Red Hat Enterprise Linux 6

6.0 Release Notes

Release Notes for Red Hat Enterprise Linux 6

Edition 1

Red Hat Enterprise Linux 6 6.0 Release Notes

Release Notes for Red Hat Enterprise Linux 6
Edition 1

Martin Prpic

Legal Notice

Copyright © 2010 Red Hat.

Abstract

The Release Notes document the major features and enhancements implemented in the Red Hat Enterprise Linux 6 release.

Table of Contents

1. INTRODUCTION

Red Hat is pleased to announce the availability of Red Hat Enterprise Linux 6. Red Hat Enterprise Linux 6 is the next generation of Red Hat's comprehensive suite of operating systems, designed for mission-critical enterprise computing and certified by top enterprise software and hardware vendors.

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, systems and the overall Red Hat open source experience.

> **NOTE**
>
> This version of the Release Notes may contain outdated material. Refer to the Online Release Notes for a current overview of the new features contained in this release

2. INSTALLER

The Red Hat Enterprise Linux installer (also known as **anaconda**) assists in the installation of Red Hat Enterprise Linux 6. This section of the release notes provides an overview of the new features implemented in the installer for Red Hat Enterprise Linux 6.
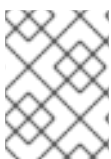
> **NOTE**
>
> The Red Hat Enterprise Linux 6 Installation Guide provides detailed documentation of the installer and the installation process.

2.1. Installation Methods

The installer provides three main interfaces to install Red Hat Enterprise Linux: *kickstart*, the *graphical installer* and the *text-based installer*.

2.1.1. Graphical Installer

The Red Hat Enterprise Linux graphical installer steps the user through the major steps involved in preparing a system for installation. The Red Hat Enterprise Linux 6 installation GUI introduces major usability enhancements for disk partitioning and storage configuration.

Early in the installation process, the user is now given the choice of *basic storage devices* or *specialized storage devices*. *Basic Storage Devices* typically do not need any additional configuration settings before the device is usable. A new interface has been implemented for configuring specialized storage

devices. Firmware RAID devices, Fibre Channel over Ethernet (FCoE) devices, multipath devices, and other storage area network (SAN) devices can now be easily configured using the new interface.
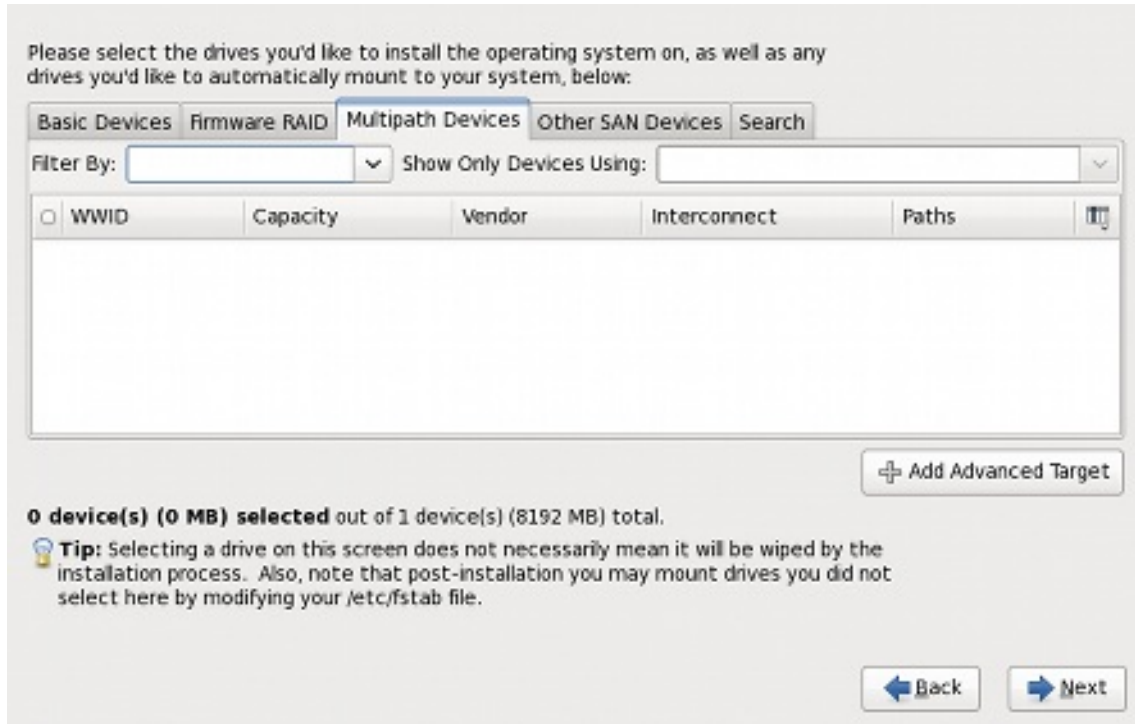
Figure 1. Specialized Storage Devices Configuration

The interface for choosing partitioning layouts has been enhanced, providing detailed descriptions and diagrams for each default partitioning layout
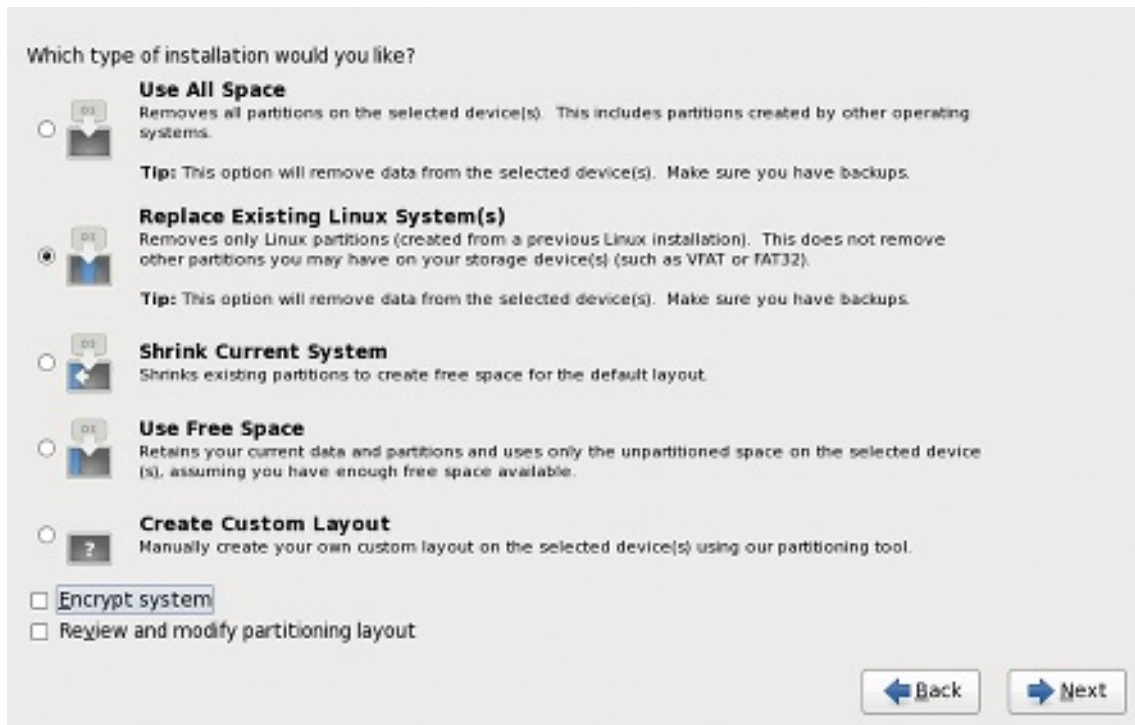
Figure 2. Partitioning layout choices

The Installer allows storage devices to be specified as either install target devices or data storage devices prior to installation.
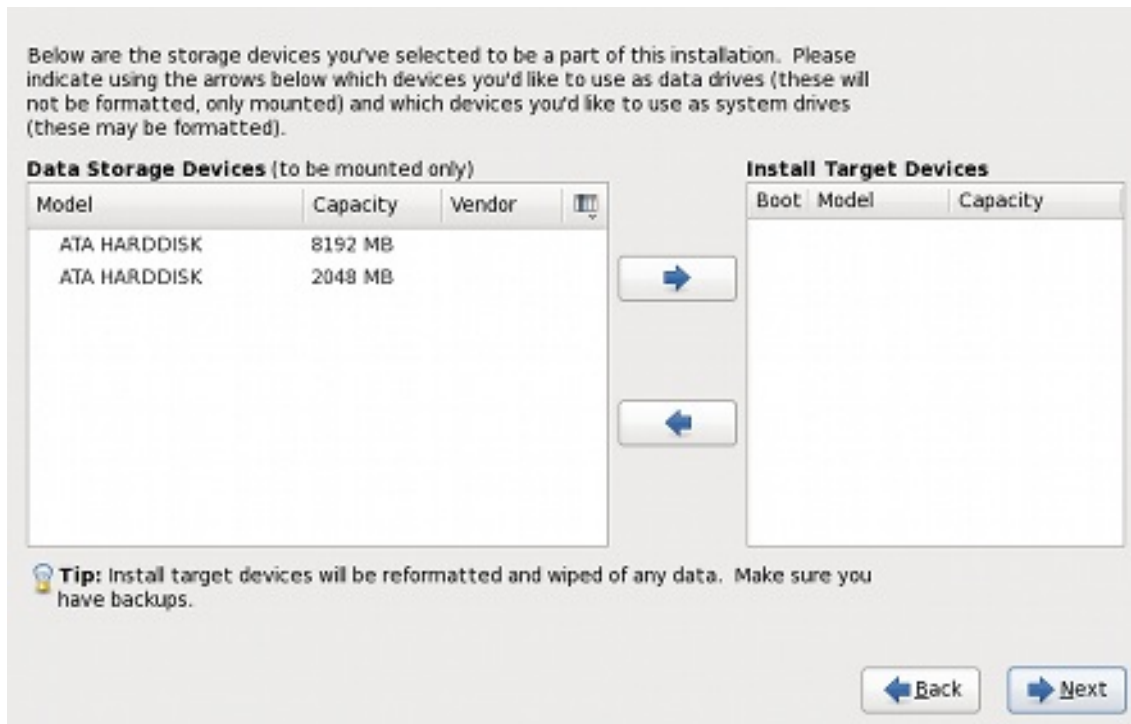
Figure 3. Specifying Storage Devices

2.1.2. Kickstart

Kickstart is an automated installation method that system administrators use to install Red Hat Enterprise Linux. Using kickstart, a single file is created, containing the answers to all the questions that would normally be asked during a typical installation.

Red Hat Enterprise Linux 6 introduces improvements to the validation of kickstart files, allowing the installer to capture issues with kickstart file syntax before an installation commences.

2.1.3. Text-based Installer

The text-based installer is provided primarily for systems with limited resources. The text-based installer has been simplified, permitting installation to the default disk layouts, and installation of new and updated packages.
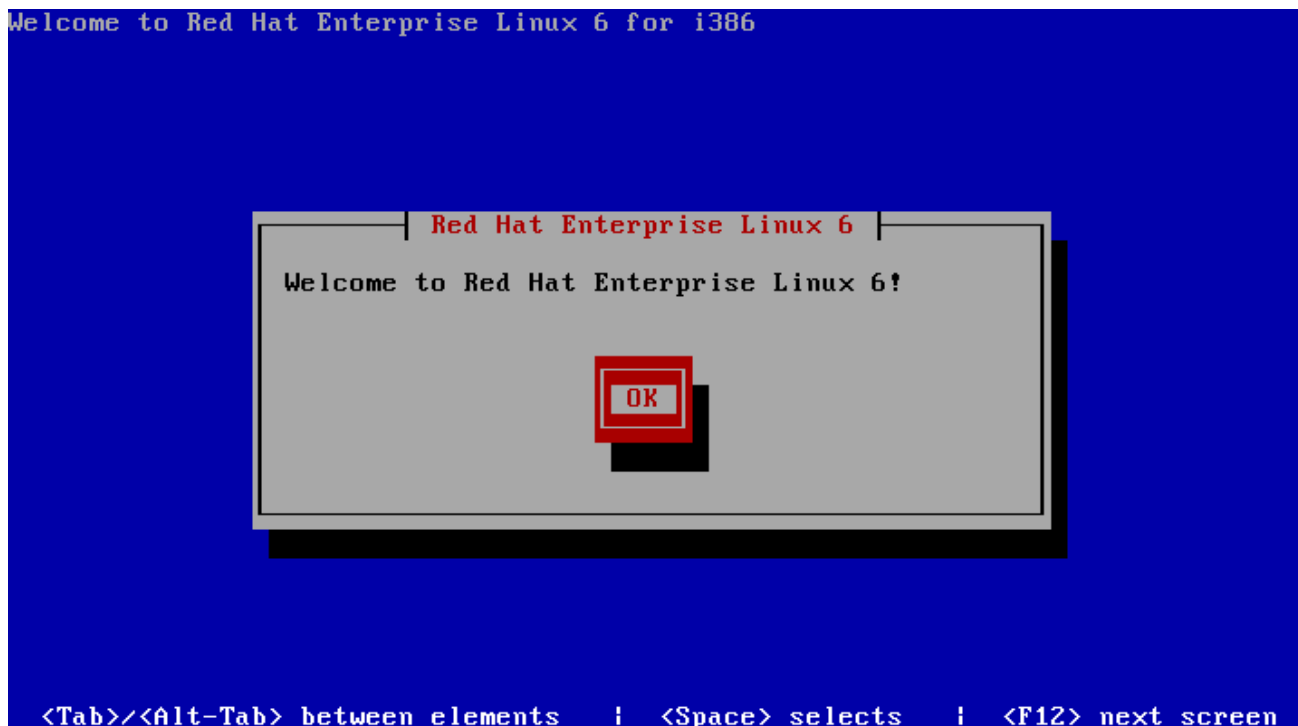
Figure 4. text-based installer

NOTE

Some installations require advanced installation options that are not present in the text-based installer. If the target system cannot run the graphical installer locally, use the Virtual Network Computing (VNC) display protocol to complete the installation.

2.2. Creating Backup Passphrases During Installation

The installer in Red Hat Enterprise Linux 6 provides the ability to save encryption keys and create backup passphrases for encrypted filesystems. This feature is discussed in futher detail in Section 8.3, "Backup Passphrases for Encrypted Storage Devices"

NOTE

Currently, creating backup passphrases for encrypted devices during installation can only be achieved during a kickstart installation. More information on this new feature, including how to utilize this feature in a kickstart installation of Red Hat Enterprise Linux 6, refer to the Disk Encryption appendix in the Installation Guide.

2.3. DVD Media Boot Catalog Entries

The DVD media for Red Hat Enterprise Linux 6 include boot catalog entries for both BIOS- and UEFI-based computers. This allows the media to boot systems based on either firmware interface. (UEFI is the Unified Extensible Firmware Interface, a standard software interface initially developed by Intel and now managed by the Unified EFI Forum. It is intended as a replacement for the older BIOS firmware.)

IMPORTANT

Some systems with very old BIOS implementations will not boot from media which include more than one boot catalog entry. Such systems will not boot from a Red Hat Enterprise Linux 6 DVD but may be bootable using a USB drive or over a network using PXE.

NOTE

UEFI and BIOS boot configurations differ significantly from each other and are not interchangeable. An installed instance of Red Hat Enterprise Linux 6 will not boot if the firmware it was configured for is changed. You cannot, for example, install the operating system on a BIOS-based system and then boot the installed instance on a UEFI-based system.

2.4. Installation Crash Reporting

Red Hat Enterprise Linux 6 features enhanced installation crash reporting in the installer. If the installer encounters an error during the installation process, details of the error are reported to the user.
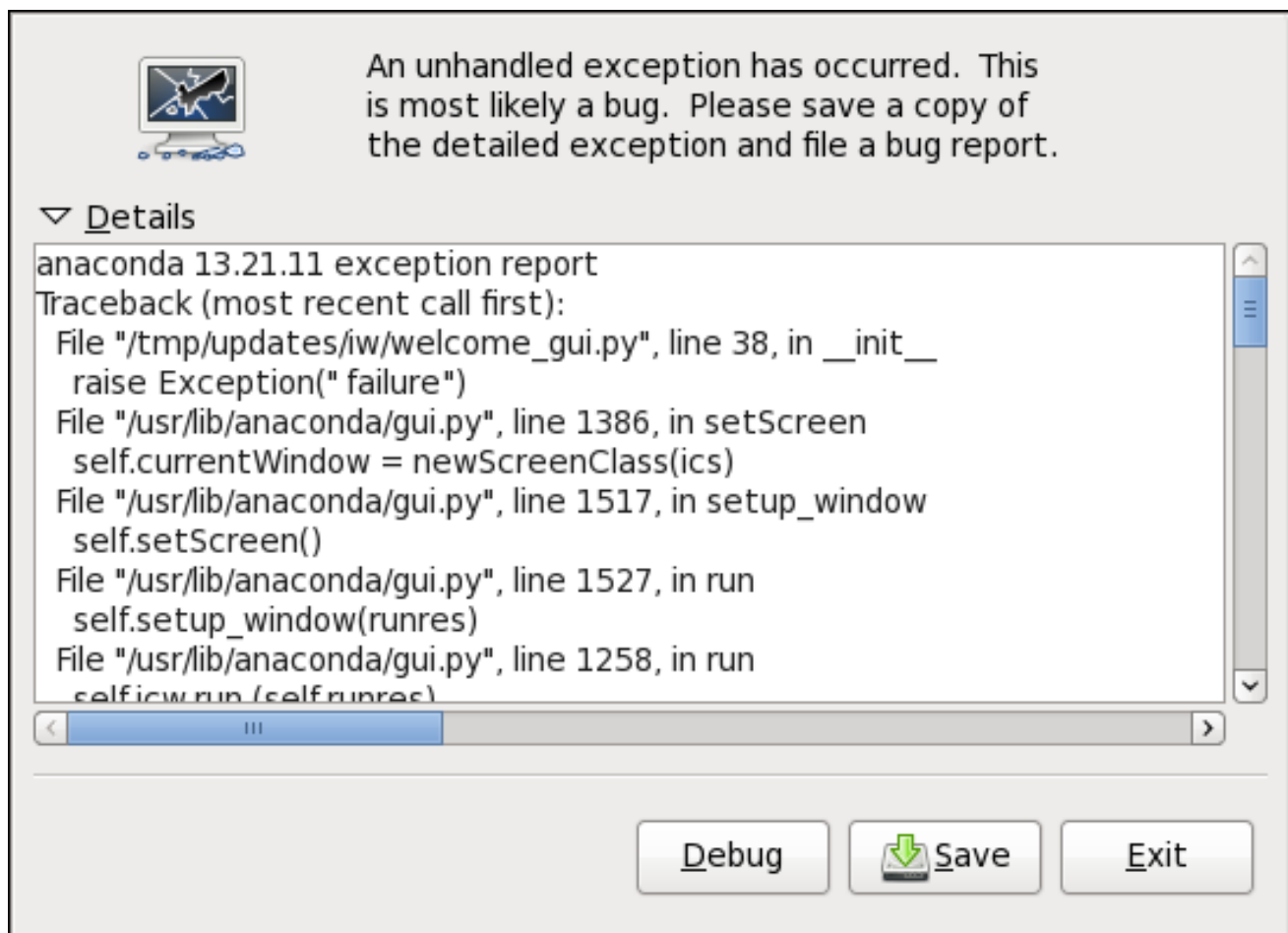
Figure 5. installation error reporting

The details of the error can be instantly reported to the Red Hat Bugzilla bug tracking website, or in cases where there is no internet connectivity, saved locally to disk.

Figure 6. Sending to Bugzilla

2.5. Installation Logs

To assist troubleshooting and debugging of installations, additional details are now included in log files produced by the installer. Further information on installation logs, and how to use them for troubleshooting can be found in the following sections of the Installation Guide.

- Troubleshooting Installation on an Intel or AMD System

- Troubleshooting Installation on an IBM POWER System

- Troubleshooting Installation on an IBM System z System

3. FILE SYSTEMS

NOTE

The Storage Administration Guide provides further instructions on how to effectively manage file systems on Red Hat Enterprise Linux 6. Additionally, the Global File System 2 document details specific information on configuring and maintaining Red Hat Global File System 2 for Red Hat Enterprise Linux 6.

3.1. Fourth Extended Filesystem (ext4) Support

The fourth extended filesystem (ext4) is based on the third extended filesystem (ext3) and features a number of improvements. These include support for larger file systems and larger files, faster and more efficient allocation of disk space, no limit on the number of subdirectories within a directory, faster file system checking, and more robust journaling. The ext4 file system is selected by default and is highly recommended.

3.2. XFS

XFS is a highly scalable, high-performance file system which was originally designed at Silicon Graphics, Inc. It was created to support filesystems up to 16 exabytes (approximately 16 million terabytes), files up to 8 exabytes (approximately 8 million terabytes) and directory structures containing tens of millions of entries.

XFS supports metadata journaling, which facilitates quicker crash recovery. The XFS file systems can also be defragmented and expanded while mounted and active.

3.3. Block Discard — enhanced support for thinly provisioned LUNs and SSD devices

Filesystems in Red Hat Enterprise Linux 6 use the new block discard feature to allows a storage device to be informed when the filesystem detects that portions of a device (also known as blocks) are no longer in active use. While few storage devices feature block discard capabilities, newer solid state drives (SSDs) utilize this feature to optimize internal data layout and invoke proactive wear levelling. Additionally, some high end SCSI devices use block discard information to help implement thinly provisioned LUNs.

3.4. Network File System (NFS)

A Network File System (NFS) allows remote hosts to mount file systems over a network and interact with those file systems as though they were mounted locally. This enables system administrators to consolidate resources onto centralized servers on the network. Red Hat Enterprise Linux 6 supports NFSv2, NFSv3, and NFSv4 clients. Mounting a file system via NFS now defaults to NFSv4.

Additional improvements have been made to the NFS in Red Hat Enterprise Linux 6, providing enhanced support over Internet Protocol version 6 (IPv6)

4. STORAGE

4.1. Storage Input/Output Alignment and Size

Recent enhancements to the SCSI and ATA standards allow storage devices to indicate their preferred (and in some cases, required) I/O alignment and I/O size. This information is particularly useful with newer disk drives that increase the physical sector size from 512 byes to 4K bytes. This information may also be beneficial for RAID devices, where the chunk size and stripe size may impact performance.

The Red Hat Enterprise Linux 6 provides the ability to read and utilize this information, and optimize how data is read and written from storage devices.

NOTE

The Storage Administation Guide features a chapter that covers I/O Limits in further detail.

4.2. Dynamic Load Balancing with DM-Multipath

Device Mapper Multipathing (DM-Multipath) creates a single conceptual device from the multiple cables, switches and controllers that connect servers to storage arrays. This enables centralized management of connection devices (also known as paths) and makes it possible to balance loads over all available paths.

DM-Multipath in Red Hat Enterprise Linux 6 introduces two new options when dynamically balancing load over paths. Paths can now be dynamically selected depending on either the queue size of each path or previous I/O time data.

> **NOTE**
>
> The DM Multipath book provides information on using the Device-Mapper Multipath feature of Red Hat Enterprise Linux 6.

4.3. Logical Volume Manager (LVM)

Volume management creates a layer of abstraction over physical storage by creating logical storage volumes. This provides greater flexibility over just using physical storage directly. Red Hat Enterprise Linux 6 manages logical volumes using the Logical Volume Manager (LVM).

> **IMPORTANT**
>
> `system-config-lvm` is a graphical user interface provided in Red Hat Enterprise Linux to manage logical volumes. The functionality provided by `system-config-lvm` is in the process of transitioning to a more maintainable tool named `gnome-disk-utility` (also referred to as `palimpsest`). As a result, Red Hat will be very selective in updating `system-config-lvm`. As `gnome-disk-utility` reaches feature parity with `system-config-lvm`, Red Hat reserves the right to remove `system-config-lvm` during the life of Red Hat Enterprise Linux 6.

> **NOTE**
>
> The Logical Volume Manager Administration document describes the LVM logical volume manager, including information on running LVM in a clustered environment.

4.3.1. LVM Mirror Improvements

LVM supports mirrored volumes. By creating mirrored logical volumes, LVM ensures that data written to an underlying physical volume is mirrored onto a separate physical volume.

4.3.1.1. Snapshots of Mirrors

The LVM snapshot feature provides the ability to create backup images of a logical volume at a particular instant without causing a service interruption. When a change is made to the original device (the origin) after a snapshot is taken, the snapshot feature makes a copy of the changed data area as it was prior to the change so that it can reconstruct the state of the device. Red Hat Enterprise Linux 6 introduces the ability to take a snapshot of a mirrored logical volume.

4.3.1.2. Merging Snapshots

Red Hat Enterprise Linux 6 introduces the ability to merge a snapshot of a logical volume back into the origin logical volume. This allows system administrators to revert any changes that have occurred on a logical volume by merging back to the point preserved by a snapshot.

For more information about the new snapshot merge feature, consult the `lvconvert` manpage.

4.3.1.3. Four-Volume Mirrors

LVM in Red Hat Enterprise Linux 6 supports creating a logical volume with up to four mirrors.

4.3.1.4. Mirroring mirror logs

LVM maintains a small log (on a separate device) which it uses to keep track of which regions are in sync with the mirror or mirrors. Red Hat Enterprise Linux 6 provides the ability to mirror this log device.

4.3.2. LVM Application Library

Red Hat Enterprise Linux 6 features the new LVM Application Library (lvm2app), allowing the development of LVM based storage management applications.

5. POWER MANAGEMENT

> **NOTE**
>
> The Power Management Guide provides information on effectively managing power consumption on Red Hat Enterprise Linux 6.

5.1. powertop

The introduction of the tickless kernel in Red Hat Enterprise Linux 6 (refer to Section 12.4.2, "Tickless Kernel") allows the CPU to enter the idle state more frequently, reducing power consumption and improving power management. The new **powertop** tool provides the ability to identify specific components of kernel and userspace applications that frequently wake up the CPU. **powertop** was used in development to identify and tune many applications in this release, reducing unnecessary CPU wake up by a factor of 10.

5.2. tuned

tuned is a system tuning daemon that monitors system components and dynamically tunes system settings. Utilizing **ktune** (the static mechanism for system tuning), **tuned** can monitor and tune devices (e.g. hard disk drives and ethernet devices). Red Hat Enterprise Linux 6 also introduces **diskdevstat** for monitoring disk operations and **netdevstat** for monitoring network operations.

6. PACKAGE MANAGEMENT

6.1. Strong package checksums

RPM provides support for signed packages using strong hash algorithms such as SHA-256 in order to ensure package integrity and increase security. Red Hat Enterprise Linux 6 packages are transparently compressed with the XZ lossless compression library, which implements the LZMA2 compression algorithm for greater compression (thus reducing package size) and speedier unpacking (when installing RPMs). Further information on the stronger package checksums is available in the Deployment Guide

6.2. The PackageKit Package Manager

Red Hat provides PackageKit for viewing, managing, updating, installing and uninstalling packages and package groups compatible with your system, and enabled in Yum repositories. PackageKit consists of several graphical interfaces that can be opened from the GNOME panel menu, or from the Notification Area, when PackageKit alerts you that updates are available. Additionally, PackageKit allows for quick repository enablement and disablement, a graphical and searchable transaction log, and PolicyKit integration. Futher information on Package Kit is available in the Deployment Guide

6.3. Yum

Via its plugin architecture, Yum provides new or enhanced support for various capabilities such as delta RPMs (using the presto plugin), RHN communication (rhnplugin), and auditing and applying—using a calculated least-invasive (minimal) number of updates—only relevant security fixes to a system (security plugin).

Yum also ships with the yum-config-manager utility, which shows exhaustive information about all set configuration options and parameters for each individual repository. Further information on updates to Yum is available in the Deployment Guide

7. CLUSTERING

Clusters are multiple computers (nodes) working in concert to increase reliability, scalability, and availability to critical production services. High Availability using Red Hat Enterprise Linux 6 can be deployed in a variety of configurations to suit varying needs for performance, high-availability, load balancing, and file sharing.

NOTE

The Cluster Suite Overview document provides an overview of Red Hat Cluster Suite for Red Hat Enterprise Linux 6. Additionally, the High Availability Administration document describes the configuration and management of Red Hat cluster systems for Red Hat Enterprise Linux 6.

7.1. Corosync Cluster Engine

Red Hat Enterprise Linux 6 utilizes the Corosync Cluster Engine for core cluster functionality.

7.2. Unified Logging Configuration

The various daemons that High Availability employs now utilize a shared unified logging configuration. This allows system administrators to enable, capture and read cluster system logs via a single command in the cluster configuration.

7.3. High Availability Administration

Conga is an integrated set of software components that provides centralized configuration and management for Red Hat Enterprise Linux High Availability. One of the primary components of Conga is luci, a server that runs on one computer and communicates with multiple clusters and computers. In Red Hat Enterprise Linux 6 the web interface that is used to interact with luci has been redesigned.

7.4. General High Availability Improvements

In addition to the features and improvements detailed above, the following features and enhancements to clustering have been implemented for Red Hat Enterprise Linux 6.

- Enhanced support for Internet Protocol version 6 (IPv6)

- SCSI persistent reservation fencing support is improved.

- Virtualized KVM guests can now be run as managed services.

8. SECURITY

> **NOTE**
>
> The Security Guide assists users and administrators in learning the processes and practices of securing workstations and servers against local and remote intrusion, exploitation and malicious activity.

8.1. System Security Services Daemon (SSSD)

The System Security Services Daemon (SSSD) is a new feature in Red Hat Enterprise Linux 6 that implements a set of services for central management of identity and authentication. Centralizing identity and authentication services enables local caching of identities, allowing users to still identify in cases where the connection to the server is interrupted. SSSD supports many types of identity and authentication services, including: Red Hat Directory Server, Active Directory, OpenLDAP, 389, Kerberos and LDAP.

> **NOTE**
>
> The Deployment Guide contains a section that describes how to install and configure the System Security Services Daemon (SSSD), and how to use the features that it provides.

8.2. Security-Enhanced Linux (SELinux)

Security-Enhanced Linux (SELinux) adds Mandatory Access Control (MAC) to the Linux kernel, and is enabled by default in Red Hat Enterprise Linux 6. A general purpose MAC architecture needs the ability to enforce an administratively-set security policy over all processes and files in the system, basing decisions on labels containing a variety of security-relevant information.

8.2.1. Confined Users

Traditionally, SELinux is used to define and control how an application interacts with the system. SELinux in Red Hat Enterprise Linux 6 introduces a set of policies that allows system administrators to control what particular users can access on a system.

8.2.2. Sandbox

SELinux in Red Hat Enterprise Linux 6 features the new security sandbox feature. The security sandbox adds a set of SELinux policies that enables a system administrator to run any application within a tightly confined SELinux domain. Using the sandbox, system administrators can test the processing of untrusted content without damaging the system.

8.2.3. X Access Control Extension (XACE)

The X Window System (commonly refered to a "X") provides the base framework for displaying the graphical user interface (GUI) on Red Hat Enterprise Linux 6. This release features the new X Access Control Extension (XACE), which permits SELinux to access decisions made within X, specifically, controlling information flow between window objects.

8.3. Backup Passphrases for Encrypted Storage Devices

Red Hat Enterprise Linux provides the ability to encrypt the data on storage devices, assisting in the prevention of unauthorized access of the data. Encryption is achieved by transforming the data into a

format that can only be read using a specific encryption key. This key — which is created during the installation process, and protected by a passphrase — is the only way to decrypt the encrypted data.

Figure 7. Decrypting Data

However, if the passphrase is misplaced, the encryption key cannot be used, and data on the encrypted storage device cannot be accessed.

Red Hat Enterprise Linux 6 provides the ability to save encryption keys and create backup passphrases. This feature allows for the recovery of an encrypted volume (including the root device) even when the original passphrase is misplaced.

8.4. sVirt

libvirt is a C language application programming interface (API) for managing and interacting with the virtualization capabilities of Red Hat Enterprise Linux 6. In this release, libvirt features the new sVirt component. sVirt integrates with SELinux, providing security mechanisms to prevent unauthorized access of guests and hosts in a virtualized environment.

8.5. Enterprise Security Client

The Enterprise Security Client (ESC) is a simple GUI that allows Red Hat Enterprise Linux to manage smart cards and tokens. New smart cards can be formatted and enrolled, meaning that new keys are generated and certificates requested for the smart card automatically. The smart card lifecycle can be managed, as well, so that lost smart cards can have their certificates revoked and expired certificates can be renewed. The ESC works in conjunction with a larger public-key infrastructure management product, either Red Hat Certificate System or Dogtag PKI.

9. NETWORKING

9.1. Multiqueue Networking

Every data packet transferred over a network device represents processing which must be completed by a CPU. The low-level network implementation in Red Hat Enterprise Linux 6 allows network device drivers to divide network packet processing across multiple queues. Dividing these processes allows a system to better utilize the multiple processors and CPU cores present on modern systems.

9.2. Internet Protocol version 6 (IPv6)

The next-generation Internet Protocol version 6 (IPv6) specification is designed as the successor to Internet Protocol version 4 (IPv4). IPv6 specifies a wide range of improvements over IPv4, including: expanded addressing capabilites, flow labeling and simplified header formats.

9.2.1. Optimistic Duplicate Address Detection

Duplicate Address Detection (DAD) is a feature of the Neighbor Discovery Protocol portion of IPv6. Specifically, DAD is tasked with checking if an IPv6 address is already being used. Red Hat Enterprise Linux features Optimistic Duplicate Address Detection, a speed optimization of DAD.

9.2.2. Intra-Site Automatic Tunnel Addressing Protocol

Red Hat Enterprise Linux 6 features support for the Intra-Site Automatic Tunnel Addressing Protocol (ISATAP). ISATAP is a protocol designed to assist in the transition from IPv4 to IPv6, by providing a mechanism to connect IPv6 routers and hosts over IPv4 network infrastructure.

9.3. Netlabel

Netlabel is a new kernel-level feature in Red Hat Enterprise Linux 6 that provides network packet labeling services for Linux Security Modules (LSMs). Labeling data packets using netlabel allows an LSM to better enforce security requirements on incoming network packets.

9.4. Generic Receive Offload

The low-level network implementation in Red Hat Enterprise Linux 6 features Generic Receive Offload (GRO) support. The GRO system increases the performance of inbound network connections by reducing the amount of processing done by the CPU. GRO implements the same technique as the Large Receive Offload (LRO) system, but can be applied to a wider range of transport layer protocols.

9.5. Wireless Support

Red Hat Enterprise Linux 6 contains enhanced support for wireless networking and devices. Support for the wireless local area networking using the IEEE 802.11 set of standards has been improved, with added support for 802.11n based wireless networking.

10. DESKTOP

10.1. Graphical Startup

Red Hat Enterprise Linux 6 introduces a new, seamless graphical boot sequence that commences immediately after the hardware has initialized.

Figure 8. Graphical Boot Screen

The new graphical boot sequence provides the user with simple visual feedback on the progress of the system boot, and seamlessly switches to the login screen. The Red Hat Enterprise Linux 6 graphical boot sequence is enabled by the Kernel Modesetting feature and is available on ATI, Intel and NVIDIA graphics hardware.

NOTE

System Administrators are still able to view detailed progress of the boot sequence by pressing the F11 key at any time during the graphical boot.

10.2. Suspend and Resume

Suspend and resume is a current feature in Red Hat Enterprise Linux that allows a machine to be placed into and removed from a low power state. The new kernel modesetting feature enables enhanced support for the suspend and resume feature. Previously, graphics hardware was suspended and resumed via userspace applications. In Red Hat Enterprise Linux 6, this functionality has moved into the kernel, providing a more reliable mechanism for enabling low power mode.

10.3. Multiple Display Support

Red Hat Enterprise Linux 6 features enhanced support for workstations with multiple displays. When an additional display is attached to a machine, the graphics driver detects it and automatically adds it to the desktop. Conversely, when a display is unplugged, the graphics driver automatically removes it from the desktop.

NOTE

By default, the additional display is added in a spanning layout to the left of the current display.

The automatic detection of additional displays is useful in situations where displays are added and removed frequently (e.g. setting up a laptop with an external projector)

10.3.1. Display Preferences

The new Display Preferences dialog provides the ability to further customize multiple display layouts.
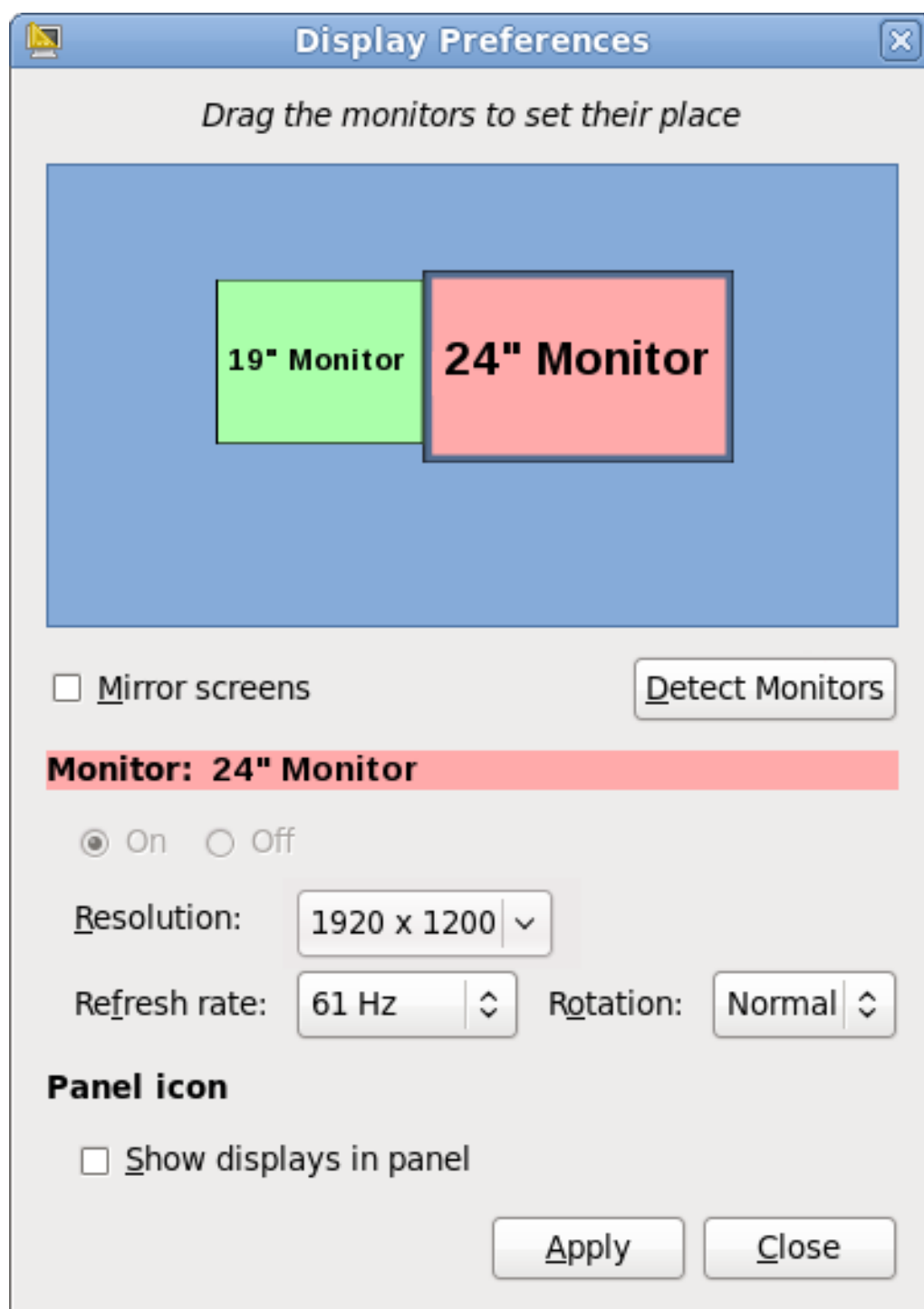
Figure 9. Display Preferences dialog

The new dialog provides the ability to instantly change the positioning, resolution, refresh rate and rotation settings for each individual display that is currently attached to a machine.

10.4. nouveau Driver for NVIDIA Graphics Devices

Red Hat Enterprise Linux 6 features the new nouveau driver as default for NVIDIA graphics devices up to and including the NVIDIA GeForce 200 series. nouveau supports 2D and software video acceleration and kernel modesetting.

> **NOTE**
>
> The previous default driver for NVIDIA hardware (nv) is still available in Red Hat Enterprise Linux 6.

10.5. Internationalization

10.5.1. IBus

Red Hat Enterprise Linux 6 introduces the Intelligent Input Bus (IBus) as the default input method framework for Asian languages.

10.5.2. Choosing and Configuring Input Methods

Red Hat Enterprise Linux 6 includes `im-chooser`, a graphical user interface to enable and configure input methods. im-chooser (located under `System > Preferences > Input Method` in the main menu) allows the user to easily enable and configure the input methods available on the system.

10.5.3. Indic Onscreen Keyboard

The new Indic Onscreen Keyboard (iok) is a screen based virtual keyboard for Indic languages, enabling input using Inscript keymap layouts and other 1:1 key mappings.

10.5.4. Indic Collation Support

Red Hat Enterprise Linux 6 includes improved sorting for Indic languages. The order of menus and other interface elements are now correctly sorted in Indic languages.

10.5.5. Fonts

Font support in Red Hat Enterprise Linux 6 has been improved, with updates to fonts for Chinese, Japanese, Korean, Indic and Thai languages.

10.6. Applications

The majority of applications on the Red Hat Enterprise Linux 6 desktop have been updated. The following section documents the most notable updates.

10.6.1. Firefox

Red Hat Enterprise Linux 6 introduces version 3.5 of the Mozilla Firefox web browser.

For details on the new features in Firefox, refer to the Firefox Release Notes

10.6.2. Thunderbird 3

Red Hat Enterprise Linux 6 includes version 3 of the Mozilla Thunderbird email client, providing tabbed messaging, smart folders, and a message archive. For further details on new features in Thunderbird 3, refer to the Thunderbird Release Notes

10.6.3. OpenOffice.org 3.1

Red Hat Enterprise Linux 6 features OpenOffice.org 3.1, adding support for reading a wider range of file formats, including Microsoft Office OOXML format. Additionally, OpenOffice.org has improved file locking support and has the ability to render graphics using anti-aliasing.
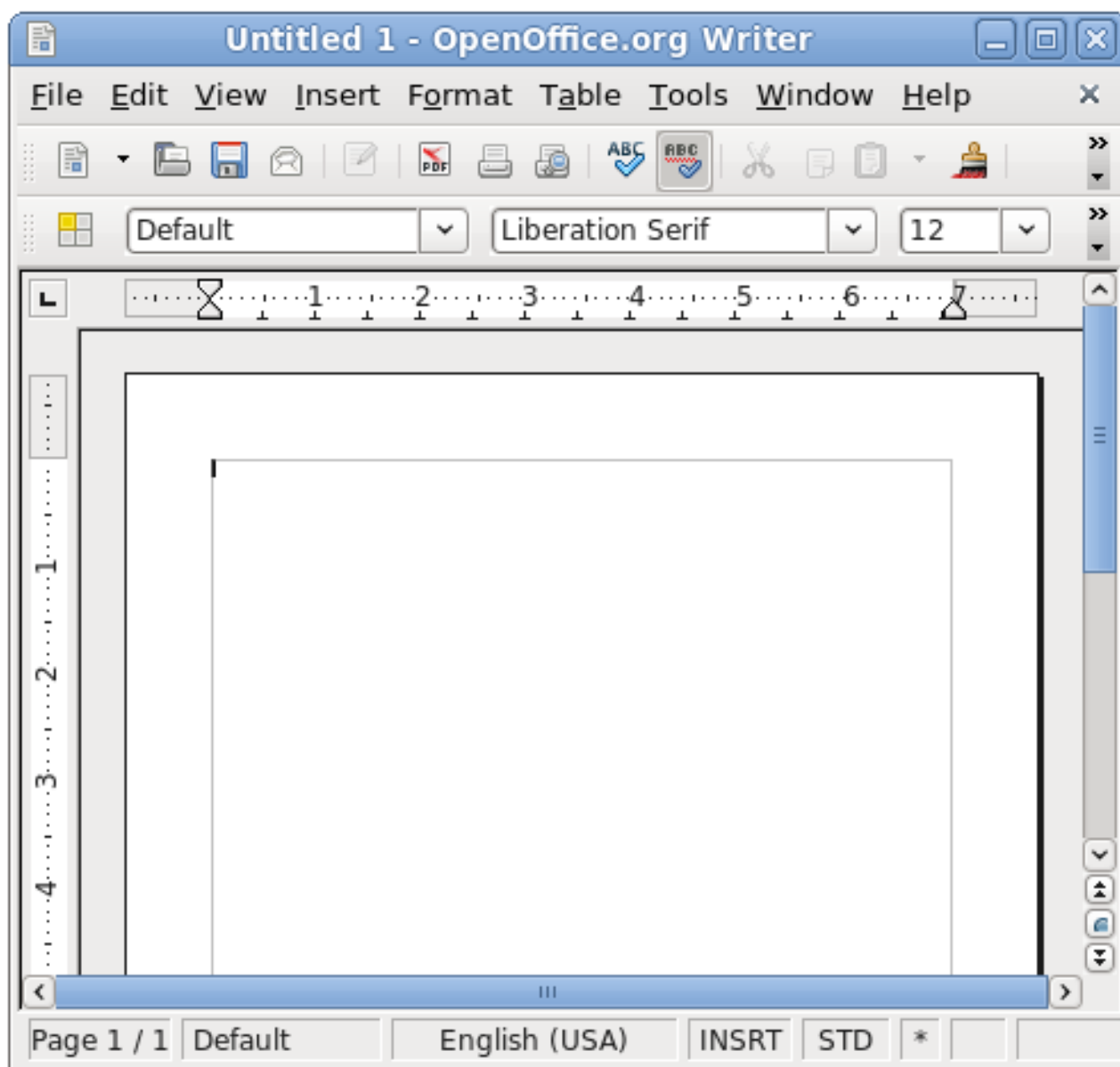
Figure 10. OpenOffice.org 3.1

Full details on all the features in this version of OpenOffice.org are available in the OpenOffice.org Release Notes .

10.7. NetworkManager

NetworkManager is the desktop tool that is used to set up, configure and manage a wide range of network connection types.
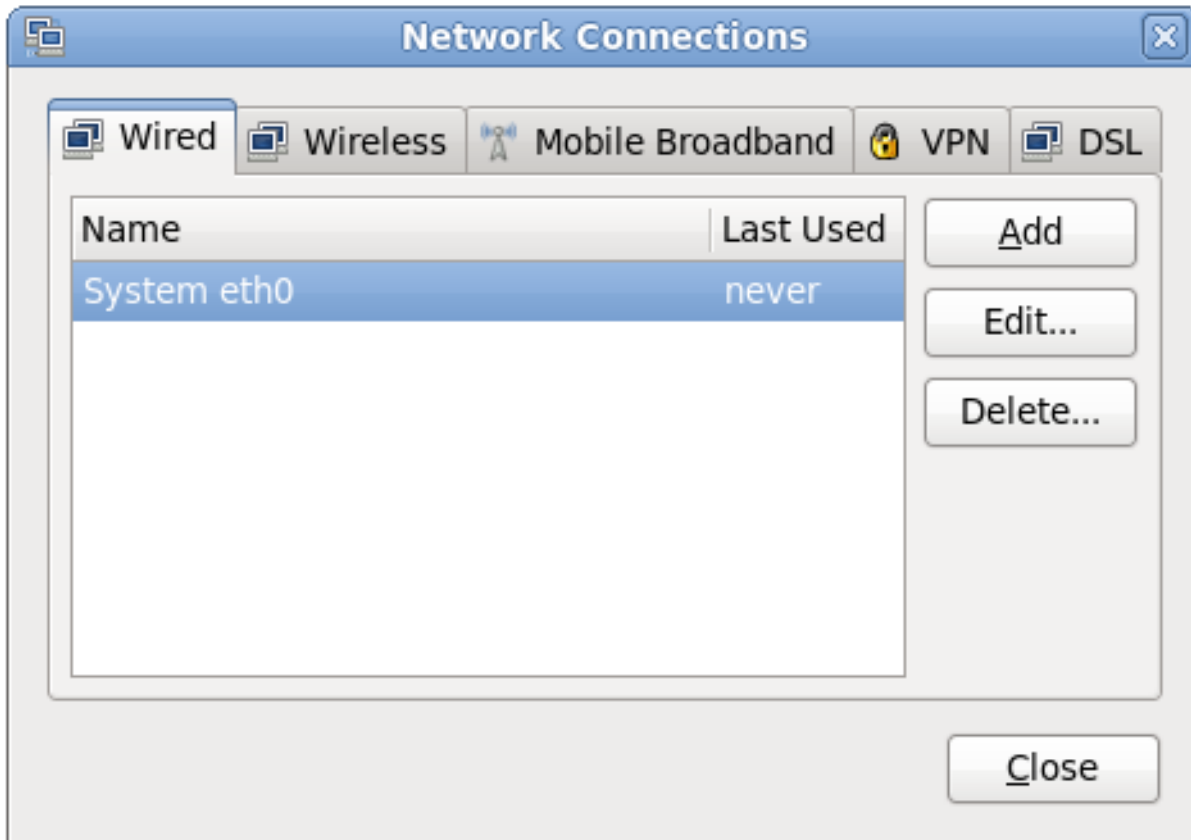
Figure 11. NetworkManager

In Red Hat Enterprise Linux 6, NetworkManager provides enhanced support for Mobile Broadband devices, IPv6 and added support for connecting to Bluetooth Personal Area Network (PAN) devices.

10.8. KDE 4.3

Red Hat Enterprise Linux 6 provides KDE 4.3 as an alternative desktop enviroment.

KDE 4.3 features an entirely new user experience, featuring:

- The new Plasma Desktop Workspace, including Plasma Widgets for a more customizable desktop.

- Oxygen, with enhanced icon and sound themes.

- Enhancements to the KDE Window Manager (kwin)

Additionally, the `dolphin` file browser has replaced `konqueror` as the KDE default.

11. DOCUMENTATION

Documentation for Red Hat Enterprise Linux 6 is comprised of 18 separate documents. Each of these documents belongs to one or more of the following subject areas:

- Release Documentation

- Installation and Deployment

- Security

- Tools and Performance

- Clustering

- Virtualization

11.1. Release Documentation

Release Notes

The Release Notes document the major new features in Red Hat Enterprise Linux 6.

Technical Notes

The Red Hat Enterprise Linux Technical Notes contains detailed information specific to this release, including: Technology Previews, package change details and known issues.

Migration Guide

The Red Hat Enterprise Linux Migration Guide documents migration from Red Hat Enterprise Linux 5 to Red Hat Enterprise Linux 6.

11.2. Installation and Deployment

Installation Guide

The Installation Guide documents relevant information regarding the installation of Red Hat Enterprise Linux 6

Deployment Guide

The Deployment Guide documents relevant information regarding the deployment, configuration and administration of Red Hat Enterprise Linux 6.

Storage Administration Guide

The Storage Administration Guide provides instructions on how to effectively manage storage devices and file systems on Red Hat Enterprise Linux 6. It is intended for use by system administrators with intermediate experience in either Red Hat Enterprise Linux or Fedora distributions of Linux.

Global File System 2

The Global File System 2 book provides information about configuring and maintaining Red Hat GFS2 (Red Hat Global File System 2) for Red Hat Enterprise Linux 6.

Logical Volume Manager Administration

The Logical Volume Manager Administration book describes the LVM logical volume manager, including information on running LVM in a clustered environment.

11.3. Security

Security Guide

The Security Guide is designed to assist users and administrators in learning the processes and practices of securing workstations and servers against local and remote intrusion, exploitation and malicious activity.

SELinux User Guide

The SELinux User Guide covers the management and use of Security-Enhanced Linux for those with minimal or no experience with the framework. It serves as an introduction to SELinux and explains the terms and concepts in use.

Managing Confined Services

The Managing Confined Services guide is designed to assist advanced users and administrators when using and configuring Security-Enhanced Linux (SELinux). It is focused on Red Hat Enterprise Linux and describes the components of SELinux as they pertain to services an advanced user or administrator might need to configure. Also included are real-world examples of configuring these services and demonstrations of how SELinux complements their operation.

11.4. Tools & Performance

Resource Management Guide

The Resource Management Guide documents tools and techniques for managing system resources on Red Hat Enterprise Linux 6.

Power Management Guide

The Power Management Guide explains how to manage power consumption on Red Hat Enterprise Linux 6 systems effectively. This document discusses different techniques that lower power consumption (for both server and laptop), and how each technique affects the overall performance of a system.

Developer Guide

The Developer Guide describes the different features and utilities that make Red Hat Enterprise Linux 6 an ideal enterprise platform for application development.

SystemTap Beginners Guide

The SystemTap Beginners Guide provides basic instructions on how to use SystemTap to monitor different subsystems of Red Hat Enterprise Linux in finer detail.

SystemTap Tapset Reference

The SystemTap Tapset Reference guide describes the most common tapset definitions users can apply to SystemTap scripts.

11.5. High Availability

Cluster Suite Overview

The Cluster Suite Overview document provides an overview of High Availability for Red Hat Enterprise Linux 6.

High Availability Administration

The High Availability Administration document describes the configuration and management of Red Hat High Availability systems for Red Hat Enterprise Linux 6.

Virtual Server Administration

The Virtual Server Administration book discusses the configuration of high-performance systems and services with Red Hat Enterprise Linux 6 and the Linux Virtual Server (LVS) system.

DM Multipath

The DM Multipath book provides information on using the Device-Mapper Multipath feature of Red Hat Enterprise Linux 6.

11.6. Virtualization

Virtualization Guide

The Virtualization Guide details the process to install, configure and manage the virtualization technologies in Red Hat Enterprise Linux 6.

12. KERNEL

12.1. Resource Control

12.1.1. Control Groups

Control groups are a new feature of the Linux kernel in Red Hat Enterprise Linux 6. Each control group is a set of tasks on a system that have been grouped together to better manage their interaction with system hardware. Control groups can be tracked to monitor the system resources that they use. Additionally, system administrators can use control group infrastructure to allow or to deny specific control groups access to system resources such as memory, CPUs (or groups of CPUs), networking, I/O, or the scheduler. Management of control groups in userspace is provided by `libcgroup`, enabling system administrators to create new control groups, start new processes in a specific control group and set control group parameters.
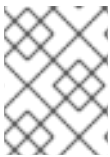
> **NOTE**
>
> Control Groups and other resource management features are discussed in detail in the Red Hat Enterprise Linux 6 Resource Management Guide

12.2. Scalability

12.2.1. Completely Fair Scheduler (CFS)

A process (or task) scheduler is a specific kernel subsystem that is responsible for assigning the order in which processes are sent to the CPU. The kernel (version 2.6.32) shipped in Red Hat Enterprise Linux 6 replaces the `O(1)` scheduler with the new **Completely Fair Scheduler (CFS)**. The CFS implements the *fair queuing* scheduling algorithm.

12.2.2. Virtual Memory Pageout Scalability

Implemented by the kernel, virtual memory presents applications with a single, contiguous block of memory addresses. The reality underlying this presentation is complex, with actual physical addresses commonly fragmented and even paged out to much slower devices such as fixed disks. The virtual memory addresses are organized by the kernel into standard units called pages. The kernel in Red Hat Enterprise Linux 6 features enhanced management of virtual memory pages, reducing the processing load required on systems with large amounts of physical memory.

12.3. Error Reporting

12.3.1. Advanced Error Reporting (AER)

The kernel in Red Hat Enterprise Linux 6 features Advanced Error Reporting (AER). AER is a new kernel feature that provides enhanced error reporting for PCI-Express devices.

12.3.2. Kdump Auto Enablement

Kdump is now enabled by default on systems with large amounts of memory. Specifically, kdump is enabled by default on:

- systems with more than 4GB of memory on architectures with a 4KB page size (i.e. x86 or x86_64), or

- systems with more than 8GB of memory on architectures with larger than a 4KB page size (i.e PPC64).

12.4. Power Management

12.4.1. Aggressive Link Power Management (ALPM)

The kernel in Red Hat Enterprise Linux 6 features support for Aggressive Link Power Management (ALPM). ALPM is a power-saving technique that helps the disk save power by setting a SATA link to the disk to a low-power setting during idle time (i.e. when there is no I/O). ALPM automatically sets the SATA link back to an active power state once I/O requests are queued to that link.

12.4.2. Tickless Kernel

Previously the kernel implemented a timer that periodically queried the system to check if there were any outstanding tasks to process. Consequently, the CPU would remain in an active state, consuming unnecessary power. The kernel in Red Hat Enterprise Linux 6 enables the new tickless kernel feature, replacing the periodic timer interrupts with on-demand interrupts. The tickless kernel allows a CPU to enter longer sleep states when idle, and wake only when a task is queued for processing.

12.5. Analyzing Kernel Performance

12.5.1. Performance Counter for Linux (PCL)

The Linux Performance Counter infrastructure provides an abstraction of performance counter hardware capabilities, such as instructions executed, cache misses, and branches mis-predicted. PCL provides per-task and per-CPU counters, and adds event capabilities on top of these counters. Performance counter information can be used to profile kernel functions and events, and assist in the analysis of kernel performance issues.

12.5.2. Ftrace and perf

Two new tools are available in Red Hat Enterprise Linux 6 to assist in analyzing kernel performance. Ftrace provides call graph style tracing for the kernel. The new perf tool monitors, logs and analyzes system hardware events.

12.6. General Kernel Updates

12.6.1. Physical Address Extension (PAE)

The Physical Address Extension (PAE) is a feature implemented in modern x86 processors. PAE extends memory addressing capabilities, allowing more than 4 gigabytes (GB) of random access

memory (RAM) to be used. The default kernel shipped with the x86 architecture version of Red Hat Enterprise Linux 6 is PAE enabled. A PAE enabled processor is a minimum requirement for the x86 variant of Red Hat Enterprise Linux 6.

12.6.2. Loadable Firmware Files

Firmware files for which there is no appropriately licensed source code have been removed from the Red Hat Enterprise Linux 6 kernel. Modules that require loadable firmware now use a kernel interface to request firmware from userspace.

13. COMPILER AND TOOLS

13.1. SystemTap

SystemTap is a tracing and probing tool that allows users to study and monitor the activities of the operating system (particularly, the kernel) in fine detail. It provides information similar to the output of tools like netstat, ps, top, and iostat; however, SystemTap is designed to provide more filtering and analysis options for collected information.

Red Hat Enterprise Linux 6 features SystemTap version 1.1, which introduces many new features and enhancements, including:

- Improved support for user-space probing.

- Support for probing C++ programs with native C++ syntax.

- A more secure script-compile server.

- The new unprivileged mode, allowing non-root users to use SystemTap.
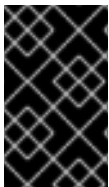
IMPORTANT

Unprivileged mode is new and experimental. The stap-server facility on which it relies is undergoing work for security improvements and should be deployed with care on a trustworthy network.

13.2. OProfile

OProfile is a system-wide profiler for Linux systems. The profiling runs transparently in the background and profile data can be collected at any time.

Red Hat Enterprise Linux 6 features version 0.9.5 of OProfile, adding support for new Intel and AMD processors.

13.3. GNU Compiler Collection (GCC)

The GNU Compiler Collection (GCC) includes, among others, C, C++, and Java GNU compilers and related support libraries. Red Hat Enterprise Linux 6 features version 4.4 of GCC, which includes the following features and enhancements:

- Conformance to version 3.0 of the Open Multi-Processing (OpenMP) application programming interface (API).

- Additional C++ libraries to utilize OpenMP threads

- Futher implementations of the next ISO C++ standard draft (C++0x)

- Introduction of variable tracking assignments to improve debugging using the GNU Project Debugger (GDB) and SystemTap.

More information about the improvements implemented in GCC 4.4 is available from the GCC website.

13.4. GNU C Library (glibc)

The GNU C Library (glibc) packages contain the standard C libraries used by multiple programs on Red Hat Enterprise Linux. These packages contains the standard C and the standard math libraries. Without these two libraries, the Linux system cannot function properly.

Red Hat Enterprise Linux 6 features version 2.11 of glibc, providing many features and enhancements, including:

- An enhanced dynamic memory allocation (malloc) behaviour enabling higher scalability across many sockets and cores. This is achieved by assigning threads their own memory pools and by avoiding locking in some situations. The amount of additional memory used for the memory pools (if any) can be controlled using the environment variables MALLOC_ARENA_TEST and MALLOC_ARENA_MAX. MALLOC_ARENA_TEST specifies that a test for the number of cores is performed once the number of memory pools reaches this value. MALLOC_ARENA_MAX sets the maximum number of memory pools used, regardless of the number of cores.

- Improved efficiency when using condition variables (condvars) with priority inheritance (PI) mutual exclusion (mutex) operations by utilizing support in the kernel for PI fast userspace mutexes.

- Optimized string operations on the x86_64 architecture.

- The `getaddrinfo()` function now has support for the Datagram Congestion Control Protocol (DCCP) and the UDP-Lite protocol. Additionally, `getaddrinfo()` now has the ability to look up IPv4 and IPv6 addresses simultaneously.

13.5. GNU Project debugger (GDB)

The GNU Project debugger (normally referred to as GDB) debugs programs written in C, C++, and other languages by executing them in a controlled fashion, and then printing out their data. Red Hat Enterprise Linux 6 features version 7.0 of GDB.

Python Scripting

This updated version of GDB introduces the new Python API, allowing GDB to be automated using scripts written in the Python Programming Language.

One notable feature of the Python API is the ability to format GDB output (normally referred to as pretty-printing) using Python scripts. Previously, pretty-printing in GDB was configured using a standard set of print settings. The ability to create custom pretty-printer scripts gives the user control of the way GDB displays information for specific applications. Red Hat Enterprise Linux will ship with a complete suite of pretty-printer scripts for the GNU Standard C++ Library (**libstdc++**).

Enhanced C++ support

Support for the C++ programming language in GDB has been improved. Notable improvements include:

- Many improvements to expression parsing.

- Better handling of type names.

- The need for extraneous quoting has nearly been eliminated

- "next" and other stepping commands work properly even when the inferior throws an exception.

- GDB has a new "catch syscall" command. This can be used to stop the inferior whenever it makes a system call.

Independent thread debugging

Thread execution now permits debugging threads individually and independently of each other; enabled by new settings "set target-async" and "set non-stop".

14. INTEROPERABILITY

14.1. Samba

Samba is a suite of programs which use NetBIOS over TCP/IP (NetBT) to enable the sharing of files, printers and other information (such as directories of available files and printers). This package provides a Server Message Block or SMB server (also known as a Common Internet File System or CIFS server) which can provide network services to SMB/CIFS clients.

Red Hat Enterprise Linux 6 provides the following significant enhancements to Samba:

- Internet Protocol version 6 support (IPv6)

- Support for Windows 2008 (R2) trust relationships.

- Support for Windows 7 domain members.

- Support for Active Directory LDAP signing/sealing policy.

- Improvements for libsmbclient

- Better support for Windows management tools (mmc and User Manager)

- Automatic machine password changes as domain member

- New registry based configuration layer

- Encrypted SMB transport between Samba client and server

- Full support for Windows cross-forest, transitive trusts and one-way domain trusts

- New NetApi remote management and winbind client C libraries

- A new graphical user interface for joining Windows Domains

NOTE

Refer to the Deployment Guide for futher information on Samba configuration on Red Hat Enterprise Linux 6.

15. VIRTUALIZATION

15.1. Kernel-based Virtual Machine

Red Hat Enterprise Linux 6 includes full support for the *Kernel-based Virtual Machine (KVM)* hypervisor on the AMD64 and Intel 64 architectures. KVM is integrated into the Linux kernel, providing a virtualization platform that takes advantage of the stability, features, and hardware support inherent in Red Hat Enterprise Linux.

15.1.1. Memory enhancements

- Transparent Hugepages increase the memory page size from 4 kilobytes to 2 megabytes. Transparent Hugepages provide significant performance advantages on systems with highly contended resources and large memory workloads. Additionally, Red Hat Enterprise Linux 6 provides support for utilizing Transparent Hugepages with KSM.

- Extended Page Table age bits enables a host to make smarter choices for swapping memory under memory pressure and allows swapping of Transparent Hugepages by breaking the extended pages into smaller pages.

15.1.2. Virtualized CPU features

- Red Hat Enterprise Linux 6 supports up to 64 virtualized CPUs for a single virtualized guest.

- CPU extensions present on the host processor can now be utilized by virtualized guests. Support for these instruction sets allow virtualized guests to take advantage of modern processor instruction sets and hardware features.

- The new **x2apic** virtual Advanced Programmable Interrupt Controller (APIC) improves virtualized **x86_64** guest performance by allowing direct guest APIC access and removing the overhead of emulated access.

- New user space notifiers allow the caching of CPU registers, avoiding the computationally expensive actions of preserving register states of unused components during context switches.

- Read copy update (RCU) kernel locking is now uses enhanced symmetric multiprocessing support. RCU kernel locking provides greater performance for networking functions and multi-processing systems.

15.1.3. Storage

- The **QEMU** emulated block driver features support for fully asynchronous I/O, **preadv** and **pwritev** functions. These functions increase performance for storage devices using the QEMU emulated block driver.

- The QEMU Monitor Protocol (QMP) allows applications to communicate with the QEMU Monitor correctly. QEMU provides a text-based format that can be easily parsed and support for asynchronous messages and capabilities negotiation.

- Indirect ring entries (spin locks) for the para-virtualized (**virtio**) driver improve block I/O performance and allows more concurrent I/O operations.

- Virtualized storage devices can now be added and removed (hot plugged) from guests during runtime.

- Support for block alignment storage topology awareness. Underlying storage hardware features and physical storage sector sizes (for example, 4KB sectors) are presented to guests. This feature requires compatible storage device information and commands. Guest topology awareness allows virtualized guests to optimize file system layouts and improved performance of applications using I/O optimizations.

- Performance enhancements for the qcow2 virtualized image format.

15.1.4. Networking

- The **vhost-net** feature moves various network functions from the QEMU user space into the kernel. **vhost-net** uses fewer context switches and **vmexit** calls. These enhancements improve performance of SR-IOV devices, directly assigned network device and other network devices.

- MSI-X support which increases the number of interrupts available to network devices. MSI-X support increases the performance of compatible hardware.

- Virtualized network devices can now be hot plugged and hot removed from running guests. Network boot using gpxe fora more advanced PXE network booting.

15.1.5. Kernel SamePage Merging

The KVM hypervisor in Red Hat Enterprise Linux 6 features *Kernel SamePage Merging (KSM)*, allowing KVM guests to share identical memory pages. Page sharing reduces memory duplication and makes running more similar guest operating systems on a given host practical.

15.1.6. PCI passthrough

PCI passthrough (direct assignment) devices can now be hot plugged and hot removed from running guests.

15.1.7. SR-IOV

SR-IOV now supports a raw socket mode. Previously networking interrupts were handled through software bridging in tap mode. SR-IOV supports assigning logical network interfaces to guests.

SR-IOV, previously, did not support migration. The vhost-net abstraction provides SR-IOV with transparent assignment and allows migration with non-identical systems.

15.1.8. virtio-serial

The para-virtualized serial device (virtio-serial) provides a simple communication interface between the host's user space and the guest's user space. virtio-serial can be used for communication where networking is not be available or unusable.

15.1.9. sVirt

sVirt is a new feature included with Red Hat Enterprise Linux 6.0 that integrates SELinux and virtualization. sVirt applies Mandatory Access Control (MAC) to improve security when using virtualized guests. sVirt improves security and hardens the system against bugs in the hypervisor that might be used as an attack vector for the host or to another virtualized guest.

15.1.10. Migration

- Guest ABI stability provides enhanced migration support. Guests PCI device numbers are

preserved during migration and identical PCI device positions are presented after migrating the guest.

- Migration now accounts for CPU models. CPU models allow guests to take advantage of new processor instruction sets. Guests can be migrated to hosts with a compatible CPU model.

- The vhost-net feature allows guests using SR-IOV to migrate to non-identical host configurations that also use SR-IOV devices.

- Enhancements to the migration protocol.

15.1.11. Guest device ABI stability

As part of the new qdev device model, the guest ABI is now stable and will be kept consistent for newer releases. The devices and device arrangements on guests will remain consistent in future updates. This feature resolves issues with some operating system activation processes.

NOTE

Red Hat Enterprise Linux 6 includes components providing functionality for the **Simple Protocol for Independent Computing Environments (SPICE)** remote display protocol. These components are only supported for use in conjunction with Red Hat Enterprise Virtualization products and are not guaranteed to have a stable ABI. The components will be updated to synchronize with functional requirements of Red Hat Enterprise Virtualization products. Migration to future releases may require manual operations on a per-system basis.

15.2. Xen

Red Hat Enterprise Linux 6 is supported as a Xen guest for the x86 and the AMD 64 and Intel 64 architectures. The para-virtualized operations (pv-ops) are included in the Red Hat Enterprise Linux 6 kernel. The default Red Hat Enterprise Linux 6 kernel can be used as a Xen para-virtualized guest and as a Xen full virtualized guest on Red Hat Enterprise Linux 5 hosts. Red Hat Enterprise Linux 6 includes the para-virtualized drivers for fully virtualized Xen guest installations.

Red Hat Enterprise Linux 6 is not supported as a Xen host.

NOTE

The Virtualization Guide details the process to install, configure and manage the virtualization technologies in Red Hat Enterprise Linux 6.

15.3. virt-v2v

Red Hat Enterprise Linux 6 features the new `virt-v2v` tool, enabling system administrators to convert and import virtual machines created on other systems such as Xen and VMware ESX. `virt-v2v` provides a migration path for Xen guests running on a Red Hat Enterprise Linux 5 hypervisor.

16. SUPPORTABILITY AND MAINTENANCE

16.1. firstaidkit System Recovery Tool

Red Hat Enterprise Linux 6 includes the new `firstaidkit` system recovery tool. By automating

common recovery processes, `firstaidkit` provides an interactive environment to assists in the troubleshooting and recovery of a system that boots incorrectly. Additionally, system administrators are able to create custom automated recovery processes using the `firstaidkit` plugin infrastructure.

> **IMPORTANT**
>
> `firstaidkit` is considered a Technology Preview in Red Hat Enterprise Linux 6.

16.2. Bug Reporting

16.2.1. Installation Crash Reporting

Red Hat Enterprise Linux 6 features enhanced installation crash reporting in the installer. Refer to Section 2.4, "Installation Crash Reporting"

16.3. Automated Bug Reporting Tool

Red Hat Enterprise Linux 6 features the new Automated Bug Reporting Tool (ABRT). ABRT logs details of software crashes on a local system, and provides interfaces (both graphical and command line based) to instantly open a ticket in the Red Hat Bugzilla bug tracking website.
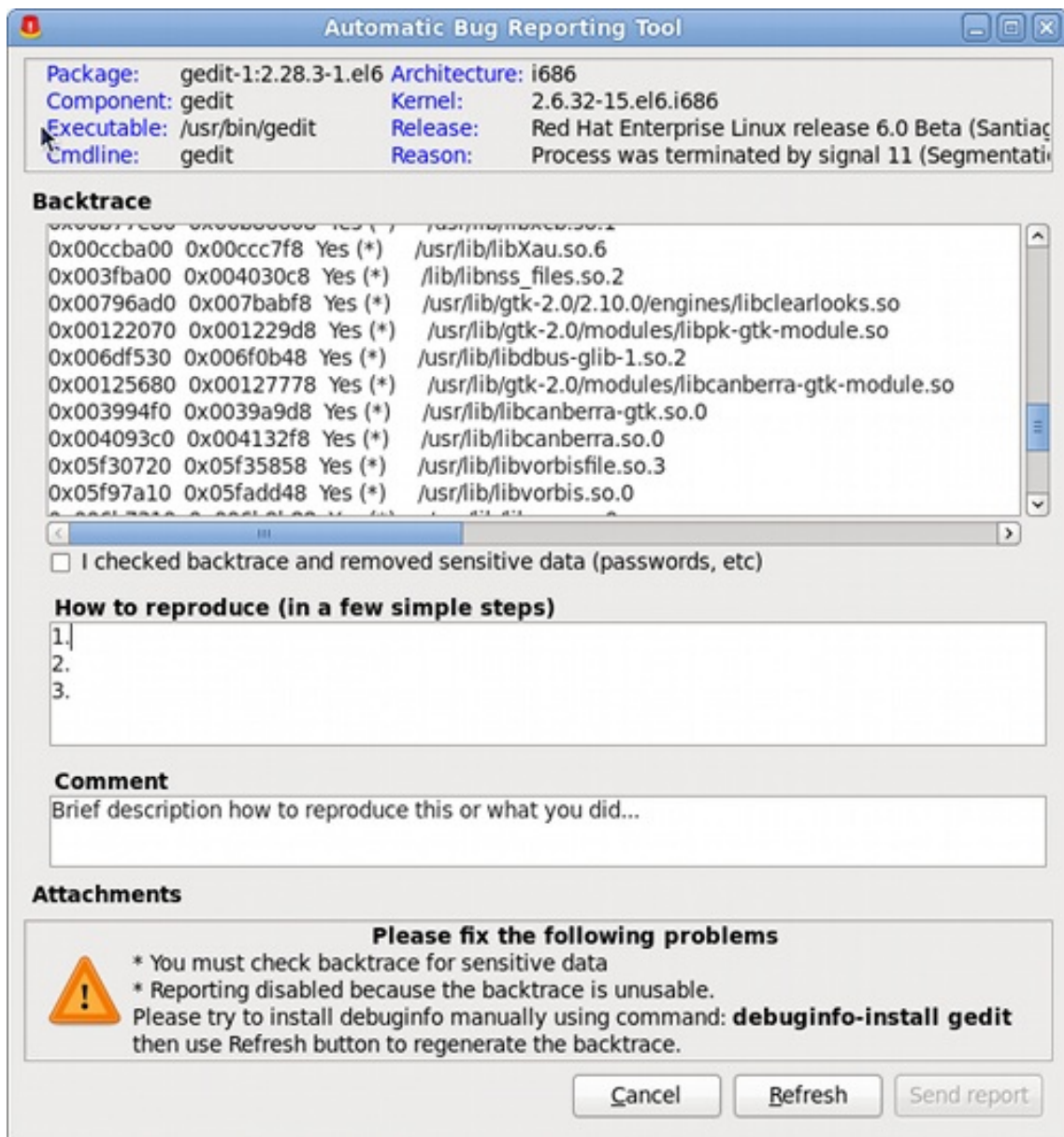
Figure 12. Automated Bug Reporting Tool

17. WEB SERVERS AND SERVICES

17.1. Apache HTTP Web Server

The Apache HTTP Server is a robust, commercial-grade open source Web server. Red Hat Enterprise Linux 6 includes the Apache HTTP Server 2.2.15 as well as a number of server modules designed to enhance its functionality.

Apache in Red Hat Enterprise Linux 6 features support for the Server Name Indication (SNI) protocol, which enables name-based virtual hosting over Secure Sockets Layer (SSL) connections. Additionally, support for the Web Server Gateway Interface (WSGI) has been added to Apache for this release, enabling the use of python web application frameworks that implement the WSGI standard.

17.2. PHP: Hypertext Preprocessor (PHP)

PHP is an HTML-embedded scripting language commonly used with the Apache HTTP Web server. In Red Hat Enterprise Linux, PHP now supports the Alternative PHP Cache (APC).

17.3. memcached

memcached is a high-performance distributed object caching server that is designed to increase the performance of dynamic web applications by reducing database load. memcached is a new feature in this release, and provides bindings for C, PHP, Perl and Python programming languages.

18. DATABASES

18.1. PostgreSQL

PostgreSQL is an advanced Object-Relational database management system (DBMS). The postgresql packages include the client programs and libraries needed to access a PostgreSQL DBMS server.

Red Hat Enterprise Linux 6 features version 8.4 of PostgreSQL

18.2. MySQL

MySQL is a multi-user, multi-threaded SQL database server. It consists of the MySQL server daemon (mysqld) and many client programs and libraries.

This release features version 5.1 of MySQL. For a list of all enhancements that this version provides, refer to the MySQL Release Notes

19. ARCHITECTURE SPECIFIC NOTES

Red Hat Enterprise Linux 6 is architecturally complete, and all supported architectures are now available.

Red Hat Enterprise Linux 6 will not provide support for the Intel® Itanium® architecture. All Itanium-related development will be incorporated into Red Hat Enterprise Linux 5 exclusively. Through March 2014, Red Hat Enterprise Linux 5 will provide support, deliver new features, and enable new Itanium hardware in accordance with the published Red Hat Enterprise Linux product life-cycle. In addition, extended support for Red Hat Enterprise Linux 5 for Itanium is available up to March 2017 from selected OEMs.

On the POWER architecture, Red Hat Enterprise Linux 6 requires a POWER6 or higher CPU. POWER5 processors are not supported on Red Hat Enterprise Linux 6.

A. REVISION HISTORY

Revision 1-1   **Wed Feb 25 2015**   **Laura Bailey**
   Adding metadata to improve document display on the portal.

Revision 1-0   **Wed Aug 12 2010**   **Ryan Lerch**
   Initial version of the Red Hat Enterprise Linux 6 Release Notes