Red Hat Enterprise Linux 8.0 Beta

8.0 Beta release notes

Release notes for Red Hat Enterprise Linux 8.0 Beta

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Legal Notice

Abstract

The release notes provide high-level coverage of the improvements and additions that have been implemented in Red Hat Enterprise Linux Beta 8.0 and document known problems in this release, as well as notable bug fixes, Technology Previews, deprecated functionality, and other details.

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THIS IS A BETA VERSION!

This document is only provided as a preview. It is under development and is subject to substantial change. Consider the included information incomplete and use it with caution.

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CHAPTER 1. OVERVIEW

Based on Fedora 28 and the upstream kernel 4.18, Red Hat Enterprise Linux 8.0 provides users with a stable, secure, consistent foundation across hybrid cloud deployments with the tools needed to support traditional and emerging workloads. Highlights of the release include:

Distribution

- Content is available through the **BaseOS** and Application Stream (**AppStream**) repositories.
- The **AppStream** repository supports a new extension of the traditional RPM format - *modules*. This allows for multiple major versions of a component to be available for install.

Software Management

- The **YUM** package manager is now based on the **DNF** technology and it provides support for modular content, increased performance, and a well-designed stable API for integration with tooling.

Web servers, databases, dynamic languages

- **Python** 3.6 is the default Python implementation in RHEL 8; limited support for Python 2.7 is provided. No version of Python is installed by default.
- RHEL 8 provides the following **database servers**: MariaDB 10.3, MySQL 8.0, PostgreSQL 10, PostgreSQL 9.6, and Redis 4.0.

Desktop

- **GNOME Shell** has been rebased to version 3.28.
- The GNOME session and the GNOME Display Manager use **Wayland** as their default display server. The **X.Org** server, which is the default display server in RHEL 7, is available as well.

Installer and image creation

- The **Anaconda** installer can utilize **LUKS2** disk encryption, and install the system on **NVDIMM** devices.
- The new **Composer** tool enables users to create customized system images in a variety of formats, including images prepared for deployment on clouds of various providers. Composer is available as a *Technology Preview*.
- Installation from a DVD using Hardware Management Console (**HMC**) and Support Element (**SE**) on **IBM Z**.

File systems and storage

- The **Stratis** local storage manager has been introduced. Stratis enables you to easily perform complex storage tasks and manage your storage stack using a unified interface.
- 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.

Security

- System-wide **cryptographic policies**, which configures the core cryptographic subsystems, covering the TLS, IPSec, SSH, DNSSec, and Kerberos protocols, are applied by default. With the new **`update-crypto-policies`** command, the administrator can easily switch between modes: default, legacy, future, and fips.

- Support for **smart cards** and Hardware Security Modules (**HSM**) with **PKCS #11** is now consistent across the system.

Networking

- The **`nftables`** framework replaces **`iptables`** in the role of the default network packet filtering facility.

- The **`firewalld`** daemon now uses **`nftables`** as its default backend.

- Support for **IPVLAN** virtual network drivers that enable the network connectivity for multiple containers.

Virtualization

- A more modern PCI Express-based machine type (**Q35**) is now supported and automatically configured in virtual machines created in RHEL 8. This provides a variety of improvements in features and compatibility of virtual devices.

- Virtual machines can now be created and managed using the **Cockpit** web interface.

- The **QEMU** emulator introduces the **sandboxing** feature, which provides configurable limitations to what systems calls QEMU can perform, and thus makes virtual machines more secure.

Compilers and development tools

- The **GCC** compiler based on version 8.2 brings support for more recent C++ language standard versions, better optimizations, new code hardening techniques, improved warnings, and new hardware features.

- Support for the **DWARF5** debugging information format across various tools for code generation, manipulation, and debugging.

- Kernel support for **eBPF** tracing is available for some tools, such as **`BCC`**, **`PCP`**, and **`SystemTap`**.

- The **`glibc`** libraries based on version 2.28 add support for Unicode 11, newer Linux system calls, key improvements in the DNS stub resolver, additional security hardening, and improved performance.

High availability and clusters

- The **Pacemaker** cluster resource manager has been upgraded to upstream version 2.0.0, which provides a number of bug fixes and enhancements.

- In RHEL 8, the **pcs** configuration system fully supports Corosync 3, **`knet`**, and node names.

Integration with Satellite 5

Currently, Red Hat Enterprise Linux 8.0 Beta systems cannot be configured to consume updates from Satellite 5. The minimum supported version is Satellite 5.8. Integration with Satellite 5 will not be available at the same time as that of Red Hat Enterprise Linux 8.0 Beta availability. We anticipate making this available shortly after Red Hat Enterprise Linux 8.0 Beta is publicly available.

See the Running Red Hat Enterprise Linux 8 on Satellite 5.8 article for more information.

CHAPTER 2. ARCHITECTURES

Red Hat Enterprise Linux 8.0 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

CHAPTER 3. DISTRIBUTION OF CONTENT IN RHEL 8

Red Hat Enterprise Linux 8 can be installed using ISO images. Two basic types of installation media are available for the AMD64 and Intel 64 (x86_64), ARM (aarch64), IBM POWER Systems, Little Endian (ppc64le), and IBM Z (s390x) architectures:

- Binary DVD - A full installation image, which can be used to boot the installation program and perform an entire installation without additional package content sets.
- Netinstall DVD (**`boot.iso`**) - A minimal boot image, which can be used to boot into the installation program. This option requires access to a local or remote repository providing additional packages.

The document Installing and Deploying RHEL provides instructions for using these ISO images to create bootable media.

3.1. REPOSITORIES

Red Hat Enterprise Linux 8 is split across two repositories:

- BaseOS
- Application Stream (AppStream)

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

Content in BaseOS 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 Appendix B, *Packages in BaseOS*.

Content in Application Stream 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*. One of the many advantages of modules is that this mechanism allows for multiple major versions of a component to be available for install in the AppStream content set. Modules are similar to Software Collections but much easier to install and use. For a list of packages available in AppStream, see Appendix C, *Packages in AppStream*.

3.2. WORKING WITH MODULES

Modules introduce the concept of *streams*, which represent versions of a component. In RHEL 8, numerous modules will eventually be available in one or multiple streams, with each stream corresponding to a major version of the component. For example, Red Hat Enterprise Linux 8.0 includes the PostgreSQL database as a module. The associated **`postgresql`** module offers the choice between installing version 9.6 or version 10 (but not both concurrently). Users who install PostgreSQL will install PostgreSQL 10, the default stream. Optionally, a user can install PostgreSQL 9.6 by specifying the 9.6 stream. Different streams from the same module cannot be installed in parallel on the same system but can be used in separate containers.

Modules can be installed a number of ways:

- Content from modules can be made available by installing a package from its default module using the traditional **`yum install <package-name>`** command. This will install the package

and enable the default module which provides a package by that name. The module that provides the package is enabled even if the component is being installed as a dependency.

- Specific module streams can be installed using the **`yum install @<module-name>:<stream>`** command, for example: **`yum install @postgresql:9.6`**
- Besides selecting module streams, RHEL 8 users can choose module *profiles*, which will install preselected content for specific module use cases.

Detailed module commands are described in the Using Application Stream document.

For a list of modules available in AppStream, see Appendix A, *Modules available in RHEL 8.0 Beta*.

CHAPTER 4. NEW FEATURES

This part describes new features and major enhancements introduced in Red Hat Enterprise Linux 8.

4.1. COCKPIT

NOTE

The Cockpit's Subscriptions page is now provided by the new **`subscription-manager-cockpit`** package.

A firewall interface has been added to Cockpit

Cockpit's **Networking** page now includes a **Firewall** section. In this section, users can enable or disable the firewall, as well as add, remove, and modify firewall rules.

(BZ#1647110)

Cockpit is now available by default

Packages for the Cockpit interface 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, Cockpit is automatically installed and firewall ports required by Cockpit are automatically open. A system message has also been added prior to login that provides information about how to enable or access Cockpit.

(JIRA:RHELPLAN-10355)

Better IdM integration for Cockpit

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

- The IdM domain's administrators can use Cockpit to manage the local machine.
- Cockpit'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 Cockpit.
- SSH hosts known to the IdM domain are accessible to Cockpit without manually adding an SSH connection.

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

(JIRA:RHELPLAN-3010)

Cockpit is now compatible with mobile browsers

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

(JIRA:RHELPLAN-10352)

The Cockpit front page now displays missing updates and subscriptions

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

(JIRA:RHELPLAN-10353)

Cockpit now supports PBD enrollment

With this update, you can use the Cockpit 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 Cockpit, such as automatic unlocking of LUKS-encrypted disk partitions.

(JIRA:RHELPLAN-10354)

Virtual Machines can now be managed using Cockpit

The **`Virtual Machines`** page can now be added to the Cockpit interface, which enables the user to create and manage libvirt-based virtual machines.

(JIRA:RHELPLAN-2896)

4.2. INSTALLER AND IMAGE CREATION

Installing and booting from NVDIMM devices is now supported

Prior to this update, Nonvolatile Dual Inline Memory Module (NVDIMM) devices in any mode were ignored by the installer.

With this update, kernel improvements to support NVDIMM devices provide improved system performance capabilities and enhanced file system access for write-intensive applications like database or analytic workloads, as well as reduced CPU overhead.

This update introduces support for:

- The use of NVDIMM devices for installation using the **`nvdimm`** Kickstart command and the GUI, making it possible to install and boot from NVDIMM devices in sector mode and reconfigure NVDIMM devices into sector mode during installation.
- The extension of **`Kickstart`** scripts for **Anaconda** with commands for handling NVDIMM devices.
- The ability of **`grub2`**, **`efibootmgr`**, and **`efivar`** system components to handle and boot from NVDIMM devices.

(BZ#1499442)

Installing RHEL from a DVD using SE and HMC is now fully supported on IBM Z

The installation of Red Hat Enterprise Linux 8 on IBM Z hardware from a DVD using the **Support Element (SE)** and **Hardware Management Console (HMC)** is now fully supported. This addition simplifies the installation process on IBM Z with **SE** and **HMC**.

When booting from a binary DVD, the installer prompts the user to enter additional kernel parameters. To set the DVD as an installation source, append **`inst.repo=hmc`** to the kernel parameters. The installer then enables **SE** and **HMC** file access, fetches the images for stage2 from the DVD, and provides access to the packages on the DVD for software selection.

The new feature eliminates the requirement of an external network setup and expands the installation options.

(BZ#1500792)

Installer now supports the LUKS2 disk encryption format

Red Hat Enterprise Linux 8 installer now uses the LUKS2 format by default but you can select a LUKS version from **Anaconda's** Custom Partitioning window or by using the new options in Kickstart's **`autopart`**, **`logvol`**, **`part`**, and **`RAID`** commands.

LUKS2 provides many improvements and features, for example, it extends the capabilities of the on-disk format and provides flexible ways of storing metadata.

(BZ#1547908)

Anaconda supports System Purpose in RHEL 8

Previously, **Anaconda** did not provide system purpose information to **Subscription Manager**. In Red Hat Enterprise Linux 8.0, you can set the intended purpose of the system during installation by using **Anaconda's `System Purpose`** window or Kickstart's **`syspurpose`** command. When the installation completes, **Subscription Manager** uses the system purpose information when subscribing the system.

(BZ#1612060)

`Pykickstart` supports System Purpose in RHEL 8

Previously, it was not possible for the **`pykickstart`** library to provide system purpose information to **Subscription Manager**. In Red Hat Enterprise Linux 8.0, **`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 **Anaconda**, saved on the newly-installed system, and available for **Subscription Manager** when subscribing the system.

(BZ#1612061)

Anaconda supports a new kernel boot parameter in RHEL 8

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 https://anaconda-installer.readthedocs.io/en/latest/boot-options.html#inst-addrepo

(BZ#1595415)

Anaconda supports a unified ISO in RHEL 8

In Red Hat Enterprise Linux 8.0, 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 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.

(BZ#1610806)

4.3. KERNEL

Support for 5-level paging

New `P4d_t` software page table type has been added into the Linux kernel in order to support 5-level paging in Red Hat Enterprise Linux 8.

(BZ#1485532)

Memory management supports 5-level page tables

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 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.

(BZ#1485525)

Control Group v2 in RHEL 8

Red Hat Enterprise Linux 8 supports the **Control Group v2** mechanism, which 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 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.
- Writeback controller interacts with both Memory and I/O controllers and is **Control Group v2** specific.

The information above was based on https://www.kernel.org/doc/Documentation/cgroup-v2.txt. You can refer to the same link to obtain more information about particular **Control Group v2** controllers.

(BZ#1401552)

sosreport can report eBPF-based programs and maps

The **sosreport** tool has been enhanced to report any loaded extended Berkeley Packet Filtering (eBPF) programs and maps in Red Hat Enterprise Linux 8.

(BZ#1559836)

`bpftool` for inspection and manipulation of eBPF-based programs and maps added

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.

(BZ#1559607)

Red Hat Enterprise Linux 8 supports `early kdump`

Previously, the **`kdump`** service started too late to capture crash information (**`vmcore`**) of early kernel crashes. The new **`early kdump`** feature allows the crash kernel and initramfs to load early enough to capture the **`vmcore`** information even for early crashes. For more details about **`early kdump`**, see the **`/usr/share/doc/kexec-tools/early-kdump-howto.txt`** file.

(BZ#1520209)

4.4. SOFTWARE MANAGEMENT

YUM performance improvement and support for modular content

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

YUM based on **DNF** 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** tool and the previous version **YUM v3** from RHEL 7, see http://dnf.readthedocs.io/en/latest/cli_vs_yum.html.

YUM based on **DNF** 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. Packages can be installed under the previous names using **Provides**. Packages also provide compatibility symlinks, so the binaries, configuration files and directories can be found in usual locations.

Note that the legacy Python API provided by **YUM v3** and the Libdnf C API are unstable and will likely change during Red Hat Enterprise Linux 8 life cycle. Users are advised to migrate their plugins and scripts to the new DNF Python API, which is stable and fully supported. The DNF Python API is available at https://dnf.readthedocs.io/en/latest/api.html

Some of the **YUM v3** features may behave differently in **YUM** based on **DNF**. If any such change negatively impacts your workflows, please open a bug in Red Hat Bugzilla.

(BZ#1581198)

Notable RPM features in RHEL 8

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

Also, the most notable changes include:

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

(BZ#1581990)

RPM now validates the entire package contents before starting an installation

On Red Hat Enterprise Linux 7, the **RPM** utility verified payload contents of individual files while unpacking. However, this is insufficient for multiple reasons:

- If the payload is damaged, it is only noticed after executing script actions, which are irreversible.
- If the payload is damaged, upgrade of a package aborts after replacing some files of the previous version, which breaks a working installation.
- The hashes on individual files are performed on uncompressed data, which makes **RPM** vulnerable to decompressor vulnerabilities.

On Red Hat Enterprise Linux 8, the entire package is validated prior to the installation in a separate step, using the best available hash.

Packages built on Red Hat Enterprise Linux 8 use a new **SHA-256** hash on the compressed payload. On signed packages, the payload hash is additionally protected by the signature, and thus cannot be altered without breaking a signature and other hashes on the package header. Older packages use the **MD5**

hash of the header and payload unless it is disabled by configuration.

The **%_pkgverify_level** macro can be used to additionally enable enforcing signature verification before installation or disable the payload verification completely. In addition, the **%_pkgverify_flags** macro can be used to limit which hashes and signatures are allowed. For example, it is possible to disable the use of the weak **MD5** hash at the cost of compatibility with older packages.

(JIRA:RHELPLAN-10596)

4.5. INFRASTRUCTURE SERVICES

Notable changes in the recommended Tuned profile in RHEL 8

With this update, the recommended Tuned profile (reported by the **tuned-adm recommend** command) is now selected based on the following rules - the first rule that matches takes effect:

- 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

(BZ#1565598)

Geolite Databases have been replaced by Geolite2 Databases

Geolite Databases that were present in Red Hat Enterprise Linux 7 were replaced by Geolite2 Databases on Red Hat Enterprise Linux 8.

Geolite Databases were provided by the **GeoIP** package. This package together with the legacy database is no longer supported in the upstream.

Geolite2 Databases are provided by multiple packages. The **libmaxminddb** package includes the library and the **mmdblookup** command line tool, which enables manual searching of addresses. The **geoipupdate** binary from the legacy **GeoIP** package is now provided by the **geoipupdate** package, and is capable of downloading both legacy databases and the new Geolite2 databases.

(JIRA:RHELPLAN-6746)

4.6. SHELLS AND COMMAND-LINE TOOLS

The nobody user replaces nfsnobody

In Red Hat Enterprise Linux 7, there was:

- 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 the default kernel overflow ID, too.

Both of these have been merged into the **nobody** user and group pair, which uses the 65534 ID in Red Hat Enterprise Linux 8. New installations no longer create the **nfsnobody** pair.

This change reduces the confusion about files that are owned by **nobody** but have nothing to do with NFS.

(BZ#1591969)

4.7. WEB SERVERS, DATABASES, DYNAMIC LANGUAGES

Database servers in RHEL 8

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 4.0**, 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 Beta because it uses the Server Side Public License (SSPL).

(BZ#1647908)

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
```

(BZ#1649891, BZ#1519450, BZ#1631400)

Notable changes in MariaDB 10.3

MariaDB 10.3 provides numerous new features over the version 5.5 distributed in RHEL 7. Some of the most notable changes are:

- **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**.
- 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.

See also Using MariaDB on Red Hat Enterprise Linux 8.

(BZ#1637034, BZ#1519450)

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, and attempts to correct hashbangs in all executable files. The BRP script will generate errors when encountering a Python script with an ambiguous hashbang, such as:

- **#! /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 this command to the **%prep** section or at the end of the **%install** section.

For more information, see Handling hashbangs in Python scripts.

(BZ#1583620)

Python 3 is the default Python implementation in RHEL 8

Red Hat Enterprise Linux 8 is distributed with **Python 3.6**. The package is not 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 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.

(BZ#1580387)

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.

(BZ#1648843)

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 warning 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 following extensions have been removed:

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

(BZ#1580430)

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.

(BZ#1511131)

Notable changes in Apache `httpd`

RHEL 8 is distributed with the Apache HTTP Server 2.4.35. This version introduces the following changes over **httpd** available in RHEL 7:

- HTTP/2 support is now provided by the **mod_http2** package, which is a part of the **httpd** module.

- 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.
- 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.

For more information about **httpd**, see Setting up the Apache HTTP web server.

(BZ#1632754, BZ#1527084, BZ#1581178)

The nginx web server new in RHEL 8

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 certificates and 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.

(BZ#1545526)

4.8. DESKTOP

GNOME Shell rebased to version 3.28

GNOME Shell has been rebased to upstream version 3.28. 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

(BZ#1649404)

Wayland is the default display server

With Red Hat Enterprise Linux 8, the GNOME session and the GNOME Display Manager (GDM) use **Wayland** as their default display server instead of the **X.org** server, which was used with the previous major version of RHEL.

Wayland provides multiple advantages and improvements over **X.org**. Most notably:

- Stronger security model

- Improved multi-monitor handling
- Improved user interface (UI) scaling
- The desktop can control window handling directly.

Note that the following features are currently unavailable or do not work as expected:

- Multi-GPU setups are not supported under **Wayland**.
- The **NVIDIA** binary driver does not work under **Wayland**.
- The `xrandr` utility does not work under **Wayland** due to its different approach to handling, resolutions, rotations, and layout. Note that other **X.org** utilities for manipulating the screen do not work under **Wayland**, either.
- Screen recording, remote desktop, and accessibility do not always work correctly under **Wayland**.
- No clipboard manager is available.
- **Wayland** ignores keyboard grabs issued by X11 applications, such as virtual machines viewers.
- **Wayland** inside guest virtual machines (VMs) has stability and performance problems, so it is recommended to use the X11 session for virtual environments.

If you upgrade to RHEL 8 from a RHEL 7 system where you used the **X.org** GNOME session, your system continues to use **X.org**. The system also automatically falls back to **X.org** when the following graphics drivers are in use:

- The NVIDIA binary driver
- The `cirrus` driver
- The `mga` driver
- The `aspeed` driver

You can disable the use of **Wayland** manually:

- To disable **Wayland** in **GDM**, set the `WaylandEnable=false` option in the `/etc/gdm/custom.conf` file.
- To disable **Wayland** in the GNOME session, select the legacy X11 option by using the cogwheel menu on the login screen after entering your login name.

For more details on **Wayland**, see https://wayland.freedesktop.org/.

(BZ#1589678)

Locating RPM packages that are in repositories not enabled by default

Additional repositories for desktop are not enabled by default. The disablement is indicated by the `enabled=0` line in the corresponding `.repo` file. If you attempt to install a package from such repository using PackageKit, PackageKit shows an error message announcing that the application is not available. To make the package available, replace previously used `enabled=0` line in the respective `.repo` file with `enabled=1`.

(JIRA:RHELPLAN-2878)

GNOME Sofware for package management

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

(JIRA:RHELPLAN-3001)

4.9. HARDWARE ENABLEMENT

ARM 52-bit physical addressing is now available

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

(BZ#1643522)

The IOMMU code supports 5-level page tables in RHEL 8

The I/O memory management unit (IOMMU) code in the Linux kernel has been updated to support 5-level page tables in Red Hat Enterprise Linux 8.

(BZ#1485546)

4.10. IDENTITY MANAGEMENT

New password syntax checks in Directory Server

This enhancement adds new password syntax checks to Directory Server. Administrators can now, for example, enable dictionary checks, allow or deny using character sequences and palindromes. As a result, if enabled, the password policy syntax check in Directory Server enforces more secure passwords.

(BZ#1334254)

Directory Server now provides improved internal operations logging support

Several operations in Directory Server, initiated by the server and clients, cause additional operations in the background. Previously, the server only logged for internal operations the **Internal** connection keyword, and the operation ID was always set to **-1**. With this enhancement, Directory Server logs the real connection and operation ID. You can now trace the internal operation to the server or client operation that caused this operation.

(BZ#1358706)

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.

(JIRA:RHELPLAN-10439)

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.

(JIRA:RHELPLAN-10440)

Active Directory users can now administer Identity Management

With this update, RHEL 8 allows adding a user ID override for an Active Directory (AD) user as a member of an Identity Management (IdM) group. An ID override is a record describing what a specific AD 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 that currently, selected features in IdM may still be unavailable to AD users.

(JIRA:RHELPLAN-10442)

`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.

(JIRA:RHELPLAN-10443)

Identity Management packages are available as a module

In RHEL 8, the packages necessary for installing an Identity Management (IdM) server and client are shipped 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: . Enable the stream. . Switch to the RPMs delivered through the stream. . Run the **yum module install idm:DL1/profile_name** command.

(JIRA:RHELPLAN-10438)

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 Cockpit 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 Cockpit web-based interface or from the Command-Line Interface using the **tlog-play** utility.

(JIRA:RHELPLAN-10585)

authselect simplifies the configuration of user authentication

This update introduces the **authselect** utility that simplifies the configuration of user authentication on RHEL 8 hosts, replacing 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. Note that **authselect** does not configure services required to join remote domains. This task is performed by specialized tools, such as **realmd** or **ipa-client-install**.

(JIRA:RHELPLAN-10445)

4.11. COMPILERS AND DEVELOPMENT TOOLS

Boost updated to version 1.66

The **Boost** C++ library has been updated to upstream version 1.66. The version of **Boost** included in Red Hat Enterprise Linux 7 is 1.53. For details, see the upstream changelogs: https://www.boost.org/users/history/

This update introduces the following changes breaking compatibility with previous versions:

- The **bs_set_hook()** function, the **splay_set_hook()** function from splay containers, and the **bool splay = true** extra parameter in the **splaytree_algorithms()** function in the **Intrusive** library have been removed.
- Comments or string concatenation in JSON files are no longer supported by the parser in the **Property Tree** library.
- Some distributions and special functions from the **Math** library have been fixed to behave as documented and raise an **overflow_error** instead of returning the maximum finite value.
- Some headers from the **Math** library have been moved into the directory **libs/math/include_private**.

- Behavior of the **`basic_regex<>::mark_count()`** and **`basic_regex<>::subexpression(n)`** functions from the **Regex** library has been changed to match their documentation.
- Use of variadic templates in the **Variant** library may break metaprogramming functions.
- The **`boost::python::numeric`** API has been removed. Users can use **`boost::python::numpy`** instead.
- Arithmetic operations on pointers to non-object types are no longer provided in the Atomic library.

(BZ#1494495)

Unicode 11.0.0 support

The Red Hat Enterprise Linux core C library, **glibc**, has been updated to support the Unicode standard version 11.0.0. As a result, all wide character and multi-byte character APIs including transliteration and conversion between character sets provide accurate and correct information conforming to this standard.

(BZ#1512004)

Support for linking against the `libpthread_nonshared.a` archive file

This update provides the new **`compat-libpthread-nonshared`** package that allows applications which directly reference **`/usr/lib64/libpthread_nonshared.a`** to work properly.

(BZ#1614439)

The `boost` package is now independent of Python

With this update, installing the **`boost`** package no longer installs the **`Boost.Python`** library as a dependency. In order to use **`Boost.Python`**, you need to explicitly install the **`boost-python3`** or **`boost-python3-devel`** packages.

(BZ#1616244)

A new `compat-libgfortran-48` package available

For compatibility with Red Hat Enterprise Linux 6 and 7 applications using the Fortran library, a new **`compat-libgfortran-48`** compatibility package is now available, which provides the **`libgfortran.so.3`** library.

(BZ#1607227)

Retpoline support in GCC

This update adds support for retpolines to GCC. A retpoline is a software construct used by the kernel to reduce overhead of mitigating Spectre Variant 2 attacks described in CVE-2017-5715.

(BZ#1535774)

Enhanced support for the 64-bit ARM architecture in toolchain components

Toolchain components, **`GCC`** and **`binutils`**, now provide extended support for the 64-bit ARM architecture. For example:

- **`GCC`** and **`binutils`** now support Scalable Vector Extension (SVE).

- Support for the **FP16** data type, provided by ARM v8.2, has been added to **GCC**. The **FP16** data type improves performance of certain algorithms.
- Tools from **binutils** now support the ARM v8.3 architecture definition, including Pointer Authentication. The Pointer Authentication feature prevents malicious code from corrupting the normal execution of a program or the kernel by crafting their own function pointers. As a result, only trusted addresses are used when branching to different places in the code, which improves security.

(BZ#1504980, BZ#1550501, BZ#1504995, BZ#1504993, BZ#1504994)

Optimizations to glibc for IBM POWER systems

This update provides a new version of **glibc** that is optimized for both IBM POWER 8 and IBM POWER 9 architectures. As a result, IBM POWER 8 and IBM POWER 9 systems now automatically switch to the appropriate, optimized **glibc** variant at run time.

(BZ#1376834)

GNU C Library updated to version 2.28

Red Hat Enterprise Linux 8 Beta includes version 2.28 of the GNU C Library (glibc). Notable improvements include:

- Security hardening features:
  - Secure binary files marked with the **AT_SECURE** flag ignore the **LD_LIBRARY_PATH** environment variable.
  - Backtraces are no longer printed for stack checking failures to speed up shutdown and avoid running more code in a compromised environment.
- Performance improvements:
  - Performance of the **malloc()** function has been improved with a thread local cache.
  - Addition of the **GLIBC_TUNABLES** environment variable to alter library performance characteristics.
  - Implementation of thread semaphores has been improved and new scalable **pthread_rwlock_xxx()** functions have been added.
  - Performance of the math library has been improved.
- Support for Unicode 11.0.0 has been added.
- Improved support for 128-bit floating point numbers as defined by the ISO/IEC/IEEE 60559:2011, IEEE 754-2008, and ISO/IEC TS 18661-3:2015 standards has been added.
- Domain Name Service (DNS) stub resolver improvements related to the **/etc/resolv.conf** configuration file:
  - Configuration is automatically reloaded when the file is changed.
  - Support for an arbitrary number of search domains has been added.
  - Proper random selection for the **rotate** option has been added.

- New features for development have been added, including:
  - Linux wrapper functions for the **preadv2** and **pwritev2** kernel calls
  - New functions including **reallocarray()** and **explicit_bzero()**
  - New flags for the **posix_spawnattr_setflags()** function such as **POSIX_SPAWN_SETSID**

(BZ#1512010, BZ#1504125, BZ#506398)

CMake available in RHEL

The CMake build system version 3.11 is available in Red Hat Enterprise Linux 8 Beta as the **cmake** package.

(BZ#1590139, BZ#1502802)

make version 4.2.1

Red Hat Enterprise Linux 8 is distributed with the **make** build tool version 4.2.1. Notable changes include:

- When a recipe fails, the name of the makefile and line number of the recipe are shown.
- The **--trace** option has been added to enable tracing of targets. When this option is used, every recipe is printed before invocation even if it would be suppressed, together with the file name and line number where this recipe is located, and also with the prerequisites causing it to be invoked.
- Mixing explicit and implicit rules no longer cause **make** to terminate execution. Instead, a warning is printed. Note that this syntax is deprecated and may be completely removed in the future.
- The **$(file …)** function has been added to write text to a file. When called without a text argument, it only opens and immediately closes the file.
- A new option, **--output-sync** or **-O**, causes an output from multiple jobs to be grouped per job and enables easier debugging of parallel builds.
- The **--debug** option now accepts also the **n** (none) flag to disable all currently enabled debugging settings.
- The **!=** shell assignment operator has been added as an alternative to the **$(shell …)** function to increase compatibility with BSD makefiles. For more details and differences between the operator and the function, see the GNU make manual.

Note that as a consequence, variables with a name ending in exclamation mark and immediately followed by assignment, such as **variable!=value**, are now interpreted as the new syntax. To restore the previous behavior, add a space after the exclamation mark, such as **variable! =value**.

- The **::=** assignment operator defined by the POSIX standard has been added.
- When the **.POSIX** variable is specified, **make** observes the POSIX standard requirements for handling backslash and new line. In this mode, any trailing space before the backslash is preserved, and each backslash followed by a new line and white space characters is converted to a single space character.

- Behavior of the **MAKEFLAGS** and **MFLAGS** variables is now more precisely defined.
- A new variable, **GNUMAKEFLAGS**, is parsed for **make** flags identically to **MAKEFLAGS**. As a consequence, GNU **make**-specific flags can be stored outside **MAKEFLAGS** and portability of makefiles is increased.
- A new variable, **MAKE_HOST**, containing the host architecture has been added.
- The new variables, **MAKE_TERMOUT** and **MAKE_TERMERR**, indicate whether **make** is writing standard output and error to a terminal.
- Setting the **-r** and **-R** options in the **MAKEFLAGS** variable inside a makefile now works correctly and removes all built-in rules and variables, respectively.
- The **.RECIPEPREFIX** setting is now remembered per recipe. Additionally, variables expanded in that recipe also use that recipe prefix setting.
- The **.RECIPEPREFIX** setting and all target-specific variables are displayed in the output of the **-p** option as if in a makefile, instead of as comments.

(BZ#1641015)

Go programs built with Go Toolset are FIPS compliant

The cryptographic library available in Go Toolset has been changed to use the OpenSSL library version 1.1.0 if the host system is configured in FIPS mode. As a consequence, programs built with this version of Go Toolset are FIPS compliant.

To make Go programs use only the uncertified standard cryptographic routines, use the **-tags no_openssl** option of the **go** compiler at build time.

(BZ#1512570)

SystemTap version 4.0

Red Hat Enterprise Linux 8 Beta is distributed with the SystemTap instrumentation tool version 4.0. Notable improvements include:

- The extended Berkeley Packet Filter (eBPF) backend has been improved, especially strings and functions. To use this backend, start SystemTap with the **--runtime=bpf** option.
- A new export network service for use with the Prometheus monitoring system has been added.
- Implementation of system call probing has been improved to use the kernel tracepoints if necessary.

(BZ#1641032)

Improvements in `binutils` version 2.30

Red Hat Enterprise Linux 8 Beta includes version 2.30 of the **binutils** package. Notable improvements include:

- Support for new s390x architecture extensions has been improved.

Assembler:

- Support for the WebAssembly file format, and conversion of WebAssembly to the wasm32 ELF file format have been added.
- Support for the ARMv8-R architecture and Cortex-R52, Cortex-M23, and Cortex-M33 processors has been added.
- Support for the RISC-V architecture has been added.

Linkers:

- The linker now puts code and read-only data into separate segments by default. As a result, the created executable files are bigger and more safe to run, because the dynamic loader can disable execution of any memory page containing read-only data.
- Support for GNU Property notes which provide hints to the dynamic loader about the binary file has been added.
- Previously, the linker generated invalid executable code for the Intel Indirect Branch Tracking (IBT) technology. As a consequence, the generated executable files could not start. This bug has been fixed.
- Previously, the **gold** linker merged property notes improperly. As a consequence, wrong hardware features could be enabled in the generated code, and the code could terminate unexpectedly. This bug has been fixed.
- Previously, the **gold** linker created note sections with padding bytes at the end to achieve alignment according to architecture. Because the dynamic loader did not expect the padding, it coud terminate unexpectedly the program it was loading. This bug has been fixed.

Other tools:

- The **readelf** and **objdump** tools now have options to follow links into separate debug information files and display information in them, too.
- The new **--inlines** option extends the existing **--line-numbers** option of the **objdump** tool to display nesting information for inlined functions.
- The **nm** tool gained a new option **--with-version-strings** to display version information of a symbol after its name, if present.

(BZ#1641004, BZ#1637072, BZ#1501420, BZ#1504114, BZ#1614908, BZ#1614920)

Performace co-pilot version 4.1.3

Red Hat Enterprise Linux 8 Beta is distributed with Performance co-pilot (pcp) version 4.1.3. Notable improvements include:

- Support for historical analysis and CSV format output in the **pcp-dstat** tool.
- Log utilities can use metric labels and help text records.
- The **pmdaperfevent** tool now reports correct CPU numbers in lower SMT levels.
- The **pmdapostgresql** tool now supports Postgres series 10.x.
- The **pmdaredis** tool now supports Redis series 5.x.

- The **pmdabcc** tool has been enhanced with dynamic process filtering and per-process syscalls, ucalls, and ustat.
- The **pmdammv** tool supports exporting metric labels, increasing format version to 3.
- The **pmdagfs2** tool supports additional glock and glock holder metrics.
- Several fixes have been made to the SElinux policy.

(BZ#1641034)

Memory Protection Keys

This update enables hardware features which allow per-thread page protection flag changes. The new **glibc** system call wrappers have been added for the **pkey_alloc()**, **pkey_free()**, and **pkey_mprotect()** functions. In addition, the **pkey_set()** and **pkey_get()** functions have been added to allow access to the per-thread protection flags.

(BZ#1304448)

GCC now defaults to z13 on IBM Z

With this update, by default GCC on the IBM Z architecture builds code for the z13 processor, and the code is tuned for the z14 processor. This is equivalent to using the **-march=z13** and **-mtune=z14** options. Users can override this default by explicitly using options for target architecture and tuning.

(BZ#1571124)

elfutils updated to version 0.174

In Red Hat Enterprise Linux 8, the **elfutils** package is available in version 0.174. Notable changes include:

- Previously, the **eu-readelf** tool could show a variable with a negative value as if it had a large unsigned value, or show a large unsigned value as a negative value. This has been corrected and **eu-readelf** now looks up the size and signedness of constant value types to display them correctly.
- A new function **dwarf_next_lines()** for reading **.debug_line** data lacking CU has been added to the **libdw** library. This function can be used as alternative to the **dwarf_getsrclines()** and **dwarf_getsrcfiles()** functions.
- Previously, files with more than 65280 sections could cause errors in the **libelf** and **libdw** libraries and all tools using them. This bug has been fixed. As a result, extended **shnum** and **shstrndx** values in ELF file headers are handled correctly.

(BZ#1641007)

Valgrind updated to version 3.14

Red Hat Enterprise Linux 8 is distributed with the Valgrind executable code analysis tool version 3.14. Notable changes include:

- A new **--keep-debuginfo** option has been added to enable retention of debug info for unloaded code. As a result, saved stack traces can include file and line information for code that is no longer present in memory.
- Suppressions based on source file name and line number have been added.

- The **Helgrind** tool has been extended with an option **--delta-stacktrace** to specify computation of full history stack traces. Notably, using this option together with **--history-level=full** can improve **Helgrind** performance by up to 25%.
- False positive rate in the **Memcheck** tool for optimised code on the Intel and AMD 64-bit arcitectures and the ARM 64-bit architecture has been reduced. Note that you can use the **--expensive-definedness-checks** to control handling of definedness checks and improve the rate at the expense of performance.
- Valgrind can now recognize more instructions of the little-endian variant of IBM Power Systems.
- Valgrind can now partially process integer and string vector instructions of the IBM Z architecture z13 processor.

For more information about the new options and their known limitations, see the **valgrind(1)** manual page.

(BZ#1641029, BZ#1501419)

GDB version 8.2

Red Hat Enterprise Linux 8 is distributed with the GDB debugger version 8.2 Notable changes include:

- The IPv6 protocol is supported for remote debugging with GDB and **gdbserver**.
- Debugging without debug information has been improved.
- Symbol completion in the GDB user interface has been improved to offer better suggestions by using more syntactic constructions such as ABI tags or namespaces.
- Commands can now be executed in the background.
- Debugging programs created in the Rust programming language is now possible.
- Debugging C and C++ languages has been improved with parser support for the **_Alignof** and **alignof** operators, C++ rvalue references, and C99 variable-length automatic arrays.
- GDB extension scripts can now use the Guile scripting language.
- The Python scripting language interface for extensions has been improved with new API functions, frame decorators, filters, and unwinders. Additionally, scripts in the **.debug_gdb_scripts** section of GDB configuration are loaded automatically.
- GDB now uses Python version 3 to run its scripts, including pretty printers, frame decorators, filters, and unwinders.
- The ARM and 64-bit ARM architectures have been improved with process execution record and replay, including Thumb 32-bit and system call instructions.
- Support for Intel MPX register and bound violation, the PKU register, and Intel Processor Trace has been added.
- Record and replay functionality has been extended to include the **rdrand** and **rdseed** instructions on Intel based systems.
- Functionality of GDB on the IBM Z architecture has been extended with suport for tracepoints and fast tracepoints, vector registers and ABI, and the **Catch** system call.

- GDB can now use the SystemTap static user space probes (SDT) on the 64-bit ARM architecture.

(BZ#1641022)

Localization for RHEL is distributed in multiple packages

In RHEL 8.0 Beta, 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.

For more information about using langpacks, see Installing and using langpacks.

(BZ#1512009)

GCC version 8.2

In Red Hat Enterprise Linux 8, the GCC toolchain is based on the GCC 8.2 release series. Notable changes 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 and Undefined Behavior Sanitizer have been improved. The Leak Sanitizer for detection of memory leaks has been added.
- Support for the DWARF 5 debug information format has been added.
- The source code coverage analysis tool GCOV has been extended with various improvements.
- New warnings and improved diagnostics have been added for static detection of certain likely programming errors.
- GCC has been extended to provide tools to ensure additional hardening of the generated code. Improvements related to security include built-ins for overflow checking, additional protection against stack clash, checking target addresses of control-flow instructions, warnings for bounded string manipulation functions, and warnings to detect out-of-bounds array indices.

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.
- Support for the z13 and z14 processors of the IBM Z architecture has been added.

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.
- Support for the C language standard C11 has been improved.
- 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.
- 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.
- 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.

(JIRA:RHELPLAN-7437, BZ#1512593)

4.12. FILE SYSTEMS AND STORAGE

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.

(BZ#1494028)

VDO now supports all architectures

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

For the list of supported architectures, see Chapter 2, *Architectures*.

(BZ#1534087)

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.

(BZ#1649582)

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.

(BZ#1564540)

NVMe/FC is fully supported on Broadcom Emulex Fibre Channel Adapters

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

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.

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
```

Drivers other than **lpfc** still remain in Technology Preview.

Additional restrictions:

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

(BZ#1649497)

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.

(BZ#1643294)

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**, and
- **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.

(BZ#1643550)

Multiqueue default behavior

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.

(BZ#1647612)

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 like:

- 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.

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

(JIRA:RHELPLAN-10600)

4.13. HIGH AVAILABILITY AND CLUSTERS

New pcs commands to list available watchdog devices and test watchdog devices

In order to configure SBD with Pacemaker, a functioning watchdog device is required. This release supports the **pcs stonith sbd watchdog list** command to list available watchdog devices on the local node, and the **pcs stonith sbd watchdog test** command to test a watchdog device. For information on the **sbd** command line tool, see the **sbd**(8) man page.

(BZ#1578891)

The `pcs` command now supports filtering resource failures by an operation and its interval

Pacemaker now tracks resource failures per a resource operation on top of a resource name, and a node. The **`pcs resource failcount show`** command now allows filtering failures by a resource, node, operation, and interval. It provides an option to display failures aggregated per a resource and node or detailed per a resource, node, operation, and its interval. Additionally, the **`pcs resource failcount reset`** command now allows filtering failures by a resource, node, operation, and interval.

(BZ#1591308)

Timestamps enabled in `corosync` log

The **`corosync`** log did not previously contain timestamps, which made it difficult to relate it to logs from other nodes and daemons. With this release, timestamps are present in the **`corosync`** log.

(BZ#1615420)

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 Corosync 3, **`knet`**, and node names. Node names 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.

(BZ#1158816)

Pacemaker 2.0.0 in RHEL 8

The **`pacemaker`** packages have been upgraded to the upstream version of Pacemaker 2.0.0, which provides a number of bug fixes and enhancements over the previous version:

- The Pacemaker detail log is now **`/var/log/pacemaker/pacemaker.log`** by default (not directly in **`/var/log`** or combined with the **`corosync`** log under **`/var/log/cluster`**).
- The Pacemaker daemon processes have been renamed to make reading the logs more intuitive. For example, **`pengine`** has been renamed to **`pacemaker-schedulerd`**.
- Support for the deprecated **`default-resource-stickiness`** and **`is-managed-default`** cluster properties has been dropped. The **`resource-stickiness`** and **`is-managed`** properties should be set in resource defaults instead. Existing configurations (though not newly created ones) with the deprecated syntax will automatically be updated to use the supported syntax.
- A more complete list of changes is available at https://access.redhat.com/articles/3681151.

It is recommended that users who are upgrading an existing cluster using Red Hat Enterprise Linux 7 or earlier, run **pcs cluster cib-upgrade** on any cluster node before and after upgrading RHEL on all cluster nodes.

(BZ#1543494)

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.

(BZ#1542288)

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.

(BZ#1549535)

The `pcs` commands now support display, cleanup, and synchronization of fencing history

Pacemaker's fence daemon tracks a history of all fence actions taken (pending, successful, and failed). With this release, the **`pcs`** commands allow users to access the fencing history in the following ways:

- The **`pcs status`** command shows failed and pending fencing actions
- The **`pcs status --full`** command shows the entire fencing history
- The **`pcs stonith history`** command provides options to display and clean up fencing history
- Although fencing history is synchronized automatically, the **`pcs stonith history`** command now supports an **`update`** option that allows a user to manually synchronize fencing history should that be necessary

(BZ#1620190, BZ#1615891)

4.14. NETWORKING

`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`** ruleset operations, such as the **`nft flush ruleset`** command, might affect rulesets 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 backend name. In RHEL8, 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)
```

(BZ#1644030)

Notable TCP features in RHEL 8

Red Hat Enterprise Linux 8 is distributed with TCP networking stack version 4.16, 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.

(BZ#1562998)

firewalld uses **nftables** by default

With this update, the **nftables** filtering subsystem is the default firewall backend for the **firewalld** daemon. To change the backend, use the **FirewallBackend** option in the **/etc/firewalld.conf** file.

This change introduces the following differences in behavior when using **nftables**:

1. **iptables** rule executions always occur before **firewalld** rules
   - **DROP** in **iptables** means a packet is never seen by **firewalld**
   - **ACCEPT** in **iptables** means a packet is still subject to **firewalld** rules
2. **firewalld** direct rules are still implemented through **iptables** while other **firewalld** features use **nftables**
3. direct rule execution occurs before **firewalld** generic acceptance of established connections

(BZ#1509026)

Notable change in **wpa_supplicant** in RHEL 8

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.

(BZ#1582538)

NetworkManager now supports SR-IOV virtual functions

In Red Hat Enterprise Linux 8.0, **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.

(BZ#1555013)

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 guest a lot of containers overcoming the possible limitation on the number of MAC addresses supported by the peer networking equipment.

(BZ#1261167)

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.

(BZ#1555012)

Improvements in the networking stack 4.18

Red Hat Enterprise Linux 8.0 includes the networking stack upgraded to upstream version 4.18, which provides several bug fixes and enhancements. Notable changes include:

- Introduced new offload features, such as **UDP_GSO**, and, for some device drivers, **GRO_HW**.
- Improved significant scalability for the User Datagram Protocol (UDP).
- Improved the generic busy polling code.
- Improved scalability for the IPv6 protocol.
- Improved scalability for the routing code.
- Added a new default transmit queue scheduling algorithm, **fq_codel**, which improves a transmission delay.
- Improved scalability for some transmit queue scheduling algorithms. For example, **pfifo_fast** is now lockless.

(BZ#1562987)

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
| ...
```

(BZ#1564596)

New features added to VPN using NetworkManager

In Red Hat Enterprise Linux 8.0, **NetworkManager** provides the following new features to VPN:

- Support for the Internet Key Exchange version 2 (IKEv2) protocol.
- Added some more **Libreswan** options, such as the **rightid**, **leftcert**, **narrowing**, **rekey**, **fragmentation** options. For more details on the supported options, see the **nm-settings-libreswan** man page.
- Updated the default ciphers. This means that when the user does not specify the ciphers, the **NetworkManager-libreswan** plugin allows the **Libreswan** application to choose the system default cipher. The only exception is when the user selects an IKEv1 aggressive mode configuration. In this case, the **ike = aes256-sha1;modp1536** and **eps = aes256-sha1** values are passed to **Libreswan**.

(BZ#1557035)

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.

(BZ#1273139)

4.15. SECURITY

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.

(BZ#1622511)

RSA-PSS is now supported in OpenSC

This update adds support for the RSA-PSS cryptographic signature scheme to the **OpenSC** smart card driver. The new scheme enables a secure cryptographic algorithm required for the TLS 1.3 support in the client software.

(BZ#1595626)

rsyslog rebased to version 8.37.0

The **rsyslog** packages have been upgraded to upstream version 8.37.0, which provides many bug fixes and enhancements over the previous versions. Most notable changes include:

- Enhanced processing of **rsyslog** internal messages; possibility of rate-limiting them; fixed possible deadlock.
- Enhanced rate-limiting in general; the actual *spam source* is now logged.
- Improved handling of oversized messages - the user can now set how to treat them both in the core and in certain modules with separate actions.
- **mmnormalize** rule bases can now be embedded in the **config** file instead of creating separate files for them.
- The user can now set the **GnuTLS** priority string for **imtcp** that allows fine-grained control over encryption.
- All **config** variables, including variables in JSON, are now case-insensitive.
- Various improvements of PostgreSQL output.
- Added a possibility to use shell variables to control **config** processing, such as conditional loading of additional configuration files, executing statements, or including a text in **config**. Note that an excessive use of this feature can make it very hard to debug problems with **rsyslog**.
- 4-digit file creation modes can be now specified in **config**.
- Reliable Event Logging Protocol (RELP) input can now bind also only on a specified address.
- The default value of the **enable.body** option of mail output is now aligned to documentation

- The user can now specify insertion error codes that should be ignored in **MongoDB** output.
- Parallel TCP (pTCP) input has now the configurable backlog for better load-balancing.

(BZ#1613880)

New rsyslog module: `omkafka`

To enable **kafka** centralized data storage scenarios, you can now forward logs to the **kafka** infrastructure using the new **`omkafka`** module.

(BZ#1542497)

`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.

(BZ#1485241)

PKCS #11 support for smart cards and HSMs is now consistent across the system

With this update, using smart cards and Hardware Security Modules (HSM) with PKCS #11 cryptographic token interface becomes consistent. This means that the user and the administrator can use the same syntax for all related tools in the system. Notable enhancements include:

- Support for the PKCS #11 Uniform Resource Identifier (URI) scheme that ensures a simplified enablement of tokens on RHEL servers both for administrators and application writers.
- A system-wide registration method for smart cards and HSMs using the **`pkcs11.conf`**.
- Consistent support for HSMs and smart cards is available in NSS, GnuTLS, and OpenSSL (through the **`openssl-pkcs11`** engine) applications.
- The Apache HTTP server (**`httpd`**) now seamlessly supports HSMs.

For more information, see the **`pkcs11.conf(5)`** man page.

(BZ#1516741)

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, SSH, DNSSec, and Kerberos protocols. 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. This policy is also compatible with PCI-DSS requirements. 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 Customer Portal and the **`update-crypto-policies(8)`** man page for more information.

(BZ#1591620)

SCAP Security Guide supports OSPP 4.2

SCAP Security Guide provides a draft of the OSPP (Protection Profile for General Purpose Operating Systems) profile version 4.2 for Red Hat Enterprise Linux 8. This profile reflects mandatory configuration controls identified in the NIAP Configuration Annex to the Protection Profile for General Purpose Operating Systems (Protection Profile Version 4.2). SCAP Security Guide provides automated checks and scripts that enable users to meet requirements defined in the OSPP.

(BZ#1618518)

OpenSCAP command-line interface has been improved

The verbose mode is now available in all **oscap** modules and submodules. The tool output has improved formatting.

Deprecated options have been removed to improve the usability of the command-line interface.

The following options are no longer available:

- **--show** in **oscap xccdf generate report** has been completely removed.
- **--probe-root** in **oscap oval eval** has been removed. It can be replaced by setting the environment variable, **OSCAP_PROBE_ROOT**.
- **--sce-results** in **oscap xccdf eval** has been replaced by **--check-engine-results**
- **validate-xml** submodule has been dropped from CPE, OVAL, and XCCDF modules. **validate** submodules can be used instead to validate SCAP content against XML schemas and XSD schematrons.
- **oscap oval list-probes** command has been removed, the list of available probes can be displayed using **oscap --version** instead.

OpenSCAP allows to evaluate all rules in a given XCCDF benchmark regardless of the profile by using **--profile '(all)'**.

(BZ#1618484)

Support for a new map permission check on the `mmap` syscall

The SELinux **map** permission has been added to control memory mapped access to files, directories, sockets, and so on. This allows the SELinux policy to prevent direct memory access to various file system objects and ensure that every such access is revalidated.

(BZ#1592244)

SELinux now supports systemd `No New Privileges`

This update introduces the **nnp_nosuid_transition** policy capability that enables SELinux domain transitions under **No New Privileges** (NNP) or **nosuid** if **nnp_nosuid_transition** is allowed between the old and new contexts. The **selinux-policy** packages now contain a policy for **systemd** services that use the **NNP** security feature.

The following rule describes allowing this capability for a service:

```
   allow source_domain  target_type:process2 { nnp_transition
nosuid_transition };
```

For example:

```
allow init_t fprintd_t:process2 { nnp_transition nosuid_transition };
```

The distribution policy now also contains the m4 macro interface, which can be used in SELinux security policies for services that use the **`init_nnp_daemon_domain()`** function.

(BZ#1594111)

SELinux now supports `getrlimit` permission in the `process` class

This update introduces a new SELinux access control check, **`process:getrlimit`**, which has been added for the **`prlimit()`** function. This enables SELinux policy developers to control when one process attempts to read and then modify the resource limits of another process using the **`process:setrlimit`** permission. Note that SELinux does not restrict a process from manipulating its own resource limits through **`prlimit()`**. See the **`prlimit(2)`** and **`getrlimit(2)`** man pages for more information.

(BZ#1549772)

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.

(BZ#1516728)

`OpenSCAP` rebased to version 1.3.0

The **`OpenSCAP`** suite has been upgraded to upstream version 1.3.0, which introduces many enhancements over the previous versions. The most notable features include:

- API and ABI have been consolidated - updated, deprecated and/or unused symbols have been removed.
- The probes are not run as independent processes, but as threads within the **`oscap`** process.
- The command-line interface has been updated.
- **`Python 2`** bindings have been replaced with **`Python 3`** bindings.

(BZ#1614273)

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.

(BZ#1616428)

rsyslog `imfile` now supports symlinks

With this update, the **rsyslog `imfile`** module delivers better performance and more configuration options. This allows you to use the module for more complicated file monitoring use cases. For example, you can now use file monitors with glob patterns anywhere along the configured path and rotate symlink

targets with increased data throughput.

(BZ#1614179)

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

For more details, see the output of the following command:

```
# semanage boolean -l
```

(JIRA:RHELPLAN-10347)

4.16. VIRTUALIZATION

KVM supports 5-level paging

With Red Hat Enterprise Linux 8, KVM virtualization supports the 5-level paging feature, which significantly increases the physical and virtual address space that the host and guest systems can use.

(BZ#1485229)

KVM supports UMIP in RHEL 8

KVM virtualization now supports the User-Mode Instruction Prevention (UMIP) feature, which can help prevent user-space applications from accessing to system-wide settings. This reduces the potential vectors for privilege escalation attacks, and thus makes the KVM hypervisor and its guest machines more secure.

(BZ#1494651)

Additional information in KVM guest crash reports

The crash information that KVM hypervisor generates if a guest terminates unexpectedly or becomes unresponsive has been expanded. This makes it easier to diagnose and fix problems in KVM virtualization deployments.

(BZ#1508139)

`qemu-kvm` 2.12 in RHEL 8

Red Hat Enterprise Linux 8 is distributed with **`qemu-kvm`** 2.12. This version fixes multiple bugs and adds a number of enhancements over the version 1.5.3, available in Red Hat Enterprise Linux 7.

Notably, the following features have been introduced:

- Q35 guest machine type
- UEFI guest boot
- NUMA tuning and pinning in the guest
- vCPU hot plug and hot unplug
- guest I/O threading

Note that some of the features available in **qemu-kvm** 2.12 are not supported on Red Hat Enterprise Linux 8.

(BZ#1559240)

NVIDIA vGPU is now compatible with the VNC console

When using the NVIDIA virtual GPU (vGPU) feature, it is now possible to use the VNC console to display the visual output of the guest.

(BZ#1497911)

Ceph is supported by virtualization

With this update, Ceph storage is supported by KVM virtualization on all CPU architectures supported by Red Hat.

(BZ#1578855)

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.

Also note that the previously default **PC** machine type has become deprecated and should only be used when virtualizing older operating systems that do not support Q35.

(BZ#1599777)

QEMU sandboxing has been added

In Red Hat Enterprise Linux 8, the QEMU emulator introduces the sandboxing feature. QEMU sandboxing provides configurable limitations to what systems calls QEMU can perform, and thus makes virtual machines more secure. Note that this feature is enabled and configured by default.

(JIRA:RHELPLAN-10628)

CHAPTER 5. BUG FIXES

This part describes bugs fixed in Red Hat Enterprise Linux 8.0 that have a significant impact on users.

5.1. DESKTOP

PackageKit can now operate on rpm packages

With this update, the support for operating on **rpm** packages has been added into **PackageKit**.

(BZ#1559414)

5.2. GRAPHICS INFRASTRUCTURES

QEMU does not handle 8-byte ggtt entries correctly

QEMU occasionally splits an 8-byte **ggtt** entry write to two consecutive 4-byte writes. Each of these partial writes can trigger a separate host **ggtt** write. Sometimes the two **ggtt** writes are combined incorrectly. Consequently, translation to a machine address fails, and an error log occurs.

(BZ#1598776)

5.3. IDENTITY MANAGEMENT

The Enterprise Security Client uses theopensc library for token detection

Red Hat Enterprise Linux 8.0 only supports the **opensc** library for smart cards. With this update, the Enterprise Security Client (ESC) use **opensc** for token detection instead of the removed **coolkey** library. As a result, applications correctly detect supported tokens.

(BZ#1538645)

Certificate System now supports rotating debug logs

Previously, Certificate System used a custom logging framework, which did not support log rotation. As a consequence, debug logs such as **/var/log/pki/*instance_name*/ca/debug** grew indefinitely. With this update, Certificate System uses the **java.logging.util** framework, which supports log rotation. As a result, you can configure log rotation in the **/var/lib/pki/*instance_name*/conf/logging.properties** file.

For further information on log rotation, see documentation for the **java.util.logging** package.

(BZ#1565073)

Certificate System no longer logs SetAllPropertiesRule operation warnings when the service starts

Previously, Certificate System logged warnings on the **SetAllPropertiesRule** operation in the **/var/log/messages** log file when the service started. The problem has been fixed, and the mentioned warnings are no longer logged.

(BZ#1424966)

The Certificate System KRA client parses Key Request responses correctly

Previously, Certificate System switched to a new JSON library. As a consequence, serialization for certain objects differed, and the Python key recovery authority (KRA) client failed to parse **`Key Request`** responses. The client has been modified to support responses using both the old and the new JSON library. As a result, the Python KRA client parses **`Key Request`** responses correctly.

(BZ#1623444)

5.4. COMPILERS AND DEVELOPMENT TOOLS

GCC no longer produces false positive warnings about out-of-bounds access

Previously, when compiling with the **`-O3`** optimization level option, the GNU Compiler Collection (GCC) could emit a false positive warning about an out-of-bounds access, even if the compiled code did not contain it. GCC optimization has been fixed and GCC no longer displays the false positive warning.

(BZ#1246444)

`ltrace` displays large structures correctly

Previously, the **`ltrace`** tool could not correctly print large structures returned from functions. Handling of large structures in **`ltrace`** has been improved and they are now printed correctly.

(BZ#1584322)

5.5. FILE SYSTEMS AND STORAGE

Higher print levels no longer cause `iscsiadm` to terminate unexpectedly

Previously, the **`iscsiadm`** utility terminated unexpectedly when the user specified a print level higher than 0 with the **`--print`** or **`-P`** option. This problem has been fixed, and all print levels now work as expected.

(BZ#1582099)

5.6. HIGH AVAILABILITY AND CLUSTERS

New `/etc/sysconfig/pcsd` option to reject client-initiated SSL/TLS renegotiation

When TLS renegotiation is enabled on the server, a client is allowed to send a renegotiation request, which initiates a new handshake. Computational requirements of a handshake are higher on a server than on a client. This makes the server vulnerable to DoS attacks. With this fix, the setting **`PCSD_SSL_OPTIONS`** in the **`/etc/sysconfig/pcsd`** configuration file accepts the **`OP_NO_RENEGOTIATION`** option to reject renegotiations. Note that the client can still open multiple connections to a server with a handshake performed in all of them.

(BZ#1566430)

A removed cluster node is no longer displayed in the cluster status

Previously, when a node was removed with the **`pcs cluster node remove`** command, the removed node remained visible in the output of a **`pcs status`** display. With this fix, the removed node is no longer displayed in the cluster status.

(BZ#1595829)

Fence agents can now be configured using either newer, preferred parameter names or deprecated parameter names

A large number of fence agent parameters have been renamed while the old parameter names are still supported as deprecated. Previously, **pcs** was not able to set the new parameters unless used with the **--force** option. With this fix, **pcs** now supports the renamed fence agent parameters while maintaining support for the deprecated parameters.

(BZ#1436217)

The pcs command now correctly reads the XML status of a cluster for display

The **pcs** command runs the **crm_mon** utility to get the status of a cluster in XML format. The **crm_mon** utility prints XML to standard output and warnings to standard error output. Previously **pcs** mixed XML and warnings into one stream and was then unable to parse it as XML. With this fix, standard and error outputs are separated in **pcs** and reading the XML status of a cluster works as expected.

(BZ#1578955)

Users no longer advised to destroy clusters when creating new clusters with nodes from existing clusters

Previously, when a user specified nodes from an existing cluster when running the **pcs cluster setup** command or when creating a cluster with the **pcsd** Web UI, pcs reported that as an error and suggested that the user destroy the cluster on the nodes. As a result, users would destroy the cluster on the nodes, breaking the cluster the nodes were part of as the remaining nodes would still consider the destroyed nodes to be part of the cluster. With this fix, users are instead advised to remove nodes from their cluster, better informing them of how to address the issue without breaking their clusters.

(BZ#1596050)

pcs commands no longer interactively ask for credentials

When a non-root user runs a **pcs** command that requires root permission, **pcs** connects to the locally running **pcsd** daemon and passes the command to it, since the **pcsd** daemon runs with root permissions and is capable of running the command. Previously, if the user was not authenticated to the local **pcsd** daemon, **pcs** asked for a user name and a password interactively. This was confusing to the user and required special handling in scripts running **pcs**. With this fix, if the user is not authenticated then **pcs** exits with an error advising what to do: Either run **pcs** as root or authenticate using the new **pcs client local-auth** command. As a result, **pcs** commands do not interactively ask for credentials, improving the user experience.

(BZ#1554310)

The pcsd daemon now starts with its default self-generated SSL certificate when crypto-policies is set to FUTURE.

A **crypto-policies** setting of **FUTURE** requires RSA keys in SSL certificates to be at least 3072b long. Previously, the **pcsd** daemon would not start when this policy was set since it generates SSL certificates with a 2048b key. With this update, the key size of **pcsd** self-generated SSL certificates has been increased to 3072b and **pcsd** now starts with its default self-generated SSL certificate.

(BZ#1638852)

The pcsd service now starts when the network is ready

Previously, When a user configured **pcsd** to bind to a specific IP address and the address was not ready

during boot when **pcsd** attempted to start up, then **pcsd** failed to start and a manual intervention was required to start **pcsd**. With this fix, **pcsd.service** depends on **network-online.target**. As a result, **pcsd** starts when the network is ready and is able to bind to an IP address.

(BZ#1640477)

5.7. SECURITY

SELinux policy now allows `iscsiuio` processes to connect to the discovery portal

Previously, SELinux policy was too restrictive for **iscsiuio** processes and these processes were not able to access **/dev/uio*** devices using the **mmap** system call. As a consequence, connection to the discovery portal failed. This update adds the missing rules to the SELinux policy and **iscsiuio** processes work as expected in the described scenario.

(BZ#1626446)

5.8. VIRTUALIZATION

Mounting ephemeral disks on Azure now works more reliably

Previously, mounting an ephemeral disk on a virtual machine (VM) running on the Microsoft Azure platform failed if the disk was detached from the VM shortly before. This update ensures that reconnecting disks is handled correctly in the described circumstances, which prevents the problem from occurring.

(BZ#1615599)

CHAPTER 6. TECHNOLOGY PREVIEWS

This part provides a list of all Technology Previews available in Red Hat Enterprise Linux 8.0 Beta.

For information on Red Hat scope of support for Technology Preview features, see Technology Preview Features Support Scope.

6.1. INSTALLER AND IMAGE CREATION

Custom system image creation with Composer available as a Technology Preview

The Composer tool enables users to create customized RHEL images. Composer is available in Application Stream as a Technology Preview in the **lorax-composer** package.

With Composer, users can create custom system images which include additional packages. Composer functionality can be accessed through a graphical user interface in Web Console, or with a command line interface in the **`composer-cli`** tool. Composer output formats include, among others:

- live ISO installer 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 Composer, see the chapter Building Custom System Images with Composer in the documentation title Installing Red Hat Enterprise Linux 8.

(JIRA:RHELPLAN-7291, BZ#1628645, BZ#1628646, BZ#1628647, BZ#1628648)

6.2. KERNEL

XDP available as a Technology Preview

The **eXpress Data Path (XDP)** feature, which is available as a Technology Preview, provides a means to upload Berkeley Packet Filter (BPF) programs for high performance packet processing in the kernel, making the kernel's networking data path programmable.

(BZ#1503672)

eBPF is available in RHEL 8 Beta 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 allows to create various types of maps, and also to insert various types of programs into the kernel. See the **`bpf`**(2) man page for more information.

(BZ#1559616)

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 Beta. **`BCC`** provides tools for I/O analysis, networking, and monitoring of Linux operating systems using the

extended Berkeley Packet Filtering (eBPF).

(BZ#1548302)

6.3. FILE SYSTEMS AND STORAGE

VDO logical volumes available as a Technology Preview

Creation of Virtual Data Optimizer (VDO) LVM logical volumes is available as a Technology Preview. You can now create and remove logical volumes of type VDO.

(BZ#1643553)

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.

(BZ#1649493)

NVMe/FC is available as a Technology Preview in Qlogic adapters using `qla2xxx`

The NVMe over Fibre Channel (NVMe/FC) transport type is available as a Technology Preview in Qlogic adapters using the **qla2xxx** driver.

(BZ#1649922)

6.4. HIGH AVAILABILITY AND CLUSTERS

Pacemaker `podman` bundles available as a Technology Preview

Pacemaker container bundles now run on the **podman** container platform, with the container bundle feature being available as a Technology Preview. There is one exception to this feature being Technology Preview: Red Hat fully supports the use of Pacemaker bundles for Red Hat Openstack.

(BZ#1619620)

6.5. SECURITY

SWID tag of the RHEL 8.0 Beta release

To enable identification of RHEL 8.0 Beta installations using the ISO/IEC 19770-2:2015 mechanism, a software identification (SWID) tag is installed in the **/usr/share/redhat.com/com.redhat.RHEL-8-Beta-<architecture>.swidtag** file. The XML signature of the file can be verified using the **xmlsec1 verify** command, for example:

```
xmlsec1 verify --trusted-pem
/etc/pki/swid/CA/redhat.com/redhatcodesignca.cert
/usr/share/redhat.com/com.redhat.RHEL-8-Beta-x86_64.swidtag
```

The certificate of the code signing certification authority can also be obtained from the Product Signing Keys page on the Customer Portal.

(BZ#1636338)

CHAPTER 7. CHANGES TO PACKAGES

This part provides an overview of changes to packages in Red Hat Enterprise Linux 8.

7.1. REMOVED PACKAGES

The following packages are available in Red Hat Enterprise Linux 7, but are no longer present in Red Hat Enterprise Linux 8. Some of these packages may have functionally equivalent replacements available; see Section 7.2, “Package Replacements” for details.

- a2ps
- audit-libs-python
- bridge-utils
- bltk
- breeze-icon-theme
- compat-db
- compat-expat1
- compat-glibc
- coolkey
- crash-spu-commands
- createrepo
- crypto-utils
- cryptopp
- cvs
- ebtables
- ekiga
- Electric Fence
- empathy
- epydoc
- fedfs-utils
- finger
- ghostscript-fonts
- glib-networking-tests
- gnome-contacts

- gnome-dictionary
- gnome-documents
- gnome-packagekit
- gnote
- gperftools
- gstreamer
- gstreamer-plugins-base
- hmaccalc
- ImageMagick
- jansson-devel-doc
- jruby
- jBCrypt
- kabi-yum-plugins
- kactivities
- kate4
- kde-dev-scripts
- kde-filesystem
- kde-l10n
- kde-runtime
- kdelibs
- kde-settings
- kf5
- kf5-archive
- kf5-kconfig
- kf5-kdoctools
- kf5-ki18n
- kpatch-patch
- kyua-cli
- kyua-testers

- libcgroup
- libcgroup-tools
- libdbi
- libdbi-drivers
- libesmtp
- libgnome-keyring
- libkml
- libmnl-devel
- libmnl-static
- libmcrypt
- libndp-devel
- libnet-devel
- libnl
- libnl-devel
- libnm-gtk
- libnm-gtk-devel
- libproxy-kde
- libproxy-mozjs
- libproxy-python
- libproxy-webkitgtk3
- libreoffice-kde4
- libssh2
- libteam-devel
- libunwind
- libwvstreams
- libXfont
- m2crypto
- memstomp
- mgetty

- mipv6-daemon
- mkbootdisk
- mod_auth_kerb
- mod_revocator
- MySQL-python
- netsniff-ng
- NetworkManager-glib
- NetworkManager-glib-devel
- nss_compat_ossl
- nss-pem
- ntp
- openldap-servers
- openobex
- opensaml-java
- openssl098e
- oprofile
- oxygen-fonts
- oxygen-icon-theme
- PackageKit-yum
- pam_krb5
- pam_pkcs11
- perl-Crypt-Blowfish
- perl-Crypt-RC4
- perl-Crypt-Rijndael
- perl-Data-Serializer
- perl-LDAP
- perl-Spreadsheet-ParseExcel
- perl-SQL-Translator
- phonon

- phonon-backend-gstreamer
- pm-utils
- polkit-qt
- pycryptopp
- python-backports_abc
- python-backports-functools_lru_cache
- python-backports-lzma
- python-backports-shutil_get_terminal_size
- python-backports-ssl_match_hostname
- python-cherrypy
- python-docker-py
- python-docs
- python-enum34
- python-firewall
- python-functools32
- python-kerberos
- python-krbV
- python-libteam
- python-memcached
- python-paramiko
- python-requests-kerberos
- python-subprocess32
- python-traceback2
- pywbem-twisted
- python-urlgrabber
- python-virtualenv
- qemu
- qemu-kvm-tools
- qemu-sanity-check

- qjson
- qt5-qtwebkit
- qt5-qtwebengine
- rcs
- rdate
- rdist
- rhdb-utils
- rsh
- rt
- rtcheck
- rubygem-json
- rubygem-minitest
- rubygem-net-http-persistent
- rubygem-power_assert
- rubygem-rake
- rubygem-rdoc
- rubygem-rspec2
- rubygem-test-unit
- rubygem-thor
- rubygems
- rust-rpm-macros
- rusers
- rwho
- snapper
- spice-xpi
- subversion-kde
- system-config-firewall
- system-config-firewall-base
- system-config-firewall-tui

- system-config-printer
- tcl-pgtcl
- tclx
- tcp_wrappers
- teamd-devel
- trilead-ssh2
- tunctl
- urw-fonts
- valgrind-devel
- webalizer
- wvdial
- wxGTK
- x86info
- xen
- xemacs
- ypserv
- yum-metadata-parser
- 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
- yum-plugin-protectbase
- yum-plugin-ps

- yum-plugin-rpm-warm-cache
- yum-plugin-show-leaves
- yum-plugin-upgrade-helper
- yum-plugin-verify
- yum-updateonboot

7.2. PACKAGE REPLACEMENTS

The functionality of packages available in Red Hat Enterprise Linux 7 is now provided by the following packages:

Table 7.1. Replaced packages

Removed package	Replacement	Notes
authconfig	authselect	For more details, see Chapter 4, *New features*
audit-libs-python3	python3-audit	
coolkey	opensc	
createrepo	createrepo_c	**`createrepo_c`** is also installable as **`createrepo`**
ebtables	iptables-ebtables	
Electric Fence	Valgrind	
fedfs-utils	nfs-utils	
GeoIP	libmaxminddb, geoipupdate, geolite2	For more details, see Chapter 4, *New features*
gnome-system-log	gnome-logs	
gucharmap	gnome-characters	
hmaccalc	libkcapi-hmaccalc	
jruby	ruby	
kyua-cli	kyua	
kyua-testers	kyua	

Removed package	Replacement	Notes
libproxy-mozjs	libproxy-webkitgtk4	
libproxy-python	python3-libproxy	
libproxy-webkitgtk3	libproxy-webkitgtk4	
libssh2	libssh	
mod_auth_kerb	mod_auth_gssapi	
mod_nss	mod_ssl	
mysql-connector-java	mariadb-java-client	
mysql-connector-odbc	mariadb-connector-odbc	
MySQL-python	python3-PyMySQL	
ntp	chrony	For more details, see Using the chrony suite to configure NTP
oprofile	perf	
pam_krb5	sssd	
pam_pkcs11	sssd	
PyGreSQL	python3-psycopg2	
python-backports_abc	python3's collections.abc	
python-backports-functools_lru_cache	python3's @lru_cache	
python-backports-lzma	python3's lzma	
python-backports-shutil_get_terminal_size	python3's get_terminal_size	
python-backports-ssl_match_hostname	python3's ssl.match_hostname	
python-docker-py	python-docker	
python-enum34	python3's enum	

Removed package	Replacement	Notes
python-firewall	python3-firewall	
python-functools32	python3's functools	
python-kerberos	python-gssapi	
python-krbV	python-gssapi	
python-psycopg2	python3-psycopg2	
python-requests-kerberos	python-requests-gssapi	
python-subprocess32	python3's subprocess	
python-traceback2	python3's traceback	
python-urlgrabber	python3-pycurl and librepo	
python-virtualenv	python3's venv	
qemu	qemu-kvm	
qt	qt5-qt	
rubygem-json	ruby	
rubygem-minitest	ruby	
rubygem-power_assert	ruby	
rubygem-rake	ruby	
rubygem-rdoc	ruby	
rubygem-test-unit	ruby	
rubygems	ruby	
rust-rpm-macros	rust-srpm-macros	
screen	tmux	
shotwell	gnome-photos	

Removed package	Replacement	Notes
tcp_wrappers	firewalld	**`firewalld`** does not provide all the functionality of **`tcp_wrappers`**.
xchat	hexchat	
x86info	lshw, util-linux	
yum-cron	dnf-automatic	The dnf-automatic package provides similar functionality, but not compatible with yum-cron configuration files.
yum-langpacks	dnf	Localization is now an integral part of dnf.
yum-plugin-auto-update-debug-info	dnf-plugins-core	The functionality is still installable also as yum-plugin-auto-update-debug-info.
yum-plugin-copr	dnf-plugins-core	The functionality is still installable also as yum-plugin-copr.
yum-plugin-fastestmirror	librepo	The fastest mirror is always chosen automatically.
yum-plugin-priorities	dnf	The priority option is now integral part of dnf repository configuration.
yum-plugin-remove-with-leaves	dnf	The funtionality is covered by dnf remove and dnf autoremove commands, unused dependencies are removed automatically.
yum-plugin-tmprepo	dnf	The functionality is provided by the **`--repofrompath`** option.
yum-plugin-tsflags	dnf	Setting the tsflags option is now integral part of dnf: **`--setopt=tsflags=<flags>`**.
yum-plugin-versionlock	dnf-plugin-versionlock	The functionality is still installable also as yum-plugin-versionlock.

Removed package	Replacement	Notes
yum-rhn-plugin	dnf-plugin-spacewalk	The functionality is still installable also as yum-rhn-plugin.
yum-utils	dnf-utils	The functionality is still installable also as yum-utils.

7.3. DEPRECATED PACKAGES

The following packages have been deprecated and will not be included in a future major release of Red Hat Enterprise Linux:

- custodia
- hesiod
- hostname
- libidn
- libnsl2
- net-tools
- nss_nis
- nss-pam-ldap
- sendmail
- ypserv
- ypbind
- yp-tools

CHAPTER 8. REMOVED FUNCTIONALITY

This chapter lists functionalities that were supported in RHEL 7 but are no longer available in RHEL 8.0.

8.1. 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.

8.1.1. Removed device drivers

- 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

- 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

8.1.2. Removed adapters

- The following adapters from the **`aacraid`** driver have been removed:
  - PERC 2/Si (Iguana/PERC2Si), PCI ID 0x1028:0x0001
  - PERC 3/Di (Opal/PERC3Di), PCI ID 0x1028:0x0002
  - PERC 3/Si (SlimFast/PERC3Si), PCI ID 0x1028:0x0003
  - PERC 3/Di (Iguana FlipChip/PERC3DiF), PCI ID 0x1028:0x0004
  - PERC 3/Di (Viper/PERC3DiV), PCI ID 0x1028:0x0002
  - PERC 3/Di (Lexus/PERC3DiL), PCI ID 0x1028:0x0002
  - PERC 3/Di (Jaguar/PERC3DiJ), PCI ID 0x1028:0x000a
  - PERC 3/Di (Dagger/PERC3DiD), PCI ID 0x1028:0x000a
  - PERC 3/Di (Boxster/PERC3DiB), PCI ID 0x1028:0x000a
  - catapult, PCI ID 0x9005:0x0283
  - tomcat, PCI ID 0x9005:0x0284
  - Adaptec 2120S (Crusader), PCI ID 0x9005:0x0285
  - Adaptec 2200S (Vulcan), PCI ID 0x9005:0x0285
  - Adaptec 2200S (Vulcan-2m), PCI ID 0x9005:0x0285
  - Legend S220 (Legend Crusader), PCI ID 0x9005:0x0285
  - Legend S230 (Legend Vulcan), PCI ID 0x9005:0x0285
  - Adaptec 3230S (Harrier), PCI ID 0x9005:0x0285
  - Adaptec 3240S (Tornado), PCI ID 0x9005:0x0285
  - ASR-2020ZCR SCSI PCI-X ZCR (Skyhawk), PCI ID 0x9005:0x0285
  - ASR-2025ZCR SCSI SO-DIMM PCI-X ZCR (Terminator), PCI ID 0x9005:0x0285
  - ASR-2230S + ASR-2230SLP PCI-X (Lancer), PCI ID 0x9005:0x0286
  - ASR-2130S (Lancer), PCI ID 0x9005:0x0286
  - AAR-2820SA (Intruder), PCI ID 0x9005:0x0286

- AAR-2620SA (Intruder), PCI ID 0x9005:0x0286
- AAR-2420SA (Intruder), PCI ID 0x9005:0x0286
- ICP9024RO (Lancer), PCI ID 0x9005:0x0286
- ICP9014RO (Lancer), PCI ID 0x9005:0x0286
- ICP9047MA (Lancer), PCI ID 0x9005:0x0286
- ICP9087MA (Lancer), PCI ID 0x9005:0x0286
- ICP5445AU (Hurricane44), PCI ID 0x9005:0x0286
- ICP9085LI (Marauder-X), PCI ID 0x9005:0x0285
- ICP5085BR (Marauder-E), PCI ID 0x9005:0x0285
- ICP9067MA (Intruder-6), PCI ID 0x9005:0x0286
- Themisto Jupiter Platform, PCI ID 0x9005:0x0287
- Themisto Jupiter Platform, PCI ID 0x9005:0x0200
- Callisto Jupiter Platform, PCI ID 0x9005:0x0286
- ASR-2020SA SATA PCI-X ZCR (Skyhawk), PCI ID 0x9005:0x0285
- ASR-2025SA SATA SO-DIMM PCI-X ZCR (Terminator), PCI ID 0x9005:0x0285
- AAR-2410SA PCI SATA 4ch (Jaguar II), PCI ID 0x9005:0x0285
- CERC SATA RAID 2 PCI SATA 6ch (DellCorsair), PCI ID 0x9005:0x0285
- AAR-2810SA PCI SATA 8ch (Corsair-8), PCI ID 0x9005:0x0285
- AAR-21610SA PCI SATA 16ch (Corsair-16), PCI ID 0x9005:0x0285
- ESD SO-DIMM PCI-X SATA ZCR (Prowler), PCI ID 0x9005:0x0285
- AAR-2610SA PCI SATA 6ch, PCI ID 0x9005:0x0285
- ASR-2240S (SabreExpress), PCI ID 0x9005:0x0285
- ASR-4005, PCI ID 0x9005:0x0285
- IBM 8i (AvonPark), PCI ID 0x9005:0x0285
- IBM 8i (AvonPark Lite), PCI ID 0x9005:0x0285
- IBM 8k/8k-l8 (Aurora), PCI ID 0x9005:0x0286
- IBM 8k/8k-l4 (Aurora Lite), PCI ID 0x9005:0x0286
- ASR-4000 (BlackBird), PCI ID 0x9005:0x0285
- ASR-4800SAS (Marauder-X), PCI ID 0x9005:0x0285

- ASR-4805SAS (Marauder-E), PCI ID 0x9005:0x0285
- ASR-3800 (Hurricane44), PCI ID 0x9005:0x0286
- Perc 320/DC, PCI ID 0x9005:0x0285
- Adaptec 5400S (Mustang), PCI ID 0x1011:0x0046
- Adaptec 5400S (Mustang), PCI ID 0x1011:0x0046
- Dell PERC2/QC, PCI ID 0x1011:0x0046
- HP NetRAID-4M, PCI ID 0x1011:0x0046
- Dell Catchall, PCI ID 0x9005:0x0285
- Legend Catchall, PCI ID 0x9005:0x0285
- 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 0x19a2:0700
    - BladeEngine2 Network Adapter, PCI ID 0x19a2:0211
  - BladeEngine 3 (BE3) devices

        - OneConnect TOMCAT NIC, PCI ID 0x19a2:0x0710
        - BladeEngine3 Network Adapter, PCI ID 0x19a2:0221
- 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

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

Note that other adapters from the mentioned drivers that are not listed here remain unchanged.

8.1.3. 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** and **qla2xxx** FCoE drivers. 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.

8.2. OTHER REMOVED FUNCTIONALITY

8.2.1. Cockpit

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.

(BZ#1534870)

8.2.2. Installer and image creation

Installer support for `Btrfs` has been removed in RHEL 8

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

(BZ#1533904)

8.2.3. Infrastructure services

The `ntp` package has been removed

Red Hat Enterprise Linux 7 supported two implementations of the **NTP** protocol: **ntp** and **chrony**. In Red Hat Enterpise Linux 8, only **chrony** is available.

Migration from **ntp** to **chrony** is documented in Migrating 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.

(JIRA:RHELPLAN-1842)

8.2.4. Desktop

KDE unsupported in RHEL 8

With Red Hat Enterprise Linux 8, 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.

(BZ#1581496)

8.2.5. Hardware enablement

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.

(BZ#1596240)

8.2.6. Identity Management

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.

(BZ#1570056)

`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.

(JIRA:RHELPLAN-10441)

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.

(JIRA:RHELPLAN-10444)

8.2.7. Compilers and development tools

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

(BZ#1512006)

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.

(BZ#1500481)

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.

(BZ#1538009)

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.

(BZ#1514839)

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.

(BZ#1650618)

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.

(BZ#1650675)

8.2.8. File systems and storage

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 or mount Btrfs file systems in Red Hat Enterprise Linux 8.

(BZ#1582530)

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**

(BZ#1639432)

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.

(BZ#1639512)

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.

(BZ#1643543)

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=[]** (an empty list) in the **lvm.conf** file.

(BZ#1643545)

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. Volume groups using the **lvm1** format should be converted to the **lvm2** format using the **vgconvert** command on Red Hat Enterprise Linux 7 or earlier.

(BZ#1643547)

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.

(BZ#1643549)

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**.

(BZ#1643562)

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.

(BZ#1643576)

8.2.9. Networking

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.

(BZ#1640991)

8.2.10. Security

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

(BZ#1618464)

8.2.11. Virtualization

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.

(BZ#1621817)

CHAPTER 9. DEPRECATED FUNCTIONALITY

This part provides an overview of functionality that has been deprecated in Red Hat Enterprise Linux 8.0 Beta.

Deprecated functionality continues to be supported until the end of life of Red Hat Enterprise Linux 8. Deprecated functionality will likely not be supported in future major releases of this product and is not recommended for new deployments. For the most recent list of deprecated functionality within a particular major release, refer to the latest version of release documentation.

Deprecated hardware components are not recommended for new deployments on the current or future major releases. Hardware driver updates are limited to security and critical fixes only. Red Hat recommends replacing this hardware as soon as reasonably feasible.

A package can be deprecated and not recommended for further use. Under certain circumstances, a package can be removed from a product. Product documentation then identifies more recent packages that offer functionality similar, identical, or more advanced to the one deprecated, and provides further recommendations.

9.1. COMPILERS AND DEVELOPMENT TOOLS

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.

(BZ#1533608)

9.2. NETWORKING

Network scripts are deprecated in RHEL 8

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

Note that 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 **`ifdown`** scripts link to the installed legacy network scripts.

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

(BZ#1647725)

9.3. SECURITY

DSA is deprecated in Red Hat Enterprise Linux 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. Support for DSA may be enabled by using the Crypto Policy mechanism and setting the system profile to "LEGACY". However, this mechanism might be removed completely in future releases of Red Hat Enterprise Linux.

(BZ#1646541)

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.

(BZ#1645153)

9.4. VIRTUALIZATION

Creating internal snapshots of virtual machines has been deprecated

Due to their lack of optimization and stability, internal virtual machine snapshots are now deprecated. Instead, external snapshots are recommended for use.

(BZ#1621944)

The Cirrus VGA virtual GPU type has been deprecated

With a future major update of Red Hat Enterprise Linux, the **Cirrus VGA** GPU device will no longer be supported in KVM virtual machines. Therefore, Red Hat recommends using the **stdvga**, **virtio-vga**, or **qxl** devices instead of Cirrus VGA.

(BZ#1651994)

virt-manager has been deprecated

The Virtual Machine Manager application, also known as **virt-manager**, has been deprecated. **Cockpit** is intended to become its replacement in a subsequent release. It is, therefore, recommended that you use Cockpit for managing virtualization in a GUI. However, in Red Hat Enterprise Linux 8.0, some features may only be accessible from either **virt-manager** or the command line.

(JIRA:RHELPLAN-10304)

CHAPTER 10. KNOWN ISSUES

This part describes known issues in Red Hat Enterprise Linux 8.

10.1. INSTALLER AND IMAGE CREATION

The `auth` and `authconfig` Kickstart commands require the AppStream repository

The **`authselect-compat`** package is required by the **`auth`** and **`authconfig`** Kickstart commands during installation. Without this package, the installation fails if **`auth`** or **`authconfig`** are used. However, by design, the **`authselect-compat`** package is only available in the AppStream repository.

To work around this problem, verify that the BaseOS and AppStream repositories are available to the installer or use the **`authselect`** Kickstart command during installation.

(BZ#1640697)

The `--interactive` option of the `ignoredisk` Kickstart command does not work in RHEL 8

A Red Hat Enterprise Linux 8.0 installation using the **`ignoredisk --interactive`** Kickstart command will fail with an error message. To work around this problem, remove the **`ignoredisk --interactive`** command from the Kickstart file.

(BZ#1637872)

Unable to restrict bugs to the `redhat` Bugzilla group without permission

Previously, ksc Bugzilla submissions were restricted to **`redhat`** Bugzilla group. As a consequence, an error message displayed for users who were not able to restrict bugs to this group. To work around this issue, **`redhat`** group restriction is removed. As a result, enabling report filing using Bugzilla accounts that cannot restrict bugs to this group is now successful.

(BZ#1642134)

Physical memory hotplugging does not work

Memory blocks in the movable zone occasionally cannot be reported as movable due to a race window. Consequently, the **`removable`** attribute of some memory blocks on a hot-pluggable node is set to 0 and hot removals of those hot-pluggable nodes always fail. As a result, physical memory hotplugging does not work.

(BZ#1643839)

10.2. SOFTWARE MANAGEMENT

Dependent modules can cause a rejection of `yum` module operations

Certain modules depend on other modules. Modules consist of one or more streams that can be active or inactive. Streams are active either if marked as default or if they are explicitly enabled by a user action. Maximum one stream of a particular module can be active at a given point in time.

`Yum 4` performs strict checking of package dependencies during the **`enable`** and **`disable`** module operations for all modules that have active streams. Disabling a stream can be rejected if it would break a dependent module, even if the user does not intend to make use of that module. In RHEL 8.0 Beta, the

App-cpanminus, **DBD-MySQL**, **DBD-Pg**, **DBD-SQLite**, **DBI**, **YAML**, and **freeradius** modules depend on the **perl** module. Consequently, disabling the default **perl:5.26** stream without enabling the **perl:5.24** stream is rejected due to potential broken dependencies because it causes the **perl** module to have no active streams.

In addition, the **freeradius** module depends only on the **perl:5.26** stream. Thus, when the user attempts to enable the **perl:5.24** stream, the operation is also rejected due to the broken dependency.

To work around this problem:

- Either disable modules that you do not actively use, for example:

```
yum module disable freeradius
```

- Or use the "--skip-broken" parameter to override the dependency problem. Note that once you use this parameter, you will have to keep using the parameter for all other future module operations and for all modules, otherwise the operations will be rejected with a **Modular dependency problem** error message. In addition, **Yum 4** will continue to return a harmless **Modular dependency problem** error message for all **yum** operations that not related to modules, such as the **install**, **erase**, **search** package operations.

To reset a module and its streams to the default state, use the **yum module reset** command, for example:

```
yum module reset perl
```

(BZ#1640711)

Running `yum list` under a non-root user causes YUM crash

When running the **yum list** command under a non-root user after the **libdnf** package has been updated, **YUM** can terminate unexpectedly. If you hit this bug, run **yum list** under root to resolve the problem. As a result, subsequent attempts to run **yum list** under a non-root user no longer cause **YUM** crash.

(BZ#1642458)

The `yum(8)` man page incorrectly mentions the `yum module profile` command

The **yum(8)** manual page incorrectly states that the **YUM** package management tool includes the **yum module profile** command to provide details about module profiles. However, this command is no longer available and when used, **YUM** displays an error message about an invalid command. For details about module profiles, use the new **yum module info --profile** command instead.

(BZ#1622580)

`yum-plugin-aliases` currently not available

The **yum-plugin-aliases** package, which provides the **alias** command for adding custom yum aliases, is currently not available. Consequently, it is not currently possible to use aliases.

(BZ#1647760)

`yum-plugin-changelog` currently not available

The **yum-plugin-changelog** package, which enables viewing package change logs before and after package updating, is currently not available.

(BZ#1581191)

10.3. INFRASTRUCTURE SERVICES

Tuned does not set kernel boot command line parameters

The **Tuned** tool does not support Boot Loader Specification (BLS), which is enabled by default. Consequently, **Tuned** does not set certain kernel boot command line parameters, which causes some issues, such as performance decrease or CPU cores not being isolated. To work around this problem, disable BLS and restart **Tuned**.

1. Install the *grubby* package.
2. Remove the following line from the **/etc/default/grub** file:

```
GRUB_ENABLE_BLSCFG=true
```

3. Re-generate the **grub2.cfg** file by running for non-EFI systems:

```
grub2-mkconfig -o /etc/grub2.cfg
```

```
or for EFI systems:
```

```
grub2-mkconfig -o /etc/grub2-efi.cfg
```

4. Restart **Tuned** by running:

```
systemctl restart tuned
```

As a result, **Tuned** sets the kernel boot parameters as expected.

(BZ#1576435)

10.4. SHELLS AND COMMAND-LINE TOOLS

Python binding of the net-snmp package is unavailable

The **Net-SNMP** suite of tools currently 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 currently unavailable in RHEL 8.

(BZ#1584510)

TCP connections are reset or slowed down due to ECN

Currently, Explicit Congestion Notifications (ECN) are requested also on outgoing TCP connections. ECN enabled routers to report congestion by setting a flag in an IP packet header. Consequently, some network devices can drop such packets, and TCP connection is reset or slowed down significantly.

To work around this problem, remove the following line from the **usr/lib/sysctl.d/50-default.conf** file:

```
net.ipv4.tcp_ecn = 1
```

As a result, ECN is reset to the kernel's default value, and ECN is not negotiated on outgoing TCP connections.

(BZ#1619790)

10.5. WEB SERVERS, DATABASES, DYNAMIC LANGUAGES

Database servers are not installable in parallel

The **mariadb** and **mysql** modules cannot be installed in parallel in RHEL 8.0 Beta 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.

(BZ#1566048)

Python 3 bindings for Subversion unavailable

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

(BZ#1571415)

Problems in mod_cgid logging

If the **mod_cgid** Apache httpd module is used under a threaded multi-processing module (MPM), which is the default situation in RHEL 8, the following logging problems occur:

- The **stderr** output of the CGI script is not prefixed with standard timestamp information.
- The **stderr** output of the CGI script is not correctly redirected to a log file specific to the **VirtualHost**, if configured.

(BZ#1633224)

10.6. DESKTOP

The gnome-shell-extension-desktop-icons package is only available in BuildRoot

The **gnome-shell-extension-desktop-icons** package is only available in the **BuildRoot** repository. It will be moved to the **AppStream** repository by the RHEL 8.0 GA release.

(BZ#1648863)

10.7. HARDWARE ENABLEMENT

The i40iw module does not load automatically on boot

Due to many i40e NICs not supporting iWarp and the **i40iw** module not fully supporting suspend/resume, this module is not automatically loaded by default to ensure suspend/resume works properly. To work around this problem, manually edit the **/lib/udev/rules.d/90-rdma-hw-modules.rules** file to enable automated load of **i40iw**.

Also note that if there is another RDMA device installed with a i40e device on the same machine, the non-i40e RDMA device triggers the **rdma** service, which loads all enabled RDMA stack modules, including the **i40iw** module.

(BZ#1623712)

Clevis does not work with `tpm2-tools`

The **tpm2-tools** packages in version 3.1.0 contain a new unified environment variable to configure the TPM (Trusted Platform Module) command transmission interface (TCTI) - **TPM2TOOLS_ENV_TCTI**. This variable does not offer backward compatibility with the legacy **TPM2TOOLS_*** environment variables. Consequently, applications that use the environment variables, such as the **Clevis** policy decryption framework, do not work.

To work around this problem, use the **-T** option to configure the TCTI module and parameters. As a result, **tpm2-tools** can be used after the administrator uses the described workaround, however, **Clevis** automated unlocking of encrypted volumes with a TPM2 device does not work at this time.

(BZ#1648001)

10.8. IDENTITY MANAGEMENT

The KCM credential cache is not suitable for a large number of credentials in a single credential cache

If the credential cache contains too many credentials, Kerberos operations, such as **kinit**, fail due to a hardcoded limit on the buffer used to transfer data between the **sssd-kcm** component and the underlying database.

To work around this problem, add the **ccache_storage = memory** option in the **kcm** section of the **/etc/sssd/sssd.conf** file. This instructs the **kcm** responder to only store the credential caches in-memory, not persistently. Note that if you do this, restarting the system or **sssd-kcm** clears the credential caches.

(BZ#1448094)

SSSD only runs as root

Due to packaging errors, the System Security Services Daemon (SSSD) does not start if it is configured to run as a non-root user, with the **user** parameter set to **sssd** in the **[sssd]** section of the **/etc/sssd/sssd.conf** file.

(BZ#1578014)

Conflicting timeout values prevent SSSD from connecting to servers

Some of the default timeout values related to the failover operations used by the System Security Services Daemon (SSSD) are conflicting. Consequently, the timeout value reserved for SSSD to talk to a single server prevents SSSD from trying other servers before the connecting operation as a whole time out. To work around the problem, set the value of the **ldap_opt_timeout** timeout parameter higher

than the value of the **dns_resolver_timeout** parameter, and set the value of the **dns_resolver_timeout** parameter higher than the value of the **dns_resolver_op_timeout** parameter.

(BZ#1382750)

Using a smart card to log into the IdM web UI does not work

When a user attempts to log in to the Identity Management (IdM) web UI using a certificate stored on their smart card, the System Security Services Daemon (SSSD) D-Bus interface code uses an incorrect callback to look the user up. Consequently, the lookup crashes. To work around the problem, use other methods of authentication.

(BZ#1642508)

10.9. COMPILERS AND DEVELOPMENT TOOLS

Synthetic functions generated by GCC confuse SystemTap

GCC optimization can generate synthetic functions for partially inlined copies of other functions. Tools such as SystemTap and GDB can not distinguish these synthetic functions from real functions. As a consequence, SystemTap can place probes on both synthetic and real function entry points, and thus register multiple probe hits for a single real function call.

To work around this problem, SystemTap scripts must be adapted with measures such as detecting recursion and suppressing probes related to inlined partial functions. For example, a script

```
probe kernel.function("can_nice").call { }
```

can try to avoid the described problem as follows:

```
global in_can_nice%

probe kernel.function("can_nice").call {
  in_can_nice[tid()] ++;
  if (in_can_nice[tid()] > 1) { next }
  /* code for real probe handler */
}

probe kernel.function("can_nice").return {
  in_can_nice[tid()] --;
}
```

Note that this example script does not take into account all possible scenarios, such as missed kprobes or kretprobes, or genuine intended recursion.

(BZ#1169184)

Time zone data for the Europe/Volgograd zone not yet updated

Due to the timing of the upstream release, the tzdata package has not yet been updated to reflect the recent changes for Morocco, Volgograd, Fiji, and parts of Chili. These updates will be part of a future release.

(BZ#1641393)

Time zone data with new upstream default data format

The RHEL 8.0 Beta release provides a version of the **tzdata-2018e** package that supports the new default upstream data format, including negative DST offsets. As a consequence, future upstream data format changes could break tools that process the **tzdata** files.

A future update of **tzdata** will revert back to the traditional (rearguard) format to prevent the described problem.

(BZ#1583794)

The `ltrace` tool does not report function calls

Because of improvements to binary hardening applied to all RHEL components, the **ltrace** tool can no longer detect function calls in binary files coming from RHEL components. As a consequence, **ltrace** output is empty because it does not report any detected calls when used on such binary files. There is no workaround currently available.

As a note, **ltrace** can correctly report calls in custom binary files built without the respective hardening flags.

(BZ#1618748, BZ#1655368)

10.10. FILE SYSTEMS AND STORAGE

The I/O performance of Qlogic HBAs might be degraded

Direct I/O write performance with Qlogic Host Bus Adapters (HBAs) might be inferior compared to Red Hat Enterprise Linux 7. This might affect workloads in a Storage Area Network (SAN) environment.

(BZ#1615896)

The system does not boot from FCoE SAN

Red Hat Enterprise Linux 8 currently cannot boot from Storage Area Network (SAN) with supported Fibre Channel over Ethernet (FCoE) adapters. This is caused by the Blivet storage configuration tool, which lacks revised FCoE support in Red Hat Enterprise Linux 8.0 Beta.

Red Hat recommends that you defer the testing of boot from SAN with FCoE in Beta until Blivet is updated.

For more information about changes in FCoE, see Chapter 8, *Removed functionality*.

(BZ#1575953)

Unable to discover an iSCSI target using the`iscsiuio` package

Red Hat Enterprise Linux 8 does not allow concurrent access to PCI register areas. As a consequence, a **could not set host net params (err 29)** error was set and the connection to the discovery portal failed. To work around this problem, set the kernel parameter **iomem=relaxed** in the kernel command line for the iSCSI offload. This specifically involves any offload using the **bnx2i** driver. As a result, connection to the discovery portal is now successful and **iscsiuio** package now works correctly.

(BZ#1626629)

The system sometimes becomes unresponsive when many devices are connected

When Red Hat Enterprise Linux 8 configures a large number of devices, a large number of console

messages occurs on the system console. This happens, for example, when there are a large number of logical unit numbers (LUNs), with multiple paths to each LUN. The flood of console messages, in addition to other work the kernel is doing, might cause the kernel watchdog to force a kernel panic because the kernel appears to be hung.

Because the scan happens early in the boot cycle, the system becomes unresponsive when many devices are connected. This typically occurs at boot time.

If **kdump** is enabled on your machine during the device scan event after boot, the hard lockup results in a capture of a **vmcore** image.

To work around this problem, increase the watchdog lockup timer. To do so, add the **watchdog_thresh=*N*** option to the kernel command line. Replace ***N*** with the number of seconds:

- If you have less than a thousand devices, use **30**.
- If you have more than a thousand devices, use **60**.

For storage, the number of device is the number of paths to all the LUNs: generally, the number of **/dev/sd*** devices.

After applying the workaround, the system no longer becomes unresponsive when configuring a large amount of devices.

(BZ#1598448)

10.11. SECURITY

Libreswan is terminated unexpectedly with a segmentation fault when loading large ike= configurations

Libreswan handling of large default **ike=** proposals as defined inside the system-wide crypto policy contains a memory allocation error that causes the parser to crash.

To work around this problem, remove the line starting with the **ike=** string from the **/etc/crypto-policies/back-ends/libreswan.config** file.

(BZ#1645137)

OpenSCAP rpmverifypackage does not work correctly

The **chdir** and **chroot** system calls are called twice by the **rpmverifypackage** probe. Consequently, an error occurs when the probe is utilized during an **OpenSCAP** scan with custom Open Vulnerability and Assessment Language (OVAL) content.

To work around this problem, do not use the **rpmverifypackage_test** OVAL test in your content or use only the content from the **scap-security-guide** package where **rpmverifypackage_test** is not used.

(BZ#1646197)

libssh does not comply with the system-wide crypto policy

The **libssh** library does not follow system-wide cryptographic policy settings. As a consequence, the set of supported algorithms is not changed when the administrator changes the crypto policies level using the **update-crypto-policies** command.

To work around this problem, the set of advertised algorithms needs to be set individually by every application that uses **libssh**. As a result, when the system is set to the LEGACY or FUTURE policy level, applications that use **libssh** behave inconsistently when compared to **OpenSSH**.

(BZ#1646563)

SCAP Workbench fails to generate results-based remediations from tailored profiles

The following error occurs when trying to generate results-based remediation roles from a customized profile using the **SCAP Workbench** tool:

```
Error generating remediation role .../remediation.sh: Exit code of oscap
was 1: [output truncated]
```

To work around this problem, use the **oscap** command with the **--tailoring-file** option.

(BZ#1640715)

SCAP Security Guide PCI-DSS profile aligns with version 3.1

The **SCAP Security Guide** project provides the PCI-DSS (Payment Card Industry Data Security Standard) profile for Red Hat Enterprise Linux 8. However, this profile adheres to PCI-DSS version 3.1, and it has not been updated to align with the latest PCI-DSS version 3.2.1.

(BZ#1618528)

OpenSCAP `rpmverifyfile` does not work

The **OpenSCAP** scanner does not correctly change the current working directory in offline mode, and the **fchdir** function is not called with the correct arguments in the **OpenSCAP** **rpmverifyfile** probe. Consequently, scanning arbitrary file systems using the **oscap-chroot** command fails if **rpmverifyfile_test** is used in an SCAP content. As a result, **oscap-chroot** aborts in the described scenario.

(BZ#1636431)

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 RHEL8 at the moment.

(BZ#1642373)

Audit remote logging does not work with SELinux in enforcing mode.

SELinux prevents the **/sbin/audisp-remote** remote logging client to read local **Audit** events from the relevant socket. Consequently, the remote logging process is terminated unexpectedly.

To work around this problem, use the **semodule -i** command to load a custom policy module, which contains the following rule:

```
( allow audisp_remote_t auditd_t ( unix_stream_socket ( read )))
```

As a result, without the described workaround, the **Audit** remote logging does not work with SELinux in enforcing mode.

(BZ#1639675)

10.12. SUBSCRIPTION MANAGEMENT

Repositories are not enabled as expected

Systems that have successfully registered with Satellite or the Red Hat Customer Portal may experience unexpected behavior when trying to access content from repositories that have been enabled in addition to the default BaseOS and AppStream repositories, for example, the High Availability (HA) and Core Ready Builder (CRB) repositories. As a workaround, see Enabling Repositories in Red Hat Enterprise Linux 8 Beta for more information.

(BZ#1649825)

10.13. VIRTUALIZATION

Virtual machines can access any network services reachable by the host

As of the RHEL 8 Beta release, the newly implemented **nftables** backend for **firewalld** has not been fully integrated into the **libvirt** library. As a consequence, KVM virtual machines that use libvirt-managed virtual networks have access to all network services that are listening on the host, which may be a security concern.

(BZ#1638864)

Glusterfs storage does not work with virtual machines

Due to incompatibility with the **libvirt** API, glusterfs storage currently cannot be used for KVM virtual machines in Red Hat Enterprise Linux 8.

(BZ#1599339)

`virt-v2v` and `virt-p2v` do not work on IBM POWER, IBM Z, and the 64-bit ARM architecture

The **`virt-v2v`** and **`virt-p2v`** utilities are currently only supported on the AMD64 and Intel 64 architecture, also known as x86_64. On other architectures, including IBM Z, IBM POWER, and 64-bit ARM, **`virt-v2v`** and **`virt-p2v`** do not work correctly.

(BZ#1621850)

10.14. SUPPORTABILITY

redhat-support-tool not available in RHEL 8 Beta

The **redhat-support-tool** utility is not included in Red Hat Enterprise Linux (RHEL) 8 Beta.

(BZ#1647187)

10.15. SATELLITE AND RED HAT NETWORK CLIENT TOOLS

The `rhn-tools` default profile cannot be installed

Modular metadata for rhn-tools module are currently incorrect. Consequently, the "yum module install rhn-tools" command fails due to incorrect modular metadata. To work around this problem, individual

packages from the module can be installed using the regular "yum install" package operation, just like in previous RHEL releases.

(BZ#1643064)

CHAPTER 11. NOTABLE CHANGES TO CONTAINERS

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

- 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.

  For **podman** documentation, see Using podman to work with containers.

- The **RHSCL**, **DTS**, and **DotNet** container images are not provided in RHEL 8 Beta.

- 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-tools`** container does not contain the **strace** and **tcpdump** packages. The description label in Beta, which states that **strace** and **tcpdump** are present, is incorrect.

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

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

- On RHEL 7 systems, you can not build container images using the Beta version of the RHEL 8 image.

- On RHEL 7 systems, you can not update the Beta version of the RHEL 8 image.

APPENDIX A. MODULES AVAILABLE IN RHEL 8.0 BETA

RHEL 8.0 Beta is distributed with the following modules and streams in the AppStream repository:

Module	Streams	Default stream
389-ds	1.4	-
ant	1.10	1.10
App-cpanminus	1.7044	1.7044
container-tools	1.0	1.0
DBD-MySQL	4.046	4.046
DBD-Pg	3.7	3.7
DBD-SQLite	1.58	1.58
DBI	1.641	1.641
freeradius	3.0	3.0
gimp	2.8	2.8
go-toolset	rhel8	rhel8
httpd	2.4	2.4
idm	client, DL1	client
inkscape	0.92.3	0.92.3
javapackages-runtime	201801	201801
llvm-toolset	rhel8	rhel8
mailman	2.1	2.1
mariadb	10.3	10.3
maven	3.5	3.5
mercurial	4.6	4.6
mod_auth_openidc	2.3	-

Module	Streams	Default stream
mod_perl	2.0.10	2.0.10
mysql	8.0	8.0
nginx	1.14	1.14
nodejs	10, 8	10
parfait	0.5	-
perl	5.26, 5.24	5.26
php	7.2, 7.1	7.2
pki-core	10.6	-
pki-deps	10.6	-
postgresql	10, 9.6	10
python27	2.7	2.7
python36	3.6	3.6
redis	4.0	4.0
rhn-tools	1.0	1.0
ruby	2.5	2.5
rust-toolset	rhel8	rhel8
satellite-5-client	1.0	1.0
scala	2.10	2.10
sos-collector	rhel8	rhel8
squid	4	4
subversion	1.10	1.10
swig	3.0	3.0
varnish	6	6

Module	Streams	Default stream
virt	rhel	rhel
YAML	1.24	1.24

APPENDIX B. PACKAGES IN BASEOS

The following packages are available in the BaseOS repository:

- ModemManager
- ModemManager-glib
- NetworkManager
- NetworkManager-adsl
- NetworkManager-bluetooth
- NetworkManager-config-connectivity-redhat
- NetworkManager-config-server
- NetworkManager-dispatcher-routing-rules
- NetworkManager-libnm
- NetworkManager-ovs
- NetworkManager-ppp
- NetworkManager-team
- NetworkManager-tui
- NetworkManager-wifi
- NetworkManager-wwan
- OpenIPMI
- OpenIPMI-lanserv
- OpenIPMI-libs
- OpenIPMI-perl
- aajohan-comfortaa-fonts
- acl
- acpica-tools
- adcli
- adcli-doc
- arpwatch
- at
- atlas

- atlas-corei2
- atlas-corei2-devel
- atlas-devel
- attr
- audispd-plugins
- audispd-plugins-zos
- audit
- audit-libs
- audit-libs-devel
- augeas
- augeas-libs
- authselect
- authselect-libs
- autofs
- avahi
- avahi-autoipd
- avahi-glib
- avahi-gobject
- avahi-libs
- basesystem
- bash
- bash-completion
- bash-doc
- bc
- bind-export-devel
- bind-export-libs
- binutils
- biosdevname
- blktrace

- bluez
- bluez-hid2hci
- bluez-libs
- bluez-obexd
- bolt
- boom-boot
- boom-boot-conf
- boom-boot-grub2
- bpftool
- brotli
- bsdtar
- bubblewrap
- bzip2
- bzip2-devel
- bzip2-libs
- c-ares
- c-ares-devel
- ca-certificates
- cachefilesd
- checkpolicy
- chkconfig
- chrony
- chrpath
- cifs-utils
- cockpit
- cockpit-bridge
- cockpit-doc
- cockpit-system
- cockpit-ws

- compat-openssl10
- conntrack-tools
- coreutils
- coreutils-common
- coreutils-single
- cpio
- cracklib
- cracklib-dicts
- crda
- cronie
- cronie-anacron
- cronie-noanacron
- crontabs
- crypto-policies
- cryptsetup
- cryptsetup-libs
- cryptsetup-reencrypt
- ctdb
- ctdb-tests
- cups-libs
- curl
- cyrus-sasl
- cyrus-sasl-devel
- cyrus-sasl-gs2
- cyrus-sasl-gssapi
- cyrus-sasl-ldap
- cyrus-sasl-lib
- cyrus-sasl-md5
- cyrus-sasl-ntlm

- cyrus-sasl-plain
- cyrus-sasl-scram
- daxctl
- daxctl-libs
- dbus
- dbus-common
- dbus-daemon
- dbus-glib
- dbus-libs
- dbus-tools
- dbxtool
- dejavu-fonts-common
- dejavu-sans-fonts
- dejavu-sans-mono-fonts
- dejavu-serif-fonts
- device-mapper
- device-mapper-event
- device-mapper-event-libs
- device-mapper-libs
- device-mapper-multipath
- device-mapper-multipath-libs
- device-mapper-persistent-data
- dhcp-client
- dhcp-common
- dhcp-libs
- dhcp-relay
- dhcp-server
- diffutils
- dmidecode

- dnf
- dnf-automatic
- dnf-data
- dnf-plugin-subscription-manager
- dnf-plugins-core
- dnf-utils
- dos2unix
- dosfstools
- dracut
- dracut-caps
- dracut-config-generic
- dracut-config-rescue
- dracut-live
- dracut-network
- dracut-squash
- dracut-tools
- dump
- dvd+rw-tools
- e2fsprogs
- e2fsprogs-devel
- e2fsprogs-libs
- ed
- efi-filesystem
- efibootmgr
- efivar
- efivar-libs
- elfutils
- elfutils-default-yama-scope
- elfutils-devel

- elfutils-libelf
- elfutils-libelf-devel
- elfutils-libs
- emacs-filesystem
- environment-modules
- ethtool
- expat
- expat-devel
- expect
- fcoe-utils
- file
- file-libs
- filesystem
- findutils
- fipscheck
- fipscheck-lib
- firewalld
- firewalld-filesystem
- fontconfig
- fontconfig-devel
- fontpackages-filesystem
- freeipmi
- freeipmi-bmc-watchdog
- freeipmi-ipmidetectd
- freeipmi-ipmiseld
- freetype
- freetype-devel
- fuse
- fuse-common

- fuse-devel
- fuse-libs
- fuse3
- fuse3-devel
- fuse3-libs
- fwupd
- fwupdate
- fwupdate-efi
- fwupdate-libs
- fxload
- gamin
- gawk
- gdbm
- gdbm-devel
- gdbm-libs
- gdisk
- gdk-pixbuf2
- genisoimage
- genwqe-tools
- genwqe-vpd
- genwqe-zlib
- genwqe-zlib-devel
- gettext
- gettext-common-devel
- gettext-devel
- gettext-libs
- gfs2-utils
- glib-networking
- glib2

- glib2-devel
- glib2-fam
- glib2-tests
- glibc
- glibc-all-langpacks
- glibc-common
- glibc-devel
- glibc-headers
- 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
- glusterfs
- glusterfs-client-xlators
- glusterfs-fuse
- glusterfs-libs
- glusterfs-rdma
- gmp
- gmp-c++
- gmp-devel
- gnupg2
- gnupg2-smime
- gnutls
- gobject-introspection
- gpgme
- gpgmepp
- grep
- groff-base
- grub2-common
- grub2-efi-aa64-modules
- grub2-efi-ia32
- grub2-efi-ia32-cdboot
- grub2-efi-ia32-modules
- grub2-efi-x64
- grub2-efi-x64-cdboot
- grub2-efi-x64-modules
- grub2-pc
- grub2-pc-modules

- grub2-ppc64le-modules
- grub2-tools
- grub2-tools-efi
- grub2-tools-extra
- grub2-tools-minimal
- grubby
- gsettings-desktop-schemas
- gssproxy
- gzip
- hardlink
- hdparm
- hesiod
- hostname
- hwdata
- hwloc
- hwloc-libs
- ibacm
- icu
- ima-evm-utils
- infiniband-diags
- info
- initscripts
- intel-cmt-cat
- iotop
- ipcalc
- iproute
- iproute-tc
- iprutils
- ipset

- ipset-libs
- ipset-service
- iptables
- iptables-devel
- iptables-ebtables
- iptables-libs
- iptables-services
- iptables-utils
- iptraf-ng
- iptstate
- iputils
- iputils-ninfod
- irqbalance
- iscsi-initiator-utils
- iscsi-initiator-utils-iscsiuio
- isns-utils
- isns-utils-devel
- isns-utils-libs
- iw
- iwl100-firmware
- iwl105-firmware
- iwl135-firmware
- iwl1000-firmware
- iwl2000-firmware
- iwl2030-firmware
- iwl3160-firmware
- iwl3945-firmware
- iwl4965-firmware
- iwl5000-firmware

- iwl5150-firmware
- iwl6000-firmware
- iwl6000g2a-firmware
- iwl6000g2b-firmware
- iwl6050-firmware
- iwl7260-firmware
- iwpmd
- jansson
- jimtcl
- json-c
- json-glib
- kabi-dw
- kbd
- kbd-legacy
- kbd-misc
- kernel
- kernel-abi-whitelists
- kernel-core
- kernel-cross-headers
- kernel-debug
- kernel-debug-core
- kernel-debug-devel
- kernel-debug-modules
- kernel-debug-modules-extra
- kernel-devel
- kernel-headers
- kernel-modules
- kernel-modules-extra
- kernel-tools

- kernel-tools-libs
- kexec-tools
- keyutils
- keyutils-libs
- keyutils-libs-devel
- kmod
- kmod-kvdo
- kmod-libs
- kpartx
- kpatch
- krb5-devel
- krb5-libs
- krb5-pkinit
- krb5-server
- krb5-server-ldap
- krb5-workstation
- ksc
- ldb-tools
- ledmon
- less
- libacl
- libacl-devel
- libaio
- libaio-devel
- libappstream-glib
- libarchive
- libasan
- libassuan
- libatomic

- libatomic-static
- libattr
- libattr-devel
- libbasicobjects
- libblkid
- libblkid-devel
- libcap
- libcap-devel
- libcap-ng
- libcap-ng-devel
- libcap-ng-utils
- libcgroup
- libcgroup-pam
- libcgroup-tools
- libcollection
- libcom_err
- libcom_err-devel
- libcomps
- libcomps-devel
- libconfig
- libcroco
- libcurl
- libcurl-devel
- libcurl-minimal
- libdaemon
- libdb
- libdb-utils
- libdhash
- libdmmp

- libdnf
- libedit
- liberation-fonts
- liberation-fonts-common
- liberation-mono-fonts
- liberation-narrow-fonts
- liberation-sans-fonts
- liberation-serif-fonts
- libertas-sd8686-firmware
- libertas-sd8787-firmware
- libertas-usb8388-firmware
- libertas-usb8388-olpc-firmware
- libevent
- libevent-doc
- libfabric
- libfdisk
- libfdisk-devel
- libffi
- libffi-devel
- libgcab1
- libgcc
- libgcrypt
- libgcrypt-devel
- libgfortran
- libgomp
- libgomp-offload-nvptx
- libgpg-error
- libgpg-error-devel
- libgudev

- libgusb
- libhbaapi
- libhbalinux
- libhbalinux-devel
- libhugetlbfs
- libhugetlbfs-devel
- libhugetlbfs-utils
- libibumad
- libibverbs
- libibverbs-utils
- libical
- libicu
- libicu-devel
- libicu-doc
- libidn
- libidn2
- libini_config
- libipa_hbac
- libitm
- libjpeg-turbo
- libjpeg-turbo-devel
- libkadm5
- libkcapi
- libkcapi-hmaccalc
- libkeepalive
- libksba
- libldb
- libldb-devel
- libmbim

- libmbim-utils
- libmetalink
- libmicrohttpd
- libmnl
- libmodman
- libmodulemd
- libmount
- libndp
- libnetfilter_conntrack
- libnetfilter_cthelper
- libnetfilter_cttimeout
- libnetfilter_queue
- libnfnetlink
- libnfsidmap
- libnftnl
- libnghttp2
- libnl3
- libnl3-cli
- libnl3-devel
- libnl3-doc
- libnsl
- libnsl2
- libpath_utils
- libpcap
- libpciaccess
- libpeas
- libpfm
- libpfm-devel
- libpipeline

- libpkgconf
- libpng
- libpng-devel
- libproxy
- libpsl
- libpsm2
- libpsm2-compat
- libpwquality
- libqb
- libqb-devel
- libqmi
- libqmi-utils
- libquadmath
- librabbitmq
- librdmacm
- librdmacm-utils
- libref_array
- librepo
- libreport-filesystem
- librhsm
- libseccomp
- libsecret
- libsecret-devel
- libselinux
- libselinux-devel
- libselinux-utils
- libsemanage
- libsepol
- libsepol-devel

- libsigsegv
- libsmartcols
- libsmartcols-devel
- libsmbclient
- libsmbios
- libsolv
- libsoup
- libss
- libssh
- libsss_autofs
- libsss_certmap
- libsss_idmap
- libsss_nss_idmap
- libsss_simpleifp
- libsss_sudo
- libstdc++
- libstdc++-devel
- libstemmer
- libstoragemgmt
- libstoragemgmt-arcconf-plugin
- libstoragemgmt-hpsa-plugin
- libstoragemgmt-local-plugin
- libstoragemgmt-megaraid-plugin
- libstoragemgmt-netapp-plugin
- libstoragemgmt-nfs-plugin
- libstoragemgmt-nfs-plugin-clibs
- libstoragemgmt-nstor-plugin
- libstoragemgmt-smis-plugin
- libstoragemgmt-udev

- libsysfs
- libtalloc
- libtalloc-devel
- libtasn1
- libtdb
- libtdb-devel
- libteam
- libteam-doc
- libtevent
- libtevent-devel
- libtirpc
- libtirpc-devel
- libtool-ltdl
- libtsan
- libubsan
- libunistring
- libusal
- libusb
- libusbx
- libusbx-devel
- libusbx-devel-doc
- libuser
- libutempter
- libuuid
- libuuid-devel
- libvarlink
- libverto
- libverto-devel
- libverto-libevent

- libwbclient
- libxcrypt
- libxcrypt-devel
- libxml2
- libxslt
- libyaml
- linux-firmware
- lksctp-tools
- lksctp-tools-devel
- lksctp-tools-doc
- lldpad
- lm_sensors
- lm_sensors-devel
- lm_sensors-libs
- lockdev
- logrotate
- logwatch
- lrzsz
- lshw-B.02.18
- lsof
- lsscsi
- lua-libs
- lvm2
- lvm2-dbusd
- lvm2-libs
- lz4
- lz4-devel
- lz4-libs
- lzo

- lzo-devel
- lzo-minilzo
- lzop
- m4
- mailcap
- mailx
- make
- make-devel
- man-db
- man-db-cron
- man-pages
- 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
- mcelog
- mcstrans
- mdadm
- memtest86+
- microcode_ctl
- microdnf
- minicom
- mksh

- mlocate
- mobile-broadband-provider-info
- mokutil
- mozjs52
- mpfr
- mtools
- mtr
- nano
- ncurses
- ncurses-base
- ncurses-c++-libs
- ncurses-compat-libs
- ncurses-devel
- ncurses-libs
- ncurses-term
- ndctl
- ndctl-libs
- net-snmp-libs
- net-tools
- netconsole-service
- netlabel_tools
- nettle
- nettle-devel
- network-scripts
- newt
- nfs-utils
- nfs4-acl-tools
- nftables
- npth

- nscd
- nss_db
- nss_nis
- ntsysv
- numactl
- numactl-devel
- numactl-libs
- numad
- nvme-cli
- nvmetcli
- opa-address-resolution
- opa-basic-tools
- opa-fastfabric
- opa-fm
- opa-libopamgt
- opencryptoki
- opencryptoki-icsftok
- opencryptoki-libs
- opencryptoki-swtok
- opencryptoki-tpmtok
- openhpi
- openhpi-libs
- openldap
- openldap-clients
- openldap-devel
- opensc
- opensm
- opensm-libs
- openssh

- openssh-cavs
- openssh-clients
- openssh-keycat
- openssh-ldap
- openssh-server
- openssl
- openssl-devel
- openssl-ibmpkcs11
- openssl-libs
- openssl-perl
- openssl-pkcs11
- os-prober
- p11-kit
- p11-kit-devel
- p11-kit-server
- p11-kit-trust
- pam
- pam-devel
- pam_cifscreds
- pam_ssh_agent_auth
- papi
- papi-devel
- papi-libs
- parted
- passwd
- patch
- pciutils
- pciutils-devel
- pciutils-libs

- pcre
- pcre-cpp
- pcre-devel
- pcre-utf16
- pcre-utf32
- pcre2
- pcre2-devel
- pcre2-utf16
- pcre2-utf32
- pcsc-lite
- pcsc-lite-ccid
- pcsc-lite-doc
- pcsc-lite-libs
- perf
- perftest
- perl-Carp
- perl-DBD-SQLite
- perl-DBI
- perl-Data-Dumper
- perl-Date-Manip
- perl-Encode
- perl-Errno
- perl-Exporter
- perl-File-Path
- perl-File-Temp
- perl-Getopt-Long
- perl-HTTP-Tiny
- perl-IO
- perl-MIME-Base64

- perl-Math-BigInt
- perl-Math-Complex
- perl-Parse-Yapp
- perl-PathTools
- perl-Pod-Escapes
- perl-Pod-Perldoc
- perl-Pod-Simple
- perl-Pod-Usage
- perl-Scalar-List-Utils
- perl-Socket
- perl-Storable
- perl-Sys-CPU
- perl-Sys-MemInfo
- perl-Term-ANSIColor
- perl-Term-Cap
- perl-Text-ParseWords
- perl-Text-Tabs+Wrap
- perl-Time-Local
- perl-Unicode-Normalize
- perl-constant
- perl-interpreter
- perl-libs
- perl-macros
- perl-parent
- perl-podlators
- perl-threads
- perl-threads-shared
- pigz
- pkgconf

- pkgconf-m4
- pkgconf-pkg-config
- platform-python
- policycoreutils
- policycoreutils-dbus
- policycoreutils-devel
- policycoreutils-newrole
- policycoreutils-python-utils
- policycoreutils-restorecond
- polkit
- polkit-devel
- polkit-docs
- polkit-libs
- polkit-pkla-compat
- popt
- popt-devel
- portreserve
- postfix
- ppp
- prefixdevname
- procps-ng
- procps-ng-i18n
- ps_mem
- psacct
- psmisc
- publicsuffix-list
- publicsuffix-list-dafsa
- python3-IPy
- python3-asn1crypto

- python3-audit
- python3-avahi
- python3-boom
- python3-cffi
- python3-chardet
- python3-configobj
- python3-configshell
- python3-cryptography
- python3-dateutil
- python3-dbus
- python3-decorator
- python3-dmidecode
- python3-dnf
- python3-dnf-plugin-versionlock
- python3-dnf-plugins-core
- python3-dns
- python3-ethtool
- python3-firewall
- python3-gobject-base
- python3-gpg
- python3-hawkey
- python3-idna
- python3-iniparse
- python3-inotify
- python3-iscsi-initiator-utils
- python3-jwt
- python3-kmod
- python3-ldb
- python3-libcomps

- python3-libdnf
- python3-libipa_hbac
- python3-libnl3
- python3-libproxy
- python3-librepo
- python3-libs
- python3-libselinux
- python3-libsemanage
- python3-libsss_nss_idmap
- python3-libstoragemgmt
- python3-libstoragemgmt-clibs
- python3-libuser
- python3-libxml2
- python3-linux-procfs
- python3-magic
- python3-oauthlib
- python3-openipmi
- python3-perf
- python3-pip
- python3-ply
- python3-policycoreutils
- python3-pwquality
- python3-pyOpenSSL
- python3-pycparser
- python3-pyparsing
- python3-pysocks
- python3-pyudev
- python3-pywbem
- python3-pyyaml

- python3-requests
- python3-requests-oauthlib
- python3-rpm
- python3-rtslib
- python3-samba
- python3-samba-test
- python3-schedutils
- python3-setools
- python3-setuptools
- python3-six
- python3-slip
- python3-slip-dbus
- python3-sss
- python3-sss-murmur
- python3-sssdconfig
- python3-subscription-manager-rhsm
- python3-syspurpose
- python3-talloc
- python3-tdb
- python3-test
- python3-tevent
- python3-urllib3
- python3-urwid
- python3-varlink
- quota
- quota-doc
- quota-nld
- quota-nls
- quota-rpc

- quota-warnquota
- rasdaemon
- rdma-core
- rdma-core-devel
- readline
- readline-devel
- readonly-root
- realmd
- redhat-indexhtml
- redhat-logos
- redhat-logos-httpd
- redhat-release
- rmt
- rng-tools
- rootfiles
- rpcbind
- rpm
- rpm-apidocs
- rpm-build-libs
- rpm-cron
- rpm-devel
- rpm-libs
- rpm-plugin-ima
- rpm-plugin-prioreset
- rpm-plugin-selinux
- rpm-plugin-syslog
- rpm-plugin-systemd-inhibit
- rpm-sign
- rsync

- rsync-daemon
- samba
- samba-client
- samba-client-libs
- samba-common
- samba-common-libs
- samba-common-tools
- samba-dc-libs
- samba-krb5-printing
- samba-libs
- samba-pidl
- samba-test
- samba-test-libs
- samba-winbind
- samba-winbind-clients
- samba-winbind-krb5-locator
- samba-winbind-modules
- sed
- selinux-policy
- selinux-policy-devel
- selinux-policy-doc
- selinux-policy-minimum
- selinux-policy-mls
- selinux-policy-sandbox
- selinux-policy-targeted
- setools-console
- setserial
- setup
- sg3_utils

- sg3_utils-libs
- sgml-common
- sgpio
- shadow-utils
- shared-mime-info
- shim-ia32
- shim-x64
- slang
- smartmontools
- smc-tools
- snappy
- sos
- sos-audit
- spax
- sqlite
- sqlite-devel
- sqlite-doc
- sqlite-libs
- squashfs-tools
- srp_daemon
- sssd
- sssd-ad
- sssd-client
- sssd-common
- sssd-common-pac
- sssd-dbus
- sssd-ipa
- sssd-kcm
- sssd-krb5

- sssd-krb5-common
- sssd-ldap
- sssd-libwbclient
- sssd-nfs-idmap
- sssd-proxy
- sssd-tools
- sssd-winbind-idmap
- star
- strace
- stunnel
- subscription-manager
- subscription-manager-cockpit
- subscription-manager-plugin-container
- subscription-manager-plugin-ostree
- subscription-manager-rhsm-certificates
- sudo
- symlinks
- syslinux
- syslinux-extlinux
- syslinux-extlinux-nonlinux
- syslinux-nonlinux
- syslinux-tftpboot
- system-storage-manager
- systemd
- systemd-container
- systemd-devel
- systemd-journal-remote
- systemd-libs
- systemd-pam

- systemd-tests
- systemd-udev
- tar
- target-restore
- tboot
- tcl
- tcl-devel
- tcl-doc
- tdb-tools
- teamd
- time
- timedatex
- tmpwatch
- tmux
- tpm-quote-tools
- tpm-tools
- tpm-tools-pkcs11
- tpm2-abrmd
- tpm2-abrmd-selinux
- tpm2-tools
- tpm2-tss
- tpm2-tss-devel
- trace-cmd
- traceroute
- tree
- trousers
- trousers-lib
- tuna
- tuned

- tuned-profiles-atomic
- tuned-profiles-compat
- tuned-profiles-cpu-partitioning
- tuned-profiles-mssql
- tuned-profiles-oracle
- tuned-profiles-sap
- tuned-profiles-sap-hana
- tzdata
- units
- unzip
- usb_modeswitch
- usb_modeswitch-data
- usbutils
- usermode
- userspace-rcu
- util-linux
- util-linux-user
- uuidd
- vdo
- veritysetup
- vim-minimal
- virt-what
- vm-dump-metrics
- vm-dump-metrics-devel
- watchdog
- which
- words
- wpa_supplicant
- x3270

- x3270-text
- xdelta
- xfsdump
- xfsprogs
- xfsprogs-devel
- xml-common
- xmlrpc-c
- xmlrpc-c-client
- xz
- xz-devel
- xz-libs
- yum
- zip
- zlib
- zlib-devel
- zsh

APPENDIX C. PACKAGES IN APPSTREAM

The following packages are available in the AppStream repository:

- 389-ds-base
- 389-ds-base-devel
- 389-ds-base-legacy-tools
- 389-ds-base-libs
- 389-ds-base-snmp
- CUnit
- GConf2
- Judy
- LibRaw
- NetworkManager-libreswan
- NetworkManager-libreswan-gnome
- OpenEXR-libs
- PackageKit
- PackageKit-command-not-found
- PackageKit-cron
- PackageKit-glib
- PackageKit-gstreamer-plugin
- PackageKit-gtk3-module
- SDL
- SDL-devel
- WALinuxAgent
- Xaw3d
- abattis-cantarell-fonts
- abrt
- abrt-addon-ccpp
- abrt-addon-coredump-helper
- abrt-addon-kerneloops

- abrt-addon-pstoreoops
- abrt-addon-vmcore
- abrt-addon-xorg
- abrt-cli
- abrt-cli-ng
- abrt-console-notification
- abrt-dbus
- abrt-desktop
- abrt-gui
- abrt-gui-libs
- abrt-java-connector
- abrt-libs
- abrt-plugin-machine-id
- abrt-plugin-sosreport
- abrt-tui
- accountsservice
- accountsservice-libs
- acpid
- acpid-sysvinit
- adobe-mappings-cmap
- adobe-mappings-cmap-deprecated
- adobe-mappings-pdf
- adwaita-cursor-theme
- adwaita-gtk2-theme
- adwaita-icon-theme
- adwaita-qt
- aide
- alsa-firmware
- alsa-lib

- alsa-lib-devel
- alsa-plugins-arcamav
- alsa-plugins-maemo
- alsa-plugins-oss
- alsa-plugins-pulseaudio
- alsa-plugins-samplerate
- alsa-plugins-speex
- alsa-plugins-upmix
- alsa-plugins-usbstream
- alsa-plugins-vdownmix
- alsa-tools-firmware
- alsa-ucm
- alsa-utils
- alsa-utils-alsabat
- amanda
- amanda-client
- amanda-libs
- amanda-server
- anaconda
- anaconda-core
- anaconda-dracut
- anaconda-gui
- anaconda-install-env-deps
- anaconda-tui
- anaconda-user-help
- anaconda-widgets
- annobin
- ant
- ant-lib

- aopalliance
- apache-commons-cli
- apache-commons-codec
- apache-commons-collections
- apache-commons-collections-javadoc
- apache-commons-collections-testframework
- apache-commons-io
- apache-commons-lang
- apache-commons-lang-javadoc
- apache-commons-lang3
- apache-commons-logging
- apcu-panel
- appstream-data
- apr
- apr-devel
- apr-util
- apr-util-bdb
- apr-util-devel
- apr-util-ldap
- apr-util-mysql
- apr-util-odbc
- apr-util-openssl
- apr-util-pgsql
- apr-util-sqlite
- asciidoc
- aspell
- aspell-en
- at-spi2-atk
- at-spi2-atk-devel

- at-spi2-core
- at-spi2-core-devel
- atinject
- atk
- atk-devel
- atkmm
- authselect-compat
- autoconf
- autocorr-af
- autocorr-bg
- autocorr-ca
- autocorr-cs
- autocorr-da
- autocorr-de
- autocorr-en
- autocorr-es
- autocorr-fa
- autocorr-fi
- autocorr-fr
- autocorr-ga
- autocorr-hr
- autocorr-hu
- autocorr-is
- autocorr-it
- autocorr-ja
- autocorr-ko
- autocorr-lb
- autocorr-lt
- autocorr-mn

- autocorr-nl
- autocorr-pl
- autocorr-pt
- autocorr-ro
- autocorr-ru
- autocorr-sk
- autocorr-sl
- autocorr-sr
- autocorr-sv
- autocorr-tr
- autocorr-vi
- autocorr-zh
- autogen-libopts
- automake
- avahi-ui-gtk3
- babel
- babl
- bacula-client
- bacula-common
- bacula-console
- bacula-director
- bacula-libs
- bacula-libs-sql
- bacula-logwatch
- bacula-storage
- baobab
- bcc
- bcc-tools
- bea-stax

- bea-stax-api
- bea-stax-javadoc
- bind
- bind-chroot
- bind-devel
- bind-dyndb-ldap
- bind-libs
- bind-libs-lite
- bind-license
- bind-lite-devel
- bind-pkcs11
- bind-pkcs11-devel
- bind-pkcs11-libs
- bind-pkcs11-utils
- bind-sdb
- bind-sdb-chroot
- bind-utils
- binutils-devel
- bison
- bison-runtime
- bitmap-console-fonts
- bitmap-fangsongti-fonts
- bitmap-fixed-fonts
- bitmap-fonts-compat
- bitmap-lucida-typewriter-fonts
- blas
- blas64
- blivet-data
- bluez-cups

- bogofilter
- boost
- boost-atomic
- boost-chrono
- boost-container
- boost-context
- boost-coroutine
- boost-date-time
- boost-devel
- boost-fiber
- boost-filesystem
- boost-graph
- boost-iostreams
- boost-locale
- boost-log
- boost-math
- boost-program-options
- boost-random
- boost-regex
- boost-serialization
- boost-signals
- boost-stacktrace
- boost-system
- boost-test
- boost-thread
- boost-timer
- boost-type_erasure
- boost-wave
- bpg-algeti-fonts

- bpg-chveulebrivi-fonts
- bpg-classic-fonts
- bpg-courier-fonts
- bpg-courier-s-fonts
- bpg-dedaena-block-fonts
- bpg-dejavu-sans-fonts
- bpg-elite-fonts
- bpg-excelsior-caps-fonts
- bpg-excelsior-condenced-fonts
- bpg-excelsior-fonts
- bpg-fonts-common
- bpg-glaho-fonts
- bpg-gorda-fonts
- bpg-ingiri-fonts
- bpg-irubaqidze-fonts
- bpg-mikhail-stephan-fonts
- bpg-mrgvlovani-caps-fonts
- bpg-mrgvlovani-fonts
- bpg-nateli-caps-fonts
- bpg-nateli-condenced-fonts
- bpg-nateli-fonts
- bpg-nino-medium-cond-fonts
- bpg-nino-medium-fonts
- bpg-sans-fonts
- bpg-sans-medium-fonts
- bpg-sans-modern-fonts
- bpg-sans-regular-fonts
- bpg-serif-fonts
- bpg-serif-modern-fonts

- bpg-ucnobi-fonts
- brasero
- brasero-libs
- brasero-nautilus
- brlapi
- brlapi-java
- brltty
- brltty-at-spi2
- brltty-docs
- brltty-espeak-ng
- brltty-xw
- buildah
- byacc
- byteman
- byteman-javadoc
- c2esp
- cairo
- cairo-devel
- cairo-gobject
- cairo-gobject-devel
- cairomm
- cargo
- cargo-doc
- cargo-vendor
- cdi-api
- cdparanoia
- cdparanoia-libs
- cdrdao
- celt051

- certmonger
- check
- check-devel
- cheese
- cheese-libs
- cim-schema
- cjose
- cjose-devel
- clang
- clang-analyzer
- clang-devel
- clang-libs
- clang-tools-extra
- cldr-emoji-annotation
- clevis
- clevis-dracut
- clevis-luks
- clevis-systemd
- clevis-udisks2
- cloud-init
- cloud-utils-growpart
- clucene-contribs-lib
- clucene-core
- clutter
- clutter-gst2
- clutter-gst3
- clutter-gtk
- cmake
- cmake-data

- cmake-doc
- cmake-filesystem
- cmake-gui
- cmake-rpm-macros
- cockpit
- cockpit-composer
- cockpit-dashboard
- cockpit-machines
- cockpit-machines-ovirt
- cockpit-packagekit
- cockpit-pcp
- cockpit-session-recording
- cockpit-storaged
- cockpit-tests
- cogl
- color-filesystem
- colord
- colord-gtk
- colord-libs
- compat-libgfortran
- compat-libpthread-nonshared
- compat-locales-sap
- compiler-rt
- composer-cli
- container-exception-logger
- container-selinux
- container-storage-setup
- containernetworking-plugins
- containers-common

- convmv
- copy-jdk-configs
- cpp
- crash
- crash-gcore-command
- crash-ptdump-command
- crash-trace-command
- createrepo_c
- createrepo_c-devel
- createrepo_c-libs
- criu
- cryptsetup-devel
- cscope
- ctags
- culmus-aharoni-clm-fonts
- culmus-caladings-clm-fonts
- culmus-david-clm-fonts
- culmus-drugulin-clm-fonts
- culmus-ellinia-clm-fonts
- culmus-fonts-common
- culmus-frank-ruehl-clm-fonts
- culmus-hadasim-clm-fonts
- culmus-keteryg-fonts
- culmus-miriam-clm-fonts
- culmus-miriam-mono-clm-fonts
- culmus-nachlieli-clm-fonts
- culmus-shofar-fonts
- culmus-simple-clm-fonts
- culmus-stamashkenaz-clm-fonts

- culmus-stamsefarad-clm-fonts
- culmus-yehuda-clm-fonts
- cups
- cups-client
- cups-devel
- cups-filesystem
- cups-filters
- cups-filters-libs
- cups-ipptool
- cups-lpd
- cups-pk-helper
- custodia
- cyrus-imapd
- cyrus-imapd-utils
- cyrus-imapd-vzic
- cyrus-sasl-sql
- daxio
- dbus-devel
- dbus-glib-devel
- dbus-x11
- dconf
- dconf-editor
- dcraw
- desktop-file-utils
- devhelp
- devhelp-libs
- dialog
- diffstat
- dleyna-connector-dbus

- dleyna-core
- dleyna-renderer
- dleyna-server
- dlm-lib
- dnf-plugin-spacewalk
- dnsmasq
- dnsmasq-utils
- dnssec-trigger
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