul 28 2015 Mark Flitter

Publishing for RHEL 6.7

Revision 6.6-2 Fri Apr 17 2015 Laura Bailey

Publishing for RHEL 6.7 Beta.

Revision 6.6-1 Tue Dec 16 2014 Laura Bailey

Updated metadata to aid doc presentation on the portal.

Revision 6.2-8 Thu Aug 18 2014 Laura Bailey

Combined two separate list items that were intended to be a single point.

Revision 6.2-7 Mon Aug 11 2014 Laura Bailey

Corrected the name of the replaced sysklogd package, BZ1088684.

Revision 6.2-6 Fri Aug 08 2014 Laura Bailey

Preparing document for release alongside RHEL 6.6 Beta.

Revision 6.2-5 Tue Jul 29 2014 Laura Bailey

Updated wording in libnl3/libnl parallel install section, BZ1092776.

Revision 6.2-4 Tue Jul 29 2014 Laura Bailey

Actually added sections on Preupgrade Assistant BZ1088147 and Red Hat Upgrade Tool BZ1087196.

Revision 6.2-3 Mon Jul 28 2014 Laura Bailey

Added details about rsyslog7 package and changes to rsyslog maintenance, BZ1088684.
Added information about the new libnl3 package, BZ1092776.

Revision 6.2-1 Wed Jun 11 2014 Laura Bailey

Added details about RSA and DSA key generation changes BZ1088154. Confirmed by tmraz.

Revision 6.2-0 Wed Jun 04 2014 Laura Bailey

Added section on Preupgrade Assistant BZ1088147.
Added section on Red Hat Upgrade Tool BZ1087196.

Revision 6.1-92 Wed May 27 2014 Laura Bailey

Corrected ABRT section in the System Monitoring and Kernel chapter BZ710098.

Revision 6.1-91 Mon May 19 2014 Laura Bailey

Added detail to ABRT section in the System Monitoring and Kernel chapter BZ710098.

Revision 6.1-89 Fri May 16 2014 Laura Bailey

Removed incorrect information about the update to Squid version 3.1 BZ1020649.
Added SCAP 1.2 certification of openscap BZ1092775.
Added and corrected details about OpenJDK8 Technology Preview BZ1088664.
Added ABRT section to the System Monitoring and Kernel chapter BZ710098.
Documented deprecated qpid packages BZ977643.

Revision 6.1-83 Wed Sep 18 2013 Laura Bailey

Noted LVS-sync interoperability issues between RHEL 6.4 and RHEL 6.5. BZ#1008708
Updated with SME feedback.

Revision 6.1-81 Thu Sep 05 2013 Laura Bailey

Applied final SME feedback for RHEL 6.5.

Revision 6.1-80 Tue Aug 13 2013 Laura Bailey

Applied SME feedback.
Applied QE feedback.

Revision 6.1-77 Fri Aug 09 2013 Laura Bailey

Applied SME feedback.
Noted new *redhat-support-lib-python* package (BZ#986093).
Noted new *redhat-support-tool* package (BZ#986106).
Noted change in NTP logging format (BZ#986774).

Revision 6.1-74 Thu Aug 01 2013 Laura Bailey

Tidied source code.
Added System Configuration chapter.
Noted change in SNMP configuration file access (BZ#977584).
Added details of ACPI CPU hotplug Technology Preview (BZ#970475).
Added details of driver support for PTP (BZ#970474).
Noted replacement of libatomic with gcc-libraries package (BZ#970441).

Revision 6.1-69 Wed Nov 21 2012 Scott Radvan

cryptoloop is deprecated.

Revision 6.1-68 Sun Oct 14 2012 Scott Radvan

Mention Samba 3.6 and link to Release Notes.

Revision 6.1-67 Mon Sep 10 2012 Scott Radvan

BZ#847907. Modify tape device limit.

Revision 6.1-66 Mon Sep 3 2012 Scott Radvan

Fix typo reported in BZ#853204

Revision 6.1-65 Mon Sep 3 2012 Scott Radvan

Include information about the dracut.conf.d configuration directory

Revision 6.1-64 Mon Aug 27 2012 Scott Radvan

Fix minor typos.

Revision 6.1-63 **Mon Aug 27 2012** **Scott Radvan**

add id tags throughout guide sections

Revision 6.1-62 **Mon Aug 27 2012** **Scott Radvan**

Add change of supported tape drives.

Revision 6.1-61 **Mon Jun 18 2012** **Scott Radvan**

Publish for 6.3 GA release.

Revision 6.1-59 **Fri Feb 17 2012** **Scott Radvan**

Drop fusecompress section as raised in BZ#791258.

Revision 6.1-58 **Mon Jan 16 2012** **Scott Radvan**

Fix minor typographical errors raised in BZ#664683.

Revision 6.1-57 **Mon Jan 16 2012** **Scott Radvan**

Note that joystick support is not provided in the default kernel. BZ#664683.

Revision 6.1-55 **Mon Nov 28 2011** **Scott Radvan**

Review for 6.2 release.

Revision 6.1-39 **Wed May 18 2011** **Scott Radvan**

Review for 6.1 release.