Red Hat Enterprise Linux 8

Considerations in adopting RHEL 8

An overview of changes in Red Hat Enterprise Linux 8 since Red Hat Enterprise Linux 7

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Abstract

This document lists notable differences between Red Hat Enterprise Linux 7 and Red Hat Enterprise Linux 8 to help you evaluate migration to Red Hat Enterprise Linux 8.

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CHAPTER 1. PREFACE

This document provides an overview of differences between two major versions of Red Hat Enterprise Linux: RHEL 7 and RHEL 8. It provides a list of changes relevant for evaluating migration to RHEL 8 rather than an exhaustive list of all alterations.

Capabilities and limits of RHEL 8 as compared to other versions of the system are available in the Knowledgebase article Red Hat Enterprise Linux technology capabilities and limits .

Information regarding the RHEL life cycle is provided in the Red Hat Enterprise Linux Life Cycle document.

The Package manifest document provides a package listing for RHEL 8.

For details regarding RHEL 8 usage, see the RHEL 8 product documentation .

For guidance regarding an in-place upgrade from RHEL 7 to RHEL 8, see Upgrading to RHEL 8 .

For information about major differences between RHEL 6 and RHEL 7, see the RHEL 7 Migration Planning Guide.

CHAPTER 2. ARCHITECTURES

Red Hat Enterprise Linux 8 is distributed with the kernel version 4.18, which provides support for the following architectures:

- AMD and Intel 64-bit architectures
- The 64-bit ARM architecture
- IBM Power Systems, little endian
- IBM Z

Make sure you purchase the appropriate subscription for each architecture. For more information, see Get Started with Red Hat Enterprise Linux - additional architectures . For a list of available subscriptions, see Subscription Utilization on the Customer Portal.

Note that all architectures are supported by the standard **kernel** packages in RHEL 8; no **kernel-alt** package is needed.

CHAPTER 3. REPOSITORIES

Red Hat Enterprise Linux 8 is distributed through two main repositories:

- BaseOS
- AppStream

Both repositories are required for a basic RHEL installation, and are available with all RHEL subscriptions.

Content in the BaseOS repository is intended to provide the core set of the underlying OS functionality that provides the foundation for all installations. This content is available in the RPM format and is subject to support terms similar to those in previous releases of RHEL. For a list of packages distributed through BaseOS, see the Package manifest.

Content in the Application Stream repository includes additional user space applications, runtime languages, and databases in support of the varied workloads and use cases. Content in AppStream is available in one of two formats - the familiar RPM format and an extension to the RPM format called *modules*. For a list of packages available in AppStream, see the Package manifest.

In addition, the CodeReady Linux Builder repository is available with all RHEL subscriptions. It provides additional packages for use by developers. Packages included in the CodeReady Linux Builder repository are unsupported.

For more information about RHEL 8 repositories, see the Package manifest.

CHAPTER 4. APPLICATION STREAMS

Red Hat Enterprise Linux 8 introduces the concept of Application Streams. Multiple versions of user space components are now delivered and updated more frequently than the core operating system packages. This provides greater flexibility to customize Red Hat Enterprise Linux without impacting the underlying stability of the platform or specific deployments.

Components made available as Application Streams can be packaged as modules or RPM packages and are delivered through the AppStream repository in RHEL 8. Each Application Stream component has a given life cycle. For details, see Red Hat Enterprise Linux Life Cycle .

Modules are collections of packages representing a logical unit: an application, a language stack, a database, or a set of tools. These packages are built, tested, and released together.

Module streams represent versions of the Application Stream components. For example, two streams (versions) of the PostgreSQL database server are available in the postgresql module: PostgreSQL 10 (the default stream) and PostgreSQL 9.6. Only one module stream can be installed on the system. Different versions can be used in separate containers.

Detailed module commands are described in the Installing, managing, and removing user space components document. For a list of modules available in AppStream, see the Package manifest.

CHAPTER 5. INSTALLER AND IMAGE CREATION

5.1. ADD-ONS

5.1.1. OSCAP

The OSCAP add-on is enabled by default in Red Hat Enterprise Linux 8.

5.1.2. Kdump

The Kdump add-on adds support for configuring kernel crash dumping during installation. This add-on has full support in Kickstart (using the **%addon com_redhat_kdump** command and its options), and is fully integrated as an additional window in the graphical and text-based user interfaces.

5.2. INSTALLER NETWORKING

5.2.1. Device naming scheme

A new network device naming scheme that generates network interface names based on a user-defined prefix is available in Red Hat Enterprise Linux 8. The **net.ifnames.prefix** boot option allows the device naming scheme to be used by the installation program and the installed system. See the **dracut.cmdline(7)** man page for information.

5.3. INSTALLATION IMAGES AND PACKAGES

5.3.1. Unified ISO

In Red Hat Enterprise Linux 8, a unified ISO automatically loads the **BaseOS** and **AppStream** installation source repositories. This feature works for the first base repository that is loaded during installation. For example, if you boot the installation with no repository configured and have the unified ISO as the base repository in the graphical user interface (GUI), or if you boot the installation using the **inst.repo=** option that points to the unified ISO.

As a result, the AppStream repository is enabled under the **Additional Repositories** section of the **Installation Source** GUI window. You cannot remove the AppStream repository or change its settings but you can disable it in **Installation Source**. This feature does not work if you boot the installation using a different base repository and then change it to the unified ISO. If you do that, the base repository is replaced. However, the AppStream repository is not replaced and points to the original file.

5.3.2. Stage2 image

In Red Hat Enterprise Linux 8, multiple network locations of **stage2** or Kickstart files can be specified to prevent installation failure. This update enables the specification of multiple **inst.stage2** and **inst.ks** boot options with network locations of **stage2** and a Kickstart file. This avoids the situation in which the requested files cannot be reached and the installation fails because the contacted server with the **stage2** or the Kickstart file is inaccessible.

With this new update, the installation failure can be avoided if multiple locations are specified. If all the defined locations are URLs, namely **HTTP**, **HTTPS**, or **FTP**, they will be tried sequentially until the requested file is fetched successfully. If there is a location that is not a URL, only the last specified location is tried. The remaining locations are ignored.

5.3.3. inst.addrepo parameter

Previously, you could only specify a base repository from the kernel boot parameters. In Red Hat Enterprise Linux 8, a new kernel parameter, **inst.addrepo=<name>,<url>**, allows you to specify an additional repository during installation. This parameter has two mandatory values: the name of the repository and the URL that points to the repository. For more information, see the inst-addrepo usage.

5.3.4. Installation from an expanded ISO

Red Hat Enterprise Linux 8 supports installing from a repository on a local hard drive. Previously, the only installation method from a hard drive was using an ISO image as the installation source. However, the Red Hat Enterprise Linux 8 ISO image might be too big for some file systems; for example, the FAT32 file system cannot store files larger than 4 GiB. In Red Hat Enterprise Linux 8, you can enable installation from a repository on a local hard drive; you only need to specify the directory instead of the ISO image. For example: **inst.repo=hd:<device>:<path to the repository>**.

For more information about the Red Hat Enterprise Linux 8 BaseOS and AppStream repositories, see the *Repositories* section of this document.

5.4. INSTALLER GRAPHICAL USER INTERFACE

5.4.1. The Installation Summary window

The Installation Summary window of the Red Hat Enterprise Linux 8 graphical installation has been updated to a new three-column layout that provides improved organization of graphical installation settings.

5.5. SYSTEM PURPOSE NEW IN RHEL

5.5.1. System Purpose support in the graphical installation

Previously, the Red Hat Enterprise Linux installation program did not provide system purpose information to Subscription Manager. In Red Hat Enterprise Linux 8, you can set the intended purpose of the system during a graphical installation by using the **System Purpose** window, or in a Kickstart configuration file by using the **syspurpose** command. When you set a system's purpose, the entitlement server receives information that helps auto-attach a subscription that satisfies the intended use of the system.

5.5.2. System Purpose support in Pykickstart

Previously, it was not possible for the **pykickstart** library to provide system purpose information to Subscription Manager. In Red Hat Enterprise Linux 8, **pykickstart** parses the new **syspurpose** command and records the intended purpose of the system during automated and partially-automated installation. The information is then passed to the installation program, saved on the newly-installed system, and available for Subscription Manager when subscribing the system.

5.6. INSTALLER MODULE SUPPORT

5.6.1. Installing modules using Kickstart

In Red Hat Enterprise Linux 8, the installation program has been extended to handle all modular features. Kickstart scripts can now enable module and stream combinations, install module profiles, and install modular packages.

5.7. KICKSTART CHANGES

The folowing sections describe the changes in Kickstart commands and options in Red Hat Enterprise Linux 8.

5.7.1. auth or authconfig is deprecated in RHEL 8

The **auth** or **authconfig** Kickstart command is deprecated in Red Hat Enterprise Linux 8 because the **authconfig** tool and package have been removed.

Similarly to **authconfig** commands issued on command line, **authconfig** commands in Kickstart scripts now use the **authselect-compat** tool to run the new **authselect** tool. For a description of this compatibility layer and its known issues, see the manual page **authselect-migration(7)**. The installation program will automatically detect use of the deprecated commands and install on the system the **authselect-compat** package to provide the compatibility layer.

5.7.2. Kickstart no longer supports Btrfs

The Btrfs file system is not supported in Red Hat Enterprise Linux 8. As a result, the Graphical User Interface (GUI) and the Kickstart commands no longer support Btrfs.

5.7.3. Using Kickstart files from previous RHEL releases

If you are using Kickstart files from previous RHEL releases, see the *Repositories* section of this document for more information about the Red Hat Enterprise Linux 8 BaseOS and AppStream repositories.

5.7.4. Deprecated Kickstart comands and options

The following Kickstart commands and options have been deprecated in Red Hat Enterprise Linux 8. Using them in Kickstart files will print a warning in the logs.

- **auth** or **authconfig** - use **authselect instead**
- **device**
- **deviceprobe**
- **dmraid**
- **install** - use the subcommands or methods directly as commands
- **lilo**
- **lilocheck**
- **mouse**
- **multipath**
- **bootloader --upgrade**

- **ignoredisk --interactive**
- **partition --active**
- **reboot --kexec**

Where only specific options are listed, the base command and its other options are still available and not deprecated.

Note also you can turn the deprecated command warnings into errors with the **inst.ksstrict** boot option.

5.7.5. Removed Kickstart comands and options

The following Kickstart commands and options have been completely removed in Red Hat Enterprise Linux 8. Using them in Kickstart files will cause an error.

- **upgrade** (This command had already previously been deprecated.)
- **btrfs**
- **part/partition btrfs**
- **part --fstype btrfs** or **partition --fstype btrfs**
- **logvol --fstype btrfs**
- **raid --fstype btrfs**
- **unsupported_hardware**

Where only specific options and values are listed, the base command and its other options are still available and not removed.

5.7.6. New Kickstart comands and options

The following commands and options have been added in Red Hat Enterprise Linux 8.

RHEL 8.0

- **authselect**
- **module**

5.8. IMAGE CREATION

5.8.1. Custom system image creation with Image Builder

The Image Builder tool enables users to create customized RHEL images. Image Builder is available in AppStream in the **lorax-composer** package.

With Image Builder, users can create custom system images which include additional packages. Image Builder functionality can be accessed through:

- a graphical user interface in the web console

- a command line interface in the **composer-cli** tool.

Image Builder output formats include, among others:

- live ISO disk image
- qcow2 file for direct use with a virtual machine or OpenStack
- file system image file
- cloud images for Azure, VMWare and AWS

To learn more about Image Builder, see the documentation title Composing a customized RHEL system image.

CHAPTER 6. SOFTWARE MANAGEMENT

6.1. NOTABLE CHANGES TO THE YUM STACK

On Red Hat Enterprise Linux (RHEL) 8, installing software is ensured by the new version of the **YUM** tool, which is based on the **DNF** technology (**YUM v4**).

6.1.1. Advantages of YUM v4 over YUM v3

YUM v4 has the following advantages over the previous **YUM v3** used on RHEL 7:

- Increased performance
- Support for modular content
- Well-designed stable API for integration with tooling

For detailed information about differences between the new **YUM v4** tool and the previous version **YUM v3** from RHEL 7, see Changes in DNF CLI compared to YUM .

6.1.2. How to use YUM v4

Installing software
YUM v4 is compatible with **YUM v3** when using from the command line, editing or creating configuration files.

For installing software, you can use the **yum** command and its particular options in the same way as on RHEL 7.

See more detailed information on Installing software with yum .

Availability of plug-ins
Legacy **YUM v3** plug-ins are incompatible with the new version of **YUM v4**. Selected yum plug-ins and utilities have been ported to the new DNF back end, and can be installed under the same names as in RHEL 7. They also provide compatibility symlinks, so the binaries, configuration files and directories can be found in usual locations.

In the event that a plug-in is no longer included, or a replacement does not meet a usability need, please reach out to Red Hat Support to request a Feature Enhancement as described in How do I open and manage a support case on the Customer Portal?

For more information, see Plugin Interface .

Availability of APIs
Note that the legacy Python API provided by **YUM v3** is no longer available. Users are advised to migrate their plug-ins and scripts to the new API provided by **YUM v4** (DNF Python API), which is stable and fully supported. The upstream project documents the new DNF Python API - see the DNF API Reference.

The Libdnf and Hawkey APIs (both C and Python) are to be considered unstable, and will likely change during RHEL 8 life cycle.

6.1.3. Availability of YUM configuration file options

This section summarizes changes in configuration file options between RHEL 7 and RHEL 8 for the **/etc/yum/yum.conf** and **/etc/yum/repos.d/*.repo** files.

Table 6.1. Changes in configuration file options for the /etc/yum/yum.conf file

RHEL 7 option	RHEL 8 status
alwaysprompt	removed
assumeno	available
assumeyes	available
autocheck_running_kernel	available
autosavets	removed
bandwidth	available
bugtracker_url	available
cachedir	available
check_config_file_age	available
clean_requirements_on_remove	available
color	available
color_list_available_downgrade	available
color_list_available_install	available
color_list_available_reinstall	available
color_list_available_running_kernel	removed
color_list_available_upgrade	available
color_list_installed_extra	available
color_list_installed_newer	available
color_list_installed_older	available
color_list_installed_reinstall	available
color_list_installed_running_kernel	removed

RHEL 7 option	RHEL 8 status
color_search_match	available
color_update_installed	available
color_update_local	available
color_update_remote	available
commands	removed
config_file_path	available
debuglevel	available
deltarpm	available
deltarpm_metadata_percentage	removed
deltarpm_percentage	available
depsolve_loop_limit	removed
disable_excludes	available
diskspacecheck	available
distroverpkg	removed
enable_group_conditionals	removed
errorlevel	available
exactarchlist	removed
exclude	available
exit_on_lock	available
fssnap_abort_on_errors	removed
fssnap_automatic_keep	removed
fssnap_automatic_post	removed

RHEL 7 option	RHEL 8 status
fssnap_automatic_pre	removed
fssnap_devices	removed
fssnap_percentage	removed
ftp_disable_epsv	removed
gpgcheck	available
group_command	removed
group_package_types	available
groupremove_leaf_only	removed
history_list_view	available
history_record	available
history_record_packages	available
http_caching	removed
installonly_limit	available
installonlypkgs	available
installrootkeep	removed
ip_resolve	available
keepalive	removed
keepcache	available
kernelpkgnames	removed
loadts_ignoremissing	removed
loadts_ignorenewrpm	removed
loadts_ignorerpm	removed

RHEL 7 option	RHEL 8 status
localpkg_gpgcheck	available
logfile	removed
max_connections	removed
mddownloadpolicy	removed
mdpolicy	removed
metadata_expire	available
metadata_expire_filter	removed
minrate	available
mirrorlist_expire	removed
multilib_policy	available
obsoletes	available
override_install_langs	removed
overwrite_groups	removed
password	available
payload_gpgcheck	removed
persistdir	available
pluginconfpath	available
pluginpath	available
plugins	available
protected_multilib	removed
protected_packages	available
proxy	available

RHEL 7 option	RHEL 8 status
proxy_password	available
proxy_username	available
query_install_excludes	removed
recent	available
recheck_installed_requires	removed
remove_leaf_only	removed
repo_gpgcheck	available
repopkgsremove_leaf_only	removed
reposdir	available
reset_nice	available
retries	available
rpmverbosity	available
shell_exit_status	removed
showdupesfromrepos	available
skip_broken	available
skip_missing_names_on_install	removed
skip_missing_names_on_update	removed
ssl_check_cert_permissions	removed
sslcacert	available
sslclientcert	available
sslclientkey	available
sslverify	available

RHEL 7 option	RHEL 8 status
syslog_device	removed
syslog_facility	removed
syslog_ident	removed
throttle	available
timeout	available
tolerant	removed
tsflags	available
ui_repoid_vars	removed
upgrade_group_objects_upgrade	available
upgrade_requirements_on_install	removed
usercache	removed
username	available
usr_w_check	removed

Table 6.2. Changes in configuration file options for the /etc/yum/repos.d/*.repo file

RHEL 7 option	RHEL 8 status
async	removed
bandwidth	available
baseurl	available
compare_providers_priority	removed
cost	available
deltarpm_metadata_percentage	removed
deltarpm_percentage	available

RHEL 7 option	RHEL 8 status
enabled	available
enablegroups	available
exclude	available
failovermethod	removed
ftp_disable_epsv	removed
gpgcakey	removed
gpgcheck	available
gpgkey	available
http_caching	removed
includepkgs	available
ip_resolve	available
keepalive	removed
metadata_expire	available
metadata_expire_filter	removed
metalink	available
mirrorlist	available
mirrorlist_expire	removed
name	available
password	available
proxy	available
proxy_password	available
proxy_username	available

RHEL 7 option	RHEL 8 status
repo_gpgcheck	available
repositoryid	removed
retries	available
skip_if_unavailable	available
ssl_check_cert_permissions	removed
sslcacert	available
sslclientcert	available
sslclientkey	available
sslverify	available
throttle	available
timeout	available
ui_repoid_vars	removed
username	available

6.1.4. YUM v4 features behaving differently

Some of the **YUM v3** features may behave differently in **YUM v4**. If any such change negatively impacts your workflows, please open a case with Red Hat Support, as described in How do I open and manage a support case on the Customer Portal?

6.1.4.1. yum list presents duplicate entries

When listing packages using the **yum list** command, duplicate entries may be presented, one for each repository where a package of the same name and version resides.

This is intentional, and it allows the users to distinguish such packages when necessary.

For example, if package-1.2 is available in both repo1 and repo2, **YUM v4** will print both instances:

```
[…]
package-1.2    repo1
package-1.2    repo2
[…]
```

By contrast, the legacy **YUM v3** command filtered out such duplicates so that only one instance was shown:

```
[…]
package-1.2    repo1
[…]
```

6.2. NOTABLE RPM FEATURES AND CHANGES

Red Hat Enterprise Linux (RHEL) 8 is distributed with RPM 4.14. This version introduces many enhancements over RPM 4.11, which is available in RHEL 7.

Notable features include:

- The debuginfo packages can be installed in parallel
- Support for weak dependencies
- Support for rich or boolean dependencies
- Support for packaging files above 4 GB in size
- Support for file triggers

See more information about New RPM features in RHEL 8 .

Notable changes include:

- Stricter spec-parser
- Simplified signature checking the output in non-verbose mode
- Additions and deprecation in macros

CHAPTER 7. INFRASTRUCTURE SERVICES

7.1. TIME SYNCHRONIZATION

Accurate timekeeping is important for a number of reasons. In Linux systems, the **Network Time Protocol (NTP)** protocol is implemented by a daemon running in user space.

7.1.1. Implementation of NTP

RHEL 7 supported two implementations of the **NTP** protocol: **ntp** and **chrony**.

In RHEL 8, the **NTP** protocol is implemented only by the **chronyd** daemon, provided by the **chrony** package.

The **ntp** daemon is no longer available. If you used **ntp** on your RHEL 7 system, you might need to migrate to chrony.

Possible replacements for previous **ntp** features that are not supported by **chrony** are documented in Achieving some settings previously supported by ntp in chrony .

7.1.2. Introduction to chrony suite

chrony is an implementation of **NTP**, which performs well in a wide range of conditions, including intermittent network connections, heavily congested networks, changing temperatures (ordinary computer clocks are sensitive to temperature), and systems that do not run continuously, or run on a virtual machine.

You can use **chrony**:

- To synchronize the system clock with **NTP** servers
- To synchronize the system clock with a reference clock, for example a GPS receiver
- To synchronize the system clock with a manual time input
- As an **NTPv4(RFC 5905)** server or peer to provide a time service to other computers in the network

For more information about **chrony**, see Configuring basic system settings.

7.1.2.1. Differences between chrony and ntp

See the following resources for information about differences between **chrony** and **ntp**:

- Configuring basic system settings
- Comparison of NTP implementations

7.1.2.1.1. Chrony applies leap second correction by default

In RHEL 8, the default **chrony** configuration file, **/etc/chrony.conf**, includes the **leapsectz** directive.

The **leapsectz** directive enables **chronyd** to:

- Get information about leap seconds from the system tz database (**tzdata**)

- Set the TAI-UTC offset of the system clock in order that the system provides an accurate International Atomic Time (TAI) clock (CLOCK_TAI)

The directive is not compatible with servers that hide leap seconds from their clients using a **leap smear**, such as **chronyd** servers configured with the **leapsecmode** and **smoothtime** directives. If a client **chronyd** is configured to synchronize to such servers, remove **leapsectz** from the configuration file.

7.1.3. Additional information

For more information on how to configure **NTP** using the **chrony** suite, see Configuring basic system settings.

7.2. BIND - IMPLEMENTATION OF DNS

RHEL 8 includes BIND (Berkeley Internet Name Domain) in version 9.11. This version of the DNS server introduces multiple new features and feature changes compared to version 9.10.

New features:

- A new method of provisioning secondary servers called **Catalog Zones** has been added.
- Domain Name System Cookies are now sent by the **named** service and the **dig** utility.
- The **Response Rate Limiting** feature can now help with mitigation of DNS amplification attacks.
- Performance of response-policy zone (RPZ) has been improved.
- A new zone file format called **map** has been added. Zone data stored in this format can be mapped directly into memory, which enables zones to load significantly faster.
- A new tool called **delv** (domain entity lookup and validation) has been added, with dig-like semantics for looking up DNS data and performing internal DNS Security Extensions (DNSSEC) validation.
- A new **mdig** command is now available. This command is a version of the **dig** command that sends multiple pipelined queries and then waits for responses, instead of sending one query and waiting for the response before sending the next query.
- A new **prefetch** option, which improves the recursive resolver performance, has been added.
- A new **in-view** zone option, which allows zone data to be shared between views, has been added. When this option is used, multiple views can serve the same zones authoritatively without storing multiple copies in memory.
- A new **max-zone-ttl** option, which enforces maximum TTLs for zones, has been added. When a zone containing a higher TTL is loaded, the load fails. Dynamic DNS (DDNS) updates with higher TTLs are accepted but the TTL is truncated.
- New quotas have been added to limit queries that are sent by recursive resolvers to authoritative servers experiencing denial-of-service attacks.
- The **nslookup** utility now looks up both IPv6 and IPv4 addresses by default.
- The **named** service now checks whether other name server processes are running before starting up.

- When loading a signed zone, **named** now checks whether a Resource Record Signature's (RSIG) inception time is in the future, and if so, it regenerates the RRSIG immediately.
- Zone transfers now use smaller message sizes to improve message compression, which reduces network usage.

Feature changes:

- The version **3 XML** schema for the statistics channel, including new statistics and a flattened XML tree for faster parsing, is provided by the HTTP interface. The legacy version **2 XML** schema is no longer supported.
- The **named** service now listens on both IPv6 and IPv4 interfaces by default.
- The **named** service no longer supports GeoIP. Access control lists (ACLs) defined by presumed location of query sender are unavailable.

7.3. PRINTING

7.3.1. Print settings tools

The **Print Settings** configuration tool, which was used in RHEL 7, is no longer available.

To achieve various tasks related to printing, you can choose one of the following tools:

- **CUPS web user interface (UI)**
- **GNOME Control center**

For more information on print setting tools in RHEL 8, see Deploying different types of servers.

7.3.2. Location of CUPs logs

CUPS provides three kinds of logs:

- Error log
- Access log
- Page log

In RHEL 8, the logs are no longer stored in specific files within the /var/log/cups directory, which was used in RHEL 7. Instead, all three types are logged centrally in systemd-journald together with logs from other programs.

For more information on how to use CUPS logs in RHEL 8, see Deploying different types of servers.

7.3.3. Additional information

For more information how to configure printing in RHEL 8, see Deploying different types of servers.

7.4. PERFORMANCE AND POWER MANAGEMENT OPTIONS

7.4.1. Notable changes in the recommended Tuned profile

In RHEL 8, the recommended Tuned profile, reported by the **tuned-adm recommend** command, is selected based on the following rules:

- If the **syspurpose** role (reported by the **syspurpose show** command) contains **atomic**, and at the same time:
  - if Tuned is running on bare metal, the **atomic-host** profile is selected
  - if Tuned is running in a virtual machine, the **atomic-guest** profile is selected
- If Tuned is running in a virtual machine, the **virtual-guest** profile is selected
- If the **syspurpose** role contains **desktop** or **workstation** and the chassis type (reported by **dmidecode**) is **Notebook**, **Laptop**, or **Portable**, then the **balanced** profile is selected
- If none of the above rules matches, the **throughput-performance** profile is selected

Note that the first rule that matches takes effect.

7.5. OTHER CHANGES TO INFRASTRUCTURE SERVICES COMPONENTS

This section summarizes other notable changes to particular infrastructure services components.

Table 7.1. Notable changes to infrastructure services components

Name	Type of change	Additional information
acpid	Option change	**-d** (debug) no longer implies**-f** (foreground)
bind	Configuration option removal	**dnssec-lookaside auto** removed; use **no** instead
brltty	Configuration option change	**--message-delay brltty** renamed to **--message-timeout**
brltty	Configuration option removal	**-U [--update-interval=]** removed
brltty	Configuration option change	A Bluetooth device address may now contain dashes (-) instead of colons (:). The **bth:** and **bluez:** device qualifier aliases are no longer supported.
cups	Functionality removal	Upstream removed support of interface scripts because of security reasons. Use ppds and drivers provided by OS or proprietary ones.
cups	Directive options removal	Removed **Digest** and **BasicDigest** authentication types for AuthType and DefaultAuthType directives in **/etc/cups/cupsd.conf**. Migrate to **Basic**.

Name	Type of change	Additional information
cups	Directive options removal	Removed **Include** from **cupsd.conf**
cups	Directive options removal	Removed **ServerCertificate** and **ServerKey** from **cups-files.conf** use **Serverkeychain** instead
cups	Directives moved between conf files	**SetEnv** and **PassEnv** moved from **cupsd.conf** to **cups-files.conf**
cups	Directives moved between conf files	**PrintcapFormat** moved from **cupsd.conf** to **cups-files.conf**
cups-filters	Default configuration change	Names of remote print queues discovered by cups-browsed are now created based on device ID of printer, not on the name of remote print queue.
cups-filters	Default configuration change	**CreateIPPPrinterQueues** must be set to **All** for automatic creation of queues of IPP printers
cyrus-imapd	Data format change	Cyrus-imapd 3.0.7 has different data format.
dhcp	Options incompatibility	The **-I** option is now used for standard-ddns-updates. For the previous functionality (dhcp-client-identifier), use the new **-C** option.
dosfstools	Behavior change	Data structures are now automatically aligned to cluster size. To disable the alignment, use the **-a** option. **fsck.fat** now defaults to interactive repair mode which previously had to be selected with the **-r** option.
finger	Functionality removal	
GeoIP	Functionality removal	
grep	Behavior change	**grep** now treats files containining data improperly encoded for the current locale as binary.
grep	Behavior change	**grep -P** no longer reports an error and exits when given invalid UTF-8 data
grep	Behavior change	**grep** now warns if the GREP_OPTIONS environment variable is now used. Use an alias or script instead.

Name	Type of change	Additional information
grep	Behavior change	**grep -P** eports an error and exits in locales with multibyte character encodings other than UTF-8
grep	Behavior change	When searching binary data, **grep** may treat non-text bytes as line terminators, which impacts performance significantly.
grep	Behavior change	**grep -z** no longer automatically treats the byte '\200' as binary data.
grep	Behavior change	Context no longer excludes selected lines omitted because of **-m**.
irssi	Behavior change	**SSLv2** and **SSLv3** no longer supported
lftp	Change of options	**xfer:log** and **xfer:log-file`deprecated; now available under `log:enabled** and **log:file** commands
ntp	Functionality removal	ntp has been removed; use chrony instead
postfix	Configuration change	3.x version have compatibility safety net that runs Postfix programs with backwards-compatible default settings after an upgrade.
postfix	Configuration change	In the Postfix MySQL database client, the default option_group value has changed to **client**, set it to empty value for backward compatible behavior.
postfix	Configuration change	The **postqueue** command no longer forces all message arrival times to be reported in UTC. To get the old behavior, set **TZ=UTC** in main.cf.
postfix	Configuration change	ECDHE - **smtpd_tls_eecdh_grade** defaults to **auto**; new parameter **tls_eecdh_auto_curves** with the names of curves that may be negotiated
postfix	Configuration change	Changed defaults for **append_dot_mydomain** (new: no, old: yes), **master.cf chroot** (new: n, old: y),**smtputf8** (new: yes, old: no).
postfix	Configuration change	Changed defaults for **relay_domains** (new: empty, old: $mydestination).
postfix	Configuration change	The **mynetworks_style** default value has changed from **subnet** to **host**.
powertop	Option removal	**-d** removed

Name	Type of change	Additional information
powertop	Option change	**-h** is no longer alias for**--html**. It is now an alias for**--help**.
powertop	Option removal	**-u** removed
quagga	Functionality removal	
sendmail	Configuration change	sendmail uses uncompressed IPv6 addresses by default, which permits a zero subnet to have a more specific match. Configuration data must use the same format, so make sure patterns such as **IPv6:[0-9a-fA-F:]*::** and **IPv6::** are updated before using 8.15.
spamassasin	Command line option removal	Removed **--ssl-version** in spamd
spamassasin	Change in supported SSL versions	In spamc and spamd, SSLv3 is no longer supported.
spamassasin	Functionality removal	**sa-update** no longer supports SHA1 validation of filtering rules, and uses SHA256/SHA512 validation instead.
vim	Default settings change	Vim runs default.vim script, if no ~/.vimrc file is available.
vim	Default settings change	Vim now supports bracketed paste from terminal. Include 'set t_BE=' in vimrc for the previous behavior.
vsfptd	Default configuration change	**anonymous_enable** disabled
vsfptd	Default configuration change	**strict_ssl_read_eof** now defaults to YES
vsfptd	Functionality removal	**tcp_wrappers** no longer supported
vsfptd	Default configuration change	TLSv1 and TLSv1.1 are disabled by default

Name	Type of change	Additional information
wireshark	Python bindings removal	Dissectors can no longer be written in Python, use C instead.
wireshark	Option removal	**-C** suboption for **-N** option for asynchronous DNS name resolution removed
wireshark	Ouput change	With the **-H** option, the output no longer shows SHA1, RIPEMD160 and MD5 hashes. It now shows SHA256, RIPEMD160 and SHA1 hashes.
wvdial	Functionality removal	

CHAPTER 8. SECURITY

8.1. CHANGES IN CORE CRYPTOGRAPHIC COMPONENTS

8.1.1. System-wide cryptographic policies are applied by default

Crypto-policies is a component in Red Hat Enterprise Linux 8, which configures the core cryptographic subsystems, covering the TLS, IPsec, DNSSEC, Kerberos protocols, and the OpenSSH suite. It provides a small set of policies, which the administrator can select using the **update-crypto-policies** command.

The **DEFAULT** system-wide cryptographic policy offers secure settings for current threat models. It allows the TLS 1.2 and 1.3 protocols, as well as the IKEv2 and SSH2 protocols. The RSA keys and Diffie-Hellman parameters are accepted if larger than 2047 bits.

See the Consistent security by crypto policies in Red Hat Enterprise Linux 8 article on the Red Hat Blog and the **update-crypto-policies(8)** man page for more information.

8.1.2. Strong crypto defaults by removing insecure cipher suites and protocols

The following list contains cipher suites and protocols removed from the core cryptographic libraries in RHEL 8. They are not present in the sources, or their support is disabled during the build, so applications cannot use them.

- DES (since RHEL 7)
- All export grade cipher suites (since RHEL 7)
- MD5 in signatures (since RHEL 7)
- SSLv2 (since RHEL 7)
- SSLv3 (since RHEL 8)
- All ECC curves < 224 bits (since RHEL 6)
- All binary field ECC curves (since RHEL 6)

8.1.3. Cipher suites and protocols disabled in all policy levels

The following cipher suites and protocols are disabled in all crypto policy levels. They can be enabled only by an explicit configuration of individual applications.

- DH with parameters < 1024 bits
- RSA with key size < 1024 bits
- Camellia
- ARIA
- SEED
- IDEA
- Integrity-only cipher suites

- TLS CBC mode cipher suites using SHA-384 HMAC
- AES-CCM8
- All ECC curves incompatible with TLS 1.3, including secp256k1
- IKEv1 (since RHEL 8)

8.1.4. Switching the system to FIPS mode

The system-wide cryptographic policies contain a policy level that enables cryptographic modules self-checks in accordance with the requirements by Federal Information Processing Standard (FIPS) Publication 140-2. The **fips-mode-setup** tool that enables or disables FIPS mode internally uses the **FIPS** system-wide cryptographic policy level.

To switch the system to FIPS mode in RHEL 8, enter the following command and restart your system:

```
# fips-mode-setup --enable
```

See the **fips-mode-setup(8)** man page for more information.

8.1.5. TLS 1.0 and TLS 1.1 are deprecated

The TLS 1.0 and TLS 1.1 protocols are disabled in the **DEFAULT** system-wide cryptographic policy level. If your scenario, for example, a video conferencing application in the Firefox web browser, requires using the deprecated protocols, switch the system-wide cryptographic policy to the **LEGACY** level:

```
# update-crypto-policies --set LEGACY
```

For more information, see the Strong crypto defaults in RHEL 8 and deprecation of weak crypto algorithms Knowledgebase article on the Red Hat Customer Portal and the **update-crypto-policies(8)** man page.

8.1.6. TLS 1.3 support in cryptographic libraries

This update enables Transport Layer Security (TLS) 1.3 by default in all major back-end crypto libraries. This enables low latency across the operating system communications layer and enhances privacy and security for applications by taking advantage of new algorithms, such as RSA-PSS or X25519.

8.1.7. DSA is deprecated in RHEL 8

The Digital Signature Algorithm (DSA) is considered deprecated in Red Hat Enterprise Linux 8. Authentication mechanisms that depend on DSA keys do not work in the default configuration. Note that **OpenSSH** clients do not accept DSA host keys even in the **LEGACY** system-wide cryptographic policy level.

8.1.8. SSL2 Client Hello has been deprecated in NSS

The Transport Layer Security (**TLS**) protocol version 1.2 and earlier allow to start a negotiation with a **Client Hello** message formatted in a way that is backward compatible with the Secure Sockets Layer (**SSL**) protocol version 2. Support for this feature in the Network Security Services (**NSS**) library has been deprecated and it is disabled by default.

Applications that require support for this feature need to use the new **SSL_ENABLE_V2_COMPATIBLE_HELLO** API to enable it. Support for this feature may be removed completely in future releases of Red Hat Enterprise Linux 8.

8.1.9. NSS now use SQL by default

The Network Security Services (NSS) libraries now use the SQL file format for the trust database by default. The DBM file format, which was used as a default database format in previous releases, does not support concurrent access to the same database by multiple processes and it has been deprecated in upstream. As a result, applications that use the NSS trust database to store keys, certificates, and revocation information now create databases in the SQL format by default. Attempts to create databases in the legacy DBM format fail. The existing DBM databases are opened in read-only mode, and they are automatically converted to the SQL format. Note that NSS support the SQL file format since Red Hat Enterprise Linux 6.

8.2. SSH

8.2.1. OpenSSH rebased to version 7.8p1

The **openssh** packages have been upgraded to upstream version 7.8p1. Notable changes include:

- Removed support for the **SSH version 1** protocol.
- Removed support for the **hmac-ripemd160** message authentication code.
- Removed support for RC4 (**arcfour**) ciphers.
- Removed support for **Blowfish** ciphers.
- Removed support for **CAST** ciphers.
- Changed the default value of the **UseDNS** option to **no**.
- Disabled **DSA** public key algorithms by default.
- Changed the minimal modulus size for **Diffie-Hellman** parameters to 2048 bits.
- Changed semantics of the **ExposeAuthInfo** configuration option.
- The **UsePrivilegeSeparation=sandbox** option is now mandatory and cannot be disabled.
- Set the minimal accepted **RSA** key size to 1024 bits.

8.2.2. libssh implements SSH as a core cryptographic component

This change introduces **libssh** as a core cryptographic component in Red Hat Enterprise Linux 8. The **libssh** library implements the Secure SHell (SSH) protocol.

Note that **libssh** does not comply with the system-wide crypto policy.

8.2.3. libssh2 is not available in RHEL 8

The deprecated **libssh2** library misses features, such as support for elliptic curves or Generic Security Service Application Program Interface (GSSAPI), and it has been removed from RHEL 8 in favor of **libssh**

8.3. RSYSLOG

8.3.1. The default rsyslog configuration file format is now non-legacy

The configuration files in the **rsyslog** packages now use the non-legacy format by default. The legacy format can be still used, however, mixing current and legacy configuration statements has several constraints. Configurations carried from previous RHEL releases should be revised. See the **rsyslog.conf(5)** man page for more information.

8.3.2. The imjournal option and configuring system logging with minimized journald usage

To avoid duplicate records that might appear when **journald** rotated its files, the **imjournal** option has been added. Note that use of this option can affect performance.

Note that the system with **rsyslog** can be configured to provide better performance as described in the Configuring system logging without journald or with minimized journald usage Knowledgebase article.

8.3.3. Negative effects of the default logging setup on performance

The default logging environment setup might consume 4 GB of memory or even more and adjustments of rate-limit values are complex when **systemd-journald** is running with **rsyslog**.

See the Negative effects of the RHEL default logging setup on performance and their mitigations Knowledgebase article for more information.

8.4. OPENSCAP

8.4.1. OpenSCAP API consolidated

This update provides OpenSCAP shared library API that has been consolidated. 63 symbols have been removed, 14 added, and 4 have an updated signature. The removed symbols in OpenSCAP 1.3.0 include:

- symbols that were marked as deprecated in version 1.2.0
- SEAP protocol symbols
- internal helper functions
- unused library symbols
- unimplemented symbols

8.4.2. A utility for security and compliance scanning of containers is not available

In Red Hat Enterprise Linux 7, the **oscap-docker** utility can be used for scanning of Docker containers based on Atomic technologies. In Red Hat Enterprise Linux 8, the Docker- and Atomic-related **OpenSCAP** commands are not available. As a result, **oscap-docker** or an equivalent utility for security and compliance scanning of containers is not available in RHEL 8 at the moment.

8.5. AUDIT

8.5.1. Audit 3.0 replaces **audispd** with **auditd**

With this update, functionality of **audispd** has been moved to **auditd**. As a result, **audispd** configuration options are now part of **auditd.conf**. In addition, the **plugins.d** directory has been moved under **/etc/audit**. The current status of **auditd** and its plug-ins can now be checked by running the **service auditd state** command.

8.6. SELINUX

8.6.1. New SELinux booleans

This update of the SELinux system policy introduces the following booleans:

- colord_use_nfs
- mysql_connect_http
- pdns_can_network_connect_db
- ssh_use_tcpd
- sslh_can_bind_any_port
- sslh_can_connect_any_port
- virt_use_pcscd

To get a list of booleans including their meaning, and to find out if they are enabled or disabled, install the **selinux-policy-devel** package and use:

```
# semanage boolean -l
```

8.6.2. SELinux packages migrated to Python 3

The functionality of the **libselinux-python** package is now provided by the **python3-libselinux** package, and the **policycoreutils-python** has been replaced by the **policycoreutils-python-utils** and **python3-policycoreutils** packages.

8.7. REMOVED SECURITY FUNCTIONALITY

8.7.1. **shadow-utils** no longer allow all-numeric user and group names

The **useradd** and **groupadd** commands disallow user and group names consisting purely of numeric characters. The reason for not allowing such names is that this can confuse potentially many tools that work with user and group names and user and group ids (which are numbers). Please note that the all-numeric user and group names are deprecated in Red Hat Enterprise Linux 7 and their support is completely removed in Red Hat Enterprise Linux 8.

8.7.2. **securetty** is now disabled by default

Because of the dynamic nature of **tty** device files on modern Linux systems, the **securetty** PAM module has been disabled by default and the **/etc/securetty** configuration file is no longer included in RHEL. Since **/etc/securetty** listed many possible devices so that the practical effect in most cases was to allow

by default, this change has only a minor impact. However, if you use a more restrictive configuration, you need to add a line enabling the **pam_securetty.so** module to the appropriate files in the **/etc/pam.d** directory, and create a new **/etc/securetty** file.

8.7.3. The Clevis HTTP pin has been removed

The **Clevis** HTTP pin has been removed from RHEL 8, and the **clevis encrypt http** sub-command is no longer available.

8.7.4. Coolkey has been removed

The **Coolkey** driver for smart cards has been removed from RHEL 8, and **OpenSC** now provides its functionality.

8.7.5. crypto-utils have been removed

The **crypto-utils** packages have been removed from RHEL 8. You can use tools provided by the **openssl**, **gnutls-utils**, and **nss-tools** packages instead.

CHAPTER 9. NETWORKING

9.1. NETWORKMANAGER

9.1.1. Legacy network scripts support

Network scripts are deprecated in Red Hat Enterprise Linux 8 and are no longer provided by default. The basic installation provides a new version of the **ifup** and **ifdown** scripts which call **NetworkManager** through the **nmcli** tool. In Red Hat Enterprise Linux 8, to run the **ifup** and the **ifdown** scripts, **NetworkManager** must be running.

NOTE

Custom commands in /**sbin**/**ifup-local**, **ifdown-pre-local** and **ifdown-local** scripts are not executed.

If any of these scripts are required, the installation of the deprecated network scripts in the system is still possible with the following command:

```
~]# yum install network-scripts
```

The **ifup** and the **ifdown** scripts link to the installed legacy network scripts.

Calling the legacy network scripts shows a warning about their deprecation.

9.1.2. NetworkManager supports SR-IOV virtual functions

In Red Hat Enterprise Linux 8, **NetworkManager** allows configuring the number of virtual functions (VF) for interfaces that support single-root I/O virtualization (SR-IOV). Additionally, **NetworkManager** allows configuring some attributes of the VFs, such as the MAC address, VLAN, the **spoof checking** setting and allowed bitrates. Note that all properties related to SR-IOV are available in the **sriov** connection setting. For more details, see the **nm-settings(5)** man page.

9.1.3. NetworkManager supports a wildcard interface name match for connections

Previously, it was possible to restrict a connection to a given interface using only an exact match on the interface name. With this update, connections have a new match.interface-name property which supports wildcards. This update enables users to choose the interface for a connection in a more flexible way using a wildcard pattern.

9.1.4. NetworkManager supports configuring ethtool offload features

With this enhancement, **NetworkManager** supports configuring **ethtool** offload features, and users no longer need to use init scripts or a **NetworkManager** dispatcher script. As a result, users can now configure the offload feature as a part of the connection profile using one of the following methods:

- By using the **nmcli** utility
- By editing key files in the /**etc**/**NetworkManager**/**system-connections**/ directory
- By editing the /**etc**/**sysconfig**/**network-scripts**/**ifcfg-*** files

Note that this feature is currently not supported in graphical interfaces and in the **nmtui** utility.

9.1.5. NetworkManager now uses the internal DHCP plug-in by default

NetworkManager supports the **internal** and **dhclient** DHCP plug-ins. By default, **NetworkManager** in Red Hat Enterprise Linux (RHEL) 7 uses the **dhclient** and RHEL 8 the **internal** plug-in. In certain situations, the plug-ins behave differently. For example, **dhclient** can use additional settings specified in the **/etc/dhcp/** directory.

If you upgrade from RHEL 7 to RHEL 8 and **NetworkManager** behaves different, add the following setting to the **[main]** section in the **/etc/NetworkManager/NetworkManager.conf** file to use the **dhclient** plug-in:

```
[main]
dhcp=dhclient
```

9.1.6. The NetworkManager-config-server package is not installed by default in RHEL 8

The **NetworkManager-config-server** package is not installed by default in Red Hat Enterprise Linux 8. To install it, use the **yum install NetworkManager-config-server** command.

9.2. PACKET FILTERING

9.2.1. nftables replaces iptables as the default network packet filtering framework

The **nftables** framework provides packet classification facilities and it is the designated successor to the **iptables**, **ip6tables**, **arptables**, and **ebtables** tools. It offers numerous improvements in convenience, features, and performance over previous packet-filtering tools, most notably:

- lookup tables instead of linear processing
- a single framework for both the **IPv4** and **IPv6** protocols
- rules all applied atomically instead of fetching, updating, and storing a complete ruleset
- support for debugging and tracing in the ruleset (**nftrace**) and monitoring trace events (in the **nft** tool)
- more consistent and compact syntax, no protocol-specific extensions
- a Netlink API for third-party applications

Similarly to **iptables**, **nftables** use tables for storing chains. The chains contain individual rules for performing actions. The **nft** tool replaces all tools from the previous packet-filtering frameworks. The **libnftables** library can be used for low-level interaction with **nftables** Netlink API over the **libmnl** library.

The **iptables**, **ip6tables**, **ebtables** and **arptables** tools are replaced by nftables-based drop-in replacements with the same name. While external behavior is identical to their legacy counterparts, internally they use **nftables** with legacy **netfilter** kernel modules through a compatibility interface where required.

Effect of the modules on the **nftables** ruleset can be observed using the **nft list ruleset** command. Since these tools add tables, chains, and rules to the **nftables** ruleset, be aware that **nftables** rule-set operations, such as the **nft flush ruleset** command, might affect rule sets installed using the formerly separate legacy commands.

To quickly identify which variant of the tool is present, version information has been updated to include the back-end name. In RHEL 8, the nftables-based **iptables** tool prints the following version string:

```
$ iptables --version
iptables v1.8.0 (nf_tables)
```

For comparison, the following version information is printed if legacy **iptables** tool is present:

```
$ iptables --version
iptables v1.8.0 (legacy)
```

9.2.2. Arptables FORWARD is removed from filter tables in RHEL 8

The **arptables** FORWARD chain functionality has been removed in Red Hat Enterprise Linux (RHEL) 8. You can now use the FORWARD chain of the **ebtables** tool adding the rules into it.

9.2.3. Output of iptables-ebtables is not 100% compatible with ebtables

In RHEL 8, the **ebtables** command is provided by the **iptables-ebtables** package, which contains an **nftables**-based reimplementation of the tool. This tool has a different code base, and its output deviates in aspects, which are either negligible or deliberate design choices.

Consequently, when migrating your scripts parsing some **ebtables** output, adjust the scripts to reflect the following:

- MAC address formatting has been changed to be fixed in length. Where necessary, individual byte values contain a leading zero to maintain the format of two characters per octet.
- Formatting of IPv6 prefixes has been changed to conform with RFC 4291. The trailing part after the slash character no longer contains a netmask in the IPv6 address format but a prefix length. This change applies to valid (left-contiguous) masks only, while others are still printed in the old formatting.

9.2.4. New tools to convert iptables to nftables

This update adds the **iptables-translate** and **ip6tables-translate** tools to convert the existing **iptables** or **ip6tables** rules into the equivalent ones for **nftables**. Note that some extensions lack translation support. If such an extension exists, the tool prints the untranslated rule prefixed with the **#** sign. For example:

```
| % iptables-translate -A INPUT -j CHECKSUM --checksum-fill
| nft # -A INPUT -j CHECKSUM --checksum-fill
```

Additionally, users can use the **iptables-restore-translate** and **ip6tables-restore-translate** tools to translate a dump of rules. Note that before that, users can use the **iptables-save** or **ip6tables-save** commands to print a dump of current rules. For example:

```
| % sudo iptables-save >/tmp/iptables.dump
| % iptables-restore-translate -f /tmp/iptables.dump
| # Translated by iptables-restore-translate v1.8.0 on Wed Oct 17 17:00:13 2018
| add table ip nat
| ...
```

9.3. CHANGES IN WPA_SUPPLICANT

9.3.1. journalctl can now read the wpa_supplicant log

In Red Hat Enterprise Linux (RHEL) 8, the **wpa_supplicant** package is built with **CONFIG_DEBUG_SYSLOG** enabled. This allows reading the **wpa_supplicant** log using the **journalctl** utility instead of checking the contents of the **/var/log/wpa_supplicant.log** file.

9.3.2. The compile-time support for wireless extensions in wpa_supplicant is disabled

The **wpa_supplicant** package does not support wireless extensions. When a user is trying to use **wext** as a command-line argument, or trying to use it on old adapters which only support wireless extensions, will not be able to run the **wpa_supplicant** daemon.

9.4. A NEW DATA CHUNK TYPE, I-DATA, ADDED TO SCTP

This update adds a new data chunk type, **I-DATA**, and stream schedulers to the Stream Control Transmission Protocol (SCTP). Previously, SCTP sent user messages in the same order as they were sent by a user. Consequently, a large SCTP user message blocked all other messages in any stream until completely sent. When using **I-DATA** chunks, the Transmission Sequence Number (TSN) field is not overloaded. As a result, SCTP now can schedule the streams in different ways, and **I-DATA** allows user messages interleaving (RFC 8260). Note that both peers must support the **I-DATA** chunk type.

9.5. NOTABLE TCP FEATURES IN RHEL 8

Red Hat Enterprise Linux 8 is distributed with TCP networking stack version 4.18, which provides higher performances, better scalability, and more stability. Performances are boosted especially for busy TCP server with a high ingress connection rate.

Additionally, two new TCP congestion algorithms, **BBR** and **NV**, are available, offering lower latency, and better throughput than cubic in most scenarios.

9.5.1. TCP BBR support in RHEL 8

A new TCP congestion control algorithm, Bottleneck Bandwidth and Round-trip time (BBR) is now supported in Red Hat Enterprise Linux (RHEL) 8. BBR attempts to determine the bandwidth of the bottleneck link and the Round-trip time (RTT). Most congestion algorithms are based on packet loss (including CUBIC, the default Linux TCP congestion control algorithm), which have problems on high-throughput links. BBR does not react to loss events directly, it adjusts the TCP pacing rate to match it with the available bandwidth. Users of TCP BBR should switch to the **fq** queueing setting on all the involved interfaces.

Note that users should explicitly use **fq** and not **fq_codel**.

For more details, see the **tc-fq** man page.

9.6. IPVLAN VIRTUAL NETWORK DRIVERS ARE NOW SUPPORTED

In Red Hat Enterprise Linux 8.0, the kernel includes support for IPVLAN virtual network drivers. With this update, IPVLAN virtual Network Interface Cards (NICs) enable the network connectivity for multiple containers exposing a single MAC address to the local network. This allows a single host to have a lot of containers overcoming the possible limitation on the number of MAC addresses supported by the peer networking equipment.

9.7. THE -OK OPTION OF THE TC COMMAND REMOVED

The **-ok** option of the **tc** command has been removed in Red Hat Enterprise Linux 8. As a workaround, users can implement code to communicate directly via netlink with the kernel. Response messages received, indicate completion and status of sent requests. An alternative way for less time-critical applications is to call **tc** for each command separately. This may happen with a custom script which simulates the **tc -batch** behavior by printing **OK** for each successful **tc** invocation.

CHAPTER 10. KERNEL

10.1. RESOURCE CONTROL

10.1.1. Control group v2 available as a Technology Preview in RHEL 8

Control group v2 mechanism is a unified hierarchy control group. **Control group v2** organizes processes hierarchically and distributes system resources along the hierarchy in a controlled and configurable manner.

Unlike the previous version, **control group v2** has only a single hierarchy. This single hierarchy enables the Linux kernel to:

- Categorize processes based on the role of their owner.
- Eliminate issues with conflicting policies of multiple hierarchies.

Control group v2 supports numerous controllers:

- CPU controller regulates the distribution of CPU cycles. This controller implements:
  - Weight and absolute bandwidth limit models for normal scheduling policy.
  - Absolute bandwidth allocation model for real time scheduling policy.
- Memory controller regulates the memory distribution. Currently, the following types of memory usages are tracked:
  - Userland memory - page cache and anonymous memory.
  - Kernel data structures such as dentries and inodes.
  - TCP socket buffers.
- I/O controller regulates the distribution of I/O resources.
- Remote Direct Memory Access (RDMA) controller limits RDMA/IB specific resources that certain processes can use. These processes are grouped through the RDMA controller.
- Process number controller enables the control group to stop any new tasks from being **fork()**'d or **clone()**'d after a certain limit.
- Writeback controller acts as a mechanism, which balances conflicts between I/O and the memory controllers.

The information above was based on *cgroups-v2 online documentation*. You can refer to the same link to obtain more information about particular **control group v2** controllers.

10.2. MEMORY MANAGEMENT

10.2.1. 52-bit PA for 64-bit ARM available

With this update, support for 52-bit physical addressing (PA) for the 64-bit ARM architecture is available. This provides a larger physical address space than previous 48-bit PA.

10.2.2. 5-level page tables x86_64

With Red Hat Enterprise Linux 7, existing memory bus had 48/46 bit of virtual/physical memory addressing capacity, and the Linux kernel implemented 4 levels of page tables to manage these virtual addresses to physical addresses. The physical bus addressing line put the physical memory upper limit capacity at 64 TB.

These limits have been extended to 57/52 bit of virtual/physical memory addressing with 128 PiB of virtual address space (64PB user/64PB kernel) and 4 PB of physical memory capacity.

With the extended address range, the memory management in Red Hat Enterprise Linux 8 adds support for 5-level page table implementation, to be able to handle the expanded address range. By default RHEL8 will disable the 5-level page table support even on systems that support this feature. This is due to a potential performance degradation when using 5 level of page tables if extended virtual or physical address space is not needed. A boot argument will enable systems with hardware that supports this feature to use it.

10.3. PERFORMANCE ANALYSIS AND OBSERVABILITY TOOLS

10.3.1. bpftool added to kernel

The **bpftool** utility that serves for inspection and simple manipulation of programs and maps based on extended Berkeley Packet Filtering (eBPF) has been added into the Linux kernel. **bpftool** is a part of the kernel source tree, and is provided by the **bpftool** package, which is included as a sub-package of the **kernel** package.

10.3.2. eBPF available as a Technology Preview

The **extended Berkeley Packet Filtering (eBPF)**feature is available as a Technology Preview for both networking and tracing. **eBPF** enables the user space to attach custom programs onto a variety of points (sockets, trace points, packet reception) to receive and process data. The feature includes a new system call **bpf()**, which supports creating various types of maps, and also to insert various types of programs into the kernel. Note that the **bpf()** syscall can be successfully used only by a user with the **CAP_SYS_ADMIN** capability, such as a root user. See the **bpf**(2) man page for more information.

10.3.3. BCC is available as a Technology Preview

BPF Compiler Collection (BCC) is a user space tool kit for creating efficient kernel tracing and manipulation programs that is available as a Technology Preview in Red Hat Enterprise Linux 8. **BCC** provides tools for I/O analysis, networking, and monitoring of Linux operating systems using the **extended Berkeley Packet Filtering (eBPF)**.

10.4. BOOTING PROCESS

10.4.1. How to install and boot custom kernels in RHEL 8

The Boot Loader Specification (BLS) defines a scheme and file format to manage bootloader configurations for each boot option in a drop-in directory. There is no need to manipulate the individual drop-in configuration files. This premise is particularly relevant in Red Hat Enterprise Linux 8 because not all architectures use the same bootloader:

- **x86_64**, **aarch64** and **ppc64le** with open firmware use **GRUB2**

- **ppc64le** with Open Power Abstraction Layer (OPAL) uses **Petitboot**
- **s390x** uses **zipl**

Each bootloader has a different configuration file and format that has to be modified when a new kernel is installed or removed. In the previous versions of Red Hat Enterprise Linux the component that permitted this work was the **grubby** utility. However, for Red Hat Enterprise Linux 8 the bootloader configuration was standardized by implementing the BLS file format, where **grubby** works as a thin wrapper around the BLS operations.

CHAPTER 11. HARDWARE ENABLEMENT

11.1. REMOVED HARDWARE SUPPORT

This section lists device drivers and adapters that were supported in RHEL 7 but are no longer available in RHEL 8.0.

11.1.1. Removed device drivers

Support for the following device drivers has been removed in RHEL 8:

- 3w-9xxx
- 3w-sas
- aic79xx
- aoe
- arcmsr
- ata drivers:
  - acard-ahci
  - sata_mv
  - sata_nv
  - sata_promise
  - sata_qstor
  - sata_sil
  - sata_sil24
  - sata_sis
  - sata_svw
  - sata_sx4
  - sata_uli
  - sata_via
  - sata_vsc
- bfa
- cxgb3
- cxgb3i
- e1000

- floppy
- hptiop
- initio
- isci
- iw_cxgb3
- mptbase
- mptctl
- mptsas
- mptscsih
- mptspi
- mtip32xx
- mvsas
- mvumi
- OSD drivers:
  - osd
  - libosd
- osst
- pata drivers:
  - pata_acpi
  - pata_ali
  - pata_amd
  - pata_arasan_cf
  - pata_artop
  - pata_atiixp
  - pata_atp867x
  - pata_cmd64x
  - pata_cs5536
  - pata_hpt366
  - pata_hpt37x

    - pata_hpt3x2n
    - pata_hpt3x3
    - pata_it8213
    - pata_it821x
    - pata_jmicron
    - pata_marvell
    - pata_netcell
    - pata_ninja32
    - pata_oldpiix
    - pata_pdc2027x
    - pata_pdc202xx_old
    - pata_piccolo
    - pata_rdc
    - pata_sch
    - pata_serverworks
    - pata_sil680
    - pata_sis
    - pata_via
    - pdc_adma
- pm80xx(pm8001)
- pmcraid
- qla3xxx
- stex
- sx8
- tulip
- ufshcd
- wireless drivers:
    - carl9170
    - iwl4965

- iwl3945
- mwl8k
- rt73usb
- rt61pci
- rtl8187
- wil6210

11.1.2. Removed adapters

Support for the adapters listed below has been removed in RHEL 8. Support for other than listed adapters from the mentioned drivers remains unchanged.

PCI IDs are in the format of *vendor:device:subvendor:subdevice*. If the *subdevice* or *subvendor:subdevice* entry is not listed, devices with any values of such missing entries have been removed.

To check the PCI IDs of the hardware on your system, run the **lspci -nn** command.

- The following adapters from the **aacraid** driver have been removed:
  - PERC 2/Si (Iguana/PERC2Si), PCI ID 0x1028:0x0001:0x1028:0x0001
  - PERC 3/Di (Opal/PERC3Di), PCI ID 0x1028:0x0002:0x1028:0x0002
  - PERC 3/Si (SlimFast/PERC3Si), PCI ID 0x1028:0x0003:0x1028:0x0003
  - PERC 3/Di (Iguana FlipChip/PERC3DiF), PCI ID 0x1028:0x0004:0x1028:0x00d0
  - PERC 3/Di (Viper/PERC3DiV), PCI ID 0x1028:0x0002:0x1028:0x00d1
  - PERC 3/Di (Lexus/PERC3DiL), PCI ID 0x1028:0x0002:0x1028:0x00d9
  - PERC 3/Di (Jaguar/PERC3DiJ), PCI ID 0x1028:0x000a:0x1028:0x0106
  - PERC 3/Di (Dagger/PERC3DiD), PCI ID 0x1028:0x000a:0x1028:0x011b
  - PERC 3/Di (Boxster/PERC3DiB), PCI ID 0x1028:0x000a:0x1028:0x0121
  - catapult, PCI ID 0x9005:0x0283:0x9005:0x0283
  - tomcat, PCI ID 0x9005:0x0284:0x9005:0x0284
  - Adaptec 2120S (Crusader), PCI ID 0x9005:0x0285:0x9005:0x0286
  - Adaptec 2200S (Vulcan), PCI ID 0x9005:0x0285:0x9005:0x0285
  - Adaptec 2200S (Vulcan-2m), PCI ID 0x9005:0x0285:0x9005:0x0287
  - Legend S220 (Legend Crusader), PCI ID 0x9005:0x0285:0x17aa:0x0286
  - Legend S230 (Legend Vulcan), PCI ID 0x9005:0x0285:0x17aa:0x0287
  - Adaptec 3230S (Harrier), PCI ID 0x9005:0x0285:0x9005:0x0288

- Adaptec 3240S (Tornado), PCI ID 0x9005:0x0285:0x9005:0x0289
- ASR-2020ZCR SCSI PCI-X ZCR (Skyhawk), PCI ID 0x9005:0x0285:0x9005:0x028a
- ASR-2025ZCR SCSI SO-DIMM PCI-X ZCR (Terminator), PCI ID 0x9005:0x0285:0x9005:0x028b
- ASR-2230S + ASR-2230SLP PCI-X (Lancer), PCI ID 0x9005:0x0286:0x9005:0x028c
- ASR-2130S (Lancer), PCI ID 0x9005:0x0286:0x9005:0x028d
- AAR-2820SA (Intruder), PCI ID 0x9005:0x0286:0x9005:0x029b
- AAR-2620SA (Intruder), PCI ID 0x9005:0x0286:0x9005:0x029c
- AAR-2420SA (Intruder), PCI ID 0x9005:0x0286:0x9005:0x029d
- ICP9024RO (Lancer), PCI ID 0x9005:0x0286:0x9005:0x029e
- ICP9014RO (Lancer), PCI ID 0x9005:0x0286:0x9005:0x029f
- ICP9047MA (Lancer), PCI ID 0x9005:0x0286:0x9005:0x02a0
- ICP9087MA (Lancer), PCI ID 0x9005:0x0286:0x9005:0x02a1
- ICP5445AU (Hurricane44), PCI ID 0x9005:0x0286:0x9005:0x02a3
- ICP9085LI (Marauder-X), PCI ID 0x9005:0x0285:0x9005:0x02a4
- ICP5085BR (Marauder-E), PCI ID 0x9005:0x0285:0x9005:0x02a5
- ICP9067MA (Intruder-6), PCI ID 0x9005:0x0286:0x9005:0x02a6
- Themisto Jupiter Platform, PCI ID 0x9005:0x0287:0x9005:0x0800
- Themisto Jupiter Platform, PCI ID 0x9005:0x0200:0x9005:0x0200
- Callisto Jupiter Platform, PCI ID 0x9005:0x0286:0x9005:0x0800
- ASR-2020SA SATA PCI-X ZCR (Skyhawk), PCI ID 0x9005:0x0285:0x9005:0x028e
- ASR-2025SA SATA SO-DIMM PCI-X ZCR (Terminator), PCI ID 0x9005:0x0285:0x9005:0x028f
- AAR-2410SA PCI SATA 4ch (Jaguar II), PCI ID 0x9005:0x0285:0x9005:0x0290
- CERC SATA RAID 2 PCI SATA 6ch (DellCorsair), PCI ID 0x9005:0x0285:0x9005:0x0291
- AAR-2810SA PCI SATA 8ch (Corsair-8), PCI ID 0x9005:0x0285:0x9005:0x0292
- AAR-21610SA PCI SATA 16ch (Corsair-16), PCI ID 0x9005:0x0285:0x9005:0x0293
- ESD SO-DIMM PCI-X SATA ZCR (Prowler), PCI ID 0x9005:0x0285:0x9005:0x0294
- AAR-2610SA PCI SATA 6ch, PCI ID 0x9005:0x0285:0x103C:0x3227
- ASR-2240S (SabreExpress), PCI ID 0x9005:0x0285:0x9005:0x0296

- ASR-4005, PCI ID 0x9005:0x0285:0x9005:0x0297
- IBM 8i (AvonPark), PCI ID 0x9005:0x0285:0x1014:0x02F2
- IBM 8i (AvonPark Lite), PCI ID 0x9005:0x0285:0x1014:0x0312
- IBM 8k/8k-l8 (Aurora), PCI ID 0x9005:0x0286:0x1014:0x9580
- IBM 8k/8k-l4 (Aurora Lite), PCI ID 0x9005:0x0286:0x1014:0x9540
- ASR-4000 (BlackBird), PCI ID 0x9005:0x0285:0x9005:0x0298
- ASR-4800SAS (Marauder-X), PCI ID 0x9005:0x0285:0x9005:0x0299
- ASR-4805SAS (Marauder-E), PCI ID 0x9005:0x0285:0x9005:0x029a
- ASR-3800 (Hurricane44), PCI ID 0x9005:0x0286:0x9005:0x02a2
- Perc 320/DC, PCI ID 0x9005:0x0285:0x1028:0x0287
- Adaptec 5400S (Mustang), PCI ID 0x1011:0x0046:0x9005:0x0365
- Adaptec 5400S (Mustang), PCI ID 0x1011:0x0046:0x9005:0x0364
- Dell PERC2/QC, PCI ID 0x1011:0x0046:0x9005:0x1364
- HP NetRAID-4M, PCI ID 0x1011:0x0046:0x103c:0x10c2
- Dell Catchall, PCI ID 0x9005:0x0285:0x1028
- Legend Catchall, PCI ID 0x9005:0x0285:0x17aa
- Adaptec Catch All, PCI ID 0x9005:0x0285
- Adaptec Rocket Catch All, PCI ID 0x9005:0x0286
- Adaptec NEMER/ARK Catch All, PCI ID 0x9005:0x0288

- The following adapters from the **mpt2sas** driver have been removed:
  - SAS2004, PCI ID 0x1000:0x0070
  - SAS2008, PCI ID 0x1000:0x0072
  - SAS2108_1, PCI ID 0x1000:0x0074
  - SAS2108_2, PCI ID 0x1000:0x0076
  - SAS2108_3, PCI ID 0x1000:0x0077
  - SAS2116_1, PCI ID 0x1000:0x0064
  - SAS2116_2, PCI ID 0x1000:0x0065
  - SSS6200, PCI ID 0x1000:0x007E
- The following adapters from the **megaraid_sas** driver have been removed:
  - Dell PERC5, PCI ID 0x1028:0x15

    - SAS1078R, PCI ID 0x1000:0x60
    - SAS1078DE, PCI ID 0x1000:0x7C
    - SAS1064R, PCI ID 0x1000:0x411
    - VERDE_ZCR, PCI ID 0x1000:0x413
    - SAS1078GEN2, PCI ID 0x1000:0x78
    - SAS0079GEN2, PCI ID 0x1000:0x79
    - SAS0073SKINNY, PCI ID 0x1000:0x73
    - SAS0071SKINNY, PCI ID 0x1000:0x71
- The following adapters from the **qla2xxx** driver have been removed:
    - ISP24xx, PCI ID 0x1077:0x2422
    - ISP24xx, PCI ID 0x1077:0x2432
    - ISP2422, PCI ID 0x1077:0x5422
    - QLE220, PCI ID 0x1077:0x5432
    - QLE81xx, PCI ID 0x1077:0x8001
    - QLE10000, PCI ID 0x1077:0xF000
    - QLE84xx, PCI ID 0x1077:0x8044
    - QLE8000, PCI ID 0x1077:0x8432
    - QLE82xx, PCI ID 0x1077:0x8021
- The following adapters from the **qla4xxx** driver have been removed:
    - QLOGIC_ISP8022, PCI ID 0x1077:0x8022
    - QLOGIC_ISP8324, PCI ID 0x1077:0x8032
    - QLOGIC_ISP8042, PCI ID 0x1077:0x8042
- The following adapters from the **be2iscsi** driver have been removed:
    - BladeEngine 2 (BE2) devices
        - BladeEngine2 10Gb iSCSI Initiator (generic), PCI ID 0x19a2:0x212
        - OneConnect OCe10101, OCm10101, OCe10102, OCm10102 BE2 adapter family, PCI ID 0x19a2:0x702
        - OCe10100 BE2 adapter family, PCI ID 0x19a2:0x703
    - BladeEngine 3 (BE3) devices
        - OneConnect TOMCAT iSCSI, PCI ID 0x19a2:0x0712

        - BladeEngine3 iSCSI, PCI ID 0x19a2:0x0222

- The following Ethernet adapters controlled by the **be2net** driver have been removed:
    - BladeEngine 2 (BE2) devices
        - OneConnect TIGERSHARK NIC, PCI ID 0x19a2:0x0700
        - BladeEngine2 Network Adapter, PCI ID 0x19a2:0x0211
    - BladeEngine 3 (BE3) devices
        - OneConnect TOMCAT NIC, PCI ID 0x19a2:0x0710
        - BladeEngine3 Network Adapter, PCI ID 0x19a2:0x0221
- The following adapters from the **lpfc** driver have been removed:
    - BladeEngine 2 (BE2) devices
        - OneConnect TIGERSHARK FCoE, PCI ID 0x19a2:0x0704
    - BladeEngine 3 (BE3) devices
        - OneConnect TOMCAT FCoE, PCI ID 0x19a2:0x0714
    - Fibre Channel (FC) devices
        - FIREFLY, PCI ID 0x10df:0x1ae5
        - PROTEUS_VF, PCI ID 0x10df:0xe100
        - BALIUS, PCI ID 0x10df:0xe131
        - PROTEUS_PF, PCI ID 0x10df:0xe180
        - RFLY, PCI ID 0x10df:0xf095
        - PFLY, PCI ID 0x10df:0xf098
        - LP101, PCI ID 0x10df:0xf0a1
        - TFLY, PCI ID 0x10df:0xf0a5
        - BSMB, PCI ID 0x10df:0xf0d1
        - BMID, PCI ID 0x10df:0xf0d5
        - ZSMB, PCI ID 0x10df:0xf0e1
        - ZMID, PCI ID 0x10df:0xf0e5
        - NEPTUNE, PCI ID 0x10df:0xf0f5
        - NEPTUNE_SCSP, PCI ID 0x10df:0xf0f6
        - NEPTUNE_DCSP, PCI ID 0x10df:0xf0f7
        - FALCON, PCI ID 0x10df:0xf180

        - SUPERFLY, PCI ID 0x10df:0xf700
        - DRAGONFLY, PCI ID 0x10df:0xf800
        - CENTAUR, PCI ID 0x10df:0xf900
        - PEGASUS, PCI ID 0x10df:0xf980
        - THOR, PCI ID 0x10df:0xfa00
        - VIPER, PCI ID 0x10df:0xfb00
        - LP10000S, PCI ID 0x10df:0xfc00
        - LP11000S, PCI ID 0x10df:0xfc10
        - LPE11000S, PCI ID 0x10df:0xfc20
        - PROTEUS_S, PCI ID 0x10df:0xfc50
        - HELIOS, PCI ID 0x10df:0xfd00
        - HELIOS_SCSP, PCI ID 0x10df:0xfd11
        - HELIOS_DCSP, PCI ID 0x10df:0xfd12
        - ZEPHYR, PCI ID 0x10df:0xfe00
        - HORNET, PCI ID 0x10df:0xfe05
        - ZEPHYR_SCSP, PCI ID 0x10df:0xfe11
        - ZEPHYR_DCSP, PCI ID 0x10df:0xfe12
    - Lancer FCoE CNA devices
        - OCe15104-FM, PCI ID 0x10df:0xe260
        - OCe15102-FM, PCI ID 0x10df:0xe260
        - OCm15108-F-P, PCI ID 0x10df:0xe260

11.1.3. Other removed hardware support

11.1.3.1. FCoE software removal

Fibre Channel over Ethernet (FCoE) software has been removed from Red Hat Enterprise Linux 8. Specifically, the **fcoe.ko** kernel module is no longer available for creating software FCoE interfaces over Ethernet adapters and drivers. This change is due to a lack of industry adoption for software-managed FCoE.

Specific changes to Red Hat Enterprise 8 include:

- The **fcoe.ko** kernel module is no longer available. This removes support for software FCoE with Data Center Bridging enabled Ethernet adapters and drivers.

- Link-level software configuration via Data Center Bridging eXchange (DCBX) using **lldpad** is no longer supported for FCoE.
  - The **fcoe-utils** tools (specifically **fcoemon**) is configured by default to not validate DCB configuration or communicate with **lldpad**.
  - The **lldpad** integration in **fcoemon** might be permanently disabled.
- The **libhbaapi** and **libhbalinux** libraries are no longer used by **fcoe-utils**, and will not undergo any direct testing from Red Hat.

Support for the following remains unchanged:

- Currently supported offloading FCoE adapters that appear as Fibre Channel adapters to the operating system and do not use the **fcoe-utils** management tools, unless stated in a separate note. This applies to select adapters supported by the **lpfc** FC driver. Note that the **bfa** driver is not included in Red Hat Enterprise Linux 8.
- Currently supported offloading FCoE adapters that do use the **fcoe-utils** management tools but have their own kernel drivers instead of **fcoe.ko** and manage DCBX configuration in their drivers and/or firmware, unless stated in a separate note. The **fnic**, **bnx2fc**, and **qedf** drivers will continue to be fully supported in Red Hat Enterprise Linux 8.
- The **libfc.ko** and **libfcoe.ko** kernel modules that are required for some of the supported drivers covered by the previous statement.

For more information, see Section 12.2.8, “Software FCoE and Fibre Channel no longer support the target mode”.

11.1.3.2. The e1000 network driver is not supported in RHEL 8

In Red Hat Enterprise Linux 8, the **e1000** network driver is not supported. This affects both bare metal and virtual environments. However, the newer **e1000e** network driver continues to be fully supported in RHEL 8.

11.1.3.3. RHEL 8 does not support the tulip driver

With this update, the **tulip** network driver is no longer supported. As a consequence, when using RHEL 8 on a Generation 1 virtual machine (VM) on the Microsoft Hyper-V hypervisor, the "Legacy Network Adapter" device does not work, which causes PXE installation of such VMs to fail.

For the PXE installation to work, install RHEL 8 on a Generation 2 Hyper-V VM. If you require a RHEL 8 Generation 1 VM, use ISO installation.

11.1.3.4. The qla2xxx driver no longer supports target mode

Support for target mode with the **qla2xxx** QLogic Fibre Channel driver has been disabled. The effects of this change are:

- The kernel no longer provides the **tcm_qla2xxx** module.
- The **rtslib** library and the **targetcli** utility no longer support **qla2xxx**.

Initiator mode with **qla2xxx** is still supported.

CHAPTER 12. FILE SYSTEMS AND STORAGE

12.1. FILE SYSTEMS

12.1.1. Btrfs has been removed

The Btrfs file system has been removed in Red Hat Enterprise Linux 8. This includes the following components:

- The **btrfs.ko** kernel module
- The **btrfs-progs** package
- The **snapper** package

You can no longer create, mount, or install on Btrfs file systems in Red Hat Enterprise Linux 8. The Anaconda installer and the Kickstart commands no longer support Btrfs.

12.1.2. XFS now supports shared copy-on-write data extents

The XFS file system supports shared copy-on-write data extent functionality. This feature enables two or more files to share a common set of data blocks. When either of the files sharing common blocks changes, XFS breaks the link to common blocks and creates a new file. This is similar to the copy-on-write (COW) functionality found in other file systems.

Shared copy-on-write data extents are:

Fast

Creating shared copies does not utilize disk I/O.

Space-efficient

Shared blocks do not consume additional disk space.

Transparent

Files sharing common blocks act like regular files.

Userspace utilities can use shared copy-on-write data extents for:

- Efficient file cloning, such as with the **cp --reflink** command
- Per-file snapshots

This functionality is also used by kernel subsystems such as Overlayfs and NFS for more efficient operation.

Shared copy-on-write data extents are now enabled by default when creating an XFS file system, starting with the **xfsprogs** package version **4.17.0-2.el8**.

Note that Direct Access (DAX) devices currently do not support XFS with shared copy-on-write data extents. To create an XFS file system without this feature, use the following command:

```
# mkfs.xfs -m reflink=0 block-device
```

Red Hat Enterprise Linux 7 can mount XFS file systems with shared copy-on-write data extents only in the read-only mode.

12.1.3. The ext4 file system now supports metadata checksums

With this update, ext4 metadata is protected by checksums. This enables the file system to recognize the corrupt metadata, which avoids damage and increases the file system resilience.

12.1.4. The /etc/sysconfig/nfs file and legacy NFS service names are no longer available

In Red Hat Enterprise Linux 8.0, the NFS configuration has moved from the **/etc/sysconfig/nfs** configuration file, which was used in Red Hat Enterprise Linux 7, to **/etc/nfs.conf**.

The **/etc/nfs.conf** file uses a different syntax. Red Hat Enterprise Linux 8 attempts to automatically convert all options from **/etc/sysconfig/nfs** to **/etc/nfs.conf** when upgrading from Red Hat Enterprise Linux 7.

Both configuration files are supported in Red Hat Enterprise Linux 7. Red Hat recommends that you use the new **/etc/nfs.conf** file to make NFS configuration in all versions of Red Hat Enterprise Linux compatible with automated configuration systems.

Additionally, the following NFS service aliases have been removed and replaced by their upstream names:

- **nfs.service**, replaced by **nfs-server.service**
- **nfs-secure.service**, replaced by **rpc-gssd.service**
- **rpcgssd.service**, replaced by **rpc-gssd.service**
- **nfs-idmap.service**, replaced by **nfs-idmapd.service**
- **rpcidmapd.service**, replaced by **nfs-idmapd.service**
- **nfs-lock.service**, replaced by **rpc-statd.service**
- **nfslock.service**, replaced by **rpc-statd.service**

12.2. STORAGE

12.2.1. The BOOM boot manager simplifies the process of creating boot entries

BOOM is a boot manager for Linux systems that use boot loaders supporting the BootLoader Specification for boot entry configuration. It enables flexible boot configuration and simplifies the creation of new or modified boot entries: for example, to boot snapshot images of the system created using LVM.

BOOM does not modify the existing boot loader configuration, and only inserts additional entries. The existing configuration is maintained, and any distribution integration, such as kernel installation and update scripts, continue to function as before.

BOOM has a simplified command-line interface (CLI) and API that ease the task of creating boot entries.

12.2.2. Stratis is now available

Stratis is a new local storage manager. It provides managed file systems on top of pools of storage with additional features to the user.

Stratis enables you to more easily perform storage tasks such as:

- Manage snapshots and thin provisioning
- Automatically grow file system sizes as needed
- Maintain file systems

To administer Stratis storage, use the **stratis** utility, which communicates with the **stratisd** background service.

Stratis is provided as a Technology Preview.

For more information, see the Stratis documentation: Managing layered local storage with Stratis .

12.2.3. LUKS2 is now the default format for encrypting volumes

In RHEL 8, the LUKS version 2 (LUKS2) format replaces the legacy LUKS (LUKS1) format. The **dm-crypt** subsystem and the **cryptsetup** tool now uses LUKS2 as the default format for encrypted volumes. LUKS2 provides encrypted volumes with metadata redundancy and auto-recovery in case of a partial metadata corruption event.

Due to the internal flexible layout, LUKS2 is also an enabler of future features. It supports auto-unlocking through the generic kernel-keyring token built in **libcryptsetup** that allow users unlocking of LUKS2 volumes using a passphrase stored in the kernel-keyring retention service.

Other notable enhancements include:

- The protected key setup using the wrapped key cipher scheme.
- Easier integration with Policy-Based Decryption (Clevis).
- Up to 32 key slots - LUKS1 provides only 8 key slots.

For more details, see the **cryptsetup(8)** and **cryptsetup-reencrypt(8)** man pages.

12.2.4. Multiqueue scheduling on block devices

Block devices now use multiqueue scheduling in Red Hat Enterprise Linux 8. This enables the block layer performance to scale well with fast solid-state drives (SSDs) and multi-core systems.

The SCSI Multiqueue (**scsi-mq**) driver is now enabled by default, and the kernel boots with the **scsi_mod.use_blk_mq=Y** option. This change is consistent with the upstream Linux kernel.

Device Mapper Multipath (DM Multipath) requires the **scsi-mq** driver to be active.

12.2.5. VDO now supports all architectures

Virtual Data Optimizer (VDO) is now available on all of the architectures supported by RHEL 8.

12.2.6. VDO no longer supports read cache

The read cache functionality has been removed from Virtual Data Optimizer (VDO). The read cache is always disabled on VDO volumes, and you can no longer enable it using the **--readCache** option of the **vdo** utility.

Red Hat might reintroduce the VDO read cache in a later Red Hat Enterprise Linux release, using a different implementation.

12.2.7. The dmraid package has been removed

The **dmraid** package has been removed from Red Hat Enterprise Linux 8. Users requiring support for combined hardware and software RAID host bus adapters (HBA) should use the **mdadm** utility, which supports native MD software RAID, the SNIA RAID Common Disk Data Format (DDF), and the Intel® Matrix Storage Manager (IMSM) formats.

12.2.8. Software FCoE and Fibre Channel no longer support the target mode

- Software FCoE: NIC Software FCoE target functionality is removed in Red Hat Enterprise Linux 8.0.
- Fibre Channel no longer supports the target mode. Target mode is disabled for the **qla2xxx** QLogic Fibre Channel driver in Red Hat Enterprise Linux 8.0.

For more information, see Section 11.1.3.1, “FCoE software removal” .

12.2.9. The detection of marginal paths in DM Multipath has been improved

The **multipathd** service now supports improved detection of marginal paths. This helps multipath devices avoid paths that are likely to fail repeatedly, and improves performance. Marginal paths are paths with persistent but intermittent I/O errors.

The following options in the **/etc/multipath.conf** file control marginal paths behavior:

- **marginal_path_double_failed_time**
- **marginal_path_err_sample_time**
- **marginal_path_err_rate_threshold**
- **marginal_path_err_recheck_gap_time**

DM Multipath disables a path and tests it with repeated I/O for the configured sample time if:

- the listed **multipath.conf** options are set,
- a path fails twice in the configured time, and
- other paths are available.

If the path has more than the configured err rate during this testing, DM Multipath ignores it for the configured gap time, and then retests it to see if it is working well enough to be reinstated.

For more information, see the **multipath.conf** man page.

12.2.10. New overrides section of the DM Multipath configuration file

The **/etc/multipath.conf** file now includes an **overrides** section that allows you to set a configuration value for all of your devices. These attributes are used by DM Multipath for all devices unless they are overwritten by the attributes specified in the **multipaths** section of the **/etc/multipath.conf** file for

paths that contain the device. This functionality replaces the **all_devs** parameter of the **devices** section of the configuration file, which is no longer supported.

12.2.11. NVMe/FC is fully supported on Broadcom Emulex and Marvell Qlogic Fibre Channel adapters

The NVMe over Fibre Channel (NVMe/FC) transport type is now fully supported in Initiator mode when used with Broadcom Emulex and Marvell Qlogic Fibre Channel 32Gbit adapters that feature NVMe support.

NVMe over Fibre Channel is an additional fabric transport type for the Nonvolatile Memory Express (NVMe) protocol, in addition to the Remote Direct Memory Access (RDMA) protocol that was previously introduced in Red Hat Enterprise Linux.

Enabling NVMe/FC:

- To enable NVMe/FC in the **lpfc** driver, edit the **/etc/modprobe.d/lpfc.conf** file and add the following option:

```
lpfc_enable_fc4_type=3
```

- To enable NVMe/FC in the **qla2xxx** driver, edit the **/etc/modprobe.d/qla2xxx.conf** file and add the following option:

```
qla2xxx.ql2xnvmeenable=1
```

Additional restrictions:

- Multipath is not supported with NVMe/FC.
- NVMe clustering is not supported with NVMe/FC.
- With Marvell Qlogic adapters, Red Hat Enterprise Linux does not support using NVMe/FC and SCSI/FC on an initiator port at the same time.
- **kdump** is not supported with NVMe/FC.
- Booting from Storage Area Network (SAN) NVMe/FC is not supported.

12.2.12. Support for Data Integrity Field/Data Integrity Extension (DIF/DIX)

DIF/DIX is an addition to the SCSI Standard. It remains in Technology Preview for all HBAs and storage arrays, except for those specifically listed as supported.

DIF/DIX increases the size of the commonly used 512 byte disk block from 512 to 520 bytes, adding the Data Integrity Field (DIF). The DIF stores a checksum value for the data block that is calculated by the Host Bus Adapter (HBA) when a write occurs. The storage device then confirms the checksum on receipt, and stores both the data and the checksum. Conversely, when a read occurs, the checksum can be verified by the storage device, and by the receiving HBA.

12.3. LVM

12.3.1. Removal of clvmd for managing shared storage devices

LVM no longer uses **clvmd** (cluster lvm daemon) for managing shared storage devices. Instead, LVM now uses **lvmlockd** (lvm lock daemon).

- For details about using **lvmlockd**, see the **lvmlockd(8)** man page. For details about using shared storage in general, see the **lvmsystemid(7)** man page.
- For information on using LVM in a Pacemaker cluster, see the help screen for the **LVM-activate** resource agent.
- For an example of a procedure to configure a shared logical volume in a Red Hat High Availability cluster, see Configuring a GFS2 file system in a cluster .

12.3.2. Removal of lvmetad daemon

LVM no longer uses the **lvmetad** daemon for caching metadata, and will always read metadata from disk. LVM disk reading has been reduced, which reduces the benefits of caching.

Previously, autoactivation of logical volumes was indirectly tied to the **use_lvmetad** setting in the **lvm.conf** configuration file. The correct way to disable autoactivation continues to be setting **auto_activation_volume_list** in the **lvm.conf** file.

12.3.3. LVM can no longer manage devices formatted with the GFS pool volume manager or the lvm1 metadata format.

LVM can no longer manage devices formatted with the GFS pool volume manager or the `lvm1` metadata format. if you created your logical volume before Red Hat Enterprise Linux 4 was introduced, then this may affect you. Volume groups using the **lvm1** format should be converted to the **lvm2** format using the **vgconvert** command.

12.3.4. LVM libraries and LVM Python bindings have been removed

The **lvm2app** library and LVM Python bindings, which were provided by the **lvm2-python-libs** package, have been removed. Red Hat recommends the following solutions instead:

- The LVM D-Bus API in combination with the **lvm2-dbusd** service. This requires using Python version 3.
- The LVM command-line utilities with JSON formatting; this formatting has been available since the **lvm2** package version 2.02.158.
- The **libblockdev** library, included in AppStream, for C/C++

You must port any applications using the removed libraries and bindings to the D-Bus API before upgrading to Red Hat Enterprise Linux 8.

12.3.5. The ability to mirror the log for LVM mirrors has been removed

The mirrored log feature of mirrored LVM volumes has been removed. Red Hat Enterprise Linux (RHEL) 8 no longer supports creating or activating LVM volumes with a mirrored mirror log.

The recommended replacements are:

- RAID1 LVM volumes. The main advantage of RAID1 volumes is their ability to work even in degraded mode and to recover after a transient failure.

- Disk mirror log. To convert a mirrored mirror log to disk mirror log, use the following command: **lvconvert --mirrorlog disk my_vg/my_lv**.

CHAPTER 13. HIGH AVAILABILITY AND CLUSTERS

In Red Hat Enterprise Linux 8, **pcs** fully supports the Corosync 3 cluster engine and the Kronosnet (knet) network abstraction layer for cluster communication. When planning an upgrade to a RHEL 8 cluster from an existing RHEL 7 cluster, some of the considerations you must take into account are as follows:

- **Application versions:** What version of the highly-available application will the RHEL 8 cluster require?
- **Application process order:** What may need to change in the start and stop processes of the application?
- **Cluster infrastructure:** Since **pcs** supports multiple network connections in RHEL 8, does the number of NICs known to the cluster change?
- **Needed packages:** Do you need to install all of the same packages on the new cluster?

Because of these and other considerations for running a Pacemaker cluster in RHEL 8, it is not possible to perform in-place upgrades from RHEL 7 to RHEL 8 clusters and you must configure a new cluster in RHEL 8. You cannot run a cluster that includes nodes running both RHEL 7 and RHEL 8.

Additionally, you should plan for the following before performing an upgrade:

- **Final cutover:** What is the process to stop the application running on the old cluster and start it on the new cluster to reduce application downtime?
- **Testing:** Is it possible to test your migration strategy ahead of time in a development/test environment?

The major differences in cluster creation and administration between RHEL 7 and RHEL 8 are listed in the following sections.

13.1. NEW FORMATS FOR PCS CLUSTER SETUP, PCS CLUSTER NODE ADD AND PCS CLUSTER NODE REMOVE COMMANDS

In Red Hat Enterprise Linux 8, **pcs** fully supports the use of node names, which are now required and replace node addresses in the role of node identifier. Node addresses are now optional.

- In the **pcs host auth** command, node addresses default to node names.
- In the **pcs cluster setup** and **pcs cluster node add** commands, node addresses default to the node addresses specified in the **pcs host auth** command.

With these changes, the formats for the commands to set up a cluster, add a node to a cluster, and remove a node from a cluster have changed. For information on these new command formats, see the help display for the **pcs cluster setup**, **pcs cluster node add** and **pcs cluster node remove** commands.

13.2. MASTER RESOURCES RENAMED TO PROMOTABLE CLONE RESOURCES

Red Hat Enterprise Linux (RHEL) 8 supports Pacemaker 2.0, in which a master/slave resource is no longer a separate type of resource but a standard clone resource with a **promotable** meta-attribute set to **true**. The following changes have been implemented in support of this update:

- It is no longer possible to create master resources with the **pcs** command. Instead, it is possible to create **promotable** clone resources. Related keywords and commands have been changed from **master** to **promotable**.
- All existing master resources are displayed as promotable clone resources.
- When managing a RHEL7 cluster in the Web UI, master resources are still called master, as RHEL7 clusters do not support promotable clones.

13.3. NEW COMMANDS FOR AUTHENTICATING NODES IN A CLUSTER

Red Hat Enterprise Linux (RHEL) 8 incorporates the following changes to the commands used to authenticate nodes in a cluster.

- The new command for authentication is **pcs host auth**. This command allows users to specify host names, addresses and **pcsd** ports.
- The **pcs cluster auth** command authenticates only the nodes in a local cluster and does not accept a node list
- It is now possible to specify an address for each node. **pcs**/**pcsd** will then communicate with each node using the specified address. These addresses can be different than the ones **corosync** uses internally.
- The **pcs pcsd clear-auth** command has been replaced by the **pcs pcsd deauth** and **pcs host deauth** commands. The new commands allow users to deauthenticate a single host as well as all hosts.
- Previously, node authentication was bidirectional, and running the **pcs cluster auth** command caused all specified nodes to be authenticated against each other. The **pcs host auth** command, however, causes only the local host to be authenticated against the specified nodes. This allows better control of what node is authenticated against what other nodes when running this command. On cluster setup itself, and also when adding a node, **pcs** automatically synchronizes tokens on the cluster, so all nodes in the cluster are still automatically authenticated as before and the cluster nodes can communicate with each other.

Note that these changes are not backward compatible. Nodes that were authenticated on a RHEL 7 system will need to be authenticated again.

13.4. LVM VOLUMES IN A RED HAT HIGH AVAILABILITY ACTIVE/PASSIVE CLUSTER

When configuring LVM volumes as resources in a Red Hat HA active/passive cluster in RHEL 8, you configure the volumes as an **LVM-activate** resource. In RHEL 7, you configured the volumes as an **LVM** resource. For an example of a cluster configuration procedure that includes configuring an LVM volume as a resource in an active/passive cluster in RHEL 8, see Configuring an active/passive Apache HTTP server in a Red Hat High Availability cluster.

13.5. SHARED LVM VOLUMES IN A RED HAT HIGH AVAILABILITY ACTIVE/ACTIVE CLUSTER

In Red Hat Enterprise Linux 8, LVM uses the LVM lock daemon **lvmlockd** instead of **clvmd** for managing shared storage devices in an active/active cluster. This requires that you configure the logical volumes on which you mount a GFS2 file system as shared logical volumes. Additionally, this requires that you use the **LVM-activate** resource agent to manage an LVM volume and that you use the **lvmlockd** resource agent to manage the **lvmlockd** daemon. For a full procedure for configuring a RHEL 8 Pacemaker cluster that includes GFS2 file systems using shared logical volumes, see Configuring a GFS2 file system in a cluster.

13.6. GFS2 FILE SYSTEMS IN A RHEL 8 PACEMAKER CLUSTER

In Red Hat Enterprise Linux 8, LVM uses the LVM lock daemon **lvmlockd** instead of **clvmd** for managing shared storage devices in an active/active cluster as described in Section 12.3.1, “Removal of **clvmd** for managing shared storage devices”.

In order to use GFS2 file systems that were created on a RHEL 7 system in a RHEL 8 cluster, you must configure the logical volumes on which they are mounted as shared logical volumes in a RHEL 8 system, and you must start locking for the volume group. For an example of the procedure that configures existing RHEL 7 logical volumes as shared logical volumes for use in a RHEL 8 Pacemaker cluster, see Migrating a GFS2 file system from RHEL7 to RHEL8 .

CHAPTER 14. SHELLS AND COMMAND-LINE TOOLS

14.1. LOCALIZATION IS DISTRIBUTED IN MULTIPLE PACKAGES

In Red Hat Enterprise Linux (RHEL) 8, locales and translations are no longer provided by the single **glibc-common** package. Instead, every locale and language is available in a **glibc-langpack-*CODE*** package. Additionally, not all locales are installed by default, only these selected in the installer. Users must install all further locale packages that they need separately.

The meta-packages which install extra add-on packages containing translations, dictionaries and locales for every package installed on the system are called langpacks.

See more information about Installing and using langpacks.

14.2. REMOVED SUPPORT FOR ALL-NUMERIC USER AND GROUP NAMES

In Red Hat Enterprise Linux (RHEL) 8, the **useradd** and **groupadd** commands does not allow you to use user and group names consisting purely of numeric characters. The reason for not allowing such names is that this can confuse tools that work with user and group names and user and group ids, which are numbers.

See more information about Managing users using command-line tools.

14.3. THE NOBODY USER REPLACES NFSNOBODY

Red Hat Enterprise Linux (RHEL) 7 used the **nobody** user and group pair with the ID of 99 and the **nfsnobody** user and group pair with the ID of 65534, which is also the default kernel overflow ID.

In RHEL 8, both of these pair have been merged into the **nobody** user and group pair, which uses the ID of 65534. The **nfsnobody** pair is not created in RHEL 8.

This change reduces the confusion about files that are owned by **nobody** but are not related to NFS.

14.4. VERSION CONTROL SYSTEMS

RHEL 8 provides the following version control systems:

- **Git 2.18**, a distributed revision control system with a decentralized architecture.
- **Mercurial 4.8**, a lightweight distributed version control system, designed for efficient handling of large projects.
- **Subversion 1.10**, a centralized version control system.

Note that the Concurrent Versions System (CVS) and Revision Control System (RCS), available in RHEL 7, are not distributed with RHEL 8.

14.4.1. Notable changes in Subversion 1.10

Subversion 1.10 introduces a number of new features since the version 1.7 distributed in RHEL 7, as well as the following compatibility changes:

- Due to incompatibilities in the **Subversion** libraries used for supporting language bindings, **Python 3** bindings for **Subversion 1.10** are unavailable. As a consequence, applications that require **Python** bindings for **Subversion** are unsupported.

- Repositories based on **Berkeley DB** are no longer supported. Before migrating, back up repositories created with **Subversion 1.7** by using the **svnadmin dump** command. After installing RHEL 8, restore the repositories using the **svnadmin load** command.

- Existing working copies checked out by the **Subversion 1.7** client in RHEL 7 must be upgraded to the new format before they can be used from **Subversion 1.10**. After installing RHEL 8, run the **svn upgrade** command in each working copy.

- Smartcard authentication for accessing repositories using **https:**// is no longer supported.

CHAPTER 15. DYNAMIC PROGRAMMING LANGUAGES, WEB SERVERS, DATABASE SERVERS

15.1. DYNAMIC PROGRAMMING LANGUAGES

15.1.1. Notable changes in Python

15.1.1.1. Python 3 is the default Python implementation in RHEL 8

Red Hat Enterprise Linux 8 is distributed with **Python 3.6**. The package might not be installed by default. To install **Python 3.6**, use the **yum install python3** command.

Python 2.7 is available in the **python2** package. However, **Python 2** will have a shorter life cycle and its aim is to facilitate a smoother transition to **Python 3** for customers.

Neither the default **python** package nor the unversioned **/usr/bin/python** executable is distributed with RHEL 8. Customers are advised to use **python3** or **python2** directly. Alternatively, administrators can configure the unversioned **python** command using the **alternatives** command.

For details, see Using Python in Red Hat Enterprise Linux 8 .

15.1.1.2. Migrating from Python 2 to Python 3

As a developer, you may want to migrate your former code that is written in Python 2 to Python 3. For more information on how to migrate large code bases to Python 3, see The Conservative Python 3 Porting Guide.

Note that after this migration, the original Python 2 code becomes interpretable by the Python 3 interpreter and stays interpretable for the Python 2 interpreter as well.

15.1.1.3. Configuring the unversioned Python

System administrators can configure the unversioned **python** command on the system using the **alternatives** command. Note that the required package, either **python3** or **python2**, needs to be installed before configuring the unversioned command to the respective version.

To configure the unversioned **python** command to Python 3 directly, run:

```
alternatives --set python /usr/bin/python3
```

Use an analogous command if you choose Python 2.

Alternatively, you can configure the unversioned **python** command interactively:

1. Run the following command:

   ```
   alternatives --config python
   ```

2. Select the required version from the provided list.

To reset this configuration and remove the unversioned **python** command, run:

```
alternatives --auto python
```

WARNING

Additional Python-related commands, such as **pip3**, do not have configurable unversioned variants.

15.1.1.4. Python scripts must specify major version in hashbangs at RPM build time

In RHEL 8, executable Python scripts are expected to use hashbangs (shebangs) specifying explicitly at least the major Python version.

The **/usr/lib/rpm/redhat/brp-mangle-shebangs** buildroot policy (BRP) script is run automatically when building any RPM package. This script attempts to correct hashbangs in all executable files. When the script encounters ambiguous Python hashbangs that do not specify the major version of Python, it generates errors and the RPM build fails. Examples of such ambiguous hashbangs include:

- **#! /usr/bin/python**
- **#! /usr/bin/env python**

To modify hashbangs in the Python scripts causing these build errors at RPM build time, use the **pathfix.py** script from the **platform-python-devel** package:

```
pathfix.py -pn -i %{__python3} PATH ...
```

Multiple *PATH*s can be specified. If a *PATH* is a directory, **pathfix.py** recursively scans for any Python scripts matching the pattern **^[a-zA-Z0-9_]+\.py$**, not only those with an ambiguous hashbang. Add the command for running **pathfix.py** to the **%prep** section or at the end of the **%install** section.

For more information, see Handling hashbangs in Python scripts.

15.1.1.5. Python binding of the net-snmp package is unavailable

The **Net-SNMP** suite of tools does not provide binding for **Python 3**, which is the default **Python** implementation in RHEL 8. Consequently, **python-net-snmp**, **python2-net-snmp**, or **python3-net-snmp** packages are unavailable in RHEL 8.

15.1.1.6. Additional resources

- Packaging of Python 3 RPMs

15.1.2. Notable changes in PHP

Red Hat Enterprise Linux 8 is distributed with **PHP 7.2**. This version introduces the following major changes over **PHP 5.4**, which is available in RHEL 7:

- **PHP** uses FastCGI Process Manager (FPM) by default (safe for use with a threaded **httpd**)

- The **php_value** and **php-flag** variables should no longer be used in the **httpd** configuration files; they should be set in pool configuration instead: **/etc/php-fpm.d/*.conf**
- **PHP** script errors and warnings are logged to the **/var/log/php-fpm/www-error.log** file instead of **/var/log/httpd/error.log**
- When changing the PHP **max_execution_time** configuration variable, the **httpd ProxyTimeout** setting should be increased to match
- The user running **PHP** scripts is now configured in the FPM pool configuration (the **/etc/php-fpm/d/www.conf** file; the **apache** user is the default)
- The **php-fpm** service needs to be restarted after a configuration change or after a new extension is installed
- The **zip** extension has been moved from the **php-common** package to a separate package, **php-pecl-zip**

The following extensions have been removed:

- **aspell**
- **mysql** (note that the **mysqli** and **pdo_mysql** extensions are still available, provided by **php-mysqlnd** package)
- **memcache**

15.1.3. Notable changes in Perl

Perl 5.26, distributed with RHEL 8, introduces the following changes over the version available in RHEL 7:

- **Unicode 9.0** is now supported.
- New **op-entry**, **loading-file**, and **loaded-file SystemTap** probes are provided.
- Copy-on-write mechanism is used when assigning scalars for improved performance.
- The **IO::Socket::IP** module for handling IPv4 and IPv6 sockets transparently has been added.
- The **Config::Perl::V** module to access **perl -V** data in a structured way has been added.
- A new **perl-App-cpanminus** package has been added, which contains the **cpanm** utility for getting, extracting, building, and installing modules from the Comprehensive Perl Archive Network (CPAN) repository.
- The current directory **.** has been removed from the **@INC** module search path for security reasons.
- The **do** statement now returns a deprecation warning when it fails to load a file because of the behavioral change described above.
- The **do subroutine(LIST)** call is no longer supported and results in a syntax error.
- Hashes are randomized by default now. The order in which keys and values are returned from a hash changes on each **perl** run. To disable the randomization, set the **PERL_PERTURB_KEYS** environment variable to **0**.

- Unescaped literal **{** characters in regular expression patterns are no longer permissible.
- Lexical scope support for the **$_** variable has been removed.
- Using the **defined** operator on an array or a hash results in a fatal error.
- Importing functions from the **UNIVERSAL** module results in a fatal error.
- The **find2perl**, **s2p**, **a2p**, **c2ph**, and **pstruct** tools have been removed.
- The **${^ENCODING}** facility has been removed. The **encoding** pragma's default mode is no longer supported. To write source code in other encoding than **UTF-8**, use the encoding's **Filter** option.
- The **perl** packaging is now aligned with upstream. The **perl** package installs also core modules, while the **/usr/bin/perl** interpreter is provided by the **perl-interpreter** package. In previous releases, the **perl** package included just a minimal interpreter, whereas the **perl-core** package included both the interpreter and the core modules.

15.1.4. Notable changes in Ruby

RHEL 8 provides **Ruby 2.5**, which introduces numerous new features and enhancements over **Ruby 2.0.0** available in RHEL 7. Notable changes include:

- Incremental garbage collector has been added.
- The **Refinements** syntax has been added.
- Symbols are now garbage collected.
- The **$SAFE=2** and **$SAFE=3** safe levels are now obsolete.
- The **Fixnum** and **Bignum** classes have been unified into the **Integer** class.
- Performance has been improved by optimizing the **Hash** class, improved access to instance variables, and the **Mutex** class being smaller and faster.
- Certain old APIs have been deprecated.
- Bundled libraries, such as **RubyGems**, **Rake**, **RDoc**, **Psych**, **Minitest**, and **test-unit**, have been updated.
- Other libraries, such as **mathn**, **DL**, **ext/tk**, and **XMLRPC**, which were previously distributed with **Ruby**, are deprecated or no longer included.
- The **SemVer** versioning scheme is now used for **Ruby** versioning.

15.1.5. Notable changes in SWIG

RHEL 8 includes the Simplified Wrapper and Interface Generator (SWIG) version 3.0, which provides numerous new features, enhancements, and bug fixes over the version 2.0 distributed in RHEL 7. Most notably, support the C++11 standard has been implemented. **SWIG** now supports also **Go 1.6**, **PHP 7**, **Octave 4.2**, and **Python 3.5**.

15.1.6. Node.js new in RHEL

Node.js, a software development platform for building fast and scalable network applications in the JavaScript programming language, is provided for the first time in RHEL. It was previously available only as a Software Collection. RHEL 8 provides **Node.js 10**.

15.1.7. Tcl

Tool command language (Tcl) is a dynamic programming language. The interpreter for this language, together with the C library, is provided by the **tcl** package.

Using **Tcl** paired with **Tk** (**Tcl/Tk**) enables creating cross-platform GUI applications. **Tk** is provided by the **tk** package.

Note that **Tk** can refer to any of the the following:

- A programming toolkit for multiple languages
- A Tk C library bindings available for multiple languages, such as C, Ruby, Perl and Python
- A wish interpreter that instantiates a Tk console
- A Tk extension that adds a number of new commands to a particular Tcl interpreter

15.1.7.1. Notable changes in Tcl/Tk 8.6

RHEL 8 is distributed with **Tcl/Tk version 8.6**, which provides multiple notable changes over **Tcl/Tk version 8.5**:

- Object-oriented programming support
- Stackless evaluation implementation
- Enhanced exceptions handling
- Collection of third-party packages built and installed with Tcl
- Multi-thread operations enabled
- SQL database-powered scripts support
- IPv6 networking support
- Built-in Zlib compression
- List processing
  Two new commands, **lmap** and **dict map** are available, which allow the expression of transformations over **Tcl** containers.
- Stacked channels by script
  Two new commands, **chan push** and **chan pop** are available, which allow to add or remove transformations to or from I/O channels.

For more detailed information about **Tcl/Tk version 8.6** changes and new feaures, see the following resources:

- Configuring basic system settings
- Changes in Tcl/Tk 8.6

If you need to migrate to **Tcl/Tk 8.6**, see Migrating to Tcl/Tk 8.6 .

15.2. WEB SERVERS

15.2.1. Notable changes in the Apache HTTP Server

The **Apache HTTP Server**, has been updated from version 2.4.6 to version 2.4.37 between RHEL 7 and RHEL 8. This updated version includes several new features, but maintains backwards compatibility with the RHEL 7 version at the level of configuration and Application Binary Interface (ABI) of external modules.

New features include:

- **HTTP/2** support is now provided by the **mod_http2** package, which is a part of the **httpd** module.
- systemd socket activation is supported. See **httpd.socket(8)** man page for more details.
- Multiple new modules have been added:
  - **mod_proxy_hcheck** - a proxy health-check module
  - **mod_proxy_uwsgi** - a Web Server Gateway Interface (WSGI) proxy
  - **mod_proxy_fdpass** - provides support for the passing the socket of the client to another process
  - **mod_cache_socache** - an HTTP cache using, for example, memcache backend
  - **mod_md** - an ACME protocol SSL/TLS certificate service
- The following modules now load by default:
  - **mod_request**
  - **mod_macro**
  - **mod_watchdog**
- A new subpackage, **httpd-filesystem**, has been added, which contains the basic directory layout for the **Apache HTTP Server** including the correct permissions for the directories.
- Instantiated service support, **httpd@.service** has been introduced. See the **httpd.service** man page for more information.
- A new **httpd-init.service** replaces the **%post script** to create a self-signed **mod_ssl** key pair.
- Automated TLS certificate provisioning and renewal using the Automatic Certificate Management Environment (ACME) protocol is now supported with the **mod_md** package (for use with certificate providers such as **Let's Encrypt**).
- The **Apache HTTP Server** now supports loading TLS certificates and private keys from hardware security tokens directly from **PKCS#11** modules. As a result, a **mod_ssl** configuration can now use **PKCS#11** URLs to identify the TLS private key, and, optionally, the TLS certificate in the **SSLCertificateKeyFile** and **SSLCertificateFile** directives.
- A new **ListenFree** directive in the **/etc/httpd/conf/httpd.conf** file is now supported.

Similarly to the **Listen** directive, **ListenFree** provides information about IP addresses, ports, or IP address-and-port combinations that the server listens to. However, with **ListenFree**, the **IP_FREEBIND** socket option is enabled by default. Hence, **httpd** is allowed to bind to a nonlocal IP address or to an IP address that does not exist yet. This allows **httpd** to listen on a socket without requiring the underlying network interface or the specified dynamic IP address to be up at the time when **httpd** is trying to bind to it.

Note that the **ListenFree** directive is currently available only in RHEL 8.

For more details on **ListenFree**, see the following table:

Table 15.1. ListenFree directive's syntax, status, and modules

Syntax	Status	Modules
ListenFree [IP-address:]portnumber [protocol]	MPM	event, worker, prefork, mpm_winnt, mpm_netware, mpmt_os2

Other notable changes include:

- The following modules have been removed:
  - **mod_file_cache**
  - **mod_nss**
  - **mod_perl**
- The default type of the DBM authentication database used by the **Apache HTTP Server** in RHEL 8 has been changed from **SDBM** to **db5**.
- The **mod_wsgi** module for the **Apache HTTP Server** has been updated to Python 3. WSGI applications are now supported only with Python 3, and must be migrated from Python 2.
- The multi-processing module (MPM) configured by default with the **Apache HTTP Server** has changed from a multi-process, forked model (known as **prefork**) to a high-performance multi-threaded model, **event**.
  Any third-party modules that are not thread-safe need to be replaced or removed. To change the configured MPM, edit the **/etc/httpd/conf.modules.d/00-mpm.conf** file. See the **httpd.service(8)** man page for more information.
- The minimum UID and GID allowed for users by suEXEC are now 1000 and 500, respectively (previously 100 and 100).
- The **/etc/sysconfig/httpd** file is no longer a supported interface for setting environment variables for the **httpd** service. The **httpd.service(8)** man page has been added for the systemd service.
- Stopping the **httpd** service now uses a "graceful stop" by default.
- The **mod_auth_kerb** module has been replaced by the **mod_auth_gssapi** module.

For instructions on deploying, see Setting up the Apache HTTP web server.

15.2.2. The nginx web server new in RHEL

RHEL 8 introduces **nginx 1.14**, a web and proxy server supporting HTTP and other protocols, with a focus on high concurrency, performance, and low memory usage. **nginx** was previously available only as a Software Collection.

The **nginx** web server now supports loading TLS private keys from hardware security tokens directly from **PKCS#11** modules. As a result, an **nginx** configuration can use **PKCS#11** URLs to identify the TLS private key in the **ssl_certificate_key** directive.

15.2.3. Apache Tomcat has been removed

The Apache Tomcat server has been removed from Red Hat Enterprise Linux. Apache Tomcat is a servlet container for the Java Servlet and JavaServer Pages (JSP) technologies. Red Hat recommends that users requiring a servlet container use the JBoss Web Server.

15.3. PROXY CACHING SERVERS

15.3.1. Varnish Cache new in RHEL

Varnish Cache, a high-performance HTTP reverse proxy, is provided for the first time in RHEL. It was previously available only as a Software Collection. **Varnish Cache** stores files or fragments of files in memory that are used to reduce the response time and network bandwidth consumption on future equivalent requests. RHEL 8.0 is distributed with **Varnish Cache 6.0**.

15.3.2. Notable changes in Squid

RHEL 8.0 is distributed with **Squid 4.4**, a high-performance proxy caching server for web clients, supporting FTP, Gopher, and HTTP data objects. This release provides numerous new features, enhancements, and bug fixes over the version 3.5 available in RHEL 7.

Notable changes include:

- Configurable helper queue size
- Changes to helper concurrency channels
- Changes to the helper binary
- Secure Internet Content Adaptation Protocol (ICAP)
- Improved support for Symmetric Multi Processing (SMP)
- Improved process management
- Removed support for SSL
- Removed Edge Side Includes (ESI) custom parser
- Multiple configuration changes

15.4. DATABASE SERVERS

RHEL 8 provides the following database servers:

- **MySQL 8.0**, a multi-user, multi-threaded SQL database server. It consists of the **MySQL** server daemon, **mysqld**, and many client programs.
- **MariaDB 10.3**, a multi-user, multi-threaded SQL database server. For all practical purposes, **MariaDB** is binary-compatible with **MySQL**.
- **PostgreSQL 10** and **PostgreSQL 9.6**, an advanced object-relational database management system (DBMS).
- **Redis 5**, an advanced key-value store. It is often referred to as a data structure server because keys can contain strings, hashes, lists, sets, and sorted sets. **Redis** is provided for the first time in RHEL.

Note that the NoSQL **MongoDB** database server is not included in RHEL 8.0 because it uses the Server Side Public License (SSPL).

Database servers are not installable in parallel

The **mariadb** and **mysql** modules cannot be installed in parallel in RHEL 8.0 due to conflicting RPM packages.

By design, it is impossible to install more than one version (stream) of the same module in parallel. For example, you need to choose only one of the available streams from the **postgresql** module, either **10** (default) or **9.6**. Parallel installation of components is possible in Red Hat Software Collections for RHEL 6 and RHEL 7. In RHEL 8, different versions of database servers can be used in containers.

15.4.1. Notable changes in MariaDB 10.3

MariaDB 10.3 provides numerous new features over the version 5.5 distributed in RHEL 7, such as:

- Common table expressions
- System-versioned tables
- **FOR** loops
- Invisible columns
- Sequences
- Instant **ADD COLUMN** for **InnoDB**
- Storage-engine independent column compression
- Parallel replication
- Multi-source replication

In addition, the new **mariadb-connector-c** packages provide a common client library for **MySQL** and **MariaDB**. This library is usable with any version of the **MySQL** and **MariaDB** database servers. As a result, the user is able to connect one build of an application to any of the **MySQL** and **MariaDB** servers distributed with RHEL 8.

Other notable changes include:

- **MariaDB Galera Cluster**, a synchronous multi-master cluster, is now a standard part of **MariaDB**.

- **InnoDB** is used as the default storage engine instead of **XtraDB**.
- The mariadb-bench subpackage has been removed.
- The default allowed level of the plug-in maturity has been changed to one level less than the server maturity. As a result, plug-ins with a lower maturity level that were previously working, will no longer load.

See also Using MariaDB on Red Hat Enterprise Linux 8 .

15.4.2. Notable changes in MySQL 8.0

RHEL 8 is distributed with **MySQL 8.0**, which provides, for example, the following enhancements:

- **MySQL** now incorporates a transactional data dictionary, which stores information about database objects.
- **MySQL** now supports roles, which are collections of privileges.
- The default character set has been changed from **latin1** to **utf8mb4**.
- Support for common table expressions, both nonrecursive and recursive, has been added.
- **MySQL** now supports window functions, which perform a calculation for each row from a query, using related rows.
- **InnoDB** now supports the **NOWAIT** and **SKIP LOCKED** options with locking read statements.
- GIS-related functions have been improved.
- JSON functionality has been enhanced.
- The new **mariadb-connector-c** packages provide a common client library for **MySQL** and **MariaDB**. This library is usable with any version of the **MySQL** and **MariaDB** database servers. As a result, the user is able to connect one build of an application to any of the **MySQL** and **MariaDB** servers distributed with RHEL 8.

In addition, the **MySQL 8.0** server distributed with RHEL 8 is configured to use **mysql_native_password** as the default authentication plug-in because client tools and libraries in RHEL 8 are incompatible with the **caching_sha2_password** method, which is used by default in the upstream **MySQL 8.0** version.

To change the default authentication plug-in to **caching_sha2_password**, edit the **/etc/my.cnf.d/mysql-default-authentication-plugin.cnf** file as follows:

```
[mysqld]
default_authentication_plugin=caching_sha2_password
```

15.4.3. Notable changes in PostgreSQL

RHEL 8.0 provides two versions of the **PostgreSQL** database server, distributed in two streams of the **postgresql** module: **PostgreSQL 10** (the default stream) and **PostgreSQL 9.6**. RHEL 7 includes **PostgreSQL** version 9.2.

Notable changes in **PostgreSQL 9.6** are, for example:

- Parallel execution of the sequential operations: **scan**, **join**, and **aggregate**
- Enhancements to synchronous replication
- Improved full-text search enabling users to search for phrases
- The **postgres_fdw** data federation driver now supports remote **join**, **sort**, **UPDATE**, and **DELETE** operations
- Substantial performance improvements, especially regarding scalability on multi-CPU-socket servers

Major enhancements in **PostgreSQL 10** include:

- Logical replication using the **publish** and **subscribe** keywords
- Stronger password authentication based on the **SCRAM-SHA-256** mechanism
- Declarative table partitioning
- Improved query parallelism
- Significant general performance improvements
- Improved monitoring and control

See also Using PostgreSQL on Red Hat Enterprise Linux 8 .

CHAPTER 16. COMPILERS AND DEVELOPMENT TOOLS

16.1. CHANGES IN TOOLCHAIN SINCE RHEL 7

The following sections list changes in toolchain since the release of the described components in Red Hat Enterprise Linux 7. See also Release notes for Red Hat Enterprise Linux 8.0 .

16.1.1. Changes in GCC in RHEL 8

In Red Hat Enterprise Linux 8, the GCC toolchain is based on the GCC 8.2 release series. Notable changes since Red Hat Enterprise Linux 7 include:

- Numerous general optimizations have been added, such as alias analysis, vectorizer improvements, identical code folding, inter-procedural analysis, store merging optimization pass, and others.
- The Address Sanitizer has been improved.
- The Leak Sanitizer for detection of memory leaks has been added.
- The Undefined Behavior Sanitizer for detection of undefined behavior has been added.
- Debug information can now be produced in the DWARF5 format. This capability is experimental.
- The source code coverage analysis tool GCOV has been extended with various improvements.
- Support for the OpenMP 4.5 specification has been added. Additionally, the offloading features of the OpenMP 4.0 specification are now supported by the C, C++, and Fortran compilers.
- New warnings and improved diagnostics have been added for static detection of certain likely programming errors.
- Source locations are now tracked as ranges rather than points, which allows much richer diagnostics. The compiler now offers “fix-it” hints, suggesting possible code modifications. A spell checker has been added to offer alternative names and ease detecting typos.

Security

GCC has been extended to provide tools to ensure additional hardening of the generated code. Improvements related to security include:

- The **__builtin_add_overflow**, **__builtin_sub_overflow**, and **__builtin_mul_overflow** built-in functions for arithmetics with overflow checking have been added.
- The **-fstack-clash-protection** option has been added to generate additional code guarding against stack clash.
- The **-fcf-protection** option was introduced to check target addresses of control-flow instructions for increased program security.
- The new **-Wstringop-truncation** warning option lists calls to bounded string manipulation functions such as **strncat**, **strncpy**, or **stpncpy** that might truncate the copied string or leave the destination unchanged.
- The **-Warray-bounds** warning option has been improved to detect out-of-bounds array indices and pointer offsets better.

- The **-Wclass-memaccess** warning option has been added to warn about potentially unsafe manipulation of objects of non-trivial class types by raw memory access functions such as **memcpy** or **realloc**.

Architecture and processor support

Improvements to architecture and processor support include:

- Multiple new architecture-specific options for the Intel AVX-512 architecture, a number of its microarchitectures, and Intel Software Guard Extensions (SGX) have been added.
- Code generation can now target the 64-bit ARM architecture LSE extensions, ARMv8.2-A 16-bit Floating-Point Extensions (FPE), and ARMv8.2-A, ARMv8.3-A, and ARMv8.4-A architecture versions.
- Handling of the **-march=native** option on the ARM and 64-bit ARM architectures has been fixed.
- Support for the z13 and z14 processors of the IBM Z architecture has been added.

Languages and standards

Notable changes related to languages and standards include:

- The default standard used when compiling code in the C language has changed to C17 with GNU extensions.
- The default standard used when compiling code in the C++ language has changed to C++14 with GNU extensions.
- The C++ runtime library now supports the C++11 and C++14 standards.
- The C++ compiler now implements the C++14 standard with many new features such as variable templates, aggregates with non-static data member initializers, the extended **constexpr** specifier, sized deallocation functions, generic lambdas, variable-length arrays, digit separators, and others.
- Support for the C language standard C11 has been improved: ISO C11 atomics, generic selections, and thread-local storage are now available.
- The new **__auto_type** GNU C extension provides a subset of the functionality of C++11 **auto** keyword in the C language.
- The **_FloatN** and **_FloatNx** type names specified by the ISO/IEC TS 18661-3:2015 standard are now recognized by the C front end.
- The default standard used when compiling code in the C language has changed to C17 with GNU extensions. This has the same effect as using the **--std=gnu17** option. Previously, the default was C89 with GNU extensions.
- GCC can now experimentally compile code using the C++17 language standard, and certain features from the C++20 standard.
- Passing an empty class as an argument now takes up no space on the Intel 64 and AMD64 architectures, as required by the platform ABI. Passing or returning a class with only deleted copy and move constructors now uses the same calling convention as a class with a non-trivial copy or move constructor.

- The value returned by the C++11 **alignof** operator has been corrected to match the C **_Alignof** operator and return minimum alignment. To find the preferred alignment, use the GNU extension **__alignof__**.
- The main version of the **libgfortran** library for Fortran language code has been changed to 5.
- Support for the Ada (GNAT), GCC Go, and Objective C/C++ languages has been removed. Use the Go Toolset for Go code development.

Additional resources

- See also the Red Hat Enterprise Linux 8 Release Notes .
- Using Go Toolset

16.1.2. Security enhancements in GCC in RHEL 8

This section decribes in detail the changes in GCC related to security and added since the release of Red Hat Enterprise Linux 7.0.

New warnings

These warning options have been added:

Option	Displays warnings for
-Wstringop-truncation	Calls to bounded string manipulation functions such as **strncat**, **strncpy**, and **stpncpy** that might either truncate the copied string or leave the destination unchanged.
-Wclass-memaccess	Objects of non-trivial class types manipulated in potentially unsafe ways by raw memory functions such as **memcpy**, or **realloc**. The warning helps detect calls that bypass user-defined constructors or copy-assignment operators, corrupt virtual table pointers, data members of const-qualified types or references, or member pointers. The warning also detects calls that would bypass access controls to data members.
-Wmisleading-indentation	Places where the indentation of the code gives a misleading idea of the block structure of the code to a human reader.
-Walloc-size-larger-than=*size*	Calls to memory allocation functions where the amount of memory to allocate exceeds *size*. Works also with functions where the allocation is specified by multiplying two parameters, and with any functions decorated with attribute **alloc_size**.
-Walloc-zero	Calls to memory allocation functions that attempt to allocate zero amount of memory. Works also with functions where the allocation is specified by multiplying two parameters, and with any functions decorated with attribute **alloc_size**.
-Walloca	All calls to the **alloca** function.

Option	Displays warnings for
-Walloca-larger-than=*size*	Calls to the **alloca** function where the requested memory is more than*size*.
-Wvla-larger-than=*size*	Definitions of Variable Length Arrays (VLA) that can either exceed the specified size or whose bound is not known to be sufficiently constrained.
-Wformat-overflow=*level*	Both certain and likely buffer overflow in calls to the **sprintf** family of formatted output functions. For more details and explanation of the *level* value, see the *gcc(1)* manual page.
-Wformat-truncation=*level*	Both certain and likely output truncation in calls to the **snprintf** family of formatted output functions. For more details and explanation of the *level* value, see the *gcc(1)* manual page.
-Wstringop-overflow=*type*	Buffer overflow in calls to string handling functions such as **memcpy** and **strcpy**. For more details and explanation of the*level* value, see the *gcc(1)* manual page.

Warning improvements

These GCC warnings have been improved:

- The **-Warray-bounds** option has been improved to detect more instances of out-of-bounds array indices and pointer offsets. For example, negative or excessive indices into flexible array members and string literals are detected.
- The **-Wrestrict** option introduced in GCC 7 has been enhanced to detect many more instances of overlapping accesses to objects via restrict-qualified arguments to standard memory and string manipulation functions such as **memcpy** and **strcpy**.
- The **-Wnonnull** option has been enhanced to detect a broader set of cases of passing null pointers to functions that expect a non-null argument (decorated with attribute **nonnull**).

New UndefinedBehaviorSanitizer

A new run-time sanitizer for detecting undefined behavior called UndefinedBehaviorSanitizer has been added. The following options are noteworthy:

Option	Check
-fsanitize=float-divide-by-zero	Detect floating-point division by zero.
-fsanitize=float-cast-overflow	Check that the result of floating-point type to integer conversions do not overflow.
-fsanitize=bounds	Enable instrumentation of array bounds and detect out-of-bounds accesses.

Option	Check
-fsanitize=alignment	Enable alignment checking and detect various misaligned objects.
-fsanitize=object-size	Enable object size checking and detect various out-of-bounds accesses.
-fsanitize=vptr	Enable checking of C++ member function calls, member accesses and some conversions between pointers to base and derived classes. Additonally, detect when referenced objects do not have correct dynamic type.
-fsanitize=bounds-strict	Enable strict checking of array bounds. This enables **-fsanitize=bounds** as well as instrumentation of flexible array member-like arrays.
-fsanitize=signed-integer-overflow	Diagnose arithmetic overflows even on arithmetic operations with generic vectors.
-fsanitize=builtin	Diagnose at run time invalid arguments to **__builtin_clz** or **__builtin_ctz** prefixed builtins. Includes checks from **-fsanitize=undefined**.
-fsanitize=pointer-overflow	Perform cheap run time tests for pointer wrapping. Includes checks from **-fsanitize=undefined**.

New options for AddressSanitizer

These options have been added to AddressSanitizer:

Option	Check
-fsanitize=pointer-compare	Warn about comparison of pointers that point to a different memory object.
-fsanitize=pointer-subtract	Warn about subtraction of pointers that point to a different memory object.
-fsanitize-address-use-after-scope	Sanitize variables whose address is taken and used after a scope where the variable is defined.

Other sanitizers and instrumentation

- The option **-fstack-clash-protection** has been added to insert probes when stack space is allocated statically or dynamically to reliably detect stack overflows and thus mitigate the attack vector that relies on jumping over a stack guard page provided by the operating system.

- A new option **-fcf-protection=[full|branch|return|none]** has been added to perform code instrumentation and increase program security by checking that target addresses of control-flow transfer instructions (such as indirect function call, function return, indirect jump) are valid.

- A new bounds violation detector called Pointer Bounds Checker can be enabled with the **-fcheck-pointer-bounds** option. Memory accesses are instrumented with run-time checks of used pointers against their bounds to detect pointer bounds violations (overflows). This functionality is available on targets of the 64-bit Intel and AMD architectures with a new ISA extension Intel MPX support.

Additional resources

- For more details and explanation of the values supplied to some of the options above, see the *gcc(1)* manual page:

```
$ man gcc
```

16.2. COMPILER TOOLSETS

RHEL 8.0 provides the following compiler toolsets as Application Streams:

- Clang and LLVM Toolset 7.0.1, which provides the LLVM compiler infrastructure framework, the Clang compiler for the C and C++ languages, the LLDB debugger, and related tools for code analysis. See the Using Clang and LLVM Toolset document.

- Rust Toolset 1.31, which provides the Rust programming language compiler **rustc**, the **cargo** build tool and dependency manager, the **cargo-vendor** plugin, and required libraries. See the Using Rust Toolset document.

- Go Toolset 1.11.5, which provides the Go programming language tools and libraries. Go is alternatively known as **golang**. See the Using Go Toolset document.

16.3. JAVA IMPLEMENTATIONS AND JAVA TOOLS IN RHEL 8

The RHEL 8 AppStream repository includes:

- The **java-11-openjdk** packages, which provide the OpenJDK 11 Java Runtime Environment and the OpenJDK 11 Java Software Development Kit.

- The **java-1.8.0-openjdk** packages, which provide the OpenJDK 8 Java Runtime Environment and the OpenJDK 8 Java Software Development Kit.

- The **icedtea-web** packages, which provide an implementation of Java Web Start.

- The **ant** module, providing a Java library and command-line tool for compiling, assembling, testing, and running Java applications. **Ant** has been updated to version 1.10.

- The **maven** module, providing a software project management and comprehension tool. **Maven** was previously available only as a Software Collection or in the unsupported Optional channel.

- The **scala** module, providing a general purpose programming language for the Java platform. **Scala** was previously available only as a Software Collection.

In addition, the **java-1.8.0-ibm** packages are distributed through the Supplementary repository. Note that packages in this repository are unsupported by Red Hat.

16.4. COMPATIBILITY-BREAKING CHANGES IN GDB

The version of GDB provided in Red Hat Enterprise Linux 8 contains a number of changes that break compatibility, especially for cases where the GDB output is read directly from the terminal. The following sections provide more details about these changes.

Parsing output of GDB is not recommended. Prefer scripts using the Python GDB API or the GDB Machine Interface (MI).

16.4.1. GDBserver now starts inferiors with shell

To enable expansion and variable substitution in inferior command line arguments, GDBserver now starts the inferior in a shell, same as GDB.

To disable using the shell:

- When using the **target extended-remote** GDB command, disable shell with the **set startup-with-shell off** command.
- When using the **target remote** GDB command, disable shell with the **--no-startup-with-shell** option of GDBserver.

Example 16.1. Example of shell expansion in remote GDB inferiors

This example shows how running the **/bin/echo** /* command through GDBserver differs on Red Hat Enterprise Linux versions 7 and 8:

- On RHEL 7:

```
$ gdbserver --multi :1234
$ gdb -batch -ex 'target extended-remote :1234' -ex 'set remote exec-file /bin/echo' -ex
'file /bin/echo' -ex 'run /*'
/*
```

- On RHEL 8:

```
$ gdbserver --multi :1234
$ gdb -batch -ex 'target extended-remote :1234' -ex 'set remote exec-file /bin/echo' -ex
'file /bin/echo' -ex 'run /*'
/bin /boot (...) /tmp /usr /var
```

16.4.2. gcj support removed

Support for debugging Java programs compiled with the **gcj** has been removed.

16.4.3. New syntax for symbol dumping maintenance commands

The symbol dumping maintenance commands syntax now includes options before file names. As a result, commands that worked with GDB in RHEL 7 do not work in RHEL 8.

As an example, the following command no longer stores symbols in a file, but produces an error message:

```
(gdb) maintenance print symbols /tmp/out main.c
```

-

The new syntax for the symbol dumping maintenance commands is:

```
maint print symbols [-pc address] [--] [filename]
maint print symbols [-objfile objfile] [-source source] [--] [filename]
maint print psymbols [-objfile objfile] [-pc address] [--] [filename]
maint print psymbols [-objfile objfile] [-source source] [--] [filename]
maint print msymbols [-objfile objfile] [--] [filename]
```

16.4.4. Thread numbers are no loger global

Previously, GDB used only global thread numbering. The numbering has been extended to be displayed per inferior in the form **inferior_num.thread_num**, such as **2.1**. As consequence, thread numbers in the **$_thread** convenience variable and in the **InferiorThread.num** Python attribute are no longer unique between inferiors.

GDB now stores a second thread ID per thread, called the global thread ID, which is the new equivalent of thread numbers in previous releases. To access the global thread number, use the **$_gthread** convenience variable and **InferiorThread.global_num** Python attribute.

For backwards compatibility, the Machine Interface (MI) thread IDs always contains the global IDs.

Example 16.2. Example of GDB thread number changes

On Red Hat Enterprise Linux 7:

```
# debuginfo-install coreutils
$ gdb -batch -ex 'file echo' -ex start -ex 'add-inferior' -ex 'inferior 2' -ex 'file echo' -ex start -ex 'info
threads' -ex 'pring $_thread' -ex 'inferior 1' -ex 'pring $_thread'
(...)
  Id   Target Id         Frame
* 2    process 203923 "echo" main (argc=1, argv=0x7fffffffdb88) at src/echo.c:109
  1    process 203914 "echo" main (argc=1, argv=0x7fffffffdb88) at src/echo.c:109
$1 = 2
(...)
$2 = 1
```

On Red Hat Enterprise Linux 8:

```
# dnf debuginfo-install coreutils
$ gdb -batch -ex 'file echo' -ex start -ex 'add-inferior' -ex 'inferior 2' -ex 'file echo' -ex start -ex 'info
threads' -ex 'pring $_thread' -ex 'inferior 1' -ex 'pring $_thread'
(...)
  Id   Target Id         Frame
  1.1  process 4106488 "echo" main (argc=1, argv=0x7fffffffce58) at ../src/echo.c:109
* 2.1  process 4106494 "echo" main (argc=1, argv=0x7fffffffce58) at ../src/echo.c:109
$1 = 1
(...)
$2 = 1
```

16.4.5. Memory for value contents can be limited

Previously, GDB did not limit the amount of memory allocated for value contents. As a consequence,

debugging incorrect programs could cause GDB to allocate too much memory. The **max-value-size** setting has been added to enable limiting the amount of allocated memory. The default value of this limit is 64 KiB. As a result, GDB in Red Hat Enterprise Linux 8 will not display too large values, but report that the value is too large instead.

As an example, printing a value defined as **char s[128*1024];** produces different results:

- On Red Hat Enterprise Linux 7, **$1 = 'A' <repeats 131072 times>**
- On Red Hat Enterprise Linux 8, **value requires 131072 bytes, which is more than max-value-size**

16.4.6. Sun version of stabs format no longer supported

Support for the Sun version of the **stabs** debug file format has been removed. The **stabs** format produced by GCC in RHEL with the **gcc -gstabs** option is still supported by GDB.

16.4.7. Sysroot handling changes

The **set sysroot *path*** command specifies system root when searching for files needed for debugging. Directory names supplied to this command may now be prefixed with the string **target:** to make GDB read the shared libraries from the target system (both local and remote). The formerly available **remote:** prefix is now treated as **target:**. Additionally, the default system root value has changed from empty string to **target:** for backward compatibility.

The specified system root is prepended to the file name of the main executable, when GDB starts processes remotely, or when it attaches to already running processes (both local and remote). This means that for remote processes, the default value **target:** makes GDB always try to load the debugging information from the remote system. To prevent this, run the **set sysroot** command before the **target remote** command so that local symbol files are found before the remote ones.

16.4.8. HISTSIZE no longer controls GDB command history size

Previously, GDB used the **HISTSIZE** environment variable to determine how long command history should be kept. GDB has been changed to use the **GDBHISTSIZE** environment variable instead. This variable is specific only to GDB. The possible values and their effects are:

- a positive number - use command history of this size,
- **-1** or an empty string - keep history of all commands,
- non-numeric values - ignored.

16.4.9. Completion limiting added

The maximum number of candidates considered during completion can now be limited using the **set max-completions** command. To show the current limit, run the **show max-completions** command. The default value is 200. This limit prevents GDB from generating excessively large completion lists and becoming unresponsive.

As an example, the output after the input **p <tab><tab>** is:

- on RHEL 7: **Display all 29863 possibilities? (y or n)**
- on RHEL 8: **Display all 200 possibilities? (y or n)**

16.4.10. HP-UX XDB compatibility mode removed

The **-xdb** option for the HP-UX XDB compatibility mode has been removed from GDB.

16.4.11. Handling signals for threads

Previously, GDB could deliver a signal to the current thread instead of the thread for which the signal was actually sent. This bug has been fixed, and GDB now always passes the signal to the correct thread when resuming execution.

Additionally, the **signal** command now always correctly delivers the requested signal to the current thread. If the program is stopped for a signal and the user switched threads, GDB asks for confirmation.

16.4.12. Breakpoint modes always-inserted off and auto merged

The **breakpoint always-inserted** setting has been changed. The **auto** value and corresponding behavior has been removed. The default value is now **off**. Additionally, the **off** value now causes GDB to not remove breakpoints from the target until all threads stop.

16.4.13. remotebaud commands no longer supported

The **set remotebaud** and **show remotebaud** commands are no longer supported. Use the **set serial baud** and **show serial baud** commands instead.

16.5. COMPATIBILITY-BREAKING CHANGES IN COMPILERS AND DEVELOPMENT TOOLS

16.5.1. C++ ABI change in std::string and std::list

The Application Binary Interface (ABI) of the **std::string** and **std::list** classes from the **libstdc++** library changed between RHEL 7 (GCC 4.8) and RHEL 8 (GCC 8) to conform to the C++11 standard. The **libstdc++** library supports both the old and new ABI, but some other C++ system libraries do not. As a consequence, applications that dynamically link against these libraries will need to be rebuilt. This affects all C++ standard modes, including C++98. It also affects applications built with Red Hat Developer Toolset compilers for RHEL 7, which kept the old ABI to maintain compatibility with the system libraries.

16.5.2. librtkaio removed

With this update, the **librtkaio** library has been removed. This library provided high performance real time asynchronous I/O access for some files, which was based on Linux kernel Asynchronous I/O support (KAIO).

As a result of the removal:

- Applications using the **LD_PRELOAD** method to load **librtkaio** display a warning about a missing library, load the **librt** library instead and run correctly.
- Applications using the **LD_LIBRARY_PATH** method to load **librtkaio** load the **librt** library instead and run correctly, without any warning.
- Applications using the **dlopen()** system call to access **librtkaio** directly load the **librt** library instead.

Users of **librtkaio** have the following options:

- Use the fallback mechanism described above, without any changes to their applications.
- Change code of their applications to use the **librt** library, which offers a compatible POSIX-compliant API.
- Change code of their applications to use the **libaio** library, which offers a compatible API.

Both **librt** and **libaio** can provide comparable features and performance under specific conditions.

Note that the **libaio** package has Red Hat compatibility level of 2, while **librtk** and the removed **librtkaio** level 1.

For more details, see https://fedoraproject.org/wiki/Changes/GLIBC223_librtkaio_removal

16.5.3. Sun RPC and NIS interfaces removed from glibc

The **glibc** library no longer provides Sun RPC and NIS interfaces for new applications. These interfaces are now available only for running legacy applications. Developers must change their applications to use the **libtirpc** library instead of Sun RPC and **libnsl2** instead of NIS. Applications can benefit from IPv6 support in the replacement libraries.

16.5.4. Valgrind library for MPI debugging support removed

The **libmpiwrap.so** wrapper library for **Valgrind** provided by the **valgrind-openmpi** package has been removed. This library enabled **Valgrind** to debug programs using the Message Passing Interface (MPI). This library was specific to the Open MPI implementation version in previous versions of Red Hat Enterprise Linux.

Users of **libmpiwrap.so** are encouraged to build their own version from upstream sources specific to their MPI implementation and version. Supply these custom-built libraries to **Valgrind** using the **LD_PRELOAD** technique.

16.5.5. Development headers and static libraries removed from valgrind-devel

Previously, the **valgrind-devel** sub-package used to include development files for developing custom valgrind tools. This update removes these files because they do not have a guaranteed API, have to be linked statically, and are unsupported. The **valgrind-devel** package still does contain the development files for valgrind-aware programs and header files such as **valgrind.h**, **callgrind.h**, **drd.h**, **helgrind.h**, and **memcheck.h**, which are stable and well supported.

16.5.6. The nosegneg libraries for 32-bit Xen have been removed

Previously, the **glibc** i686 packages contained an alternative **glibc** build, which avoided the use of the thread descriptor segment register with negative offsets (**nosegneg**). This alternative build was only used in the 32-bit version of the Xen Project hypervisor without hardware virtualization support, as an optimization to reduce the cost of full paravirtualization. These alternative builds are no longer used and they have been removed.

16.5.7. GCC no longer builds Ada, Go, and Objective C/C++ code

Capability for building code in the Ada (GNAT), GCC Go, and Objective C/C++ languages has been removed from the GCC compiler.

To build Go code, use the Go Toolset instead.

16.5.8. **make** new operator **!=** causes a different interpretation of certain existing makefile syntax

The **!=** shell assignment operator has been added to GNU **make** as an alternative to the **$(shell ...)** function to increase compatibility with BSD makefiles. As a consequence, variables with name ending in exclamation mark and immediately followed by assignment such as **variable!=value** are now interpreted as the shell assignment. To restore the previous behavior, add a space after the exclamation mark, such as **variable! =value**.

For more details and differences between the operator and the function, see the GNU **make** manual.

CHAPTER 17. IDENTITY MANAGEMENT

17.1. IDENTITY MANAGEMENT PACKAGES ARE INSTALLED AS A MODULE

In RHEL 8, the packages necessary for installing an Identity Management (IdM) server and client are distributed as a module. The **client** stream is the default stream of the **idm** module, and you can download the packages necessary for installing the client without enabling the stream.

The IdM server module stream is called the **DL1** stream. The stream contains multiple profiles corresponding to different types of IdM servers: server, dns, adtrust, client, and default. To download the packages in a specific profile of the **DL1** stream:

1. Enable the stream.
2. Switch to the RPMs delivered through the stream.
3. Run the **yum module install idm:DL1/profile_name** command.

17.2. ACTIVE DIRECTORY USERS CAN NOW ADMINISTER IDENTITY MANAGEMENT

In Red Hat Enterprise Linux (RHEL) 7, external group membership allows AD users and groups to access IdM resources in a POSIX environment with the help of the System Security Services Daemon (SSSD).

The IdM LDAP server has its own mechanisms to grant access control. RHEL 8 introduces an update that allows adding an ID user override for an AD user as a member of an IdM group. An ID override is a record describing what a specific Active Directory user or group properties should look like within a specific ID view, in this case the Default Trust View. As a consequence of the update, the IdM LDAP server is able to apply access control rules for the IdM group to the AD user.

AD users are now able to use the self service features of IdM UI, for example to upload their SSH keys, or change their personal data. An AD administrator is able to fully administer IdM without having two different accounts and passwords.

NOTE

Currently, selected features in IdM may still be unavailable to AD users. For example, setting passwords for IdM users as an AD user from the IdM **admins** group might fail.

17.3. SESSION RECORDING SOLUTION FOR RHEL 8 ADDED

A session recording solution has been added to Red Hat Enterprise Linux 8 (RHEL 8). A new **tlog** package and its associated web console session player enable to record and playback the user terminal sessions. The recording can be configured per user or user group via the System Security Services Daemon (SSSD) service. All terminal input and output is captured and stored in a text-based format in a system journal. The input is inactive by default for security reasons not to intercept raw passwords and other sensitive information.

The solution can be used for auditing of user sessions on security-sensitive systems. In the event of a security breach, the recorded sessions can be reviewed as a part of a forensic analysis. The system administrators are now able to configure the session recording locally and view the result from the RHEL 8 web console interface or from the Command-Line Interface using the **tlog-play** utility.

17.4. REMOVED IDENTITY MANAGEMENT FUNCTIONALITY

17.4.1. NSS databases not supported in OpenLDAP

The OpenLDAP suite in previous versions of Red Hat Enterprise Linux (RHEL) used the Mozilla Network Security Services (NSS) for cryptographic purposes. With RHEL 8, OpenSSL, which is supported by the OpenLDAP community, replaces NSS. OpenSSL does not support NSS databases for storing certificates and keys. However, it still supports privacy enhanced mail (PEM) files that serve the same purpose.

17.4.2. Selected Python Kerberos packages have been replaced

In Red Hat Enterprise Linux (RHEL) 8, the **python-gssapi** package, **python-requests-gssapi** module, and **urllib-gssapi** library have replaced Python Kerberos packages such as **python-krbV**, **python-kerberos**, **python-requests-kerberos**, and **python-urllib2_kerberos**. Notable benefits include:

- **python-gssapi** is easier to use than **python-kerberos** and **python-krbV**
- **python-gssapi** supports both **python 2** and **python 3** whereas **python-krbV** does not
- the GSSAPI-based packages allow the use of other Generic Security Services API (GSSAPI) mechanisms in addition to Kerberos, such as the NT LAN Manager **NTLM** for backward compatibility reasons

This update improves the maintainability and debuggability of GSSAPI in RHEL 8.

17.5. SSSD

17.5.1. authselect replaces authconfig

In RHEL 8, the **authselect** utility replaces the **authconfig** utility. **authselect** comes with a safer approach to PAM stack management that makes the PAM configuration changes simpler for system administrators. **authselect** can be used to configure authentication methods such as passwords, certificates, smart cards and fingerprint. **authselect** does not configure services required to join remote domains. This task is performed by specialized tools, such as **realmd** or **ipa-client-install**.

17.5.2. KCM replaces KEYRING as the default credential cache storage

In RHEL 8, the default credential cache storage is the Kerberos Credential Manager (KCM) which is backed by the **sssd-kcm** deamon. KCM overcomes the limitations of the previously used KEYRING, such as its being difficult to use in containerized environments because it is not namespaced, and to view and manage quotas.

With this update, RHEL 8 contains a credential cache that is better suited for containerized environments and that provides a basis for building more features in future releases.

17.5.3. sssctl prints an HBAC rules report for an IdM domain

With this update, the **sssctl** utility of the System Security Services Daemon (SSSD) can print an access control report for an Identity Management (IdM) domain. This feature meets the need of certain environments to see, for regulatory reasons, a list of users and groups that can access a specific client machine. Running **sssctl access-report domain_name** on an IdM client prints the parsed subset of host-based access control (HBAC) rules in the IdM domain that apply to the client machine.

Note that no other providers than IdM support this feature.

17.5.4. Local users are cached by SSSD and served through the nss_sss module

In RHEL 8, the System Security Services Daemon (SSSD) serves users and groups from the **/etc/passwd** and **/etc/groups** files by default. The **sss** nsswitch module precedes files in the **/etc/nsswitch.conf** file.

The advantage of serving local users through SSSD is that the **nss_sss** module has a fast **memory-mapped cache** that speeds up Name Service Switch (NSS) lookups compared to accessing the disk and opening the files on each NSS request. Previously, the Name service cache daemon (**nscd**) helped accelerate the process of accessing the disk. However, using **nscd** in parallel with SSSD is cumbersome, as both SSSD and **nscd** use their own independent caching. Consequently, using **nscd** in setups where SSSD is also serving users from a remote domain, for example LDAP or Active Directory, can cause unpredictable behavior.

With this update, the resolution of local users and groups is faster in RHEL 8. Note that the **root** user is never handled by SSSD, therefore **root** resolution cannot be impacted by a potential bug in SSSD. Note also that if SSSD is not running, the **nss_sss** module handles the situation gracefully by falling back to **nss_files** to avoid problems. You do not have to configure SSSD in any way, the files domain is added automatically.

17.5.5. SSSD now allows you to select one of the multiple smart card authentication devices

By default, the System Security Services Daemon (SSSD) tries to detect a device for Smartcard authentication automatically. If there are multiple devices connected, SSSD selects the first one it detects. Consequently, you cannot select a particular device, which sometimes leads to failures.

With this update, you can configure a new **p11_uri** option for the **[pam]** section of the **sssd.conf** configuration file. This option enables you to define which device is used for Smartcard authentication.

For example, to select a reader with the slot id **2** detected by the OpenSC PKCS#11 module, add:

```
p11_uri = library-description=OpenSC%20smartcard%20framework;slot-id=2
```

to the **[pam]** section of **sssd.conf**.

For details, see the **man sssd.conf** page.

17.6. REMOVED SSSD FUNCTIONALITY

17.6.1. sssd-secrets has been removed

The **sssd-secrets** component of the System Security Services Daemon (SSSD) has been removed in Red Hat Enterprise Linux 8. This is because Custodia, a secrets service provider, is no longer actively developed. Use other Identity Management tools to store secrets, for example the Identity Management Vault.

CHAPTER 18. DESKTOP AND GRAPHICS

18.1. GNOME SHELL IS THE DEFAULT DESKTOP ENVIRONMENT

RHEL 8 is distributed with GNOME Shell as the default desktop environment.

All packages related to KDE Plasma Workspaces (KDE) have been removed, and it is no longer possible to use KDE as an alternative to the default GNOME desktop environment.

Red Hat does not support migration from RHEL 7 with KDE to RHEL 8 GNOME. Users of RHEL 7 with KDE are recommended to back up their data and install RHEL 8 with GNOME Shell.

18.2. NOTABLE CHANGES IN GNOME SHELL

RHEL 8 is distributed with GNOME Shell, version 3.28.

This section:

- Highlights enhancements related to GNOME Shell, version 3.28.
- Informs about the change in default combination of GNOME Shell environment and display protocol.
- Explains how to access features that are not available by default.
- Explains changes in GNOME tools for software management.

18.2.1. GNOME Shell, version 3.28 in RHEL 8

GNOME Shell, version 3.28 is available in RHEL 8. Notable enhancements include:

- New GNOME Boxes features
- New on-screen keyboard
- Extended devices support, most significantly integration for the Thunderbolt 3 interface
- Improvements for GNOME Software, dconf-editor and GNOME Terminal

18.2.2. GNOME Shell environments

GNOME 3 provides two essential environments:

- GNOME Standard
- GNOME Classic

Both environments can use two different protocols to build a graphical user interface:

- The **X11** protocol, which uses **X.Org** as the display server.
- The **Wayland** protocol, which uses **GNOME Shell** as the **Wayland** compositor and display server.
  This solution of display server is further referred as **GNOME Shell on Wayland**

The default combination in RHEL 8 is GNOME Standard environment using **GNOME Shell on Wayland** as the display server.

However, you may want to switch to another combination of GNOME Shell environment and graphics protocol stack. For more information, see Section 18.3, "Selecting GNOME environment and display protocol".

For more information on basics of using both GNOME Shell environments, see Managing RHEL systems from your desktop.

18.2.3. Desktop icons

In RHEL 8, the Desktop icons functionality is no longer provided by the Nautilus file manager, but by the desktop icons gnome-shell extension.

To be able to use the extension, you must install the **gnome-shell-extension-desktop-icons** package available in the Appstream repository.

For more information on Desktop icons in RHEL 8, see Managing RHEL systems from your desktop .

18.2.4. Fractional scaling

On a **GNOME Shell on Wayland** session, the fractional scaling feature is available. The feature makes it possible to scale the GUI by fractions, which improves the appearance of scaled GUI on certain displays.

Note that the feature is currently considered experimental and is, therefore, disabled by default.

To enable fractional scaling, run the following command:

```
# gsettings set org.gnome.mutter experimental-features "['scale-monitor-framebuffer']"
```

18.2.5. GNOME Software for package management

The **gnome-packagekit** package that provided a collection of tools for package management in graphical environment on RHEL 7 is no longer available.

On RHEL 8, similar functionality is provided by the **GNOME Software** utility, which enables you to install and update applications and gnome-shell extensions. **GNOME Software** is distributed in the **gnome-software** package.

For more information for installing applications with **GNOME software**, see Managing RHEL systems from your desktop.

18.2.6. Opening graphical applications with sudo

When attempting to open a graphical application in a terminal using the **sudo** command, you must do the following:

X11 applications
If the application uses the **X11** display protocol, add the local user **root** in the X server access control list. As a result, **root** is allowed to connect to **Xwayland**, which translates the **X11** protocol into the **Wayland** protocol and reversely.

Example 18.1. Adding root to the X server access control list to open xclock with sudo

```
$ xhost +si:localuser:root

$ sudo xclock
```

Wayland applications
If the application is **Wayland** native, include the **-E** option.

Example 18.2. Opening GNOME Calculator with sudo

```
$ sudo -E gnome-calculator
```

Otherwise, if you type just **sudo** and the name of the application, the operation of opening the application fails with the following error message:

```
No protocol specified
Unable to init server: could not connect: connection refused
# Failed to parse arguments: Cannot open display
```

18.3. SELECTING GNOME ENVIRONMENT AND DISPLAY PROTOCOL

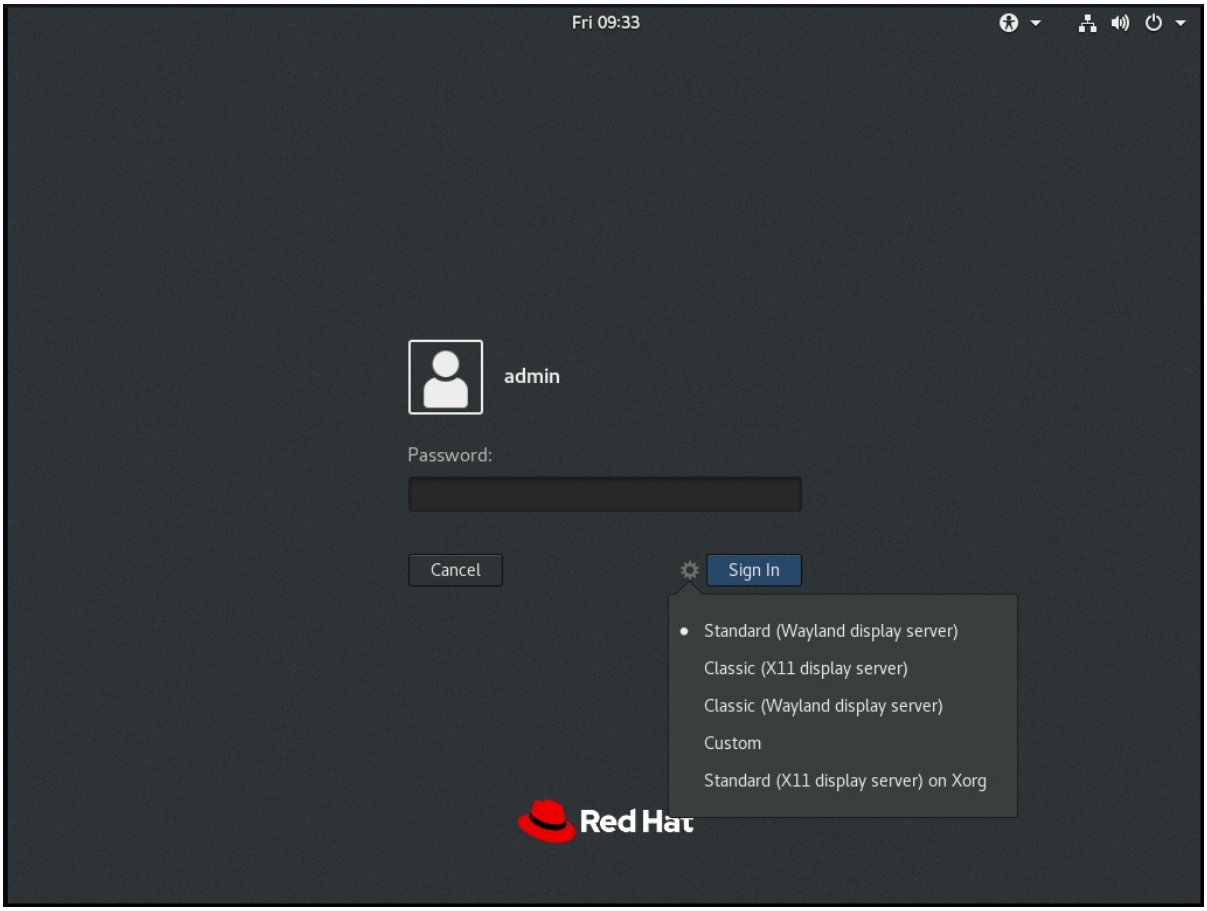
For switching between various combinations of GNOME environment and graphics protocol stacks, use the following procedure.

Procedure

1. From the login screen (GDM), click the cogwheel next to the **Sign In** button.

NOTE

You cannot access this option from the lock screen. The login screen appears when you first start RHEL 8 or when you log out of your current session.



2. From the drop-down menu that appears, select the option that you prefer.

NOTE

Note that in the menu that appears on the login screen, the **X.Org** display server is marked as **X11** display server.

IMPORTANT

The change of GNOME environment and graphics protocol stack resulting from the above procedure is persistent across user logouts, and also when powering off or rebooting the computer.

18.4. GRAPHICS STACK

In RHEL 8, you can choose between two protocols to build a graphical user interface:

- X11
- Wayland

The **X11** protocol uses **X.Org** as the display server. Displaying graphics based on this protocol works the same way as in RHEL 7, where this was the only option.

The **Wayland** protocol on RHEL 8 uses **GNOME Shell** as its compositor and display server, which is further referred as **GNOME Shell on Wayland**

New installations of RHEL 8 automatically select **GNOME Shell on Wayland**, so the **Wayland** protocol is used by default. However, due to Current Wayland limitations or in Environments where X11 is preferred

over Wayland, you may want to switch to **X.Org**, or select the required combination of GNOME environment and display server as described in Selecting GNOME environment and display protocol .

This section describes:

- Key differences between **Wayland** and **X11**
- Current **Wayland** limitations
- Environments where **X11** is preferred over **Wayland**

18.4.1. Key differences between Wayland and X11

X11 Applications
Client applications need to be ported to the **Wayland** protocol or use a graphical toolkit that has a **Wayland** backend, such as GTK, to be able to work natively with the compositor and display server based on **Wayland**.

Legacy **X11** applications that cannot be ported to **Wayland** automatically use **Xwayland** as a proxy between the **X11** legacy clients and the **Wayland** compositor. **Xwayland** functions both as an **X11** server and a **Wayland** client. The role of **Xwayland** is to translate the **X11** protocol into the **Wayland** protocol and reversely, so that **X11** legacy applications can work with the display server based on **Wayland**.

On **GNOME Shell on Wayland**, **Xwayland** is started automatically at startup, which ensures that most **X11** legacy applications work as expected when using **GNOME Shell on Wayland**. However, the **X11** and **Wayland** protocols are different, and so some clients relying on **X11**-specific features may behave differently under **Xwayland**. For such specific clients, you can switch to the **X.Org** display server as described in Section 18.3, “Selecting GNOME environment and display protocol” .

libinput
RHEL 8 uses a new unified input stack, **libinput**, which manages all common device types, such as mice, touchpads, touchscreens, tablets, trackballs and pointing sticks. This unified stack is used both by the **X.Org** and by the **GNOME Shell on Wayland** compositor.

GNOME Shell on Wayland uses **libinput** directly for all devices, and no switchable driver support is available. Under **X.Org**, **libinput** is implemented as the **X.Org libinput** driver. For information on driver support under **X.Org**, see Managing RHEL systems from your desktop .

Gestures
GNOME Shell on Wayland supports new touchpad and touchscreen gestures. These gestures include:

- Switching workspaces by dragging up or down with four fingers.
- Opening the Activities Overview by bringing three fingers closer together.

Additional information
For more information on differences between **Wayland** and **X11**, see Managing RHEL systems from your desktop.

18.4.2. Current Wayland limitations

Using the **Wayland** display protocol has currently multiple notable limitations:

- Proprietary Nvidia binary drivers are not supported.
- Certain traditional VNC tools are not available.

- The X Display Manager Control Protocol (XDMCP) is not supported.

Other limitations include:

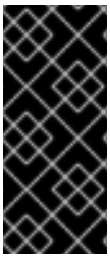
- X.Org* screen manipulation utilities are not available.
- The **xrandr** utility is not supported because **Wayland** handles layout, rotations, and resolutions differently.
- The GNOME Shell cannot be restarted using the **ALT+F2**/**r** method.
- Due to stability issues, using **X11** instead of **Wayland** is recommended in virtual environments.
- **Wayland** does not support the custom or niche devices that cannot be handled by the **libinput** driver.

For more information on current **Wayland** limitations, see Managing RHEL systems from your desktop .

18.4.3. Environments where X11 is preferred over Wayland

In certain environments, **X11** is preferred over **Wayland**:

- Cirrus graphics used in a VM environment
- Matrox graphics
- Aspeed graphics
- QXL graphics used in a VM environment
- Nvidia graphics when used with the proprietary driver



IMPORTANT

The Nvidia graphics by default use **Nouveau**, which is an open source driver. **Nouveau** is supported on **GNOME Shell on Wayland**, so you can use Nvidia graphics with **Nouveau** without any limitations. However, using Nvidia graphics with proprietary Nvidia binary drivers is not supported on **GNOME Shell on Wayland**. In this case, switch to **X.Org** as described in Section 18.3, “Selecting GNOME environment and display protocol” .

NOTE

You can find the current list of environments for which **Wayland** is not available in the **/usr/lib/udev/rules.d/61-gdm.rules** file.

18.4.4. Additional information

For more information on displaying graphics in RHEL 8, see Managing RHEL systems from your desktop .

CHAPTER 19. THE WEB CONSOLE

19.1. THE WEB CONSOLE IS NOW AVAILABLE BY DEFAULT

Packages for the RHEL 8 web console, also known as Cockpit, are now part of Red Hat Enterprise Linux default repositories, and can therefore be immediately installed on a registered RHEL 8 system.

In addition, on a non-minimal installation of RHEL 8, the web console is automatically installed and firewall ports required by the console are automatically open. A system message has also been added prior to login that provides information about how to enable or access the web console.

19.2. NEW FIREWALL INTERFACE

The **Networking** tab in the RHEL 8 Web Console now includes the **Firewall** settings. In this section, users can:

- Enable/Disable firewall
- Add/remove services

For details, see Using the web console for managing firewall .

19.3. SUBSCRIPTION MANAGEMENT

The RHEL 8 web console provides an interface for using Red Hat Subscription Manager installed on your local system. The Subscription Manager connects to the Red Hat Customer Portal and verifies all available:

- Active subscriptions
- Expired subscriptions
- Renewed subscriptions

If you want to renew the subscription or get a different one in Red Hat Customer Portal, you do not have to update the Subscription Manager data manually. The Subscription Manager synchronizes data with Red Hat Customer Portal automatically.

This paragraph is the assembly introduction. It explains what the user will accomplish by working through the modules in the assembly and sets the context for the user story the assembly is based on. Can include more than one paragraph. Consider using the information from the user story.

NOTE

The web console's Subscriptions page is now provided by the new subscription-manager-cockpit package.

For details, see Managing subscriptions in the web console .

19.4. BETTER IDM INTEGRATION FOR THE WEB CONSOLE

If your system is enrolled in an Identity Management (IdM) domain, the RHEL 8 web console now uses the domain's centrally managed IdM resources by default. This includes the following benefits:

- The IdM domain's administrators can use the web console to manage the local machine.
- The console's web server automatically switches to a certificate issued by the IdM certificate authority (CA) and accepted by browsers.
- Users with a Kerberos ticket in the IdM domain do not need to provide login credentials to access the web console.
- SSH hosts known to the IdM domain are accessible to the web console without manually adding an SSH connection.

Note that for IdM integration with the web console to work properly, the user first needs to run the ipa-advise utility with the enable-admins-sudo option in the IdM master system.

19.5. THE WEB CONSOLE IS NOW COMPATIBLE WITH MOBILE BROWSERS

With this update, the web console menus and pages can be navigated on mobile browser variants. This makes it possible to manage systems using the RHEL 8 web console from a mobile device.

19.6. THE WEB CONSOLE FRONT PAGE NOW DISPLAYS MISSING UPDATES AND SUBSCRIPTIONS

If a system managed by the RHEL 8 web console has outdated packages or a lapsed subscription, a warning is now displayed on the web console front page of the system.

19.7. THE WEB CONSOLE NOW SUPPORTS PBD ENROLLMENT

With this update, you can use the the RHEL 8 web console interface to apply Policy-Based Decryption (PBD) rules to disks on managed systems. This uses the Clevis decryption client to facilitate a variety of security management functions in the web console, such as automatic unlocking of LUKS-encrypted disk partitions.

19.8. SUPPORT LUKS V2

In the web console's **Storage** tab, you can now create, lock, unlock, resize, and otherwise configure encrypted devices using the LUKS (Linux Unified Key Setup) version 2 format.

This new version of LUKS offers:

- More flexible unlocking policies
- Stronger cryptography
- Better compatibility with future changes

19.9. VIRTUAL MACHINES CAN NOW BE MANAGED USING THE WEB CONSOLE

The Virtual Machines page can now be added to the RHEL 8 web console interface, which enables the user to create and manage libvirt-based virtual machines.

19.10. INTERNET EXPLORER UNSUPPORTED BY THE RHEL 8 WEB CONSOLE

Support for the Internet Explorer browser has been removed from the RHEL 8 web console. Attempting to open the web console in Internet Explorer now displays an error screen with a list of recommended browsers that can be used instead.

CHAPTER 20. VIRTUALIZATION

20.1. VIRTUAL MACHINES CAN NOW BE MANAGED USING THE WEB CONSOLE

The Virtual Machines page can now be added to the RHEL 8 web console interface, which enables the user to create and manage libvirt-based virtual machines (VMs).

In addition, the Virtual Machine Manager (**virt-manager**) application has been deprecated, and may become unsupported in a future major release of RHEL.

Note, however, that the web console currently does not provide all of the virtual management features that `virt-manager`does. Notably:

- To create a new VM, you can only use a fresh installation. It is not possible to import VM images.
- When creating a new VM, you cannot select a specific storage pool.
- Storage pools can only be created, not deleted, deactivated, or modified.

20.2. THE Q35 MACHINE TYPE IS NOW SUPPORTED BY VIRTUALIZATION

Red hat Enterprise Linux 8 introduces the support for **Q35**, a more modern PCI Express-based machine type. This provides a variety of improvements in features and performance of virtual devices, and ensures that a wider range of modern devices are compatible with virtualization. In addition, virtual machines created in Red Hat Enterprise Linux 8 are set to use Q35 by default.

Note that the previously default **PC** machine type has become deprecated and may become unsupported in a future major release of RHEL. However, changing the machine type of existing VMs from **PC** to **Q35** is not recommended.

Notable differences between **PC** and **Q35** include:

- Older operating systems, such as Windows XP, do not support Q35 and will not boot if used on a Q35 VM.
- Currently, when using RHEL 6 as the operating system on a Q35 VM, hot-plugging a PCI device to that VM in some cases does not work. In addition, certain legacy virtio devices do not work properly on RHEL 6 Q35 VMs.
  Therefore, using the PC machine type is recommended for RHEL 6 VMs.
- Q35 emulates PCI Express (PCI-e) buses instead of PCI. As a result, a different device topology and addressing scheme is presented to the guest OS.
- Q35 has a built-in SATA/AHCI controller, instead of an IDE controller.
- The SecureBoot feature only works on Q35 VMs.

20.3. REMOVED VIRTUALIZATION FUNCTIONALITY

IVSHMEM has been disabled

The inter-VM shared memory device (IVSHMEM) feature, which provides shared memory between multiple virtual machines, is now disabled in Red Hat Enterprise Linux 8. A virtual machine configured with this device will fail to boot. Similarly, attempting to hot-plug such a device device will fail as well.

virt-install can no longer use NFS locations

With this update, the **virt-install** utility cannot mount NFS locations. As a consequence, attempting to install a virtual machine using **virt-install** with a NFS address as a value of the **--location** option fails. To work around this change, mount your NFS share prior to using **virt-install**, or use a HTTP location.

RHEL 8 does not support the tulip driver

With this update, the tulip network driver is no longer supported. As a consequence, when using RHEL 8 on a Generation 1 virtual machine (VM) on the Microsoft Hyper-V hypervisor, the "Legacy Network Adapter" device does not work, which causes PXE installation of such VMs to fail.

For the PXE installation to work, install RHEL 8 on a Generation 2 Hyper-V VM. If you require a RHEL 8 Generation 1 VM, use ISO installation.

LSI Logic SAS and Parallel SCSI drivers are not supported

The LSI Logic SAS driver (**mptsas**) and LSI Logic Parallel driver (**mptspi**) for SCSI are no longer supported. As a consequence, the drivers can be used for installing RHEL 8 as a guest operating system on a VMWare hypervisor to a SCSI disk, but the created VM will not be supported by Red Hat.

CHAPTER 21. CONTAINERS

A set of container images is available for Red Hat Enterprise Linux (RHEL) 8.0. Notable changes include:

- Docker is not included in RHEL 8.0. For working with containers, use the **podman**, **buildah**, **skopeo**, and **runc** tools.
  For information on these tools and on using containers in RHEL 8, see Building, running, and managing containers.

- The **podman** tool has been released as a fully supported feature.
  The **podman** tool manages pods, container images, and containers on a single node. It is built on the **libpod** library, which enables management of containers and groups of containers, called pods.

  To learn how to use **podman**, see Building, running, and managing containers.

- In RHEL 8 GA, Red Hat Universal Base Images (UBI) are newly available. UBIs replace some of the images Red Hat previously provided, such as the standard and the minimal RHEL base images.
  Unlike older Red Hat images, UBIs are freely redistributable. This means they can be used in any environment and shared anywhere. You can use them even if you are not a Red Hat customer.

  For UBI documentation, see Building, running, and managing containers.

- In RHEL 8 GA, additional container images are available that provide AppStream components, for which container images are distributed with **Red Hat Software Collections** in RHEL 7. All of these RHEL 8 images are based on the **ubi8** base image.

- Container images ARM for the 64-bit ARM architecture are fully supported in RHEL 8.

- The **rhel-tools** container has been removed in RHEL 8. The **sos** and **redhat-support-tool** tools are provided in the **support-tools** container. System administrators can also use this image as a base for building system tools container image.

- The support for rootless containers is available as a technology preview in RHEL 8.
  Rootless containers are containers that are created and managed by regular system users without administrative permissions.

CHAPTER 22. RELATED INFORMATION

- Red Hat Enterprise Linux technology capabilities and limits
- Red Hat Enterprise Linux Life Cycle document
- RHEL 8 product documentation
- RHEL 8.0 Release Notes
- RHEL 8 Package manifest
- Upgrading to RHEL 8
- Application Compatibility Guide
- RHEL 7 Migration Planning Guide
- Customer Portal Labs
- Red Hat Insights

APPENDIX A. CHANGES TO PACKAGES

This chapter lists changes to packages between RHEL 7 and RHEL 8.

A.1. NEW PACKAGES

The following packages are new in RHEL 8:

| 389-ds-base-legacy-tools

A | aajohan-comfortaa-fonts, abrt-addon-coredump-helper, abrt-cli-ng, abrt-plugin-machine-id, abrt-plugin-sosreport, adcli-doc, alsa-ucm, alsa-utils-alsabat, anaconda-install-env-deps, annobin, ant-lib, ant-xz, apcu-panel, apr-util-bdb, aspell-en, assertj-core, assertj-core-javadoc, atlas-corei2, atlas-corei2-devel, audispd-plugins-zos, authselect, authselect-compat, authselect-libs

B | bacula-logwatch, beignet, blivet-data, bluez-obexd, bnd-maven-plugin, boom-boot, boom-boot-conf, boom-boot-grub2, boost-container, boost-coroutine, boost-fiber, boost-log, boost-mpich-python3, boost-numpy3, boost-openmpi-python3, boost-python3, boost-python3-devel, boost-stacktrace, boost-type_erasure, brltty-dracut, brltty-espeak-ng, brotli, brotli-devel, bubblewrap, buildah

C | c2esp, cargo, cargo-doc, cargo-vendor, cjose, cjose-devel, clang, clang-analyzer, clang-devel, clang-libs, clang-tools-extra, cldr-emoji-annotation, clippy, cmake-data, cmake-doc, cmake-filesystem, cmake-rpm-macros, cockpit-composer, cockpit-dashboard, cockpit-machines, cockpit-packagekit, cockpit-pcp, cockpit-session-recording, cockpit-storaged, compat-guile18, compat-guile18-devel, compat-libgfortran-48, compat-libpthread-nonshared, compat-openssl10, compiler-rt, composer-cli, container-exception-logger, container-selinux, containernetworking-plugins, containers-common, coreutils-common, coreutils-single, cppcheck, createrepo_c, createrepo_c-devel, createrepo_c-libs, crypto-policies, CUnit, CUnit-devel, cyrus-imapd-vzic

D | dbus-c, dbus-c-devel, dbus-c++-glib, dbus-common, dbus-daemon, dbus-tools, dhcp-client, dhcp-relay, dhcp-server, dleyna-renderer, dnf, dnf-automatic, dnf-data, dnf-plugin-spacewalk, dnf-plugin-subscription-manager, dnf-plugins-core, dnf-utils, dnssec-trigger-panel, docbook2X, dotnet, dotnet-host, dotnet-host-fxr-2.1, dotnet-runtime-2.1, dotnet-sdk-2.1, dotnet-sdk-2.1.5xx, dpdk, dpdk-devel, dpdk-doc, dpdk-tools, dracut-live, dracut-squash, driverctl, drpm, drpm-devel, dtc

E | edk2-aarch64, edk2-ovmf, efi-filesystem, efi-srpm-macros, egl-wayland, eglexternalplatform-devel, eigen3-devel, emacs-lucid, enca, enca-devel, enchant2, enchant2-devel, espeak-ng, evemu, evemu-libs, execstack

F | fence-agents-lpar, fence-agents-zvm, fftw-libs-quad, freeradius-rest, fuse-common, fuse-overlayfs, fuse-sshfs, fuse3, fuse3-devel, fuse3-libs

G | galera, gcc-gdb-plugin, gcc-offload-nvptx, gdb-headless, gdbm-libs, gdk-pixbuf2-modules, gdk-pixbuf2-xlib, gdk-pixbuf2-xlib-devel, gegl04, gegl04-devel, genwqe-tools, genwqe-vpd, genwqe-zlib, genwqe-zlib-devel, geronimo-jpa, geronimo-jpa-javadoc, gfbgraph, gflags, gflags-devel, ghc-srpm-macros, ghostscript-tools-dvipdf, ghostscript-tools-fonts, ghostscript-tools-printing, ghostscript-x11, git-clang-format, git-core, git-core-doc, git-subtree, glassfish-annotation-api, glassfish-annotation-api-javadoc, glassfish-jax-rs-api, glassfish-jax-rs-api-javadoc, glassfish-jaxb-bom, glassfish-jaxb-bom-ext, glassfish-jaxb-codemodel, glassfish-jaxb-codemodel-annotation-compiler, glassfish-jaxb-codemodel-parent, glassfish-jaxb-core, glassfish-jaxb-external-parent, glassfish-jaxb-parent, glassfish-jaxb-rngom, glassfish-jaxb-runtime, glassfish-jaxb-runtime-parent, glassfish-jaxb-txw-parent, glassfish-jaxb-txw2, glassfish-legal, glassfish-master-pom, glassfish-servlet-api, glassfish-servlet-api-javadoc, glibc-all-langpacks, glibc-langpack-aa, glibc-langpack-af, glibc-langpack-agr, glibc-langpack-ak, glibc-langpack-am, glibc-langpack-an, glibc-langpack-anp, glibc-langpack-ar, glibc-langpack-as, glibc-langpack-ast, glibc-langpack-ayc, glibc-langpack-az, glibc-langpack-be, glibc-langpack-bem, glibc-langpack-ber, glibc-langpack-bg, glibc-langpack-bhb, glibc-langpack-bho, glibc-langpack-bi, glibc-

langpack-bn, glibc-langpack-bo, glibc-langpack-br, glibc-langpack-brx, glibc-langpack-bs, glibc-langpack-byn, glibc-langpack-ca, glibc-langpack-ce, glibc-langpack-chr, glibc-langpack-cmn, glibc-langpack-crh, glibc-langpack-cs, glibc-langpack-csb, glibc-langpack-cv, glibc-langpack-cy, glibc-langpack-da, glibc-langpack-de, glibc-langpack-doi, glibc-langpack-dsb, glibc-langpack-dv, glibc-langpack-dz, glibc-langpack-el, glibc-langpack-en, glibc-langpack-eo, glibc-langpack-es, glibc-langpack-et, glibc-langpack-eu, glibc-langpack-fa, glibc-langpack-ff, glibc-langpack-fi, glibc-langpack-fil, glibc-langpack-fo, glibc-langpack-fr, glibc-langpack-fur, glibc-langpack-fy, glibc-langpack-ga, glibc-langpack-gd, glibc-langpack-gez, glibc-langpack-gl, glibc-langpack-gu, glibc-langpack-gv, glibc-langpack-ha, glibc-langpack-hak, glibc-langpack-he, glibc-langpack-hi, glibc-langpack-hif, glibc-langpack-hne, glibc-langpack-hr, glibc-langpack-hsb, glibc-langpack-ht, glibc-langpack-hu, glibc-langpack-hy, glibc-langpack-ia, glibc-langpack-id, glibc-langpack-ig, glibc-langpack-ik, glibc-langpack-is, glibc-langpack-it, glibc-langpack-iu, glibc-langpack-ja, glibc-langpack-ka, glibc-langpack-kab, glibc-langpack-kk, glibc-langpack-kl, glibc-langpack-km, glibc-langpack-kn, glibc-langpack-ko, glibc-langpack-kok, glibc-langpack-ks, glibc-langpack-ku, glibc-langpack-kw, glibc-langpack-ky, glibc-langpack-lb, glibc-langpack-lg, glibc-langpack-li, glibc-langpack-lij, glibc-langpack-ln, glibc-langpack-lo, glibc-langpack-lt, glibc-langpack-lv, glibc-langpack-lzh, glibc-langpack-mag, glibc-langpack-mai, glibc-langpack-mfe, glibc-langpack-mg, glibc-langpack-mhr, glibc-langpack-mi, glibc-langpack-miq, glibc-langpack-mjw, glibc-langpack-mk, glibc-langpack-ml, glibc-langpack-mn, glibc-langpack-mni, glibc-langpack-mr, glibc-langpack-ms, glibc-langpack-mt, glibc-langpack-my, glibc-langpack-nan, glibc-langpack-nb, glibc-langpack-nds, glibc-langpack-ne, glibc-langpack-nhn, glibc-langpack-niu, glibc-langpack-nl, glibc-langpack-nn, glibc-langpack-nr, glibc-langpack-nso, glibc-langpack-oc, glibc-langpack-om, glibc-langpack-or, glibc-langpack-os, glibc-langpack-pa, glibc-langpack-pap, glibc-langpack-pl, glibc-langpack-ps, glibc-langpack-pt, glibc-langpack-quz, glibc-langpack-raj, glibc-langpack-ro, glibc-langpack-ru, glibc-langpack-rw, glibc-langpack-sa, glibc-langpack-sah, glibc-langpack-sat, glibc-langpack-sc, glibc-langpack-sd, glibc-langpack-se, glibc-langpack-sgs, glibc-langpack-shn, glibc-langpack-shs, glibc-langpack-si, glibc-langpack-sid, glibc-langpack-sk, glibc-langpack-sl, glibc-langpack-sm, glibc-langpack-so, glibc-langpack-sq, glibc-langpack-sr, glibc-langpack-ss, glibc-langpack-st, glibc-langpack-sv, glibc-langpack-sw, glibc-langpack-szl, glibc-langpack-ta, glibc-langpack-tcy, glibc-langpack-te, glibc-langpack-tg, glibc-langpack-th, glibc-langpack-the, glibc-langpack-ti, glibc-langpack-tig, glibc-langpack-tk, glibc-langpack-tl, glibc-langpack-tn, glibc-langpack-to, glibc-langpack-tpi, glibc-langpack-tr, glibc-langpack-ts, glibc-langpack-tt, glibc-langpack-ug, glibc-langpack-uk, glibc-langpack-unm, glibc-langpack-ur, glibc-langpack-uz, glibc-langpack-ve, glibc-langpack-vi, glibc-langpack-wa, glibc-langpack-wae, glibc-langpack-wal, glibc-langpack-wo, glibc-langpack-xh, glibc-langpack-yi, glibc-langpack-yo, glibc-langpack-yue, glibc-langpack-yuw, glibc-langpack-zh, glibc-langpack-zu, glibc-locale-source, glibc-minimal-langpack, glog, glog-devel, gmock, gmock-devel, gmp-c++, gnome-autoar, gnome-backgrounds-extras, gnome-characters, gnome-control-center, gnome-control-center-filesystem, gnome-logs, gnome-photos, gnome-photos-tests, gnome-remote-desktop, gnome-shell-extension-desktop-icons, gnome-tweaks, go-compilers-golang-compiler, go-srpm-macros, go-toolset, golang, golang-bin, golang-docs, golang-misc, golang-race, golang-src, golang-tests, google-droid-kufi-fonts, google-droid-sans-fonts, google-droid-sans-mono-fonts, google-droid-serif-fonts, google-noto-cjk-fonts-common, google-noto-mono-fonts, google-noto-nastaliq-urdu-fonts, google-noto-sans-cjk-jp-fonts, google-noto-sans-cjk-ttc-fonts, google-noto-sans-oriya-fonts, google-noto-sans-oriya-ui-fonts, google-noto-sans-tibetan-fonts, google-noto-serif-bengali-fonts, google-noto-serif-cjk-ttc-fonts, google-noto-serif-devanagari-fonts, google-noto-serif-gujarati-fonts, google-noto-serif-kannada-fonts, google-noto-serif-malayalam-fonts, google-noto-serif-tamil-fonts, google-noto-serif-telugu-fonts, google-roboto-slab-fonts, gpgmepp, gpgmepp-devel, grub2-tools-efi, gssntlmssp, gstreamer1-plugins-good-gtk, gtest, gtest-devel, guava20, guava20-javadoc, guava20-testlib, guice-assistedinject, guice-bom, guice-extensions, guice-grapher, guice-jmx, guice-jndi, guice-multibindings, guice-servlet, guice-testlib, guice-throwingproviders, gutenprint-libs, gutenprint-libs-ui

H | hamcrest-core, hawtjni-runtime, hexchat, hexchat-devel, httpcomponents-client-cache, httpd-filesystem, hunspell-es-AR, hunspell-es-BO, hunspell-es-CL, hunspell-es-CO, hunspell-es-CR, hunspell-es-CU, hunspell-es-DO, hunspell-es-EC, hunspell-es-ES, hunspell-es-GT, hunspell-es-HN, hunspell-es-MX, hunspell-es-NI, hunspell-es-PA, hunspell-es-PE, hunspell-es-PR, hunspell-es-PY, hunspell-es-SV, hunspell-es-US, hunspell-es-UY, hunspell-es-VE

I | i2c-tools-perl, ibus-libzhuyin, ibus-wayland, iio-sensor-proxy, infiniband-diags-compat, integritysetup, ipa-idoverride-memberof-plugin, ipcalc, ipmievd, iproute-tc, iptables-arptables, iptables-ebtables, iptables-libs, isl, isl-devel, isns-utils-devel, isns-utils-libs, istack-commons-runtime, istack-commons-tools, ivy-local

J | jackson-annotations, jackson-annotations-javadoc, jackson-core, jackson-core-javadoc, jackson-databind, jackson-databind-javadoc, jackson-jaxrs-json-provider, jackson-jaxrs-providers, jackson-jaxrs-providers-datatypes, jackson-jaxrs-providers-javadoc, jackson-module-jaxb-annotations, jackson-module-jaxb-annotations-javadoc, javapackages-filesystem, javapackages-local, jbig2dec-libs, jboss-annotations-1.2-api, jboss-interceptors-1.2-api, jboss-interceptors-1.2-api-javadoc, jboss-jaxrs-2.0-api, jboss-logging, jboss-logging-tools, jcl-over-slf4j, jdeparser, jdom2, jdom2-javadoc, jimtcl, jimtcl-devel, jq, js-uglify, Judy, jul-to-slf4j, julietaula-montserrat-fonts

K | kabi-dw, kdump-anaconda-addon, kernel-core, kernel-cross-headers, kernel-debug-core, kernel-debug-modules, kernel-debug-modules-extra, kernel-modules, kernel-modules-extra, kernel-rpm-macros, kernel-rt-core, kernel-rt-debug-core, kernel-rt-debug-modules, kernel-rt-debug-modules-extra, kernel-rt-modules, kernel-rt-modules-extra, kernelshark, koan, kyotocabinet-libs

L | lame-devel, lame-libs, langpacks-af, langpacks-am, langpacks-ar, langpacks-as, langpacks-ast, langpacks-be, langpacks-bg, langpacks-bn, langpacks-br, langpacks-bs, langpacks-ca, langpacks-cs, langpacks-cy, langpacks-da, langpacks-de, langpacks-el, langpacks-en, langpacks-en_GB, langpacks-es, langpacks-et, langpacks-eu, langpacks-fa, langpacks-fi, langpacks-fr, langpacks-ga, langpacks-gl, langpacks-gu, langpacks-he, langpacks-hi, langpacks-hr, langpacks-hu, langpacks-ia, langpacks-id, langpacks-is, langpacks-it, langpacks-ja, langpacks-kk, langpacks-kn, langpacks-ko, langpacks-lt, langpacks-lv, langpacks-mai, langpacks-mk, langpacks-ml, langpacks-mr, langpacks-ms, langpacks-nb, langpacks-ne, langpacks-nl, langpacks-nn, langpacks-nr, langpacks-nso, langpacks-or, langpacks-pa, langpacks-pl, langpacks-pt, langpacks-pt_BR, langpacks-ro, langpacks-ru, langpacks-si, langpacks-sk, langpacks-sl, langpacks-sq, langpacks-sr, langpacks-ss, langpacks-sv, langpacks-ta, langpacks-te, langpacks-th, langpacks-tn, langpacks-tr, langpacks-ts, langpacks-uk, langpacks-ur, langpacks-ve, langpacks-vi, langpacks-xh, langpacks-zh_CN, langpacks-zh_TW, langpacks-zu, lato-fonts, lensfun, lensfun-devel, leptonica, leptonica-devel, liba52, libaec, libaec-devel, libatomic_ops, libbabeltrace, libblockdev-lvm-dbus, libcephfs-devel, libcephfs2, libcmocka, libcmocka-devel, libcomps, libcomps-devel, libcurl-minimal, libdap, libdap-devel, libdatrie, libdatrie-devel, libdazzle, libdc1394, libdnf, libEMF, libEMF-devel, libeot, libepubgen, libertas-sd8686-firmware, libertas-sd8787-firmware, libertas-usb8388-firmware, libertas-usb8388-olpc-firmware, libev, libev-devel, libev-libevent-devel, libev-source, libfdisk, libfdisk-devel, libfdt, libfdt-devel, libgit2, libgit2-devel, libgit2-glib, libgit2-glib-devel, libgomp-offload-nvptx, libgudev, libgudev-devel, libi2c, libidn2, libidn2-devel, libijs, libinput-utils, libipt, libisoburn, libisoburn-devel, libkcapi, libkcapi-hmaccalc, libkeepalive, libknet1, libknet1-compress-bzip2-plugin, libknet1-compress-lz4-plugin, libknet1-compress-lzma-plugin, libknet1-compress-lzo2-plugin, libknet1-compress-plugins-all, libknet1-compress-zlib-plugin, libknet1-crypto-nss-plugin, libknet1-crypto-openssl-plugin, libknet1-crypto-plugins-all, libknet1-devel, libknet1-plugins-all, liblangtag-data, libmad, libmad-devel, libmcpp, libmemcached-libs, libmetalink, libmodulemd, libmodulemd-devel, libmodulemd1, libnghttp2, libnghttp2-devel, libnice-gstreamer1, libnsl, libnsl2, libnsl2-devel, liboggz, libomp, libomp-devel, libomp-test, libpeas-loader-python3, libpkgconf, libpq, libpq-devel, libproxy-webkitgtk4, libpsl, libqhull, libqhull_p, libqhull_r, libqxp, librados-devel, libradosstriper-devel, libradosstriper1, librbd-devel, libreoffice-help-en, libreoffice-langpack-af, libreoffice-langpack-ar, libreoffice-langpack-as, libreoffice-langpack-bg, libreoffice-langpack-bn, libreoffice-langpack-br, libreoffice-langpack-ca, libreoffice-langpack-cs, libreoffice-langpack-cy, libreoffice-langpack-da, libreoffice-langpack-de, libreoffice-langpack-dz, libreoffice-langpack-el, libreoffice-langpack-es, libreoffice-langpack-et, libreoffice-langpack-eu, libreoffice-langpack-fa, libreoffice-langpack-fi, libreoffice-langpack-fr, libreoffice-langpack-ga, libreoffice-langpack-gl, libreoffice-langpack-gu, libreoffice-langpack-he, libreoffice-langpack-hi, libreoffice-langpack-hr, libreoffice-langpack-hu, libreoffice-langpack-id, libreoffice-langpack-it, libreoffice-langpack-ja, libreoffice-langpack-kk, libreoffice-langpack-kn, libreoffice-langpack-ko, libreoffice-langpack-lt, libreoffice-langpack-lv, libreoffice-langpack-mai, libreoffice-langpack-ml, libreoffice-langpack-mr, libreoffice-langpack-nb, libreoffice-langpack-nl, libreoffice-langpack-nn, libreoffice-langpack-nr, libreoffice-langpack-nso,

libreoffice-langpack-or, libreoffice-langpack-pa, libreoffice-langpack-pl, libreoffice-langpack-pt-BR, libreoffice-langpack-pt-PT, libreoffice-langpack-ro, libreoffice-langpack-ru, libreoffice-langpack-si, libreoffice-langpack-sk, libreoffice-langpack-sl, libreoffice-langpack-sr, libreoffice-langpack-ss, libreoffice-langpack-st, libreoffice-langpack-sv, libreoffice-langpack-ta, libreoffice-langpack-te, libreoffice-langpack-th, libreoffice-langpack-tn, libreoffice-langpack-tr, libreoffice-langpack-ts, libreoffice-langpack-uk, libreoffice-langpack-ve, libreoffice-langpack-xh, libreoffice-langpack-zh-Hans, libreoffice-langpack-zh-Hant, libreoffice-langpack-zu, librhsm, librx, librx-devel, libsass, libsass-devel, libserf, libsigsegv, libsigsegv-devel, libssh, libssh-devel, libstemmer, libstemmer-devel, libubsan, libucil, libucil-devel, libunicap, libunicap-devel, libuv, libvarlink, libvarlink-devel, libvarlink-util, libvirt-dbus, libX11-xcb, libxcam, libxcrypt, libxcrypt-devel, libxcrypt-static, libXNVCtrl, libXNVCtrl-devel, libzhuyin, libzip-tools, lld, lld-devel, lld-libs, lldb, lldb-devel, lldpd, lldpd-devel, llvm, llvm-devel, llvm-doc, llvm-googletest, llvm-libs, llvm-static, llvm-test, llvm-toolset, log4j-over-slf4j, log4j12, log4j12-javadoc, lohit-gurmukhi-fonts, lohit-odia-fonts, lorax-composer, lorax-lmc-novirt, lorax-lmc-virt, lorax-templates-generic, lorax-templates-rhel, lttng-ust, lttng-ust-devel, lua-expat, lua-filesystem, lua-json, lua-libs, lua-lpeg, lua-lunit, lua-posix, lua-socket, lvm2-dbusd, lz4-libs

M | make-devel, man-db-cron, mariadb-backup, mariadb-common, mariadb-connector-c, mariadb-connector-c-config, mariadb-connector-c-devel, mariadb-connector-odbc, mariadb-errmsg, mariadb-gssapi-server, mariadb-java-client, mariadb-oqgraph-engine, mariadb-server-galera, mariadb-server-utils, maven-artifact-transfer, maven-artifact-transfer-javadoc, maven-lib, maven-resolver, maven-resolver-api, maven-resolver-connector-basic, maven-resolver-impl, maven-resolver-javadoc, maven-resolver-spi, maven-resolver-test-util, maven-resolver-transport-classpath, maven-resolver-transport-file, maven-resolver-transport-http, maven-resolver-transport-wagon, maven-resolver-util, maven-wagon-file, maven-wagon-ftp, maven-wagon-http, maven-wagon-http-lightweight, maven-wagon-http-shared, maven-wagon-provider-api, maven-wagon-providers, mcpp, mecab, mecab-ipadic, mecab-ipadic-EUCJP, mesa-vulkan-devel, meson, metis, metis-devel, microdnf, mingw-binutils-generic, mingw-filesystem-base, mingw32-binutils, mingw32-bzip2, mingw32-bzip2-static, mingw32-cairo, mingw32-cpp, mingw32-crt, mingw32-expat, mingw32-filesystem, mingw32-fontconfig, mingw32-freetype, mingw32-freetype-static, mingw32-gcc, mingw32-gcc-c, mingw32-gettext, mingw32-gettext-static, mingw32-glib2, mingw32-glib2-static, mingw32-gstreamer1, mingw32-harfbuzz, mingw32-harfbuzz-static, mingw32-headers, mingw32-icu, mingw32-libffi, mingw32-libjpeg-turbo, mingw32-libjpeg-turbo-static, mingw32-libpng, mingw32-libpng-static, mingw32-libtiff, mingw32-libtiff-static, mingw32-openssl, mingw32-pcre, mingw32-pcre-static, mingw32-pixman, mingw32-pkg-config, mingw32-readline, mingw32-sqlite, mingw32-sqlite-static, mingw32-termcap, mingw32-win-iconv, mingw32-win-iconv-static, mingw32-winpthreads, mingw32-winpthreads-static, mingw32-zlib, mingw32-zlib-static, mingw64-binutils, mingw64-bzip2, mingw64-bzip2-static, mingw64-cairo, mingw64-cpp, mingw64-crt, mingw64-expat, mingw64-filesystem, mingw64-fontconfig, mingw64-freetype, mingw64-freetype-static, mingw64-gcc, mingw64-gcc-c, mingw64-gettext, mingw64-gettext-static, mingw64-glib2, mingw64-glib2-static, mingw64-gstreamer1, mingw64-harfbuzz, mingw64-harfbuzz-static, mingw64-headers, mingw64-icu, mingw64-libffi, mingw64-libjpeg-turbo, mingw64-libjpeg-turbo-static, mingw64-libpng, mingw64-libpng-static, mingw64-libtiff, mingw64-libtiff-static, mingw64-openssl, mingw64-pcre, mingw64-pcre-static, mingw64-pixman, mingw64-pkg-config, mingw64-readline, mingw64-sqlite, mingw64-sqlite-static, mingw64-termcap, mingw64-win-iconv, mingw64-win-iconv-static, mingw64-winpthreads, mingw64-winpthreads-static, mingw64-zlib, mingw64-zlib-static, mockito, mockito-javadoc, mod_http2, mod_md, mozvoikko, mpich, mpich-devel, mpitests-mvapich2-psm2, multilib-rpm-config, munge, munge-devel, munge-libs, mvapich2, mvapich2-psm2, mysql, mysql-common, mysql-devel, mysql-errmsg, mysql-libs, mysql-server, mysql-test

N | nbdkit-bash-completion, nbdkit-plugin-gzip, nbdkit-plugin-python3, nbdkit-plugin-xz, ncurses-c++-libs, ncurses-compat-libs, netconsole-service, network-scripts, network-scripts-team, NetworkManager-config-connectivity-redhat, nghttp2, nginx, nginx-all-modules, nginx-filesystem, nginx-mod-http-image-filter, nginx-mod-http-perl, nginx-mod-http-xslt-filter, nginx-mod-mail, nginx-mod-stream, ninja-build, nkf, nodejs, nodejs-devel, nodejs-docs, nodejs-nodemon, nodejs-packaging, npm, npth, nss_db, nss_nis, nss_wrapper, nss-altfiles, ntpstat

O | objectweb-pom, objenesis, objenesis-javadoc, ocaml-cppo, ocaml-labltk, ocaml-labltk-devel, oci-systemd-hook, oci-umount, ocl-icd, ocl-icd-devel, ongres-scram, ongres-scram-client, oniguruma, oniguruma-devel, openal-soft, openal-soft-devel, openblas, openblas-devel, openblas-openmp, openblas-openmp64, openblas-openmp64_, openblas-Rblas, openblas-serial64, openblas-serial64_, openblas-srpm-macros, openblas-static, openblas-threads, openblas-threads64, openblas-threads64_, opencl-filesystem, opencl-headers, opencv-contrib, OpenIPMI-lanserv, openscap-python3, openssl-ibmpkcs11, openssl-pkcs11, openwsman-python3, os-maven-plugin, os-maven-plugin-javadoc, osad, osgi-annotation, osgi-annotation-javadoc, osgi-compendium, osgi-compendium-javadoc, osgi-core, osgi-core-javadoc, ostree, ostree-devel, ostree-grub2, ostree-libs, overpass-mono-fonts

P | p11-kit-server, pacemaker-schemas, pam_cifscreds, pandoc, pandoc-common, papi-libs, pcaudiolib, pcp-pmda-podman, pcre-cpp, pcre-utf16, pcre-utf32, peripety, perl-AnyEvent, perl-Attribute-Handlers, perl-B-Debug, perl-B-Hooks-EndOfScope, perl-bignum, perl-Canary-Stability, perl-Class-Accessor, perl-Class-Factory-Util, perl-Class-Method-Modifiers, perl-Class-Tiny, perl-Class-XSAccessor, perl-common-sense, perl-Compress-Bzip2, perl-Config-AutoConf, perl-Config-Perl-V, perl-CPAN-DistnameInfo, perl-CPAN-Meta-Check, perl-Data-Dump, perl-Data-Section, perl-Data-UUID, perl-Date-ISO8601, perl-DateTime-Format-Builder, perl-DateTime-Format-HTTP, perl-DateTime-Format-ISO8601, perl-DateTime-Format-Mail, perl-DateTime-Format-Strptime, perl-DateTime-TimeZone-SystemV, perl-DateTime-TimeZone-Tzfile, perl-Devel-CallChecker, perl-Devel-Caller, perl-Devel-GlobalDestruction, perl-Devel-LexAlias, perl-Devel-Peek, perl-Devel-PPPort, perl-Devel-SelfStubber, perl-Devel-Size, perl-Digest-CRC, perl-DynaLoader-Functions, perl-encoding, perl-Errno, perl-Eval-Closure, perl-experimental, perl-Exporter-Tiny, perl-ExtUtils-Command, perl-ExtUtils-Miniperl, perl-ExtUtils-MM-Utils, perl-Fedora-VSP, perl-File-BaseDir, perl-File-chdir, perl-File-DesktopEntry, perl-File-Find-Object, perl-File-MimeInfo, perl-File-ReadBackwards, perl-Filter-Simple, perl-generators, perl-Import-Into, perl-Importer, perl-inc-latest, perl-interpreter, perl-IO, perl-IO-All, perl-IO-Multiplex, perl-IPC-System-Simple, perl-IPC-SysV, perl-JSON-XS, perl-libintl-perl, perl-libnet, perl-libnetcfg, perl-List-MoreUtils-XS, perl-Locale-gettext, perl-Math-BigInt, perl-Math-BigInt-FastCalc, perl-Math-BigRat, perl-Math-Complex, perl-Memoize, perl-MIME-Base64, perl-MIME-Charset, perl-MIME-Types, perl-Module-CoreList-tools, perl-Module-CPANfile, perl-Module-Install-AuthorTests, perl-Module-Install-ReadmeFromPod, perl-MRO-Compat, perl-namespace-autoclean, perl-namespace-clean, perl-Net-Ping, perl-Net-Server, perl-NKF, perl-NTLM, perl-open, perl-Params-Classify, perl-Params-ValidationCompiler, perl-Parse-PMFile, perl-Path-Tiny, perl-Perl-Destruct-Level, perl-perlfaq, perl-PerlIO-utf8_strict, perl-PerlIO-via-QuotedPrint, perl-Pod-Html, perl-Pod-Markdown, perl-Ref-Util, perl-Ref-Util-XS, perl-Role-Tiny, perl-Scope-Guard, perl-SelfLoader, perl-Software-License, perl-Specio, perl-Sub-Exporter-Progressive, perl-Sub-Identify, perl-Sub-Info, perl-Sub-Name, perl-SUPER, perl-Term-ANSIColor, perl-Term-Cap, perl-Term-Size-Any, perl-Term-Size-Perl, perl-Term-Table, perl-Test, perl-Test-LongString, perl-Test-Warnings, perl-Test2-Suite, perl-Text-Balanced, perl-Text-Tabs+Wrap, perl-Text-Template, perl-Types-Serialiser, perl-Unicode-Collate, perl-Unicode-EastAsianWidth, perl-Unicode-LineBreak, perl-Unicode-Normalize, perl-Unicode-UTF8, perl-Unix-Syslog, perl-utils, perl-Variable-Magic, perl-YAML-LibYAML, php-dbg, php-gmp, php-json, php-opcache, php-pecl-apcu, php-pecl-apcu-devel, php-pecl-zip, pigz, pinentry-emacs, pinentry-gnome3, pipewire, pipewire-devel, pipewire-doc, pipewire-libs, pipewire-utils, pkgconf, pkgconf-m4, pkgconf-pkg-config, pki-servlet-4.0-api, pki-servlet-container, platform-python, platform-python-coverage, platform-python-debug, platform-python-devel, platform-python-pip, platform-python-setuptools, plexus-interactivity-api, plexus-interactivity-jline, plexus-languages, plexus-languages-javadoc, plotutils, plotutils-devel, pmix, pmreorder, podman, podman-docker, policycoreutils-dbus, policycoreutils-python-utils, polkit-libs, poppler-qt5, poppler-qt5-devel, postfix-mysql, postfix-pgsql, postgresql-odbc-tests, postgresql-plpython3, postgresql-server-devel, postgresql-test-rpm-macros, postgresql-upgrade-devel, potrace, powermock-api-easymock, powermock-api-mockito, powermock-api-support, powermock-common, powermock-core, powermock-javadoc, powermock-junit4, powermock-reflect, powermock-testng, prefixdevname, pstoedit, ptscotch-mpich, ptscotch-mpich-devel, ptscotch-mpich-devel-parmetis, ptscotch-openmpi, ptscotch-openmpi-devel, publicsuffix-list, publicsuffix-list-dafsa, python-pymongo-doc, python-qt5-rpm-macros, python-sphinx-locale, python-sqlalchemy-doc, python-virtualenv-doc, python2, python2-attrs, python2-babel, python2-backports, python2-backports-ssl_match_hostname, python2-bson, python2-cairo, python2-cairo-devel, python2-chardet, python2-coverage, python2-Cython, python2-debug, python2-devel, python2-dns, python2-docs,

python2-docs-info, python2-docutils, python2-funcsigs, python2-idna, python2-ipaddress, python2-iso8601, python2-jinja2, python2-libs, python2-lxml, python2-markupsafe, python2-mock, python2-nose, python2-numpy, python2-numpy-doc, python2-numpy-f2py, python2-pip, python2-pluggy, python2-psycopg2, python2-psycopg2-debug, python2-psycopg2-tests, python2-py, python2-pygments, python2-pymongo, python2-pymongo-gridfs, python2-PyMySQL, python2-pysocks, python2-pytest, python2-pytest-mock, python2-pytz, python2-pyyaml, python2-requests, python2-scipy, python2-scour, python2-setuptools, python2-setuptools_scm, python2-six, python2-sqlalchemy, python2-talloc, python2-test, python2-tkinter, python2-tools, python2-urllib3, python2-virtualenv, python2-wheel, python3-abrt, python3-abrt-addon, python3-abrt-container-addon, python3-abrt-doc, python3-argcomplete, python3-argh, python3-asn1crypto, python3-attrs, python3-audit, python3-augeas, python3-avahi, python3-azure-sdk, python3-babel, python3-bcc, python3-bind, python3-blivet, python3-blockdev, python3-boom, python3-boto3, python3-botocore, python3-brlapi, python3-bson, python3-bytesize, python3-cairo, python3-cffi, python3-chardet, python3-click, python3-clufter, python3-configobj, python3-configshell, python3-cpio, python3-createrepo_c, python3-cryptography, python3-cups, python3-custodia, python3-Cython, python3-dateutil, python3-dbus, python3-dbus-client-gen, python3-dbus-python-client-gen, python3-dbus-signature-pyparsing, python3-decorator, python3-dmidecode, python3-dnf, python3-dnf-plugin-spacewalk, python3-dnf-plugin-versionlock, python3-dnf-plugins-core, python3-dns, python3-docs, python3-docutils, python3-enchant, python3-ethtool, python3-evdev, python3-fasteners, python3-firewall, python3-flask, python3-gevent, python3-gflags, python3-gobject, python3-gobject-base, python3-google-api-client, python3-gpg, python3-greenlet, python3-greenlet-devel, python3-gssapi, python3-hawkey, python3-hivex, python3-html5lib, python3-httplib2, python3-humanize, python3-hwdata, python3-hypothesis, python3-idna, python3-imagesize, python3-iniparse, python3-inotify, python3-into-dbus-python, python3-ipaclient, python3-ipalib, python3-ipaserver, python3-iscsi-initiator-utils, python3-iso8601, python3-itsdangerous, python3-jabberpy, python3-javapackages, python3-jinja2, python3-jmespath, python3-jsonpatch, python3-jsonpointer, python3-jsonschema, python3-justbases, python3-justbytes, python3-jwcrypto, python3-jwt, python3-kdcproxy, python3-keycloak-httpd-client-install, python3-kickstart, python3-kmod, python3-koan, python3-langtable, python3-ldap, python3-ldb, python3-lesscpy, python3-lib389, python3-libcomps, python3-libdnf, python3-libguestfs, python3-libipa_hbac, python3-libnl3, python3-libpfm, python3-libproxy, python3-librepo, python3-libreport, python3-libselinux, python3-libsemanage, python3-libsss_nss_idmap, python3-libstoragemgmt, python3-libstoragemgmt-clibs, python3-libuser, python3-libvirt, python3-libvoikko, python3-libxml2, python3-linux-procfs, python3-lit, python3-lldb, python3-louis, python3-lxml, python3-magic, python3-mako, python3-markdown, python3-markupsafe, python3-meh, python3-meh-gui, python3-mock, python3-mod_wsgi, python3-mpich, python3-netaddr, python3-netifaces, python3-newt, python3-nose, python3-nss, python3-ntplib, python3-numpy, python3-numpy-f2py, python3-oauth2client, python3-oauthlib, python3-openipmi, python3-openmpi, python3-ordered-set, python3-osa-common, python3-osad, python3-packaging, python3-pcp, python3-perf, python3-pexpect, python3-pid, python3-pillow, python3-pki, python3-pluggy, python3-ply, python3-policycoreutils, python3-prettytable, python3-productmd, python3-psycopg2, python3-ptyprocess, python3-pwquality, python3-py, python3-pyasn1, python3-pyasn1-modules, python3-pyatspi, python3-pycparser, python3-pycurl, python3-pydbus, python3-pygments, python3-pymongo, python3-pymongo-gridfs, python3-PyMySQL, python3-pyOpenSSL, python3-pyparsing, python3-pyparted, python3-pyqt5-sip, python3-pyserial, python3-pysocks, python3-pytest, python3-pytoml, python3-pytz, python3-pyudev, python3-pyusb, python3-pywbem, python3-pyxattr, python3-pyxdg, python3-pyyaml, python3-qrcode, python3-qrcode-core, python3-qt5, python3-qt5-base, python3-qt5-devel, python3-reportlab, python3-requests, python3-requests-file, python3-requests-ftp, python3-requests-oauthlib, python3-rhn-check, python3-rhn-client-tools, python3-rhn-setup, python3-rhn-setup-gnome, python3-rhn-virtualization-common, python3-rhn-virtualization-host, python3-rhncfg, python3-rhncfg-actions, python3-rhncfg-client, python3-rhncfg-management, python3-rhnlib, python3-rhnpush, python3-rpm, python3-rrdtool, python3-rtslib, python3-s3transfer, python3-samba, python3-samba-test, python3-schedutils, python3-scipy, python3-scons, python3-semantic_version, python3-setools, python3-setuptools_scm, python3-simpleline, python3-sip, python3-sip-devel, python3-six, python3-slip, python3-slip-dbus, python3-snowballstemmer, python3-spacewalk-abrt, python3-spacewalk-backend-libs, python3-spacewalk-koan, python3-spacewalk-oscap, python3-spacewalk-usix, python3-speechd, python3-sphinx, python3-sphinx_rtd_theme, python3-sphinx-

theme-alabaster, python3-sphinxcontrib-websupport, python3-sqlalchemy, python3-sss, python3-sss-murmur, python3-sssdconfig, python3-subscription-manager-rhsm, python3-suds, python3-sure, python3-sushy, python3-syspurpose, python3-systemd, python3-talloc, python3-tbb, python3-tdb, python3-tevent, python3-unbound, python3-unittest2, python3-uritemplate, python3-urllib3, python3-urwid, python3-varlink, python3-virtualenv, python3-webencodings, python3-werkzeug, python3-whoosh, python3-yubico, python36, python36-debug, python36-devel, python36-rpm-macros

Q | qemu-kvm-block-curl, qemu-kvm-block-gluster, qemu-kvm-block-iscsi, qemu-kvm-block-rbd, qemu-kvm-block-ssh, qemu-kvm-core, qemu-kvm-tests, qgpgme, qhull-devel, qt5-devel, qt5-srpm-macros, quota-rpc

R | re2c, readonly-root, redhat-backgrounds, redhat-logos-httpd, redhat-logos-ipa, redhat-release, redis, redis-devel, redis-doc, resteasy, resteasy-javadoc, rhel-system-roles, rhn-custom-info, rhn-virtualization-host, rhncfg, rhncfg-actions, rhncfg-client, rhncfg-management, rhnpush, rls, rpcgen, rpcsvc-proto-devel, rpm-mpi-hooks, rpm-ostree, rpm-ostree-libs, rpm-plugin-ima, rpm-plugin-prioreset, rpm-plugin-selinux, rpm-plugin-syslog, rsync-daemon, rubygem-bson, rubygem-bson-doc, rubygem-did_you_mean, rubygem-diff-lcs, rubygem-mongo, rubygem-mongo-doc, rubygem-mysql2, rubygem-mysql2-doc, rubygem-net-telnet, rubygem-openssl, rubygem-pg, rubygem-pg-doc, rubygem-power_assert, rubygem-rspec, rubygem-rspec-core, rubygem-rspec-expectations, rubygem-rspec-mocks, rubygem-rspec-support, rubygem-test-unit, rubygem-xmlrpc, runc, rust, rust-analysis, rust-debugger-common, rust-doc, rust-gdb, rust-lldb, rust-src, rust-srpm-macros, rust-std-static, rust-toolset, rustfmt

S | samyak-odia-fonts, sane-backends-daemon, sblim-sfcCommon, scala, scala-apidoc, scala-swing, scotch, scotch-devel, SDL2, SDL2-devel, SDL2-static, sendmail-milter-devel, sil-scheherazade-fonts, sisu-mojos, sisu-mojos-javadoc, skopeo, slf4j-ext, slf4j-jcl, slf4j-jdk14, slf4j-log4j12, slf4j-sources, slirp4netns, smc-tools, socket_wrapper, sombok, sombok-devel, sos-audit, spacewalk-abrt, spacewalk-client-cert, spacewalk-koan, spacewalk-oscap, spacewalk-remote-utils, spacewalk-usix, sparsehash-devel, spec-version-maven-plugin, spec-version-maven-plugin-javadoc, speech-dispatcher-espeak-ng, speexdsp, speexdsp-devel, spice-gtk, spirv-tools-libs, splix, sqlite-libs, sscg, sssd-nfs-idmap, stratis-cli, stratisd, SuperLU, SuperLU-devel, supermin-devel, swig-gdb, switcheroo-control, syslinux-extlinux-nonlinux, syslinux-nonlinux, systemd-container, systemd-journal-remote, systemd-pam, systemd-tests, systemd-udev, systemtap-exporter, systemtap-runtime-python3

T | target-restore, tcl-doc, texlive-anyfontsize, texlive-awesomebox, texlive-babel-english, texlive-breqn, texlive-capt-of, texlive-classpack, texlive-ctablestack, texlive-dvisvgm, texlive-environ, texlive-eqparbox, texlive-finstrut, texlive-fontawesome, texlive-fonts-tlwg, texlive-graphics-cfg, texlive-graphics-def, texlive-import, texlive-knuth-lib, texlive-knuth-local, texlive-latex2man, texlive-lib, texlive-lib-devel, texlive-linegoal, texlive-lineno, texlive-ltabptch, texlive-lualibs, texlive-luatex85, texlive-manfnt-font, texlive-mathtools, texlive-mflogo-font, texlive-needspace, texlive-tabu, texlive-tabulary, texlive-tex-ini-files, texlive-texlive-common-doc, texlive-texlive-docindex, texlive-texlive-en, texlive-texlive-msg-translations, texlive-texlive-scripts, texlive-trimspaces, texlive-unicode-data, texlive-updmap-map, texlive-upquote, texlive-wasy2-ps, texlive-xmltexconfig, thai-scalable-laksaman-fonts, timedatex, tinycdb, tinycdb-devel, tinyxml2, tinyxml2-devel, tlog, torque, torque-devel, torque-libs, tpm2-abrmd-selinux, tracker-miners, trousers-lib, tuned-profiles-nfv-host-bin, twolame-libs

U | uglify-js, uid_wrapper, usbguard-dbus, userspace-rcu, userspace-rcu-devel, utf8proc, uthash-devel, util-linux-user

V | varnish, varnish-devel, varnish-docs, varnish-modules, vulkan-headers, vulkan-loader, vulkan-loader-devel

W | WALinuxAgent, web-assets-devel, web-assets-filesystem, webkit2gtk3, webkit2gtk3-devel, webkit2gtk3-jsc, webkit2gtk3-jsc-devel, webkit2gtk3-plugin-process-gtk2, wireshark-cli, woff2

X | Xaw3d, Xaw3d-devel, xmlstreambuffer, xmlstreambuffer-javadoc, xmvn-api, xmvn-bisect, xmvn-

connector-aether, xmvn-connector-ivy, xmvn-core, xmvn-install, xmvn-minimal, xmvn-mojo, xmvn-parent-pom, xmvn-resolve, xmvn-subst, xmvn-tools-pom, xorg-x11-drv-wacom-serial-support, xterm-resize

Y | yasm

A.2. PACKAGE REPLACEMENTS

The following table includes packages that have been replaced, renamed, merged, or split between RHEL 7 and RHEL 8:

RHEL 7 package(s)	RHEL 8 package(s)	Note
389-ds-base	389-ds-base, 389-ds-base-legacy-tools	
AAVMF	edk2-aarch64	
abrt-addon-python	python3-abrt-addon	
abrt-python	python3-abrt	
abrt-python-doc	python3-abrt-doc	
adcli	adcli, adcli-doc	
adwaita-qt5	adwaita-qt	
alsa-utils	alsa-utils, alsa-utils-alsabat	
apache-commons-collections-testframework-javadoc	apache-commons-collections-javadoc	
apr-util	apr-util, apr-util-bdb, apr-util-openssl	The **apr-util-bdb** and **apr-util-openssl** packages have been split from **apr-util**. These package provides the loadable module supporting Berkeley DB in the **apr_dbm.h** interface, and OpenSSL in the **apr_crypto.h** interface, respectively. Both the **apr-util-bdb** and **apr-util-openssl** packages have a weak dependency from **apr-util**, so packages using these APIs should continue to work without changes.
aqute-bndlib-javadoc	aqute-bnd-javadoc	
arptables	iptables-arptables	

RHEL 7 package(s)	RHEL 8 package(s)	Note
authconfig	authselect-compat	
bacula-director	bacula-director, bacula-logwatch	
bind-libs-lite	bind-export-libs, bind-libs-lite	The **bind-libs-lite** libraries have been moved to the **bind-export-libs** package, used by the **dhcp-client** and **dhcp-server** packages. The **bind-libs-lite** libraries now contain a subset of **bind-libs**, which depends on the **bind-libs-lite** package. The **dhcp-server** and **dhcp-client** now depend on the **bind-export-libs** package.
bind-lite-devel	bind-export-devel, bind-lite-devel	The **bind-export-devel** package provides a replacement for the **bind-lite-devel** package. Cflags and libraries used for linking to export libraries should be obtained from the **isc-export-config.sh** output. Linking against the **bind-export-libs** libraries should be done using the **isc-export-config.sh** parameters.
boost-devel	boost-devel, boost-python3-devel	
boost-mpich-python	boost-mpich-python3	
boost-openmpi-python	boost-openmpi-python3	
boost-python	boost-python3	
brltty-at-spi	brltty-at-spi2	
cjkuni-uming-fonts	google-noto-serif-cjk-ttc-fonts	
compat-libgfortran-41	compat-libgfortran-48	
control-center	gnome-control-center	
control-center-filesystem	gnome-control-center-filesystem	
coreutils	coreutils, coreutils-common	

RHEL 7 package(s)	RHEL 8 package(s)	Note
createrepo	createrepo_c	
Cython	python2-Cython, python3-Cython	
dbus	dbus, dbus-common, dbus-daemon, dbus-tools	
dbus-python	python3-dbus	
deltarpm	drpm	
dhclient	dhcp-client	
dhcp	dhcp-relay, dhcp-server	
dnssec-trigger	dnssec-trigger, dnssec-trigger-panel	
dracut	dracut, dracut-live	
dstat	pcp-system-tools	
easymock2	easymock	
easymock2-javadoc	easymock-javadoc	
ebtables	iptables-ebtables	
edac-utils	rasdaemon	
emacs-common, emacs-el	emacs-common	
emacs-libidn, libidn	libidn	
emacs-mercurial, emacs-mercurial-el, mercurial	mercurial	

RHEL 7 package(s)	RHEL 8 package(s)	Note
espeak	espeak-ng	The **espeak** package, providing backends for speech synthesis, has been replaced by an actively developed **espeak-ng** package. **espeak-ng** is mostly compatible with **espeak**.
foomatic-filters	cups-filters	
freerdp	freerdp, libwinpr	
freerdp-devel	freerdp-devel, libwinpr-devel	
freerdp-libs, freerdp-plugins	freerdp-libs	
fuse	fuse, fuse-common	
gdb	gdb, gdb-headless	
gdbm	gdbm, gdbm-libs	
gdk-pixbuf2	gdk-pixbuf2, gdk-pixbuf2-modules, gdk-pixbuf2-xlib	
gdk-pixbuf2-devel	gdk-pixbuf2-devel, gdk-pixbuf2-xlib-devel	
gdm, pulseaudio-gdm-hooks	gdm	
ghostscript	ghostscript, libgs, libijs	
ghostscript-fonts	urw-base35-fonts	
git	git, git-core, git-core-doc, git-subtree	
glassfish-el-api-javadoc	glassfish-el-javadoc	
glassfish-fastinfoset	glassfish-fastinfoset, glassfish-fastinfoset-javadoc	

RHEL 7 package(s)	RHEL 8 package(s)	Note
glassfish-jaxb	glassfish-jaxb-bom, glassfish-jaxb-bom-ext, glassfish-jaxb-codemodel, glassfish-jaxb-codemodel-annotation-compiler, glassfish-jaxb-codemodel-parent, glassfish-jaxb-core, glassfish-jaxb-external-parent, glassfish-jaxb-parent, glassfish-jaxb-rngom, glassfish-jaxb-runtime, glassfish-jaxb-runtime-parent, glassfish-jaxb-txw2, glassfish-jaxb-txw-parent	
glassfish-jaxb-api	glassfish-jaxb-api, glassfish-jaxb-api-javadoc	
glibc	glibc, glibc-all-langpacks, glibc-locale-source, glibc-minimal-langpack, libnsl, libxcrypt, nss_db	
glibc-common	glibc-common, rpcgen	
glibc-devel	compat-libpthread-nonshared, glibc-devel, libnsl2-devel, libxcrypt-devel	
glibc-headers	glibc-headers, rpcsvc-proto-devel	
glibc-static	glibc-static, libxcrypt-static	
gmp	gmp, gmp-c++	
gnome-backgrounds	gnome-backgrounds, gnome-backgrounds-extras	
gnome-session, gnome-session-custom-session	gnome-session	
gnome-system-log	gnome-logs	
gnome-tweak-tool	gnome-tweaks	
golang	golang, go-srpm-macros	
google-noto-sans-cjk-fonts	google-noto-sans-cjk-ttc-fonts	

RHEL 7 package(s)	RHEL 8 package(s)	Note
google-noto-sans-japanese-fonts	google-noto-sans-cjk-jp-fonts	
grub2-common	efi-filesystem, grub2-common	
grub2-tools	grub2-tools, grub2-tools-efi	
gstreamer1-plugins-bad-free-gtk	gstreamer1-plugins-good-gtk	
guava	guava20	
guava-javadoc	guava20-javadoc	
gutenprint	gutenprint, gutenprint-libs, gutenprint-libs-ui	
hawkey, libhif	libdnf	
hmaccalc	libkcapi-hmaccalc	
hpijs	hplip	
i2c-tools	i2c-tools, i2c-tools-perl	
ibus-chewing	ibus-libzhuyin	
infiniband-diags-devel-static, libibmad-static	infiniband-diags-devel-static	
infiniband-diags-devel, libibmad-devel	infiniband-diags-devel	
infiniband-diags, libibmad	infiniband-diags	
initscripts	initscripts, netconsole-service, network-scripts, readonly-root	
iproute	iproute, iproute-tc	
iptables	iptables, iptables-libs	
istack-commons	istack-commons, istack-commons-runtime, istack-commons-tools	
ivtv-firmware, linux-firmware	linux-firmware	

RHEL 7 package(s)	RHEL 8 package(s)	Note
iwl7260-firmware, iwl7265-firmware	iwl7260-firmware	
jackson	jackson-annotations, jackson-core, jackson-databind, jackson-jaxrs-json-provider, jackson-jaxrs-providers, jackson-jaxrs-providers-datatypes, jackson-module-jaxb-annotations	
jackson-javadoc	jackson-annotations-javadoc, jackson-core-javadoc, jackson-databind-javadoc, jackson-jaxrs-providers-javadoc, jackson-module-jaxb-annotations-javadoc	
javapackages-tools	ivy-local, javapackages-filesystem, javapackages-tools	
jboss-annotations-1.1-api	jboss-annotations-1.2-api	
jboss-annotations-1.1-api-javadoc	jboss-annotations-1.2-api-javadoc	
jboss-interceptors-1.1-api	jboss-interceptors-1.2-api	
jboss-interceptors-1.1-api-javadoc	jboss-interceptors-1.2-api-javadoc	
joda-time	java-1.8.0-openjdk-headless	
joda-time-javadoc	java-1.8.0-openjdk-javadoc	
kernel	kernel, kernel-core, kernel-modules, kernel-modules-extra	
kernel-debug	kernel-debug, kernel-debug-core, kernel-debug-modules, kernel-debug-modules-extra	
kernel-rt	kernel-rt, kernel-rt-core, kernel-rt-modules, kernel-rt-modules-extra	
kernel-rt-debug	kernel-rt-debug, kernel-rt-debug-core, kernel-rt-debug-modules, kernel-rt-debug-modules-extra	

RHEL 7 package(s)	RHEL 8 package(s)	Note
kernel-tools, qemu-kvm-tools	kernel-tools	
kexec-tools-anaconda-addon	kdump-anaconda-addon	
kexec-tools, kexec-tools-eppic	kexec-tools	
langtable-python	python3-langtable	
lasso-python	python3-lasso	
ldns	ldns, ldns-utils	
libgnome-keyring	libsecret	
libgudev1	libgudev	
libgudev1-devel	libgudev-devel	
libinput	libinput, libinput-utils	
liblouis-python	python3-louis	
libmemcached	libmemcached, libmemcached-libs	
libmodulemd	libmodulemd, libmodulemd1	
libmusicbrainz	libmusicbrainz5	
libmusicbrainz-devel	libmusicbrainz5-devel	
libnice	libnice, libnice-gstreamer1	
libpeas-loader-python	libpeas-loader-python3	
libpfm-python	python3-libpfm	
libproxy-mozjs	libproxy-webkitgtk4	
libproxy-python	python3-libproxy	
libproxy-webkitgtk3	libproxy-webkitgtk4	
librabbitmq-examples	librabbitmq-tools	

RHEL 7 package(s)	RHEL 8 package(s)	Note
librados2-devel	librados-devel	
librbd1-devel	librbd-devel	
libreport-python	python3-libreport	
libselinux-python	python3-libselinux	
libsemanage-python	python3-libsemanage	
libssh2	libssh, libssh2	
libstoragemgmt-python	python3-libstoragemgmt	
libstoragemgmt-python-clibs	python3-libstoragemgmt-clibs	
libuser-python	python3-libuser	
libvirt-python	python3-libvirt	
libX11	libX11, libX11-xcb	
libxml2-python	python3-libxml2	
llvm-private	llvm	
llvm-private-devel	llvm-devel	
log4j	log4j12	
log4j-javadoc	log4j12-javadoc	
lohit-oriya-fonts	lohit-odia-fonts	
lohit-punjabi-fonts	lohit-gurmukhi-fonts	
lua	lua, lua-libs	
lvm2-python-boom	boom-boot, boom-boot-conf, boom-boot-grub2, python3-boom	
lz4	lz4, lz4-libs	
make	make, make-devel	

RHEL 7 package(s)	RHEL 8 package(s)	Note
mariadb-devel	mariadb-connector-c-devel, mariadb-devel	
mariadb-libs	mariadb-connector-c	
mariadb-server	mariadb-server, mariadb-server-utils	
maven	maven, maven-lib	
maven-downloader	maven-artifact-transfer	
maven-downloader-javadoc	maven-artifact-transfer-javadoc	
maven-doxia-tools	maven-doxia-sitetools	
maven-doxia-tools-javadoc	maven-doxia-sitetools-javadoc	
maven-local	javapackages-local, maven-local	
maven-wagon	maven-wagon, maven-wagon-file, maven-wagon-ftp, maven-wagon-http, maven-wagon-http-lightweight, maven-wagon-http-shared, maven-wagon-provider-api, maven-wagon-providers	
mod_auth_kerb	mod_auth_gssapi	
mod_nss	mod_ssl	
mod_wsgi	python3-mod_wsgi	The **mod_wsgi** module for the Apache HTTP Server has been updated to Python 3. WSGI applications are now supported only with Python 3, and must be migrated from Python 2.
mpich-3.0-devel, mpich-3.2-devel	mpich-devel	
mpich-3.0, mpich-3.2	mpich	
mpitests-mpich, mpitests-mpich32	mpitests-mpich	
mpitests-mvapich2, mpitests-mvapich222, mpitests-mvapich23	mpitests-mvapich2	

RHEL 7 package(s)	RHEL 8 package(s)	Note
mpitests-mvapich222-psm, mpitests-mvapich222-psm2, mpitests-mvapich23-psm, mpitests-mvapich23-psm2, mpitests-mvapich2-psm	mpitests-mvapich2-psm2	
mpitests-openmpi, mpitests-openmpi3	mpitests-openmpi	
mvapich2-2.0-psm, mvapich2-2.2-psm, mvapich2-2.2-psm2, mvapich23-psm, mvapich23-psm2	mvapich2-psm2	
mvapich2-2.0, mvapich2-2.2, mvapich23	mvapich2	
mysql-connector-java	mariadb-java-client	
mysql-connector-odbc	mariadb-connector-odbc	
MySQL-python	python2-PyMySQL, python3-PyMySQL	
nbdkit-plugin-python2	nbdkit-plugin-python3	
ncurses-libs	ncurses-c++-libs, ncurses-compat-libs, ncurses-libs	
newt-python	python3-newt	
nextgen-yum4	yum	
nhn-nanum-gothic-fonts	google-noto-sans-cjk-ttc-fonts	
ntp	chrony	For details, see Using the Chrony suite to configure NTP
ntpdate	chrony	
numpy	python2-numpy, python3-numpy	
numpy-f2py	python2-numpy-f2py, python3-numpy-f2py	
objectweb-asm4	objectweb-asm	

RHEL 7 package(s)	RHEL 8 package(s)	Note
objectweb-asm4-javadoc	objectweb-asm-javadoc	
opencv	opencv, opencv-contrib, opencv-core	
OpenIPMI	OpenIPMI, OpenIPMI-lanserv	
OpenIPMI-python	python3-openipmi	
openjpeg	openjpeg2	
openmpi, openmpi3	openmpi	
openmpi3-devel, openmpi-devel	openmpi-devel	
openscap-python	openscap-python3	
openscap, openscap-extra-probes	openscap	
openwsman-python	openwsman-python3	
oprofile	perf	
ostree	ostree, ostree-libs	
ostree-fuse	ostree	
OVMF	edk2-ovmf	
p11-kit-doc	p11-kit-devel	
pacemaker-cli	pacemaker-cli, pacemaker-schemas	
PackageKit, PackageKit-yum	PackageKit	
pam_krb5	sssd	For details on migrating from pam_krb5 to sssd, see Migrating from pam_krb5 to sssd n the upstream SSSD documentation.
pam_pkcs11	sssd	
papi	papi, papi-libs	

RHEL 7 package(s)	RHEL 8 package(s)	Note
pcp-pmda-kvm	pcp	
pcre	pcre, pcre-cpp, pcre-utf16, pcre-utf32	The PCRE **libpcrecpp.so.0** library with C++ API has been moved from the **pcre** package to **pcre-cpp** package. The **libpcre16.so.0** library with UTF-16 support has been moved from the **pcre** package to the **pcre-utf16** package, and the **libpcre32.so.0** library with UTF-32 support has been moved to the **pcre-utf32** package.
perl	perl, perl-Attribute-Handlers, perl-B-Debug, perl-bignum, perl-bignum, perl-Devel-Peek, perl-Devel-PPPort, perl-Devel-SelfStubber, perl-Errno, perl-ExtUtils-Command, perl-ExtUtils-Miniperl, perl-Filter-Simple, perl-interpreter, perl-IO, perl-IPC-SysV, perl-libs, perl-Math-BigInt, perl-Math-BigInt-FastCalc, perl-Math-BigRat, perl-Math-Complex, perl-Memoize, perl-MIME-Base64, perl-Net-Ping, perl-open, perl-perlfaq, perl-PerlIO-via-QuotedPrint, perl-Pod-Html, perl-SelfLoader, perl-Term-ANSIColor, perl-Term-Cap, perl-Test, perl-Text-Balanced, perl-Unicode-Collate, perl-Unicode-Normalize	
perl-core	perl	
perl-gettext	perl-Locale-gettext	
perl-libintl	perl-libintl-perl	
pexpect	python3-pexpect	
php-common	php-common, php-gmp, php-json, php-pecl-zip, php-xml	
php-mysql	php-mysqlnd	
pkgconfig	pkgconf-pkg-config	

RHEL 7 package(s)	RHEL 8 package(s)	Note
pki-base	pki-base, python3-pki	
plexus-cdc	plexus-containers-component-metadata	
plexus-cdc-javadoc	plexus-containers-javadoc	
plexus-interactivity	plexus-interactivity, plexus-interactivity-api, plexus-interactivity-jline	
policycoreutils-gui	policycoreutils-dbus, policycoreutils-gui	
policycoreutils-python	policycoreutils-python-utils, python3-policycoreutils	
polkit	polkit, polkit-libs	
postfix	postfix, postfix-mysql, postfix-pgsql	
postgresql-devel	libpq-devel	
postgresql-libs	libpq	
postgresql-plpython	postgresql-plpython3	
prelink	execstack	
pth	npth	
pth-devel	npth-devel	
pycairo	python2-cairo, python3-cairo	
pycairo-devel	python2-cairo-devel	
PyGreSQL	python3-psycopg2	
pyldb	python3-ldb	
pyOpenSSL	python3-pyOpenSSL	
pyparsing	python3-pyparsing	

RHEL 7 package(s)	RHEL 8 package(s)	Note
pyparted	python3-pyparted	
pyserial	python3-pyserial	
pytalloc	python3-talloc	
pytest	python2-pytest, python3-pytest	
python	platform-python	
python-augeas	python3-augeas	
python-azure-sdk	python3-azure-sdk	
python-babel	python2-babel, python3-babel	
python-backports	python2-backports	
python-backports-ssl_match_hostname	python2-backports-ssl_match_hostname	
python-bcc	python3-bcc	
python-blivet	python3-blivet	
python-boto3	python3-boto3	
python-brlapi	python3-brlapi	
python-cffi	python3-cffi	
python-chardet	python2-chardet, python3-chardet	
python-clufter	python3-clufter	
python-configobj	python3-configobj	
python-configshell	python3-configshell	
python-coverage	platform-python-coverage, python2-coverage	
python-cpio	python3-cpio	

RHEL 7 package(s)	RHEL 8 package(s)	Note
python-cups	python3-cups	
python-custodia	python3-custodia	
python-custodia-ipa	python3-custodia	
python-dateutil	python3-dateutil	
python-decorator	python3-decorator	
python-devel	python2-devel, python36-devel	
python-dmidecode	python3-dmidecode	
python-dns	python2-dns, python3-dns	
python-docs	python2-docs, python3-docs	
python-docutils	python2-docutils, python3-docutils	
python-enum34	python3-libs	
python-ethtool	python3-ethtool	
python-firewall	python3-firewall	
python-flask	python3-flask	
python-gevent	python3-gevent	
python-gobject	python3-gobject	
python-gobject-base	python3-gobject-base	
python-greenlet	python3-greenlet	
python-greenlet-devel	python3-greenlet-devel	
python-gssapi	python3-gssapi	
python-hivex	python3-hivex	
python-httplib2	python3-httplib2	

RHEL 7 package(s)	RHEL 8 package(s)	Note
python-hwdata	python3-hwdata	
python-idna	python2-idna, python3-idna	
python-iniparse	python3-iniparse	
python-inotify	python3-inotify	
python-ipaddress	python2-ipaddress, python3-libs	
python-itsdangerous	python3-itsdangerous	
python-javapackages	python3-javapackages	
python-jinja2	python2-jinja2, python3-jinja2	
python-jsonpatch	python3-jsonpatch	
python-jsonpointer	python3-jsonpointer	
python-jwcrypto	python3-jwcrypto	
python-jwt	python3-jwt	
python-kdcproxy	python3-kdcproxy	
python-kerberos	python3-gssapi	
python-kmod	python3-kmod	
python-krbV	python3-gssapi	
python-ldap	python3-ldap	
python-libguestfs	python3-libguestfs	
python-libipa_hbac	python3-libipa_hbac	
python-librepo	python3-librepo	
python-libs	python2-libs, python3-libs	
python-libsss_nss_idmap	python3-libsss_nss_idmap	

RHEL 7 package(s)	RHEL 8 package(s)	Note
python-linux-procfs	python3-linux-procfs	
python-lxml	python2-lxml, python3-lxml	
python-magic	python3-magic	
python-mako	python3-mako	
python-markupsafe	python2-markupsafe, python3-markupsafe	
python-meh	python3-meh	
python-meh-gui	python3-meh-gui	
python-netaddr	python3-netaddr	
python-netifaces	python3-netifaces	
python-nose	python2-nose, python3-nose	
python-nss	python3-nss	
python-ntplib	python3-ntplib	
python-pcp	python3-pcp	
python-perf	python3-perf	
python-pillow	python3-pillow	
python-ply	python3-ply	
python-prettytable	python3-prettytable	
python-psycopg2	python2-psycopg2, python3-psycopg2	
python-psycopg2-debug	python2-psycopg2-debug	
python-pwquality	python3-pwquality	
python-py	python2-py, python3-py	
python-pycparser	python3-pycparser	

RHEL 7 package(s)	RHEL 8 package(s)	Note
python-pycurl	python3-pycurl	
python-pygments	python2-pygments, python3-pygments	
python-pytoml	python3-pytoml	
python-pyudev	python3-pyudev	
python-qrcode	python3-qrcode	
python-qrcode-core	python3-qrcode-core	
python-reportlab	python3-reportlab	
python-requests	python2-requests, python3-requests	
python-rhsm	python3-subscription-manager-rhsm	
python-rhsm-certificates	subscription-manager-rhsm-certificates	
python-rtslib	python3-rtslib	
python-s3transfer	python3-botocore, python3-jmespath, python3-s3transfer	
python-schedutils	python3-schedutils	
python-setuptools	platform-python-setuptools, python2-setuptools, python3-setuptools	
python-six	python2-six, python3-six	
python-slip	python3-slip	
python-slip-dbus	python3-slip-dbus	
python-sphinx	python3-sphinx, python-sphinx-locale	
python-sqlalchemy	python2-sqlalchemy, python3-sqlalchemy	

RHEL 7 package(s)	RHEL 8 package(s)	Note
python-sss	python3-sss	
python-sss-murmur	python3-sss-murmur	
python-sssdconfig	python3-sssdconfig	
python-suds	python3-suds	
python-syspurpose	python3-syspurpose	
python-tdb	python3-tdb	
python-test	python2-test, python3-test	
python-tevent	python3-tevent	
python-tools	python2-tools	
python-urllib3	python2-urllib3, python3-urllib3	
python-urwid	python3-urwid	
python-virtualenv	python2-virtualenv, python3-virtualenv	
python-werkzeug	python3-werkzeug	
python-yubico	python3-yubico	
python2-blockdev	python3-blockdev	
python2-bytesize	python3-bytesize	
python2-cryptography	python3-cryptography	
python2-dnf	python3-dnf	
python2-dnf-plugin-versionlock	python3-dnf-plugin-versionlock	
python2-dnf-plugins-core	python3-dnf-plugins-core	
python2-hawkey	python3-hawkey	
python2-ipaclient	python3-ipaclient	

RHEL 7 package(s)	RHEL 8 package(s)	Note
python2-ipalib	python3-ipalib	
python2-ipaserver	python3-ipaserver	
python2-jmespath	python3-jmespath	
python2-keycloak-httpd-client-install	python3-keycloak-httpd-client-install	
python2-libcomps	python3-libcomps	
python2-libdnf	python3-libdnf	
python2-oauthlib	python3-oauthlib	
python2-pyasn1	python3-pyasn1	
python2-pyasn1-modules	python3-pyasn1-modules	
python2-pyatspi	python3-pyatspi	
python2-requests-oauthlib	python3-requests-oauthlib	
pytz	python2-pytz, python3-pytz	
pyusb	python3-pyusb	
pywbem	python3-pywbem	
pyxattr	python3-pyxattr	
PyYAML	python2-pyyaml, python3-pyyaml	
qemu-img-ma	qemu-img	
qemu-img-rhev	qemu-img	
qemu-kvm	qemu-kvm, qemu-kvm-block-curl, qemu-kvm-block-gluster, qemu-kvm-block-iscsi, qemu-kvm-block-rbd, qemu-kvm-block-ssh, qemu-kvm-core	
qemu-kvm-common-ma, qemu-kvm-tools-ma	qemu-kvm-common	

RHEL 7 package(s)	RHEL 8 package(s)	Note
qemu-kvm-common-rhev, qemu-kvm-tools-rhev	qemu-kvm-common	
qemu-kvm-ma	qemu-kvm, qemu-kvm-block-curl, qemu-kvm-block-gluster, qemu-kvm-block-iscsi, qemu-kvm-block-rbd, qemu-kvm-block-ssh, qemu-kvm-core	
qemu-kvm-rhev	qemu-kvm, qemu-kvm-block-curl, qemu-kvm-block-gluster, qemu-kvm-block-iscsi, qemu-kvm-block-rbd, qemu-kvm-block-ssh, qemu-kvm-core	
quota	quota, quota-rpc	The **rpc.rquotad** daemon has been moved from the **quota** RPM package to **quota-rpc**. To use disk quota limits on your NFS server and to have the limits readable or settable from other machines, install the **quota-rpc** package, and enable and start the **rpc-rquotad.service** systemd service.
redhat-logos	redhat-backgrounds, redhat-logos, redhat-logos-httpd	
redhat-release-client, redhat-release-computenode, redhat-release-server, redhat-release-workstation	redhat-release	
redhat-rpm-config	kernel-rpm-macros, redhat-rpm-config	
resteasy-base	resteasy	
resteasy-base-atom-provider	resteasy	
resteasy-base-client	resteasy	
resteasy-base-jackson-provider	resteasy	
resteasy-base-javadoc	resteasy-javadoc	
resteasy-base-jaxb-provider	resteasy	

RHEL 7 package(s)	RHEL 8 package(s)	Note
resteasy-base-jaxrs	resteasy	
resteasy-base-jaxrs-all	resteasy	
resteasy-base-jaxrs-api	resteasy	
resteasy-base-providers-pom	resteasy	
resteasy-base-resteasy-pom	resteasy	
rh-dotnet21-dotnet	dotnet	
rpm-python	python3-rpm	
rrdtool-python	python3-rrdtool	
rsync	rsync, rsync-daemon	
samba-python	python3-samba	
samba-python-test	python3-samba-test	
samyak-oriya-fonts	samyak-odia-fonts	
sane-backends	sane-backends, sane-backends-daemon	
scipy	python2-scipy, python3-scipy	
scons	python3-scons	
selinux-policy-devel	selinux-policy-devel, selinux-policy-doc	
sendmail-devel	sendmail-milter-devel	
setools-libs	python3-setools	
shotwell	gnome-photos	
sip	python3-pyqt5-sip, python3-sip	
sip-devel	python3-sip-devel, sip	
sip-macros	sip	

RHEL 7 package(s)	RHEL 8 package(s)	Note
sisu-bean, sisu-bean-binders, sisu-bean-containers, sisu-bean-converters, sisu-bean-inject, sisu-bean-locators, sisu-bean-reflect, sisu-bean-scanners, sisu-containers, sisu-inject-bean, sisu-osgi-registry, sisu-registries, sisu-spi-registry	sisu-inject	
sisu-inject-plexus, sisu-plexus-binders, sisu-plexus-converters, sisu-plexus-lifecycles, sisu-plexus-locators, sisu-plexus-metadata, sisu-plexus-scanners, sisu-plexus-shim	sisu-plexus	
sisu-maven-plugin	sisu-mojos	
sisu-maven-plugin-javadoc	sisu-mojos-javadoc	
slf4j	jcl-over-slf4j, jul-to-slf4j, log4j-over-slf4j, slf4j, slf4j-ext, slf4j-jcl, slf4j-jdk14, slf4j-log4j12	
speech-dispatcher	speech-dispatcher, speech-dispatcher-espeak-ng	
speech-dispatcher-python	python3-speechd	
speex	speex, speexdsp	
speex-devel	speex-devel, speexdsp-devel	
spice-gtk3	spice-gtk, spice-gtk3	
sssd-common	sssd-common, sssd-nfs-idmap	
strace, strace32	strace	
subscription-manager-gui	subscription-manager-cockpit	
subscription-manager-rhsm	python3-subscription-manager-rhsm	
supermin	supermin	
supermin5	supermin	

RHEL 7 package(s)	RHEL 8 package(s)	Note
supermin5-devel	supermin-devel	
syslinux	syslinux, syslinux-nonlinux	
syslinux-extlinux	syslinux-extlinux, syslinux-extlinux-nonlinux	
system-config-kdump	cockpit-system	
system-config-users	cockpit	
systemd	systemd, systemd-container, systemd-udev	
systemd-journal-gateway	systemd-journal-remote	
systemd-libs	systemd-libs, systemd-pam	
systemd-networkd, systemd-resolved	systemd	
systemd-python	python3-systemd	
systemtap-runtime-python2	systemtap-runtime-python3	
sysvinit-tools	procps-ng, util-linux	
tcl	tcl, tcl-doc	
texlive-adjustbox, texlive-adjustbox-doc	texlive-adjustbox	
texlive-ae, texlive-ae-doc	texlive-ae	
texlive-algorithms, texlive-algorithms-doc	texlive-algorithms	
texlive-amscls, texlive-amscls-doc	texlive-amscls	
texlive-amsfonts, texlive-amsfonts-doc	texlive-amsfonts	
texlive-amsmath, texlive-amsmath-doc	texlive-amsmath	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-anysize, texlive-anysize-doc	texlive-anysize	
texlive-appendix, texlive-appendix-doc	texlive-appendix	
texlive-arabxetex, texlive-arabxetex-doc	texlive-arabxetex	
texlive-arphic, texlive-arphic-doc	texlive-arphic	
texlive-attachfile, texlive-attachfile-doc	texlive-attachfile	
texlive-babel, texlive-babel-doc	texlive-babel	
texlive-babelbib, texlive-babelbib-doc	texlive-babelbib	
texlive-beamer, texlive-beamer-doc	texlive-beamer	
texlive-bera, texlive-bera-doc	texlive-bera	
texlive-beton, texlive-beton-doc	texlive-beton	
texlive-bibtex-bin, texlive-bibtex-doc	texlive-bibtex	
texlive-bibtopic, texlive-bibtopic-doc	texlive-bibtopic	
texlive-bidi, texlive-bidi-doc	texlive-bidi	
texlive-bigfoot, texlive-bigfoot-doc	texlive-bigfoot	
texlive-booktabs, texlive-booktabs-doc	texlive-booktabs	
texlive-breakurl, texlive-breakurl-doc	texlive-breakurl	
texlive-caption, texlive-caption-doc	texlive-caption	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-carlisle, texlive-carlisle-doc	texlive-carlisle	
texlive-changebar, texlive-changebar-doc	texlive-changebar	
texlive-changepage, texlive-changepage-doc	texlive-changepage	
texlive-charter, texlive-charter-doc	texlive-charter	
texlive-chngcntr, texlive-chngcntr-doc	texlive-chngcntr	
texlive-cite, texlive-cite-doc	texlive-cite	
texlive-cjk, texlive-cjk-doc	texlive-cjk	
texlive-cm-lgc, texlive-cm-lgc-doc	texlive-cm-lgc	
texlive-cm-super, texlive-cm-super-doc	texlive-cm-super	
texlive-cm, texlive-cm-doc	texlive-cm	
texlive-cmap, texlive-cmap-doc	texlive-cmap	
texlive-cns, texlive-cns-doc	texlive-cns	
texlive-collectbox, texlive-collectbox-doc	texlive-collectbox	
texlive-colortbl, texlive-colortbl-doc	texlive-colortbl	
texlive-crop, texlive-crop-doc	texlive-crop	
texlive-csquotes, texlive-csquotes-doc	texlive-csquotes	
texlive-ctable, texlive-ctable-doc	texlive-ctable	
texlive-currfile, texlive-currfile-doc	texlive-currfile	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-datetime, texlive-datetime-doc	texlive-datetime	
texlive-dvipdfm, texlive-dvipdfm-bin, texlive-dvipdfm-doc, texlive-dvipdfmx, texlive-dvipdfmx-bin, texlive-dvipdfmx-doc	texlive-dvipdfmx	
texlive-dvipdfmx-def	texlive-graphics-def	
texlive-dvipng, texlive-dvipng-bin, texlive-dvipng-doc	texlive-dvipng	
texlive-dvips, texlive-dvips-bin, texlive-dvips-doc	texlive-dvips	
texlive-ec, texlive-ec-doc	texlive-ec	
texlive-eepic, texlive-eepic-doc	texlive-eepic	
texlive-enctex, texlive-enctex-doc	texlive-enctex	
texlive-enumitem, texlive-enumitem-doc	texlive-enumitem	
texlive-epsf, texlive-epsf-doc	texlive-epsf	
texlive-epstopdf, texlive-epstopdf-bin, texlive-epstopdf-doc	texlive-epstopdf	
texlive-eso-pic, texlive-eso-pic-doc	texlive-eso-pic	
texlive-eso-pic, texlive-eso-pic-doc	texlive-eso-pic	
texlive-etex-pkg, texlive-etex-pkg-doc	texlive-etex-pkg	
texlive-etex, texlive-etex-doc	texlive-etex	
texlive-etoolbox, texlive-etoolbox-doc	texlive-etoolbox	
texlive-euenc, texlive-euenc-doc	texlive-euenc	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-euler, texlive-euler-doc	texlive-euler	
texlive-euro, texlive-euro-doc	texlive-euro	
texlive-eurosym, texlive-eurosym-doc	texlive-eurosym	
texlive-extsizes, texlive-extsizes-doc	texlive-extsizes	
texlive-fancybox, texlive-fancybox-doc	texlive-fancybox	
texlive-fancyhdr, texlive-fancyhdr-doc	texlive-fancyhdr	
texlive-fancyref, texlive-fancyref-doc	texlive-fancyref	
texlive-fancyvrb, texlive-fancyvrb-doc	texlive-fancyvrb	
texlive-filecontents, texlive-filecontents-doc	texlive-filecontents	
texlive-filehook, texlive-filehook-doc	texlive-filehook	
texlive-fix2col, texlive-fix2col-doc	texlive-fix2col	
texlive-fixlatvian, texlive-fixlatvian-doc	texlive-fixlatvian	
texlive-float, texlive-float-doc	texlive-float	
texlive-fmtcount, texlive-fmtcount-doc	texlive-fmtcount	
texlive-fncychap, texlive-fncychap-doc	texlive-fncychap	
texlive-fontbook, texlive-fontbook-doc	texlive-fontbook	
texlive-fontspec, texlive-fontspec-doc	texlive-fontspec	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-fontware, texlive-fontware-bin	texlive-fontware	
texlive-fontwrap, texlive-fontwrap-doc	texlive-fontwrap	
texlive-footmisc, texlive-footmisc-doc	texlive-footmisc	
texlive-fp, texlive-fp-doc	texlive-fp	
texlive-fpl, texlive-fpl-doc	texlive-fpl	
texlive-framed, texlive-framed-doc	texlive-framed	
texlive-geometry, texlive-geometry-doc	texlive-geometry	
texlive-graphics, texlive-graphics-doc, texlive-rotating, texlive-rotating-doc	texlive-graphics	
texlive-gsftopk, texlive-gsftopk-bin	texlive-gsftopk	
texlive-hyperref, texlive-hyperref-doc	texlive-hyperref	
texlive-hyph-utf8, texlive-hyph-utf8-doc	texlive-hyph-utf8	
texlive-hyph-utf8, texlive-hyph-utf8-doc	texlive-hyph-utf8	
texlive-hyphenat, texlive-hyphenat-doc	texlive-hyphenat	
texlive-ifetex, texlive-ifetex-doc	texlive-ifetex	
texlive-ifluatex, texlive-ifluatex-doc	texlive-ifluatex	
texlive-ifmtarg, texlive-ifmtarg-doc	texlive-ifmtarg	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-ifoddpage, texlive-ifoddpage-doc	texlive-ifoddpage	
texlive-iftex, texlive-iftex-doc	texlive-iftex	
texlive-ifxetex, texlive-ifxetex-doc	texlive-ifxetex	
texlive-index, texlive-index-doc	texlive-index	
texlive-jadetex, texlive-jadetex-bin, texlive-jadetex-doc	texlive-jadetex	
texlive-jknapltx, texlive-jknapltx-doc	texlive-jknapltx	
texlive-kastrup, texlive-kastrup-doc	texlive-kastrup	
texlive-kerkis, texlive-kerkis-doc	texlive-kerkis	
texlive-kpathsea-lib	texlive-lib	
texlive-kpathsea-lib-devel	texlive-lib-devel	
texlive-kpathsea, texlive-kpathsea-bin, texlive-kpathsea-doc	texlive-kpathsea	
texlive-l3experimental, texlive-l3experimental-doc	texlive-l3experimental	
texlive-l3kernel, texlive-l3kernel-doc	texlive-l3kernel	
texlive-l3packages, texlive-l3packages-doc	texlive-l3packages	
texlive-lastpage, texlive-lastpage-doc	texlive-lastpage	
texlive-latex-fonts, texlive-latex-fonts-doc	texlive-latex-fonts	
texlive-latex, texlive-latex-bin, texlive-latex-bin-bin, texlive-latex-doc	texlive-latex	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-lettrine, texlive-lettrine-doc	texlive-lettrine	
texlive-listings, texlive-listings-doc	texlive-listings	
texlive-lm-math, texlive-lm-math-doc	texlive-lm-math	
texlive-lm, texlive-lm-doc	texlive-lm	
texlive-lua-alt-getopt, texlive-lua-alt-getopt-doc	texlive-lua-alt-getopt	
texlive-lua-alt-getopt, texlive-lua-alt-getopt-doc	texlive-lua-alt-getopt	
texlive-lualatex-math, texlive-lualatex-math-doc	texlive-lualatex-math	
texlive-lualatex-math, texlive-lualatex-math-doc	texlive-lualatex-math	
texlive-luaotfload, texlive-luaotfload-bin, texlive-luaotfload-doc	texlive-luaotfload	
texlive-luatex, texlive-luatex-bin, texlive-luatex-doc	texlive-luatex	
texlive-luatexbase, texlive-luatexbase-doc	texlive-luatexbase	
texlive-makecmds, texlive-makecmds-doc	texlive-makecmds	
texlive-makeindex, texlive-makeindex-bin, texlive-makeindex-doc	texlive-makeindex	
texlive-marginnote, texlive-marginnote-doc	texlive-marginnote	
texlive-marvosym, texlive-marvosym-doc	texlive-marvosym	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-mathpazo, texlive-mathpazo-doc	texlive-mathpazo	
texlive-mathspec, texlive-mathspec-doc	texlive-mathspec	
texlive-mdwtools, texlive-mdwtools-doc	texlive-mdwtools	
texlive-memoir, texlive-memoir-doc	texlive-memoir	
texlive-metafont, texlive-metafont-bin	texlive-metafont	
texlive-metalogo, texlive-metalogo-doc	texlive-metalogo	
texlive-metapost, texlive-metapost-bin, texlive-metapost-doc, texlive-metapost-examples-doc	texlive-metapost	
texlive-mflogo, texlive-mflogo-doc	texlive-mflogo	
texlive-mfnfss, texlive-mfnfss-doc	texlive-mfnfss	
texlive-mfware, texlive-mfware-bin	texlive-mfware	
texlive-microtype, texlive-microtype-doc	texlive-microtype	
texlive-mnsymbol, texlive-mnsymbol-doc	texlive-mnsymbol	
texlive-mparhack, texlive-mparhack-doc	texlive-mparhack	
texlive-mptopdf, texlive-mptopdf-bin	texlive-mptopdf	
texlive-ms, texlive-ms-doc	texlive-ms	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-multido, texlive-multido-doc	texlive-multido	
texlive-multirow, texlive-multirow-doc	texlive-multirow	
texlive-natbib, texlive-natbib-doc	texlive-natbib	
texlive-ncctools, texlive-ncctools-doc	texlive-ncctools	
texlive-ntgclass, texlive-ntgclass-doc	texlive-ntgclass	
texlive-oberdiek, texlive-oberdiek-doc	texlive-oberdiek	
texlive-overpic, texlive-overpic-doc	texlive-overpic	
texlive-paralist, texlive-paralist-doc	texlive-paralist	
texlive-parallel, texlive-parallel-doc	texlive-parallel	
texlive-parskip, texlive-parskip-doc	texlive-parskip	
texlive-pdfpages, texlive-pdfpages-doc	texlive-pdfpages	
texlive-pdftex-def	texlive-graphics-def	
texlive-pdftex, texlive-pdftex-bin, texlive-pdftex-doc	texlive-pdftex	
texlive-pgf, texlive-pgf-doc	texlive-pgf	
texlive-philokalia, texlive-philokalia-doc	texlive-philokalia	
texlive-placeins, texlive-placeins-doc	texlive-placeins	
texlive-polyglossia, texlive-polyglossia-doc	texlive-polyglossia	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-powerdot, texlive-powerdot-doc	texlive-powerdot	
texlive-preprint, texlive-preprint-doc	texlive-preprint	
texlive-psfrag, texlive-psfrag-doc	texlive-psfrag	
texlive-psnfss, texlive-psnfss-doc	texlive-psnfss	
texlive-pspicture, texlive-pspicture-doc	texlive-pspicture	
texlive-pst-3d, texlive-pst-3d-doc	texlive-pst-3d	
texlive-pst-3d, texlive-pst-3d-doc	texlive-pst-3d	
texlive-pst-blur, texlive-pst-blur-doc	texlive-pst-blur	
texlive-pst-coil, texlive-pst-coil-doc	texlive-pst-coil	
texlive-pst-eps, texlive-pst-eps-doc	texlive-pst-eps	
texlive-pst-fill, texlive-pst-fill-doc	texlive-pst-fill	
texlive-pst-grad, texlive-pst-grad-doc	texlive-pst-grad	
texlive-pst-math, texlive-pst-math-doc	texlive-pst-math	
texlive-pst-node, texlive-pst-node-doc	texlive-pst-node	
texlive-pst-plot, texlive-pst-plot-doc	texlive-pst-plot	
texlive-pst-slpe, texlive-pst-slpe-doc	texlive-pst-slpe	
texlive-pst-text, texlive-pst-text-doc	texlive-pst-text	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-pst-tree, texlive-pst-tree-doc	texlive-pst-tree	
texlive-pstricks-add, texlive-pstricks-add-doc	texlive-pstricks-add	
texlive-pstricks, texlive-pstricks-doc	texlive-pstricks	
texlive-ptext, texlive-ptext-doc	texlive-ptext	
texlive-pxfonts, texlive-pxfonts-doc	texlive-pxfonts	
texlive-qstest, texlive-qstest-doc	texlive-qstest	
texlive-rcs, texlive-rcs-doc	texlive-rcs	
texlive-realscripts, texlive-realscripts-doc	texlive-realscripts	
texlive-rsfs, texlive-rsfs-doc	texlive-rsfs	
texlive-sansmath, texlive-sansmath-doc	texlive-sansmath	
texlive-sauerj, texlive-sauerj-doc	texlive-sauerj	
texlive-section, texlive-section-doc	texlive-section	
texlive-sectsty, texlive-sectsty-doc	texlive-sectsty	
texlive-seminar, texlive-seminar-doc	texlive-seminar	
texlive-sepnum, texlive-sepnum-doc	texlive-sepnum	
texlive-setspace, texlive-setspace-doc	texlive-setspace	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-showexpl, texlive-showexpl-doc	texlive-showexpl	
texlive-soul, texlive-soul-doc	texlive-soul	
texlive-stmaryrd, texlive-stmaryrd-doc	texlive-stmaryrd	
texlive-subfig, texlive-subfig-doc	texlive-subfig	
texlive-subfigure, texlive-subfigure-doc	texlive-subfigure	
texlive-svn-prov, texlive-svn-prov-doc	texlive-svn-prov	
texlive-svn-prov, texlive-svn-prov-doc	texlive-svn-prov	
texlive-t2, texlive-t2-doc	texlive-t2	
texlive-tetex, texlive-tetex-bin, texlive-tetex-doc	texlive-tetex	
texlive-tex-gyre-math, texlive-tex-gyre-math-doc	texlive-tex-gyre-math	
texlive-tex-gyre, texlive-tex-gyre-doc	texlive-tex-gyre	
texlive-tex, texlive-tex-bin	texlive-tex	
texlive-tex4ht, texlive-tex4ht-bin, texlive-tex4ht-doc	texlive-tex4ht	
texlive-texconfig, texlive-texconfig-bin	texlive-texconfig	
texlive-texlive.infra, texlive-texlive.infra-bin, texlive-texlive.infra-doc	texlive-texlive.infra	
texlive-textcase, texlive-textcase-doc	texlive-textcase	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-textpos, texlive-textpos-doc	texlive-textpos	
texlive-threeparttable, texlive-threeparttable-doc	texlive-threeparttable	
texlive-thumbpdf, texlive-thumbpdf-bin, texlive-thumbpdf-doc	texlive-thumbpdf	
texlive-tipa, texlive-tipa-doc	texlive-tipa	
texlive-titlesec, texlive-titlesec-doc	texlive-titlesec	
texlive-titling, texlive-titling-doc	texlive-titling	
texlive-tocloft, texlive-tocloft-doc	texlive-tocloft	
texlive-tools, texlive-tools-doc	texlive-tools	
texlive-txfonts, texlive-txfonts-doc	texlive-txfonts	
texlive-type1cm, texlive-type1cm-doc	texlive-type1cm	
texlive-typehtml, texlive-typehtml-doc	texlive-typehtml	
texlive-ucharclasses, texlive-ucharclasses-doc	texlive-ucharclasses	
texlive-ucs, texlive-ucs-doc	texlive-ucs	
texlive-uhc, texlive-uhc-doc	texlive-uhc	
texlive-ulem, texlive-ulem-doc	texlive-ulem	
texlive-underscore, texlive-underscore-doc	texlive-underscore	
texlive-unicode-math, texlive-unicode-math-doc	texlive-unicode-math	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-unicode-math, texlive-unicode-math-doc	texlive-unicode-math	
texlive-unisugar, texlive-unisugar-doc	texlive-unisugar	
texlive-url, texlive-url-doc	texlive-url	
texlive-utopia, texlive-utopia-doc	texlive-utopia	
texlive-varwidth, texlive-varwidth-doc	texlive-varwidth	
texlive-wadalab, texlive-wadalab-doc	texlive-wadalab	
texlive-was, texlive-was-doc	texlive-was	
texlive-wasy, texlive-wasy-doc	texlive-wasy	
texlive-wasysym, texlive-wasysym-doc	texlive-wasysym	
texlive-wrapfig, texlive-wrapfig-doc	texlive-wrapfig	
texlive-xcolor, texlive-xcolor-doc	texlive-xcolor	
texlive-xdvi, texlive-xdvi-bin	texlive-xdvi	
texlive-xecjk, texlive-xecjk-doc	texlive-xecjk	
texlive-xecolor, texlive-xecolor-doc	texlive-xecolor	
texlive-xecyr, texlive-xecyr-doc	texlive-xecyr	
texlive-xeindex, texlive-xeindex-doc	texlive-xeindex	
texlive-xepersian, texlive-xepersian-doc	texlive-xepersian	
texlive-xesearch, texlive-xesearch-doc	texlive-xesearch	

RHEL 7 package(s)	RHEL 8 package(s)	Note
texlive-xetex-def	texlive-graphics-def	
texlive-xetex-itrans, texlive-xetex-itrans-doc	texlive-xetex-itrans	
texlive-xetex-pstricks, texlive-xetex-pstricks-doc	texlive-xetex-pstricks	
texlive-xetex-tibetan, texlive-xetex-tibetan-doc	texlive-xetex-tibetan	
texlive-xetex, texlive-xetex-bin, texlive-xetex-doc	texlive-xetex	
texlive-xetexfontinfo, texlive-xetexfontinfo-doc	texlive-xetexfontinfo	
texlive-xifthen, texlive-xifthen-doc	texlive-xifthen	
texlive-xkeyval, texlive-xkeyval-doc	texlive-xkeyval	
texlive-xltxtra, texlive-xltxtra-doc	texlive-xltxtra	
texlive-xmltex, texlive-xmltex-bin, texlive-xmltex-doc	texlive-xmltex	
texlive-xstring, texlive-xstring-doc	texlive-xstring	
texlive-xtab, texlive-xtab-doc	texlive-xtab	
texlive-xunicode, texlive-xunicode-doc	texlive-xunicode	
tkinter	python2-tkinter, python3-tkinter	
tracker	tracker, tracker-miners	
trousers	trousers, trousers-lib	
unbound-python	python3-unbound	
urw-fonts	urw-base35-fonts	

RHEL 7 package(s)	RHEL 8 package(s)	Note
util-linux	util-linux, util-linux-user	
vlgothic-fonts	google-noto-sans-cjk-ttc-fonts	
vulkan-devel	mesa-vulkan-devel, vulkan-headers, vulkan-loader-devel	
vulkan, vulkan-filesystem	vulkan-loader	
webkitgtk4	webkit2gtk3	
webkitgtk4-devel	webkit2gtk3-devel	
webkitgtk4-jsc	webkit2gtk3-jsc	
webkitgtk4-jsc-devel	webkit2gtk3-jsc-devel	
webkitgtk4-plugin-process-gtk2	webkit2gtk3-plugin-process-gtk2	
wireshark	wireshark-cli	
wireshark-gnome	wireshark	
wqy-zenhei-fonts	google-noto-sans-cjk-ttc-fonts	
xchat	hexchat	
xmvn	xmvn, xmvn-api, xmvn-bisect, xmvn-connector-aether, xmvn-connector-ivy, xmvn-core, xmvn-install, xmvn-minimal, xmvn-mojo, xmvn-parent-pom, xmvn-resolve, xmvn-subst, xmvn-tools-pom	
xorg-x11-drv-wacom	xorg-x11-drv-wacom, xorg-x11-drv-wacom-serial-support	
xterm	xterm, xterm-resize	
yum-cron	dnf-automatic	The **dnf-automatic** package provides similar functionality, but is not compatible with the **yum-cron** configuration files.

RHEL 7 package(s)	RHEL 8 package(s)	Note
yum-metadata-parser	python3-dnf	Users should now use the DNF API (queries, package objects, and others) to work with the repodata content.
yum-plugin-aliases, yum-plugin-fastestmirror, yum-plugin-priorities, yum-plugin-remove-with-leaves, yum-plugin-tmprepo, yum-plugin-tsflags	dnf	The mentioned functionalities are now provided by DNF. The functionality of **yum-plugin-tmprepo** is provided by the **--repofrompath** option. Setting the **tsflags** option is now an integral part of **dnf**: use **--setopt=tsflags=<flags>**.
yum-plugin-auto-update-debug-info, yum-plugin-changelog, yum-plugin-copr	dnf-plugins-core	All these plug-ins are now part of the **dnf-plugins-core** package but are still installable under the original names.
yum-plugin-versionlock	python3-dnf-plugin-versionlock	Still installable under the original name.
yum-rhn-plugin	dnf-plugin-spacewalk	
yum-utils	dnf-utils	Still installable under the original name.

Note that certain replaced or split packages have been moved to the unsupported CodeReady Linux Builder repository. For details, see Section A.4, “Packages with removed support”.

A.3. REMOVED PACKAGES

The following packages are part of RHEL 7 but are not distributed with RHEL 8:

Removed package	Note
a2ps	The **a2ps** package has been removed. The**enscript** package can cover some its functionality. Users can configure **enscript** in the **/etc/enscript.cfg** file.
abrt-addon-upload-watch	
abrt-devel	
abrt-gui-devel	

Removed package	Note
abrt-retrace-client	
acpid-sysvinit	
advancecomp	
adwaita-icon-theme-devel	
adwaita-qt-common	
adwaita-qt4	
agg	
aic94xx-firmware	
akonadi	
akonadi-devel	
akonadi-mysql	
alacarte	
alsa-tools	
anaconda-widgets-devel	
ant-antunit	
ant-antunit-javadoc	
antlr-C++-doc	
antlr-python	
apache-commons-configuration	
apache-commons-configuration-javadoc	
apache-commons-daemon	

Removed package	Note
apache-commons-daemon-javadoc	
apache-commons-daemon-jsvc	
apache-commons-dbcp	
apache-commons-dbcp-javadoc	
apache-commons-digester	
apache-commons-digester-javadoc	
apache-commons-jexl	
apache-commons-jexl-javadoc	
apache-commons-pool	
apache-commons-pool-javadoc	
apache-commons-validator	
apache-commons-validator-javadoc	
apache-commons-vfs	
apache-commons-vfs-ant	
apache-commons-vfs-examples	
apache-commons-vfs-javadoc	
apache-rat	
apache-rat-core	
apache-rat-javadoc	
apache-rat-plugin	
apache-rat-tasks	

Removed package	Note
apr-util-nss	The **apr-util-nss** package provided a backend for the **apr_crypto.h** interface, using the NSS Cryptography Library. Any applications using the **NSS** backend for this interface should migrate to using the **OpenSSL** backend, which is provided in the **apr-util-openssl** package.
args4j	
args4j-javadoc	
ark	
ark-libs	
asciidoc-latex	
at-spi	
at-spi-devel	
at-spi-python	
at-sysvinit	
atlas-static	
attica	
attica-devel	
audiocd-kio	
audiocd-kio-devel	
audiocd-kio-libs	
audiofile	
audiofile-devel	
audit-libs-python	
audit-libs-static	
authconfig-gtk	

Removed package	Note
authd	
autogen-libopts-devel	
automoc	
autotrace-devel	
avahi-dnsconfd	
avahi-glib-devel	
avahi-gobject-devel	
avahi-qt3	
avahi-qt3-devel	
avahi-qt4	
avahi-qt4-devel	
avahi-tools	
avahi-ui	
avahi-ui-devel	
avahi-ui-tools	
avalon-framework	
avalon-framework-javadoc	
avalon-logkit	
avalon-logkit-javadoc	
bacula-console-bat	
bacula-devel	
bacula-traymonitor	

Removed package	Note
baekmuk-ttf-batang-fonts	
baekmuk-ttf-dotum-fonts	
baekmuk-ttf-fonts-common	
baekmuk-ttf-fonts-ghostscript	
baekmuk-ttf-gulim-fonts	
baekmuk-ttf-hline-fonts	
base64coder	
base64coder-javadoc	
batik	
batik-demo	
batik-javadoc	
batik-rasterizer	
batik-slideshow	
batik-squiggle	
batik-svgpp	
batik-ttf2svg	
bcc-devel	
bison-devel	
blas-static	
blas64-devel	
blas64-static	
bltk	

Removed package	Note
bluedevil	
bluedevil-autostart	
bmc-snmp-proxy	
bogofilter-bogoupgrade	
bridge-utils	
bsdcpio	
bsh-demo	
bsh-utils	
btrfs-progs	
btrfs-progs-devel	
buildnumber-maven-plugin	
buildnumber-maven-plugin-javadoc	
bwidget	
bzr	
bzr-doc	
cairo-tools	
caribou	
caribou-antler	
caribou-devel	
caribou-gtk2-module	
caribou-gtk3-module	
cdparanoia-static	

Removed package	Note
cdrskin	
ceph-common	
check-static	
cheese-libs-devel	
cifs-utils-devel	
cim-schema-docs	
cim-schema-docs	
cjkuni-ukai-fonts	
clutter-gst2-devel	
clutter-tests	
cmpi-bindings-pywbem	
cobertura	
cobertura-javadoc	
cockpit-machines-ovirt	
codehaus-parent	
codemodel-javadoc	
cogl-tests	
colord-extra-profiles	
colord-kde	
compat-cheese314	
compat-dapl	
compat-dapl-devel	
compat-dapl-static	

Removed package	Note
compat-dapl-utils	
compat-db	
compat-db-headers	
compat-db47	
compat-exiv2-023	
compat-gcc-44	
compat-gcc-44-c++	
compat-gcc-44-gfortran	
compat-glade315	
compat-glew	
compat-glibc	
compat-glibc-headers	
compat-gnome-desktop314	
compat-grilo02	
compat-libcap1	
compat-libcogl-pango12	
compat-libcogl12	
compat-libcolord1	
compat-libf2c-34	
compat-libgdata13	
compat-libgfortran-41	
compat-libgnome-bluetooth11	
compat-libgnome-desktop3-7	

Removed package	Note
compat-libgweather3	
compat-libical1	
compat-libmediaart0	
compat-libmpc	
compat-libpackagekit-glib2-16	
compat-libstdc++-33	
compat-libtiff3	
compat-libupower-glib1	
compat-libxcb	
compat-locales-sap-common	
compat-openldap	
compat-openmpi16	
compat-openmpi16-devel	
compat-opensm-libs	
compat-poppler022	
compat-poppler022-cpp	
compat-poppler022-glib	
compat-poppler022-qt	
compat-sap-c++-5	
compat-sap-c++-6	
compat-sap-c++-7	
conman	
console-setup	

Removed package	Note
coolkey	
coolkey-devel	
cpptest	
cpptest-devel	
cppunit	
cppunit-devel	
cppunit-doc	
cpuid	
cracklib-python	
crda-devel	
crit	
criu-devel	
crypto-utils	
cryptsetup-python	
cvs	Version control system supported in RHEL 8 are **Git**, **Mercurial**, and **Subversion**.
cvs-contrib	
cvs-doc	
cvs-inetd	
cvsps	
cyrus-imapd-devel	
dapl	
dapl-devel	

Removed package	Note
dapl-static	
dapl-utils	
dbus-doc	
dbus-python-devel	
dbus-tests	
dbusmenu-qt	
dbusmenu-qt-devel	
dbusmenu-qt-devel-docs	
debugmode	
dejavu-lgc-sans-fonts	
dejavu-lgc-sans-mono-fonts	
dejavu-lgc-serif-fonts	
deltaiso	
dhcp-devel	
dialog-devel	
dleyna-connector-dbus-devel	
dleyna-core-devel	
dlm-devel	
dmraid	Users requiring support for combined hardware and software RAID host bus adapters (HBA) should use the **mdadm** utility.
dmraid-devel	
dmraid-events	
dmraid-events-logwatch	

Removed package	Note
docbook-simple	
docbook-slides	
docbook-utils-pdf	
docbook5-style-xsl	
docbook5-style-xsl-extensions	
docker-rhel-push-plugin	
dom4j	
dom4j-demo	
dom4j-javadoc	
dom4j-manual	
dovecot-pigeonhole	
dracut-fips	
dracut-fips-aesni	
dragon	
drm-utils	
drpmsync	
dtdinst	
e2fsprogs-static	
ecj	
edac-utils-devel	
efax	
efivar-devel	

Removed package	Note
egl-utils	
ekiga	
ElectricFence	
emacs-a2ps	
emacs-a2ps-el	
emacs-auctex	
emacs-auctex-doc	
emacs-git	
emacs-git-el	
emacs-gnuplot	
emacs-gnuplot-el	
emacs-php-mode	
empathy	
enchant-aspell	
enchant-voikko	
eog-devel	
epydoc	
espeak-devel	
evince-devel	
evince-dvi	
evolution-data-server-doc	
evolution-data-server-perl	
evolution-data-server-tests	

Removed package	Note
evolution-devel	
evolution-devel-docs	
evolution-tests	
expat-static	The **expat-static** package providing a static library for the **expat** XML library is no longer provided. Use dynamic linking instead.
expect-devel	
expectk	
farstream	
farstream-devel	
farstream-python	
farstream02-devel	
fedfs-utils-admin	
fedfs-utils-client	
fedfs-utils-common	
fedfs-utils-devel	
fedfs-utils-lib	
fedfs-utils-nsdbparams	
fedfs-utils-python	
fedfs-utils-server	
felix-bundlerepository	
felix-bundlerepository-javadoc	
felix-framework	
felix-framework-javadoc	

Removed package	Note
felix-osgi-obr	
felix-osgi-obr-javadoc	
felix-shell	
felix-shell-javadoc	
fence-sanlock	
festival	
festival-devel	
festival-docs	
festival-freebsoft-utils	
festival-lib	
festival-speechtools-devel	
festival-speechtools-libs	
festival-speechtools-utils	
festvox-awb-arctic-hts	
festvox-bdl-arctic-hts	
festvox-clb-arctic-hts	
festvox-jmk-arctic-hts	
festvox-kal-diphone	
festvox-ked-diphone	
festvox-rms-arctic-hts	
festvox-slt-arctic-hts	
file-static	
filebench	

Removed package	Note
filesystem-content	
finch	
finch-devel	
finger	Users of the **finger** client/server can use the **who**, **pinky**, and **last** commands. For remote machines, use these commands with SSH.
finger-server	
flatpak-devel	
fltk-fluid	
fltk-static	
flute-javadoc	
folks	
folks-devel	
folks-tools	
fontforge-devel	
fontpackages-tools	
fonttools	
fop	
fop-javadoc	
fprintd-devel	
freeradius-python	
freetype-demos	
fros	
fros-gnome	

Removed package	Note
fros-recordmydesktop	
fwupd-devel	
fwupdate-devel	
gamin-python	
gavl-devel	
gcab	
gcc-gnat	
gcc-go	
gcc-objc	
gcc-objc++	
gcc-plugin-devel	
gconf-editor	
gd-progs	
gdk-pixbuf2-tests	
gdm-devel	
gdm-pam-extensions-devel	
gedit-devel	
gedit-plugin-bookmarks	
gedit-plugin-bracketcompletion	
gedit-plugin-charmap	
gedit-plugin-codecomment	
gedit-plugin-colorpicker	
gedit-plugin-colorschemer	

Removed package	Note
gedit-plugin-commander	
gedit-plugin-drawspaces	
gedit-plugin-findinfiles	
gedit-plugin-joinlines	
gedit-plugin-multiedit	
gedit-plugin-smartspaces	
gedit-plugin-synctex	
gedit-plugin-terminal	
gedit-plugin-textsize	
gedit-plugin-translate	
gedit-plugin-wordcompletion	
gedit-plugins	
gedit-plugins-data	
gegl-devel	
geoclue	
geoclue-devel	
geoclue-doc	
geoclue-gsmloc	
geoclue-gui	
GeoIP	The **GeoIp** package is capable of working only with legacy databases. A replacement provided in RHEL 8 is the new **libmaxminddb** package, together with the **geoipupdate** package. This is a new API created by the upstream GeoIP project and it supports new format of databases, **mmdb**.
GeoIP-data	

Removed package	Note
GeoIP-devel	
GeoIP-update	
geronimo-jaspic-spec	
geronimo-jaspic-spec-javadoc	
geronimo-jaxrpc	
geronimo-jaxrpc-javadoc	
geronimo-jta	
geronimo-jta-javadoc	
geronimo-osgi-support	
geronimo-osgi-support-javadoc	
geronimo-saaj	
geronimo-saaj-javadoc	
ghostscript-chinese	
ghostscript-chinese-zh_CN	
ghostscript-chinese-zh_TW	
ghostscript-cups	
ghostscript-devel	
ghostscript-gtk	
giflib-utils	
gimp-data-extras	
gimp-help	
gimp-help-ca	

Removed package	Note
gimp-help-da	
gimp-help-de	
gimp-help-el	
gimp-help-en_GB	
gimp-help-es	
gimp-help-fr	
gimp-help-it	
gimp-help-ja	
gimp-help-ko	
gimp-help-nl	
gimp-help-nn	
gimp-help-pt_BR	
gimp-help-ru	
gimp-help-sl	
gimp-help-sv	
gimp-help-zh_CN	
git-bzr	
git-cvs	
git-gnome-keyring	
git-hg	
git-p4	
gjs-tests	

Removed package	Note
glade	
glade3	
glade3-libgladeui	
glade3-libgladeui-devel	
glassfish-dtd-parser	
glassfish-dtd-parser-javadoc	
glassfish-jaxb-javadoc	
glassfish-jsp	
glassfish-jsp-javadoc	
glew	
glib-networking-tests	
gmp-static	
gnome-clocks	
gnome-contacts	
gnome-desktop3-tests	
gnome-devel-docs	
gnome-dictionary	
gnome-doc-utils	
gnome-doc-utils-stylesheets	
gnome-documents	
gnome-documents-libs	
gnome-icon-theme	

Removed package	Note
gnome-icon-theme-devel	
gnome-icon-theme-extras	
gnome-icon-theme-legacy	
gnome-icon-theme-symbolic	
gnome-packagekit	
gnome-packagekit-common	
gnome-packagekit-installer	
gnome-packagekit-updater	
gnome-python2	
gnome-python2-bonobo	
gnome-python2-canvas	
gnome-python2-devel	
gnome-python2-gconf	
gnome-python2-gnome	
gnome-python2-gnomevfs	
gnome-settings-daemon-devel	
gnome-software-devel	
gnome-vfs2	
gnome-vfs2-devel	
gnome-vfs2-smb	
gnome-weather	
gnome-weather-tests	

Removed package	Note
gnote	
gnu-efi-utils	
gnu-getopt	
gnu-getopt-javadoc	
gnuplot-latex	
gnuplot-minimal	
gob2	
gom-devel	
google-noto-sans-korean-fonts	
google-noto-sans-simplified-chinese-fonts	
google-noto-sans-traditional-chinese-fonts	
gperftools	
gperftools-devel	
gperftools-libs	
gpm-static	
grantlee	
grantlee-apidocs	
grantlee-devel	
graphviz-graphs	
graphviz-guile	
graphviz-java	
graphviz-lua	

Removed package	Note
graphviz-ocaml	
graphviz-perl	
graphviz-php	
graphviz-python	
graphviz-ruby	
graphviz-tcl	
groff-doc	
groff-perl	
groff-x11	
groovy	
groovy-javadoc	
grub2	
grub2-ppc-modules	
grub2-ppc64-modules	
gsm-tools	
gsound-devel	
gssdp-utils	
gstreamer	
gstreamer-devel	
gstreamer-devel-docs	
gstreamer-plugins-bad-free	
gstreamer-plugins-bad-free-devel	

Removed package	Note
gstreamer-plugins-bad-free-devel-docs	
gstreamer-plugins-base	
gstreamer-plugins-base-devel	
gstreamer-plugins-base-devel-docs	
gstreamer-plugins-base-tools	
gstreamer-plugins-good	
gstreamer-plugins-good-devel-docs	
gstreamer-python	
gstreamer-python-devel	
gstreamer-tools	
gstreamer1-devel-docs	
gstreamer1-plugins-base-devel-docs	
gstreamer1-plugins-base-tools	
gstreamer1-plugins-ugly-free-devel	
gtk-vnc	
gtk-vnc-devel	
gtk-vnc-python	
gtk-vnc2-devel	
gtk3-devel-docs	
gtk3-immodules	

Removed package	Note
gtk3-tests	
gtkhtml3	
gtkhtml3-devel	
gtksourceview3-tests	
gucharmap	
gucharmap-devel	
gucharmap-libs	
gupnp-av-devel	
gupnp-av-docs	
gupnp-dlna-devel	
gupnp-dlna-docs	
gupnp-docs	
gupnp-igd-python	
gutenprint-devel	
gutenprint-extras	
gutenprint-foomatic	
gvfs-tests	
gvnc-devel	
gvnc-tools	
gvncpulse	
gvncpulse-devel	
gwenview	

Removed package	Note
gwenview-libs	
hawkey-devel	
highcontrast-qt	
highcontrast-qt4	
highcontrast-qt5	
highlight-gui	
hispavoces-pal-diphone	
hispavoces-sfl-diphone	
hsakmt	
hsakmt-devel	
hspell-devel	
hsqldb	
hsqldb-demo	
hsqldb-javadoc	
hsqldb-manual	
htdig	
html2ps	
http-parser-devel	
httpunit	
httpunit-doc	
httpunit-javadoc	
i2c-tools-eepromer	

Removed package	Note
i2c-tools-python	
ibus-pygtk2	
ibus-qt	
ibus-qt-devel	
ibus-qt-docs	
ibus-rawcode	
ibus-table-devel	
ibutils	
ibutils-devel	
ibutils-libs	
icc-profiles-openicc	
icon-naming-utils	
im-chooser	
im-chooser-common	
ImageMagick	
ImageMagick-c++	
ImageMagick-c++-devel	
ImageMagick-devel	
ImageMagick-doc	
ImageMagick-perl	
imsettings	
imsettings-devel	

Removed package	Note
imsettings-gsettings	
imsettings-libs	
imsettings-qt	
imsettings-xim	
indent	
infinipath-psm	
infinipath-psm-devel	
iniparser	
iniparser-devel	
iok	
ipa-gothic-fonts	
ipa-mincho-fonts	
ipa-pgothic-fonts	
ipa-pmincho-fonts	
iperf3-devel	
iproute-doc	
ipset-devel	
ipsilon	
ipsilon-authform	
ipsilon-authgssapi	
ipsilon-authldap	
ipsilon-base	
ipsilon-client	

Removed package	Note
ipsilon-filesystem	
ipsilon-infosssd	
ipsilon-persona	
ipsilon-saml2	
ipsilon-saml2-base	
ipsilon-tools-ipa	
iputils-sysvinit	
iscsi-initiator-utils-devel	
isdn4k-utils	
isdn4k-utils-devel	
isdn4k-utils-doc	
isdn4k-utils-static	
isdn4k-utils-vboxgetty	
isomd5sum-devel	
istack-commons-javadoc	
ixpdimm_sw	
ixpdimm_sw-devel	
ixpdimm-cli	
ixpdimm-monitor	
jai-imageio-core	
jai-imageio-core-javadoc	
jakarta-taglibs-standard	

Removed package	Note
jakarta-taglibs-standard-javadoc	
jandex	
jandex-javadoc	
jansson-devel-doc	
jarjar	
jarjar-javadoc	
jarjar-maven-plugin	
jasper	
jasper-utils	
java-1.6.0-openjdk	
java-1.6.0-openjdk-demo	
java-1.6.0-openjdk-devel	
java-1.6.0-openjdk-javadoc	
java-1.6.0-openjdk-src	
java-1.7.0-openjdk	
java-1.7.0-openjdk-accessibility	
java-1.7.0-openjdk-demo	
java-1.7.0-openjdk-devel	
java-1.7.0-openjdk-headless	
java-1.7.0-openjdk-javadoc	
java-1.7.0-openjdk-src	
java-1.8.0-openjdk-accessibility-debug	

Removed package	Note
java-1.8.0-openjdk-debug	
java-1.8.0-openjdk-demo-debug	
java-1.8.0-openjdk-devel-debug	
java-1.8.0-openjdk-headless-debug	
java-1.8.0-openjdk-javadoc-debug	
java-1.8.0-openjdk-javadoc-zip-debug	
java-1.8.0-openjdk-src-debug	
java-11-openjdk-debug	
java-11-openjdk-demo-debug	
java-11-openjdk-devel-debug	
java-11-openjdk-headless-debug	
java-11-openjdk-javadoc-debug	
java-11-openjdk-javadoc-zip-debug	
java-11-openjdk-jmods-debug	
java-11-openjdk-src-debug	
jboss-ejb-3.1-api	
jboss-ejb-3.1-api-javadoc	
jboss-el-2.2-api	
jboss-el-2.2-api-javadoc	
jboss-jaxrpc-1.1-api	
jboss-jaxrpc-1.1-api-javadoc	

Removed package	Note
jboss-servlet-2.5-api	
jboss-servlet-2.5-api-javadoc	
jboss-servlet-3.0-api	
jboss-servlet-3.0-api-javadoc	
jboss-specs-parent	
jboss-transaction-1.1-api	
jboss-transaction-1.1-api-javadoc	
jettison	
jettison-javadoc	
jetty-annotations	
jetty-ant	
jetty-artifact-remote-resources	
jetty-assembly-descriptors	
jetty-build-support	
jetty-build-support-javadoc	
jetty-client	
jetty-continuation	
jetty-deploy	
jetty-distribution-remote-resources	
jetty-http	
jetty-io	
jetty-jaas	

Removed package	Note
jetty-jaspi	
jetty-javadoc	
jetty-jmx	
jetty-jndi	
jetty-jsp	
jetty-jspc-maven-plugin	
jetty-maven-plugin	
jetty-monitor	
jetty-parent	
jetty-plus	
jetty-project	
jetty-proxy	
jetty-rewrite	
jetty-runner	
jetty-security	
jetty-server	
jetty-servlet	
jetty-servlets	
jetty-start	
jetty-test-policy	
jetty-test-policy-javadoc	
jetty-toolchain	

Removed package	Note
jetty-util	
jetty-util-ajax	
jetty-version-maven-plugin	
jetty-version-maven-plugin-javadoc	
jetty-webapp	
jetty-websocket-api	
jetty-websocket-client	
jetty-websocket-common	
jetty-websocket-parent	
jetty-websocket-server	
jetty-websocket-servlet	
jetty-xml	
jing	
jing-javadoc	
jline-demo	
jna-contrib	
jna-javadoc	
joda-convert	
joda-convert-javadoc	
js	
js-devel	
jsch-demo	

Removed package	Note
json-glib-tests	
jsr-311	
jsr-311-javadoc	
juk	
junit-demo	
k3b	
k3b-common	
k3b-devel	
k3b-libs	
kaccessible	
kaccessible-libs	
kactivities	
kactivities-devel	
kamera	
kate	
kate-devel	
kate-libs	
kate-part	
kcalc	
kcharselect	
kcm_colors	
kcm_touchpad	
kcm-gtk	

Removed package	Note
kcolorchooser	
kcoloredit	
kde-base-artwork	
kde-baseapps	
kde-baseapps-devel	
kde-baseapps-libs	
kde-filesystem	
kde-l10n	
kde-l10n-Arabic	
kde-l10n-Basque	
kde-l10n-Bosnian	
kde-l10n-British	
kde-l10n-Bulgarian	
kde-l10n-Catalan	
kde-l10n-Catalan-Valencian	
kde-l10n-Croatian	
kde-l10n-Czech	
kde-l10n-Danish	
kde-l10n-Dutch	
kde-l10n-Estonian	
kde-l10n-Farsi	
kde-l10n-Finnish	
kde-l10n-Galician	

Removed package	Note
kde-l10n-Greek	
kde-l10n-Hebrew	
kde-l10n-Hungarian	
kde-l10n-Icelandic	
kde-l10n-Interlingua	
kde-l10n-Irish	
kde-l10n-Kazakh	
kde-l10n-Khmer	
kde-l10n-Latvian	
kde-l10n-Lithuanian	
kde-l10n-LowSaxon	
kde-l10n-Norwegian	
kde-l10n-Norwegian-Nynorsk	
kde-l10n-Polish	
kde-l10n-Portuguese	
kde-l10n-Romanian	
kde-l10n-Serbian	
kde-l10n-Slovak	
kde-l10n-Slovenian	
kde-l10n-Swedish	
kde-l10n-Tajik	
kde-l10n-Thai	
kde-l10n-Turkish	

Removed package	Note
kde-l10n-Ukrainian	
kde-l10n-Uyghur	
kde-l10n-Vietnamese	
kde-l10n-Walloon	
kde-plasma-networkmanagement	
kde-plasma-networkmanagement-libreswan	
kde-plasma-networkmanagement-libs	
kde-plasma-networkmanagement-mobile	
kde-print-manager	
kde-runtime	
kde-runtime-devel	
kde-runtime-drkonqi	
kde-runtime-libs	
kde-settings	
kde-settings-ksplash	
kde-settings-minimal	
kde-settings-plasma	
kde-settings-pulseaudio	
kde-style-oxygen	
kde-style-phase	
kde-wallpapers	

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kde-workspace	
kde-workspace-devel	
kde-workspace-ksplash-themes	
kde-workspace-libs	
kdeaccessibility	
kdeadmin	
kdeartwork	
kdeartwork-screensavers	
kdeartwork-sounds	
kdeartwork-wallpapers	
kdeclassic-cursor-theme	
kdegraphics	
kdegraphics-devel	
kdegraphics-libs	
kdegraphics-strigi-analyzer	
kdegraphics-thumbnailers	
kdelibs	
kdelibs-apidocs	
kdelibs-common	
kdelibs-devel	
kdelibs-ktexteditor	
kdemultimedia	

Removed package	Note
kdemultimedia-common	
kdemultimedia-devel	
kdemultimedia-libs	
kdenetwork	
kdenetwork-common	
kdenetwork-devel	
kdenetwork-fileshare-samba	
kdenetwork-kdnssd	
kdenetwork-kget	
kdenetwork-kget-libs	
kdenetwork-kopete	
kdenetwork-kopete-devel	
kdenetwork-kopete-libs	
kdenetwork-krdc	
kdenetwork-krdc-devel	
kdenetwork-krdc-libs	
kdenetwork-krfb	
kdenetwork-krfb-libs	
kdepim	
kdepim-devel	
kdepim-libs	
kdepim-runtime	

Removed package	Note
kdepim-runtime-libs	
kdepimlibs	
kdepimlibs-akonadi	
kdepimlibs-apidocs	
kdepimlibs-devel	
kdepimlibs-kxmlrpcclient	
kdeplasma-addons	
kdeplasma-addons-devel	
kdeplasma-addons-libs	
kdesdk	
kdesdk-cervisia	
kdesdk-common	
kdesdk-devel	
kdesdk-dolphin-plugins	
kdesdk-kapptemplate	
kdesdk-kapptemplate-template	
kdesdk-kcachegrind	
kdesdk-kioslave	
kdesdk-kmtrace	
kdesdk-kmtrace-devel	
kdesdk-kmtrace-libs	
kdesdk-kompare	
kdesdk-kompare-devel	

Removed package	Note
kdesdk-kompare-libs	
kdesdk-kpartloader	
kdesdk-kstartperf	
kdesdk-kuiviewer	
kdesdk-lokalize	
kdesdk-okteta	
kdesdk-okteta-devel	
kdesdk-okteta-libs	
kdesdk-poxml	
kdesdk-scripts	
kdesdk-strigi-analyzer	
kdesdk-thumbnailers	
kdesdk-umbrello	
kdeutils	
kdeutils-common	
kdeutils-minimal	
kdf	
kernel-rt-doc	
kernel-rt-trace	
kernel-rt-trace-devel	
kernel-rt-trace-kvm	
keytool-maven-plugin	
keytool-maven-plugin-javadoc	

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kgamma	
kgpg	
kgreeter-plugins	
khotkeys	
khotkeys-libs	
kiconedit	
kinfocenter	
kio_sysinfo	
kmag	
kmenuedit	
kmix	
kmod-oracleasm	
kolourpaint	
kolourpaint-libs	
konkretcmpi	
konkretcmpi-devel	
konkretcmpi-python	
konsole	
konsole-part	
kross-interpreters	
kross-python	
kross-ruby	
kruler	

Removed package	Note
ksaneplugin	
kscreen	
ksnapshot	
ksshaskpass	
ksysguard	
ksysguard-libs	
ksysguardd	
ktimer	
kwallet	
kwin	
kwin-gles	
kwin-gles-libs	
kwin-libs	
kwrite	
kxml	
kxml-javadoc	
lapack64-devel	
lapack64-static	
lasso-devel	
latrace	
lcms2-utils	
ldns-doc	
ldns-python	

Removed package	Note
libabw-devel	
libabw-doc	
libabw-tools	
libappindicator	
libappindicator-devel	
libappindicator-docs	
libappstream-glib-builder	
libappstream-glib-builder-devel	
libart_lgpl	
libart_lgpl-devel	
libasan-static	
libavc1394-devel	
libbase-javadoc	
libblockdev-btrfs	
libblockdev-btrfs-devel	
libblockdev-crypto-devel	
libblockdev-devel	
libblockdev-dm-devel	
libblockdev-fs-devel	
libblockdev-kbd-devel	
libblockdev-loop-devel	
libblockdev-lvm-devel	
libblockdev-mdraid-devel	

Removed package	Note
libblockdev-mpath-devel	
libblockdev-nvdimm-devel	
libblockdev-part-devel	
libblockdev-swap-devel	
libblockdev-utils-devel	
libblockdev-vdo-devel	
libbluedevil	
libbluedevil-devel	
libbluray-devel	
libbonobo	
libbonobo-devel	
libbonoboui	
libbonoboui-devel	
libbytesize-devel	
libcacard-tools	
libcap-ng-python	
libcdr-devel	
libcdr-doc	
libcdr-tools	
libcgroup-devel	
libchamplain-demos	
libchewing	
libchewing-devel	

Removed package	Note
libchewing-python	
libcmis-devel	
libcmis-tools	
libcryptui	
libcryptui-devel	
libdb-devel-static	
libdb-java	
libdb-java-devel	
libdb-tcl	
libdb-tcl-devel	
libdbi	
libdbi-dbd-mysql	
libdbi-dbd-pgsql	
libdbi-dbd-sqlite	
libdbi-devel	
libdbi-drivers	
libdbusmenu-gtk2	
libdbusmenu-gtk2-devel	
libdhash-devel	
libdmapsharing-devel	
libdmmp-devel	
libdmx-devel	
libdnet-progs	

Removed package	Note
libdnet-python	
libdnf-devel	
libdv-tools	
libdvdnav-devel	
libeasyfc-devel	
libeasyfc-gobject-devel	
libee	
libee-devel	
libee-utils	
libesmtp	
libesmtp-devel	
libestr-devel	
libetonyek-doc	
libetonyek-tools	
libevdev-utils	
libexif-doc	
libexttextcat-devel	
libexttextcat-tools	
libfastjson-devel	
libfonts-javadoc	
libformula-javadoc	
libfprint-devel	
libfreehand-devel	

Removed package	Note
libfreehand-doc	
libfreehand-tools	
libgcab1-devel	
libgccjit	
libgdither-devel	
libgee06	
libgee06-devel	
libgepub	
libgepub-devel	
libgfortran-static	
libgfortran4	
libgfortran5	
libglade2	
libglade2-devel	
libGLEWmx	
libgnat	
libgnat-devel	
libgnat-static	
libgnome	
libgnome-devel	
libgnome-keyring-devel	
libgnomecanvas	
libgnomecanvas-devel	

Removed package	Note
libgnomeui	
libgnomeui-devel	
libgo	
libgo-devel	
libgo-static	
libgovirt-devel	
libgxim	
libgxim-devel	
libgxps-tools	
libhangul-devel	
libhbaapi-devel	
libhif-devel	
libical-glib	
libical-glib-devel	
libical-glib-doc	
libid3tag	
libid3tag-devel	
libiec61883-utils	
libieee1284-python	
libimobiledevice-python	
libimobiledevice-utils	
libindicator	
libindicator-devel	

Removed package	Note
libindicator-tools	
libinvm-cim	
libinvm-cim-devel	
libinvm-cli	
libinvm-cli-devel	
libinvm-i18n	
libinvm-i18n-devel	
libiodbc	
libiodbc-devel	
libipa_hbac-devel	
libiptcdata-devel	
libiptcdata-python	
libitm-static	
libixpdimm-cim	
libixpdimm-core	
libjpeg-turbo-static	
libkcddb	
libkcddb-devel	
libkcompactdisc	
libkcompactdisc-devel	
libkdcraw	
libkdcraw-devel	
libkexiv2	

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libkexiv2-devel	
libkipi	
libkipi-devel	
libkkc-devel	
libkkc-tools	
libksane	
libksane-devel	
libkscreen	
libkscreen-devel	
libkworkspace	
liblayout-javadoc	
libloader-javadoc	
liblognorm-devel	
liblouis-devel	
liblouis-doc	
liblouis-utils	
libmatchbox-devel	
libmbim-devel	
libmediaart-devel	
libmediaart-tests	
libmnl-static	
libmodman-devel	
libmpc-devel	

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libmsn	
libmsn-devel	
libmspub-devel	
libmspub-doc	
libmspub-tools	
libmtp-examples	
libmudflap	
libmudflap-devel	
libmudflap-static	
libmwaw-devel	
libmwaw-doc	
libmwaw-tools	
libmx	
libmx-devel	
libmx-docs	
libndp-devel	
libnetfilter_cthelper-devel	
libnetfilter_cttimeout-devel	
libnftnl-devel	
libnl	
libnl-devel	

Removed package	Note
libnm-gtk	
libnm-gtk-devel	
libntlm	
libntlm-devel	
libobjc	
libodfgen-doc	
libofa	
libofa-devel	
liboil	
liboil-devel	
libopenraw-pixbuf-loader	
liborcus-devel	
liborcus-doc	
liborcus-tools	
libosinfo-devel	
libosinfo-vala	
libotf-devel	
libpagemaker-devel	
libpagemaker-doc	
libpagemaker-tools	
libpinyin-devel	
libpinyin-tools	

Removed package	Note
libpipeline-devel	
libplist-python	
libpng-static	
libpng12-devel	
libproxy-kde	
libpst	
libpst-devel	
libpst-devel-doc	
libpst-doc	
libpst-python	
libpurple-perl	
libpurple-tcl	
libqmi-devel	
libquadmath-static	
LibRaw-static	
librelp-devel	
libreoffice	
libreoffice-bsh	
libreoffice-gdb-debug-support	
libreoffice-glade	
libreoffice-librelogo	
libreoffice-nlpsolver	

Removed package	Note
libreoffice-officebean	
libreoffice-officebean-common	
libreoffice-postgresql	
libreoffice-rhino	
libreofficekit-devel	
librepo-devel	
libreport-compat	
libreport-devel	
libreport-gtk-devel	
libreport-web-devel	
librepository-javadoc	
librevenge-doc	
librsvg2-tools	
libselinux-static	
libsemanage-devel	
libsemanage-static	
libserializer-javadoc	
libsexy	
libsexy-devel	
libsmbios-devel	
libsmi-devel	
libsndfile-utils	

Removed package	Note
libsolv-demo	
libsolv-devel	
libsolv-tools	
libspiro-devel	
libss-devel	
libsss_certmap-devel	
libsss_idmap-devel	
libsss_nss_idmap-devel	
libsss_simpleifp-devel	
libstaroffice-devel	
libstaroffice-doc	
libstaroffice-tools	
libstdc++-static	
libstoragemgmt-devel	
libstoragemgmt-targetd-plugin	
libtar-devel	
libteam-devel	
libtheora-devel-docs	
libtiff-static	
libtimezonemap-devel	
libtnc	
libtnc-devel	

Removed package	Note
libtranslit	
libtranslit-devel	
libtranslit-icu	
libtranslit-m17n	
libtsan-static	
libudisks2-devel	
libuninameslist-devel	
libunwind	
libunwind-devel	
libusal-devel	
libusb-static	
libusbmuxd-utils	
libuser-devel	
libvdpau-docs	
libverto-glib	
libverto-glib-devel	
libverto-libevent-devel	
libverto-tevent	
libverto-tevent-devel	
libvirt-cim	
libvirt-daemon-driver-lxc	
libvirt-daemon-lxc	
libvirt-gconfig-devel	

Removed package	Note
libvirt-glib-devel	
libvirt-gobject-devel	
libvirt-java	
libvirt-java-devel	
libvirt-java-javadoc	
libvirt-login-shell	
libvirt-snmp	
libvisio-doc	
libvisio-tools	
libvma-devel	
libvma-utils	
libvoikko-devel	
libvpx-utils	
libwebp-java	
libwebp-tools	
libwpd-tools	
libwpg-tools	
libwps-tools	
libwsman-devel	
libwvstreams	
libwvstreams-devel	
libwvstreams-static	
libxcb-doc	

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libXevie	
libXevie-devel	
libXfont	
libXfont-devel	
libxml2-static	
libxslt-python	
libXvMC-devel	
libzapojit	
libzapojit-devel	
libzmf-devel	
libzmf-doc	
libzmf-tools	
lldpad-devel	
log4cxx	
log4cxx-devel	
log4j-manual	
lpsolve-devel	
lua-devel	
lua-static	
lvm2-cluster	
lvm2-python-libs	
lvm2-sysvinit	
lz4-static	

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m17n-contrib	
m17n-contrib-extras	
m17n-db-devel	
m17n-db-extras	
m17n-lib-devel	
m17n-lib-tools	
m2crypto	
malaga-devel	
man-pages-cs	
man-pages-es	
man-pages-es-extra	
man-pages-fr	
man-pages-it	
man-pages-ja	
man-pages-ko	
man-pages-pl	
man-pages-ru	
man-pages-zh-CN	
mariadb-bench	
marisa-devel	
marisa-perl	
marisa-python	
marisa-ruby	

Removed package	Note
marisa-tools	
maven-changes-plugin	
maven-changes-plugin-javadoc	
maven-deploy-plugin	
maven-deploy-plugin-javadoc	
maven-doxia-module-fo	
maven-ear-plugin	
maven-ear-plugin-javadoc	
maven-ejb-plugin	
maven-ejb-plugin-javadoc	
maven-error-diagnostics	
maven-gpg-plugin	
maven-gpg-plugin-javadoc	
maven-istack-commons-plugin	
maven-jarsigner-plugin	
maven-jarsigner-plugin-javadoc	
maven-javadoc-plugin	
maven-javadoc-plugin-javadoc	
maven-jxr	
maven-jxr-javadoc	
maven-osgi	
maven-osgi-javadoc	
maven-plugin-jxr	

Removed package	Note
maven-project-info-reports-plugin	
maven-project-info-reports-plugin-javadoc	
maven-release	
maven-release-javadoc	
maven-release-manager	
maven-release-plugin	
maven-reporting-exec	
maven-repository-builder	
maven-repository-builder-javadoc	
maven-scm	
maven-scm-javadoc	
maven-scm-test	
maven-shared-jar	
maven-shared-jar-javadoc	
maven-site-plugin	
maven-site-plugin-javadoc	
maven-verifier-plugin	
maven-verifier-plugin-javadoc	
maven-wagon-provider-test	
maven-wagon-scm	
maven-war-plugin	

Removed package	Note
maven-war-plugin-javadoc	
mdds-devel	
meanwhile-devel	
meanwhile-doc	
memcached-devel	
memstomp	
mesa-demos	
mesa-libxatracker-devel	
mesa-private-llvm	
mesa-private-llvm-devel	
metacity-devel	
mgetty	Logins through a serial line can be done using **agetty**. Customers can use other means for faxing (web faxing, multi-function printer, and others).
mgetty-sendfax	
mgetty-viewfax	
mgetty-voice	
migrationtools	
minizip	
minizip-devel	
mkbootdisk	
mobile-broadband-provider-info-devel	
mod_auth_mellon-diagnostics	

Removed package	Note
mod_revocator	
ModemManager-vala	
mono-icon-theme	
mozjs17	
mozjs17-devel	
mozjs24	
mozjs24-devel	
mpich-3.0-autoload	
mpich-3.0-doc	
mpich-3.2-autoload	
mpich-3.2-doc	
mpitests-compat-openmpi16	
msv-demo	
msv-msv	
msv-rngconv	
msv-xmlgen	
mvapich2-2.0-devel	
mvapich2-2.0-doc	
mvapich2-2.0-psm-devel	
mvapich2-2.2-devel	
mvapich2-2.2-doc	
mvapich2-2.2-psm-devel	

Removed package	Note
mvapich2-2.2-psm2-devel	
mvapich23-devel	
mvapich23-doc	
mvapich23-psm-devel	
mvapich23-psm2-devel	
nagios-plugins-bacula	
nasm-doc	
nasm-rdoff	
ncurses-static	
nekohtml	
nekohtml-demo	
nekohtml-javadoc	
nepomuk-core	
nepomuk-core-devel	
nepomuk-core-libs	
nepomuk-widgets	
nepomuk-widgets-devel	
net-snmp-gui	
net-snmp-perl	
net-snmp-python	
net-snmp-sysvinit	
netsniff-ng	

Removed package	Note
NetworkManager-glib	
NetworkManager-glib-devel	
newt-static	
nfsometer	
nfstest	
nhn-nanum-brush-fonts	
nhn-nanum-fonts-common	
nhn-nanum-myeongjo-fonts	
nhn-nanum-pen-fonts	
nmap-frontend	
nss_compat_ossl	
nss_compat_ossl-devel	
nss-pem	
nss-pkcs11-devel	
ntp-doc	
ntp-perl	
nuvola-icon-theme	
nuxwdog	
nuxwdog-client-java	
nuxwdog-client-perl	
nuxwdog-devel	
objectweb-anttask	

Removed package	Note
objectweb-anttask-javadoc	
ocaml-brlapi	
ocaml-calendar	
ocaml-calendar-devel	
ocaml-csv	
ocaml-csv-devel	
ocaml-curses	
ocaml-curses-devel	
ocaml-docs	
ocaml-emacs	
ocaml-fileutils	
ocaml-fileutils-devel	
ocaml-gettext	
ocaml-gettext-devel	
ocaml-libvirt	
ocaml-libvirt-devel	
ocaml-ocamlbuild-doc	
ocaml-source	
ocaml-x11	
ocaml-xml-light	
ocaml-xml-light-devel	
oci-register-machine	
okular	

Removed package	Note
okular-devel	
okular-libs	
okular-part	
opa-libopamgt-devel	
opal	
opal-devel	
open-vm-tools-devel	
open-vm-tools-test	
opencc-tools	
openchange-client	
openchange-devel	
openchange-devel-docs	
opencv-devel-docs	
opencv-python	
OpenEXR	
openhpi-devel	
openjpeg-devel	
openjpeg-libs	
openldap-servers-sql	
openlmi	
openlmi-account	
openlmi-account-doc	
openlmi-fan	

Removed package	Note
openlmi-fan-doc	
openlmi-hardware	
openlmi-hardware-doc	
openlmi-indicationmanager-libs	
openlmi-indicationmanager-libs-devel	
openlmi-journald	
openlmi-journald-doc	
openlmi-logicalfile	
openlmi-logicalfile-doc	
openlmi-networking	
openlmi-networking-doc	
openlmi-pcp	
openlmi-powermanagement	
openlmi-powermanagement-doc	
openlmi-providers	
openlmi-providers-devel	
openlmi-python-base	
openlmi-python-providers	
openlmi-python-test	
openlmi-realmd	
openlmi-realmd-doc	
openlmi-service	

Removed package	Note
openlmi-service-doc	
openlmi-software	
openlmi-software-doc	
openlmi-storage	
openlmi-storage-doc	
openlmi-tools	
openlmi-tools-doc	
openobex	Customers can use **gnome-bluetooth** for transferring files between PC and mobile devices through bluetooth, or **gvfs-afc** for reading files on mobile devices. Applications using the OBEX protocol need to be rewritten.
openobex-apps	
openobex-devel	
openscap-containers	
openscap-engine-sce-devel	
openslp-devel	
openslp-server	
opensm-static	
openssh-server-sysvinit	
openssl-static	
openssl098e	
openwsman-perl	
openwsman-ruby	
oprofile-devel	

Removed package	Note
oprofile-gui	
oprofile-jit	
optipng	
ORBit2	
ORBit2-devel	
orc-doc	
ortp	
ortp-devel	
oscilloscope	
oxygen-cursor-themes	
oxygen-gtk	
oxygen-gtk2	
oxygen-gtk3	
oxygen-icon-theme	
PackageKit-yum-plugin	
pakchois-devel	
pam_snapper	
pango-tests	
paps-devel	
passivetex	
pax	
pciutils-devel-static	
pcp-collector	

Removed package	Note
pcp-monitor	
pcre-tools	
pcre2-static	
pcre2-tools	
pentaho-libxml-javadoc	
pentaho-reporting-flow-engine-javadoc	
perl-AppConfig	
perl-Archive-Extract	
perl-B-Keywords	
perl-Browser-Open	
perl-Business-ISBN	
perl-Business-ISBN-Data	
perl-CGI-Session	
perl-Class-Load	
perl-Class-Load-XS	
perl-Config-Simple	
perl-Config-Tiny	
perl-Convert-ASN1	
perl-CPAN-Changes	
perl-CPANPLUS	
perl-CPANPLUS-Dist-Build	
perl-Crypt-CBC	

Removed package	Note
perl-Crypt-DES	
perl-Crypt-OpenSSL-Bignum	
perl-Crypt-OpenSSL-Random	
perl-Crypt-OpenSSL-RSA	
perl-Crypt-PasswdMD5	
perl-Crypt-SSLeay	
perl-CSS-Tiny	
perl-Data-Peek	
perl-DateTime-Format-DateParse	
perl-DBD-Pg-tests	
perl-DBIx-Simple	
perl-Devel-Cover	
perl-Devel-Cycle	
perl-Devel-EnforceEncapsulation	
perl-Devel-Leak	
perl-Email-Address	
perl-FCGI	
perl-File-Find-Rule-Perl	
perl-File-Inplace	
perl-Font-AFM	
perl-Font-TTF	
perl-FreezeThaw	

Removed package	Note
perl-GD	
perl-GD-Barcode	
perl-Hook-LexWrap	
perl-HTML-Format	
perl-HTML-FormatText-WithLinks	
perl-HTML-FormatText-WithLinks-AndTables	
perl-Image-Base	
perl-Image-Info	
perl-Image-Xbm	
perl-Image-Xpm	
perl-Inline	
perl-Inline-Files	
perl-IO-CaptureOutput	
perl-JSON-tests	
perl-LDAP	
perl-libxml-perl	
perl-Locale-Maketext-Gettext	
perl-Locale-PO	
perl-Log-Message	
perl-Log-Message-Simple	
perl-Mail-DKIM	
perl-Mixin-Linewise	

Removed package	Note
perl-Module-Manifest	
perl-Module-Signature	
perl-Net-Daemon	
perl-Net-DNS-Nameserver	
perl-Net-DNS-Resolver-Programmable	
perl-Net-LibIDN	
perl-Net-Telnet	
perl-Newt	
perl-Object-Accessor	
perl-Object-Deadly	
perl-Package-Constants	
perl-PAR-Dist	
perl-Parallel-Iterator	
perl-Parse-CPAN-Meta	
perl-Parse-RecDescent	
perl-Perl-Critic	
perl-Perl-Critic-More	
perl-Perl-MinimumVersion	
perl-Perl4-CoreLibs	
perl-PlRPC	
perl-Pod-Coverage-TrustPod	
perl-Pod-Eventual	

Removed package	Note
perl-Pod-POM	
perl-Pod-Spell	
perl-PPI	
perl-PPI-HTML	
perl-PPIx-Regexp	
perl-PPIx-Utilities	
perl-Probe-Perl	
perl-Readonly-XS	
perl-Sort-Versions	
perl-String-Format	
perl-String-Similarity	
perl-Syntax-Highlight-Engine-Kate	
perl-Task-Weaken	
perl-Template-Toolkit	
perl-Term-UI	
perl-Test-ClassAPI	
perl-Test-CPAN-Meta	
perl-Test-DistManifest	
perl-Test-EOL	
perl-Test-HasVersion	
perl-Test-Inter	
perl-Test-Manifest	

Removed package	Note
perl-Test-Memory-Cycle	
perl-Test-MinimumVersion	
perl-Test-MockObject	
perl-Test-NoTabs	
perl-Test-Object	
perl-Test-Output	
perl-Test-Perl-Critic	
perl-Test-Perl-Critic-Policy	
perl-Test-Portability-Files	
perl-Test-Script	
perl-Test-Spelling	
perl-Test-SubCalls	
perl-Test-Synopsis	
perl-Test-Tester	
perl-Test-Vars	
perl-Test-Without-Module	
perl-Text-CSV_XS	
perl-Text-Iconv	
perl-Tree-DAG_Node	
perl-Unicode-Map8	
perl-Unicode-String	
perl-UNIVERSAL-can	
perl-UNIVERSAL-isa	

Removed package	Note
perl-Version-Requirements	
perl-WWW-Curl	
perl-XML-Dumper	
perl-XML-Filter-BufferText	
perl-XML-Grove	
perl-XML-Handler-YAWriter	
perl-XML-LibXSLT	
perl-XML-SAX-Writer	
perl-XML-TreeBuilder	
perl-XML-Writer	
perl-XML-XPathEngine	
phonon	
phonon-backend-gstreamer	
phonon-devel	
php-pecl-memcache	
php-pspell	
pidgin-perl	
pinentry-qt	
pinentry-qt4	
pki-javadoc	
plasma-scriptengine-python	
plasma-scriptengine-ruby	
plexus-digest	

Removed package	Note
plexus-digest-javadoc	
plexus-mail-sender	
plexus-mail-sender-javadoc	
plexus-tools-pom	
plymouth-devel	
pm-utils	
pm-utils-devel	
pngcrush	
pngnq	
polkit-kde	
polkit-qt	
polkit-qt-devel	
polkit-qt-doc	
poppler-demos	
poppler-qt	
poppler-qt-devel	
popt-static	
postfix-sysvinit	
pothana2000-fonts	
powerpc-utils-python	
pprof	
pps-tools	
pptp-setup	

Removed package	Note
procps-ng-devel	
protobuf-emacs	
protobuf-emacs-el	
protobuf-java	
protobuf-javadoc	
protobuf-lite-devel	
protobuf-lite-static	
protobuf-python	
protobuf-static	
protobuf-vim	
psutils	
psutils-perl	
ptlib	
ptlib-devel	
publican	
publican-common-db5-web	
publican-common-web	
publican-doc	
publican-redhat	
pulseaudio-esound-compat	
pulseaudio-module-gconf	
pulseaudio-module-zeroconf	
pulseaudio-qpaeq	

Removed package	Note
pygpgme	
pygtk2-libglade	
pykde4	
pykde4-akonadi	
pykde4-devel	
pyldb-devel	
pyliblzma	
PyOpenGL	
PyOpenGL-Tk	
pyOpenSSL-doc	
pyorbit	
pyorbit-devel	
PyPAM	
pyparsing-doc	
PyQt4	
PyQt4-devel	
pytalloc-devel	
python-appindicator	
python-beaker	
python-cffi-doc	
python-cherrypy	
python-criu	
python-debug	

Removed package	Note
python-deltarpm	
python-dtopt	
python-fpconst	
python-gpod	
python-gudev	
python-inotify-examples	
python-ipaddr	
python-lPy	
python-isodate	
python-isomd5sum	
python-kitchen	
python-kitchen-doc	
python-libteam	
python-lxml-docs	
python-matplotlib	
python-matplotlib-doc	
python-matplotlib-qt4	
python-matplotlib-tk	
python-memcached	
python-mutagen	
python-paramiko	
python-paramiko-doc	
python-paste	

Removed package	Note
python-pillow-devel	
python-pillow-doc	
python-pillow-qt	
python-pillow-sane	
python-pillow-tk	
python-rados	
python-rbd	
python-reportlab-docs	
python-rtslib-doc	
python-setproctitle	
python-slip-gtk	
python-smbc	
python-smbc-doc	
python-smbios	
python-sphinx-doc	
python-tempita	
python-tornado	
python-tornado-doc	
python-twisted-core	
python-twisted-core-doc	
python-twisted-web	
python-twisted-words	

Removed package	Note
python-urlgrabber	
python-volume_key	
python-webob	
python-webtest	
python-which	
python-zope-interface	
python2-caribou	
python2-futures	
python2-gexiv2	
python2-smartcols	
python2-solv	
python2-subprocess32	
qca-ossl	
qca2	
qca2-devel	
qimageblitz	
qimageblitz-devel	
qimageblitz-examples	
qjson	
qjson-devel	
qpdf-devel	
qt	

Removed package	Note
qt-assistant	
qt-config	
qt-demos	
qt-devel	
qt-devel-private	
qt-doc	
qt-examples	
qt-mysql	
qt-odbc	
qt-postgresql	
qt-qdbusviewer	
qt-qvfb	
qt-settings	
qt-x11	
qt3	
qt3-config	
qt3-designer	
qt3-devel	
qt3-devel-docs	
qt3-MySQL	
qt3-ODBC	
qt3-PostgreSQL	

Removed package	Note
qt5-qt3d-doc	
qt5-qtbase-doc	
qt5-qtcanvas3d-doc	
qt5-qtconnectivity-doc	
qt5-qtdeclarative-doc	
qt5-qtenginio	
qt5-qtenginio-devel	
qt5-qtenginio-doc	
qt5-qtenginio-examples	
qt5-qtgraphicaleffects-doc	
qt5-qtimageformats-doc	
qt5-qtlocation-doc	
qt5-qtmultimedia-doc	
qt5-qtquickcontrols-doc	
qt5-qtquickcontrols2-doc	
qt5-qtscript-doc	
qt5-qtsensors-doc	
qt5-qtserialbus-devel	
qt5-qtserialbus-doc	
qt5-qtserialport-doc	
qt5-qtsvg-doc	
qt5-qttools-doc	

Removed package	Note
qt5-qtwayland-doc	
qt5-qtwebchannel-doc	
qt5-qtwebsockets-doc	
qt5-qtx11extras-doc	
qt5-qtxmlpatterns-doc	
quagga	
quagga-contrib	
quota-devel	
qv4l2	
rarian-devel	
rcs	Version control system supported in RHEL 8 are **Git**, **Mercurial**, and **Subversion**.
rdate	
rdist	
readline-static	
realmd-devel-docs	
Red_Hat_Enterprise_Linux-Release_Notes-7-as-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-bn-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-de-DE	
Red_Hat_Enterprise_Linux-Release_Notes-7-en-US	
Red_Hat_Enterprise_Linux-Release_Notes-7-es-ES	

Removed package	Note
Red_Hat_Enterprise_Linux-Release_Notes-7-fr-FR	
Red_Hat_Enterprise_Linux-Release_Notes-7-gu-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-hi-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-it-IT	
Red_Hat_Enterprise_Linux-Release_Notes-7-ja-JP	
Red_Hat_Enterprise_Linux-Release_Notes-7-kn-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-ko-KR	
Red_Hat_Enterprise_Linux-Release_Notes-7-ml-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-mr-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-or-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-pa-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-pt-BR	
Red_Hat_Enterprise_Linux-Release_Notes-7-ru-RU	
Red_Hat_Enterprise_Linux-Release_Notes-7-ta-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-te-IN	
Red_Hat_Enterprise_Linux-Release_Notes-7-zh-CN	

Removed package	Note
Red_Hat_Enterprise_Linux-Release_Notes-7-zh-TW	
redhat-access-plugin-ipa	
redhat-bookmarks	
redhat-lsb-supplemental	
redhat-lsb-trialuse	
redhat-upgrade-dracut	
redhat-upgrade-dracut-plymouth	
redhat-upgrade-tool	
redland-mysql	
redland-pgsql	
redland-virtuoso	
relaxngcc	
rest-devel	
resteasy-base-jettison-provider	
resteasy-base-tjws	
rhdb-utils	
rhino	
rhino-demo	
rhino-javadoc	
rhino-manual	
rhythmbox-devel	
rngom	

Removed package	Note
rngom-javadoc	
rp-pppoe	
rrdtool-php	
rrdtool-python	
rsh	To log in to remote systems, use SSH instead.
rsh-server	
rsyslog-libdbi	
rsyslog-udpspoof	
rtcheck	
rtctl	
ruby-tcltk	
rubygem-net-http-persistent	
rubygem-net-http-persistent-doc	
rubygem-thor	
rubygem-thor-doc	
rusers	
rusers-server	
rwho	
sac-javadoc	
samba-dc	
samba-devel	
satyr-devel	

Removed package	Note
satyr-python	
saxon	
saxon-demo	
saxon-javadoc	
saxon-manual	
saxon-scripts	
sbc-devel	
sblim-cim-client2	
sblim-cim-client2-javadoc	
sblim-cim-client2-manual	
sblim-cmpi-base	
sblim-cmpi-base-devel	
sblim-cmpi-base-test	
sblim-cmpi-fsvol	
sblim-cmpi-fsvol-devel	
sblim-cmpi-fsvol-test	
sblim-cmpi-network	
sblim-cmpi-network-devel	
sblim-cmpi-network-test	
sblim-cmpi-nfsv3	
sblim-cmpi-nfsv3-test	
sblim-cmpi-nfsv4	

Removed package	Note
sblim-cmpi-nfsv4-test	
sblim-cmpi-params	
sblim-cmpi-params-test	
sblim-cmpi-sysfs	
sblim-cmpi-sysfs-test	
sblim-cmpi-syslog	
sblim-cmpi-syslog-test	
sblim-gather	
sblim-gather-devel	
sblim-gather-provider	
sblim-gather-test	
sblim-indication_helper	
sblim-indication_helper-devel	
sblim-smis-hba	
sblim-testsuite	
sblim-wbemcli	
scannotation	
scannotation-javadoc	
scpio	
screen	
SDL-static	
seahorse-nautilus	
seahorse-sharing	

Removed package	Note
sendmail-sysvinit	
setools-devel	
setools-gui	
setools-libs-tcl	
setuptool	
shared-desktop-ontologies	
shared-desktop-ontologies-devel	
shim-unsigned-ia32	
shim-unsigned-x64	
sisu	
sisu-parent	
slang-slsh	
slang-static	
smbios-utils	
smbios-utils-bin	
smbios-utils-python	
snakeyaml	
snakeyaml-javadoc	
snapper	
snapper-devel	
snapper-libs	
sntp	

Removed package	Note
SOAPpy	
soprano	
soprano-apidocs	
soprano-devel	
source-highlight-devel	
sox	
sox-devel	
speex-tools	
spice-xpi	
sqlite-tcl	
squid-migration-script	
squid-sysvinit	
sssd-libwbclient-devel	
sssd-polkit-rules	
stax2-api	
stax2-api-javadoc	
strigi	
strigi-devel	
strigi-libs	
strongimcv	
subversion-kde	
subversion-python	

Removed package	Note
subversion-ruby	
sudo-devel	
suitesparse-doc	
suitesparse-static	
supermin-helper	
svgpart	
svrcore	
svrcore-devel	
sweeper	
syslinux-devel	
syslinux-perl	
system-config-date	
system-config-date-docs	
system-config-firewall	
system-config-firewall-base	
system-config-firewall-tui	
system-config-keyboard	
system-config-keyboard-base	
system-config-language	
system-config-printer	
system-config-users-docs	
system-switch-java	

Removed package	Note
systemd-sysv	
t1lib	
t1lib-apps	
t1lib-devel	
t1lib-static	
t1utils	
taglib-doc	
talk	
talk-server	
tang-nagios	
targetd	
tcl-pgtcl	
tclx	
tclx-devel	
tcp_wrappers	See Replacing TCP Wrappers in RHEL 8.
tcp_wrappers-devel	
tcp_wrappers-libs	
teamd-devel	
teckit-devel	
telepathy-farstream	
telepathy-farstream-devel	
telepathy-filesystem	

Removed package	Note
telepathy-gabble	
telepathy-glib	
telepathy-glib-devel	
telepathy-glib-vala	
telepathy-haze	
telepathy-logger	
telepathy-logger-devel	
telepathy-mission-control	
telepathy-mission-control-devel	
telepathy-salut	
tex-preview	
texlive-collection-documentation-base	
texlive-mh	
texlive-mh-doc	
texlive-misc	
texlive-thailatex	
texlive-thailatex-doc	
tix-doc	
tncfhh	
tncfhh-devel	
tncfhh-examples	
tncfhh-libs	

Removed package	Note
tncfhh-utils	
tog-pegasus-test	
tokyocabinet-devel-doc	
tomcat	
tomcat-admin-webapps	
tomcat-docs-webapp	
tomcat-el-2.2-api	
tomcat-javadoc	
tomcat-jsp-2.2-api	
tomcat-jsvc	
tomcat-lib	
tomcat-servlet-3.0-api	
tomcat-webapps	
totem-devel	
totem-pl-parser-devel	
tracker-devel	
tracker-docs	
tracker-needle	
tracker-preferences	
trang	
trousers-static	
txw2	
txw2-javadoc	

Removed package	Note
unique3	
unique3-devel	
unique3-docs	
uriparser	
uriparser-devel	
usbguard-devel	
usbredir-server	
ustr-debug	
ustr-debug-static	
ustr-devel	
ustr-static	
uuid-c++	
uuid-c++-devel	
uuid-dce	
uuid-dce-devel	
uuid-perl	
uuid-php	
v4l-utils	
v4l-utils-devel-tools	
vala-doc	
valadoc	
valadoc-devel	
valgrind-openmpi	

Removed package	Note
vemana2000-fonts	
vigra	
vigra-devel	
virtuoso-opensource	
virtuoso-opensource-utils	
vlgothic-p-fonts	
vsftpd-sysvinit	
vte3	
vte3-devel	
wayland-doc	
webkitgtk3	
webkitgtk3-devel	
webkitgtk3-doc	
webkitgtk4-doc	
webrtc-audio-processing-devel	
whois	
woodstox-core	
woodstox-core-javadoc	
wordnet	
wordnet-browser	
wordnet-devel	
wordnet-doc	
ws-commons-util	

Removed package	Note
ws-commons-util-javadoc	
ws-jaxme	
ws-jaxme-javadoc	
ws-jaxme-manual	
wsdl4j	
wsdl4j-javadoc	
wvdial	
x86info	
xchat-tcl	
xdg-desktop-portal-devel	
xerces-c	
xerces-c-devel	
xerces-c-doc	
xferstats	
xguest	
xhtml2fo-style-xsl	
xhtml2ps	
xisdnload	
xml-commons-apis12	
xml-commons-apis12-javadoc	
xml-commons-apis12-manual	
xmlgraphics-commons	

Removed package	Note
xmlgraphics-commons-javadoc	
xmlrpc-c-apps	
xmlrpc-client	
xmlrpc-common	
xmlrpc-javadoc	
xmlrpc-server	
xmlsec1-gcrypt-devel	
xmlsec1-nss-devel	
xmlto-tex	
xmlto-xhtml	
xorg-x11-drv-intel-devel	
xorg-x11-drv-keyboard	
xorg-x11-drv-mouse	
xorg-x11-drv-mouse-devel	
xorg-x11-drv-openchrome	
xorg-x11-drv-openchrome-devel	
xorg-x11-drv-synaptics	
xorg-x11-drv-synaptics-devel	
xorg-x11-drv-vmmouse	
xorg-x11-drv-void	
xorg-x11-server-source	
xorg-x11-xkb-extras	

Removed package	Note
xpp3	
xpp3-javadoc	
xpp3-minimal	
xsettings-kde	
xstream	
xstream-javadoc	
xulrunner	
xulrunner-devel	
xz-compat-libs	
yelp-xsl-devel	
yum-langpacks	Localization is now an integral part of DNF.
yum-NetworkManager-dispatcher	
yum-plugin-filter-data	
yum-plugin-fs-snapshot	
yum-plugin-keys	
yum-plugin-list-data	
yum-plugin-local	
yum-plugin-merge-conf	
yum-plugin-ovl	
yum-plugin-post-transaction-actions	
yum-plugin-pre-transaction-actions	

Removed package	Note
yum-plugin-protectbase	
yum-plugin-ps	
yum-plugin-rpm-warm-cache	
yum-plugin-show-leaves	
yum-plugin-upgrade-helper	
yum-plugin-verify	
yum-updateonboot	

A.4. PACKAGES WITH REMOVED SUPPORT

Certain packages in RHEL 8 are distributed through the CodeReady Linux Builder repository, which contains unsupported packages for use by developers. For a complete list of packages in this repository, see the Package manifest. This section covers only packages that are supported in RHEL 7 but not in RHEL 8.

The following packages are distributed in the Base channel of RHEL 7 and in RHEL 8 they are a part of the CodeReady Linux Builder repository:

- antlr-tool
- bcel
- cal10n
- cdi-api-javadoc
- codemodel
- dejagnu
- docbook-style-dsssl
- docbook-utils
- docbook5-schemas
- easymock2; replaced with the easymock package
- geronimo-jms
- gnome-common
- hamcrest
- isorelax

- jakarta-oro
- javamail
- jaxen
- jboss-interceptors-1.1-api-javadoc; replaced with the jboss-interceptors-1.2-api-javadoc package
- jdom
- jna
- junit
- jvnet-parent
- libdbusmenu-gtk3-devel
- libfdt
- libgudev-devel
- libindicator-gtk3-devel
- libseccomp-devel
- nasm
- objectweb-asm
- openjade
- openldap-servers
- opensp
- perl-Class-Singleton
- perl-DateTime
- perl-DateTime-Locale
- perl-DateTime-TimeZone
- perl-Devel-Symdump
- perl-Digest-SHA1
- perl-HTML-Tree
- perl-HTTP-Daemon
- perl-IO-stringy
- perl-List-MoreUtils
- perl-Module-Implementation

- perl-Package-DeprecationManager
- perl-Package-Stash
- perl-Package-Stash-XS
- perl-Params-Validate
- perl-Pod-Coverage
- perl-SGMLSpm
- perl-Test-Pod
- perl-Test-Pod-Coverage
- perl-XML-Twig
- perl-YAML-Tiny
- perltidy
- prelink; replaced with the execstack package
- python-javapackages; replaced with the python3-javapackages package
- pyxattr; replaced with the python3-pyxattr package
- qdox
- regexp
- rrdtool-python; replaced with the python3-rrdtool package
- texinfo
- ustr
- weld-parent
- xmltoman
- xorg-x11-apps

The following packages from the Extras channel of RHEL 7 are distributed in the the CodeReady Linux Builder repository in RHEL 8:

- libgit2-devel
- libmodulemd-devel
- python-greenlet-devel; replaced with the python3-greenlet-devel package
- python-httplib2; replaced with the python3-httplib2 package

Certain packages from the the CodeReady Linux Builder repository in RHEL 8 have been split from packages distributed in the Base channel of RHEL 7:

- freerdp-devel, split from the freerdp-devel package
- gdk-pixbuf2-xlib, split from the gdk-pixbuf2 package
- gdk-pixbuf2-xlib-devel, split from the gdk-pixbuf2-devel package
- glassfish-jaxb-bom, glassfish-jaxb-bom-ext, glassfish-jaxb-codemodel-parent, glassfish-jaxb-external-parent, glassfish-jaxb-parent, glassfish-jaxb-runtime-parent, glassfish-jaxb-txw-parent, split from the glassfish-jaxb package
- ivy-local, javapackages-filesystem, javapackages-tools, split from the javapackages-tools package
- jcl-over-slf4j, jul-to-slf4j, log4j-over-slf4j, slf4j, slf4j-ext, slf4j-jcl, slf4j-jdk14, slf4j-log4j12, split from the slf4j package
- ldns-devel, split from the ldns package
- libnsl2-devel, split from the glibc-devel package
- rpcgen, split from the glibc-common package
- rpcsvc-proto-devel, split from the glibc-headers package

For a complete list of replaced packages, see Section A.2, “Package replacements”.