Oracle Linux 9
Release Notes for Oracle Linux 9

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Preface

Oracle Linux 9: Release Notes for Oracle Linux 9 provides information about the new features and known issues in the Oracle Linux 9 release. The information applies to both x86_64 and 64-bit Arm (aarch64) architectures. This document might be updated after it is released.

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

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For information about the accessibility of the Oracle Help Center, see the Oracle Accessibility Conformance Report at https://www.oracle.com/corporate/accessibility/templates/t2-11535.html.

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Diversity and Inclusion

Oracle is fully committed to diversity and inclusion. Oracle respects and values having a diverse workforce that increases thought leadership and innovation. As part of our initiative to build a more inclusive culture that positively impacts our employees,

customers, and partners, we are working to remove insensitive terms from our products and documentation. We are also mindful of the necessity to maintain compatibility with our customers' existing technologies and the need to ensure continuity of service as Oracle's offerings and industry standards evolve. Because of these technical constraints, our effort to remove insensitive terms is ongoing and will take time and external cooperation.

1
About Oracle Linux 9

The current Oracle Linux 9 release contains new features and enhancements that improve performance in different areas including automation and management, security and compliance, container management, and developer tools. These enhancements are especially designed to make the OS adaptable to different types of deployment such as on-premises installations, hybrid deployments that combine on-premises and cloud installations, and full cloud deployment.

> **⚠ Important:**
>
> Upgrading from an Oracle Linux Developer Preview release to its later official version is not supported. If you are running the Developer Preview version, you must reinstall the official Oracle Linux release upon its general availability.

System Requirements and Limitations

To determine whether a specific hardware is supported on the current Oracle Linux 9 release, check the Hardware Certification List at https://linux.oracle.com/hardware-certifications. Note that as hardware becomes available and validated, the hardware is added to the list.

CPU, memory, disk and file system limits for all Oracle Linux releases are described in Oracle Linux: Limits.

Available Architectures

The release is available for installation on the following platforms:

- Intel® 64-bit (x86_64) (x86-64-v2)
- AMD 64-bit (x86_64) (x86-64-v2)
- 64-bit Arm (aarch64) (Arm v8.0-A)

    The aarch64 platform is supported with Unbreakable Enterprise Kernel (UEK), which currently is the only kernel that is supported on this platform.

Shipped Kernels

For the x86_64 platform, Oracle Linux 9 ships with the following default kernel packages:

- `kernel-5.14.0-70.13.1.el9_0` (Red Hat Compatible Kernel (RHCK))
- `kernel-uek-5.15.0-0.30.19.el9uek` (Unbreakable Enterprise Kernel Release 7 (UEK R7))

    For new installations, the UEK kernel is automatically enabled and installed. It also becomes the default kernel on first boot.

For the aarch64 platform, Oracle Linux ships with the UEK kernel only.

The Oracle Linux release is tested as a bundle, as shipped on the installation media image. When installed from the installation media image, the kernel's version included in the image is the minimum version that is supported. Downgrading kernel packages is not supported, unless recommended by Oracle Support.

About the Unbreakable Enterprise Kernel

The Unbreakable Enterprise Kernel (UEK) is a Linux kernel built by Oracle and supported through Oracle Linux support. UEK is tested on Arm (aarch64), Intel® x86, and AMD x86 (x86_64) platforms. Each release contains additional features, bug fixes, and updated drivers to provide support for key functional requirements, improve performance, and optimize the kernel for use on Oracle products such as Oracle's Engineered Systems, Oracle Cloud Infrastructure, and large enterprise deployments for Oracle customers.

Typically, a UEK release contains changes to the kernel ABI relative to a previous UEK release. These changes require recompilation of third-party kernel modules on the system. To minimize impact on interoperability during releases, the Oracle Linux team works closely with third-party vendors regarding hardware and software that have dependencies on kernel modules. Thus, before installing the latest UEK release, verify its support status with your application vendor.

The kernel ABI for a UEK release remains unchanged in all subsequent updates to the initial release.

The kernel source code for UEK is available after the initial release through a public git source code repository at https://github.com/oracle/linux-uek.

For more information about UEK such as tutorials, notices, and release notes of different UEK versions, go to Unbreakable Enterprise Kernel documentation.

User Space Compatibility

Oracle Linux maintains user space compatibility with Red Hat Enterprise Linux (Oracle Linux) that is independent of the kernel version that underlies the operating system. Existing applications in user space continue to run unmodified on UEK R7 with no required recertifications for Oracle Linux certified applications.

Obtaining Installation Images

The following installation images for the current Oracle Linux 9 release are available:

- Full ISO of Oracle Linux for typical on-premises installations
- Boot ISO of Oracle Linux for network installations
- Boot ISO of the supported UEK release for installing on hardware that is supported only on UEK
- Source DVDs

You can download these images from the following locations. Note that the images in these locations are for both the x86_64 and aarch64 platforms, unless indicated otherwise:

- Oracle Software Delivery Cloud at https://edelivery.oracle.com

- Oracle Linux yum server at https://yum.oracle.com/oracle-linux-downloads.html

  For more information managing and updating software on Oracle Linux systems, see Oracle Linux: Managing Software on Oracle Linux.

To prepare a downloaded image for installing Oracle Linux, see Oracle Linux 9: Installing Oracle Linux.

> **Note:**
>
> Aside from installation ISOs, you can also use Oracle Linux images to create compute instances on Oracle Cloud Infrastructure. For information about these images, see the release notes for the specific image that you are using on the *Oracle Cloud Infrastructure Documentation* page.
>
> To use Oracle Linux on Oracle Cloud Infrastructure, see https://docs.oracle.com/iaas/oracle-linux/home.htm.

For information about the available ISOs for the three most recent updates to the Oracle Linux releases, refer to https://yum.oracle.com/oracle-linux-isos.html.

For developers who use the Raspberry Pi hardware platform, Oracle provides an unsupported developer release image, which includes the required firmware to boot this platform. For more information about using the Raspberry Pi hardware platform, see Install Oracle Linux on a Raspberry Pi.

Upgrading From Previous Oracle Linux Releases

You can upgrade an Oracle Linux 8 system to the Oracle Linux 9 release by using the `leapp` utility.

For step-by-step instructions, as well as information about any known issues that you might encounter when upgrading the system, see Oracle Linux 9: Performing System Upgrades With Leapp.

2
New Features and Changes

Unless indicated otherwise, the following new features, major enhancements, bug fixes, and other changes that are introduced in this release of Oracle Linux 9 apply to both the x86_64 and 64-bit Arm (aarch64) platforms.

Installation

The following installation features and changes are introduced in Oracle Linux 9:

- **Graphical installation program activates the network automatically during interactive installations**

  In the interactive installation mode that uses the graphical user interface, the network is automatically enabled. Manually activating the network is no longer required.

  Note that this change does not impact the kickstart installations and installations that use the `ip=` boot option.

- **Licensing and user setting configuration screens no longer part of post installation**

  Initial setup screens for licensing and for configuring users that previously appeared as post installation steps are now disabled. To restore these screens, run the following commands which install and enable the relevant packages, and then reboot the system. The initial setup screens appear when the boot up system is completed.

  ```
  sudo dnf install initial-setup initial-setup-gui -y
  systemctl enable initial setup
  reboot
  ```

  For kickstart installations, add and enable these packages as follows:

  ```
  firstboot --enable
  %packages
  @^graphical-server-environment
  initial-setup-gui
  %end
  ```

- **Root account is locked by default**

  As an added security feature, the root account in an Oracle Linux 9 installation is locked by default. However, the installation program provides options for you to enable SSH root logins with appropriately set passwords during the installation. For instructions, see Oracle Linux 9: Installing Oracle Linux.

- **Kickstart changes have been implemented**

  The following changes in Oracle Linux 9 affect how you configure automatic installations that use kickstart:

  – All boot options must use the `inst` prefix; otherwise, those options are ignored. Add the prefix to previously configured standalone options to maintain their functionality.

  – The new `timesource` command replaces the previous `timezone --ntpservers` command, which has been deprecated.

    – The following kickstart commands and options are removed and generate errors if used:

        * `device`

        * `deviceprobe`

        * `dmraid`

        * `install`

          Instead, use the subcommands or methods directly as commands.

        * `multipath`

        * `bootloader --upgrade`

        * `ignoredisk --interactive`

        * `partition --active`

        * `harddrive --biospart`

        * `autostep`

• **Changes to boot options implemented**

The following changes were applied to some boot options:

    – `inst.zram` and `inst.singlelang` options are not supported in Oracle Linux 9.

    – `inst.loglevel` is always set to debug. Other log levels in previous Oracle Linux releases have been removed.

Kernel

The following notable features, enhancements, and changes apply to the Red Hat Compatible Kernel (RHCK) that is shipped with Oracle Linux 9.

• **RHCK kernel is signed with trusted Secure Boot certificates**

This feature eliminates the need to enroll a separate public key to use the kernel versions on systems that have UEFI Secure Boot enabled. Previous releases required you to enroll a separate public key by using the Machine Owner Key (MOK) facility.

• **cgroup-v2 enabled by default**

Version 2 of the control groups (`cgroup-v2`) is enabled together with version 1 (`cgroup-v1`).

`cgroup-v2` implements a single hierarchy model to simplify the management of control groups. The model ensures that a process can only be a member of a single control group at a time. The feature is integrated with `systemd` and improves resource control configuration on an Oracle Linux system.

Note that feature incompatibilities exist between `cgroup-v2` and `cgroup-v1`. Moreover, control interfaces are different between the two versions. Consequently, third-party software that has a direct dependency on `cgroup-v1` might not run properly in the `cgroup-v2` environment.

While both versions are enabled in the kernel, no default control group version is set in the kernel. Instead, the version that mounts at startup is determined by `systemd`.

To use `cgroup-v1`, add the following parameters to the kernel command line:

```
systemd.unified_cgroup_hierarchy=0
systemd.legacy_systemd_cgroup_controller
```

- **Kernel changes might affect third-party kernel modules**

  Linux distributions with a kernel version prior to 5.9 included support for exporting GPL functions as non-GPL functions. This support enabled users to link proprietary functions to GPL kernel functions by using the `shim` mechanism. In this release, upstream changes have been incorporated into the kernel that enable Oracle Linux to enforce GPL more strictly. Accordingly, `shim` is now rebuffed.

  > **Important:**
  >
  > Partners and independent software vendors (ISVs) should test their kernel modules with an early version of Oracle Linux 9 to ensure compliance with GPL.

- **Fixes to strace utility implemented**

  In this release, the `strace` utility correctly displays SELinux context mismatches through the extension of the utilities `--secontext` option. This extension is the `mismatch` parameter. See the following example:

```
[...]
$ strace --secontext=full,mismatch -e statx stat /home/user/file
statx(AT_FDCWD, "/home/user/file" [system_u:object_r:user_home_t:s0!!
unconfined_u:object_r:user_home_t:s0], ...

$ strace --secontext=mismatch -e statx stat /home/user/file
statx(AT_FDCWD, "/home/user/file" [user_home_t:s0], ...
```

- **perf-top capable of sorting by a specific column**

  The `perf-top` system profiling tool can sort samples by an arbitrary event column instead of just the first column when multiple events in the group are sampled. Samples are sorted through the `--group-sort-idx` option, where you press a number key to sort the table by the data column that corresponds to that key. Column numbering starts from `0`.

- **New jigawatts package added**

  The new `jigawatts` package includes a Java library that works to improve the functionality of the Checkpoint/Restore in Userspace (CRIU) utility specifically on Java applications.

- **trace-cmd reset behavior change implemented**

  Instead of disabling, `trace-cmd reset` now resets settings of the `ftrace` framework to their default values. This behavior specifically affects `tracing_on`, `trace_clock`, `set_event_pid`, and `tracing_max_latency`.

- **Support for Extended Berkeley Packet Filter**

  The Extended Berkeley Packet Filter (eBPF) is an in-kernel virtual machine that enables code execution in the kernel space in a restricted sandbox environment with access to a limited set of functions. The virtual machine executes a special assembly-like code.

- **crash utility 8.0.0**

This version of the utility has a new `offset` parameter in the `add-symbol-file` command that helps to set the `kaslr-offset` to `gdb`. The parameter also upgrades `gdb-7.6` to `gdb-10.2`.

- **Changes implemented on makedumpfile utility**

  The following enhancements and improvements are in the utility:

  – **Support for the Zstandard compression capability**

    The utility is thus able to take advantage of `zstd`'s high compression ratios which improve compression efficiency especially in large memory systems. The improved compression mechanism creates a smaller `vmcore` file within a reasonable compression time.

  – **New options improve ways to obtain an estimate of the vmcore size**

    The following options can be used with the `makedump` command:

    * `--dry-run` performs all operations specified by the command without writing the output file.

    * `--show-stats` prints the report messages. This option is an alternative to enabling bit 4 that is provided to the `--message-level` option.

      The following shows an example in the use of these options:

      ```
      sudo makedumpfile --dry-run --show-stats -l --message-level 7 -d 31 /
      proc/kcore dump.dummy
      ```

- **numatop utility for Intel Xeon scalable processors supported**

  `numatop` monitors and analyzes threads and processes running on Numa systems. It uses Intel performance counter sampling technologies and associates the performance data with Linux system `runtime` information for better analysis of Numa systems deployed in production.

- **New crashkernel.default file for kdump memory allocation**

  In the `kexec-tools` package, the new `crashkernel.default` file for `kdump` contains a default crash kernel value for the corresponding kernel build. `kdump` uses the value to control the default crash kernel memory value of each kernel.

  `crashkernel.default` serves as a good reference for `kdump` memory reservation. By basing on this value, you can configure the desired setting for `crashkernel=`. Consequently, memory allocation for `kdump` is improved for systems that have less than 4 GB of available memory.

  To query the default crashkernel value, type:

  ```
  sudo kdumpctl get-default-crashkernel
  ```

  For more details, refer to the `/usr/share/doc/kexec-tools/crashkernel-howto.txt` file.

- **Core scheduling functionality added**

  The core scheduling functionality enables you to define groups of tasks that can share a CPU core, and thereby exclude tasks that should not trust each other from sharing the same resource. This feature enhances security by mitigating some cross-Symmetric Multithreading (SMT) attacks. It also isolates tasks that need a whole core, such as those that are performed in real-time environments or those that rely on specific processor features, such as Single Instruction, Multiple Data (SIMD) processing.

- **CPU hot-plug in the hv_24x7 and hv_gpci PMUs**

  PMU counters can correctly react to the hot plugging of a CPU, such that if an `hv_gpci` event counter is running on a CPU that becomes disabled, the counting redirects to another CPU.

- **IRDMA driver added**

  The IRDMA driver enables RDMA functionality on the following RDMA-capable Intel network devices:

  - Ethernet Network Adapter X722: an Internet Wide-area RDMA Protocol (iWARP) device.

    This device supports only iWARP and a more limited set of configuration parameters.

  - Ethernet Controller E810: a device that supports iWARP and RDMA over Converged Ethernet (RoCEv2)

    This device iWARP and RoCEv2 RDMA transports, Priority Flow Control (PFC), and Explicit Congestion Notification (ECN).

  The IRDMA module replaces as well as extends the Application Binary Interface (ABI) defined for the legacy i40iw module for X722. The change is backward compatible with legacy X722 RDMA-Core provider (`libi40iw`).

- **An aarch64 platforms only:**

  - **Default page size on Arm platform has changed to 4 KB**

    Based on UEK R7 implementation, the default page size on the 64-bit Arm platform has changed from 64 KB to 4 KB. This new size pairs well with the workloads and memory amounts that exist on the majority of Arm-based systems. To use large page sizes efficiently, ensure that you specify the huge pages option, which addresses a greater amount of memory for workloads with large data sets.

  - **kexec_file_load is enabled by default**

    For systems using the 64-bit Arm architecture, the added `kexec_file_load` system call provides an in-kernel `kexec` loader for `kdump` which enables an unsigned kernel to work correctly. Prior to this update, an unsigned kernel failed to load with secure boot enabled and `kexec_file_load()` specified.

  - **Armv8-R architecture is supported**

    The architecture is supported through the `-march=armv8-r` option of the improved GCC 11.2.1

Software Management

The following software management features and enhancements are introduced in Oracle Linux 9:

- **RPM updated to version 4.16**

  The updated version includes notable changes such as the following:

  - Support for new SPEC features such as caret version operator, `%autopatch` for specifying patch ranges, meta or unordered dependencies, generation of dynamic build dependencies through the `%generate_buildrequires` section, and so on.

  - RPM is fully based on the sqlite library. For Berkeley DB databases, Read-only support is provided.

- – `rpm-audit-plugin` is a new plugin for recording audit log events on transactions.

- – Validation of UTF-8 headers is performed at build time.

- – Increased parallelism is applied in package builds.

- **New RPM plugin notifies fapolicyd about changes during RPM transactions**

  Updated `rpm` packages include a new RPM plugin that integrates the `fapolicyd` framework with the RPM database. By informing `fapolicyd` about any installed and changed files during an RPM transaction, the plugin enables `fapolicyd` to support integrity checking. The plugin's functionality extends its coverage beyond just Yum transactions to changes made by RPM as a whole. Thus, the plugin is effectively a replacement to the Yum plugin.

- **Support for signing keys using EdDSA public key algorithm added to the rpm command**

  This added support to the `rpm` command enables you to use EdDSA-generated keys for signing and verifying packages. However, RSA continues to be the default public key algorithm in GnuPG.

- **RPM supports Zstd algorithm**

  RPM supports the Zstandard (`zstd`) compression algorithm, which makes package installations faster, especially in large transactions. Oracle Linux 9 uses Zstandard as the default compression algorithm.

- **New options available for DNF**

  The following are new DNF options:

  - – `exclude_from_weak_autodetect` automatically detects unwanted weak dependencies of packages being installed. Thus, providers of the weak dependencies are not installed as weak dependencies. However, if pulled in, these weak dependencies are installed as regular dependencies. The option is enabled by default.

  - – `exclude_from_weak` prevents the installation of packages as weak dependencies.

- **libmodulemd packages updated to version 2.13.0**

  This version of `libmodulemd` packages includes the following features and changes:

  - – Support for delisting demodularized packages from a module.

  - – Support for validating `modulemd-packager-v3` documents by using `modulemd-validator --type`, where `--type` is a new option.

  - – Fortified parsing integers.

Shells and Command-Line Tools

The following shells and command-line tools features and improvements are introduced in Oracle Linux 9:

- **`bashreadline` library version 8.1 is supported**

  In this library, bracketed paste mode is enabled by default. This mode causes text that you paste on your terminal to be highlighted and requires you to press Enter

to execute the command in the text. This feature prevents you from executing malicious commands.

To disable the feature, add the following line to either `~/.inputrc` or `/etc/inputrc`:

```
set enable-bracketed-paste off
```

- If added to `~/.inputrc`, the feature is disabled for a specific user.

- If added to `/etc/inputrc`, the feature is disabled for all users.

Disabling the feature causes pasted commands on the terminal to be immediately executed.

- Additional shell related packages are available with updated versions

    - `opal-prd 6.7.1`

    - `lvspd 1.7.12`

    - `Fetchmail 6.4.24`

    - `Eigen 3.4`

- **New cdrskin package is introduced**

    The package replaces the `cdrecord` executable. However, the `cdrskin` package includes the `cdrecord` command as a symbolic link to the `cdrskin` binary so that existing user scripts need not be revised.

- **util-linux-core added as a package**

    The `util-linux-core` is added as a subpackage to the `util-linux` package to manage scenarios where the size of installed package is a critical issue, such as in buildroots, some containers, and boot images.

    However, for standard installations, install the `util-linux` package, which automatically includes the `util-linux-core` package.

Compilers and Development Tools

Oracle Linux 9 introduces the following features, enhancements, and changes to compilers and development toolsets.

Summary list of tools and compilers and their latest versions

- System toolchain components

    - GCC 11.2.1

    - glibc 2.34

    - binutils 2.35.2

- Performance tools and debuggers

    - GDB 10.2

    - Valgrind 3.18.1

    - SystemTap 4.6

    - Dyninst 11.0.0

    - elfutils 0.186

- Performance monitoring tools
  - PCP 5.3.5
  - Grafana 7.5.11
- Compiler toolsets
  - LLVM Toolset 13.0.1
  - Rust Toolset 1.58.1
  - Go Toolset 1.17.7
- `python-jsonpointer` is rebased to version 2.0
- `grafana-pcp` is rebased to 3.2.0

Selected Feature Descriptions

The following are brief descriptions of some of the tools and compilers:

- **GCC 11.2**

  This version includes notable changes such as the following:

  - DWARF Version 5 is used as the default debugging format.
  - Diagnostics column numbers represent real column numbers by default and recognizes multicolumn numbers.
  - The straight-line code vectorizer considers the whole function when vectorizing.
  - A series of conditional expressions that compare the same variable can be transformed into a switch statement if each of them contains a comparison expression.
  - Procedural optimizations have been implemented through a new IPS-modref pass which tracks side effects of function calls and improves the precision of points-to analysis, and the identical code folding pass, which is improved to increase the number of unified functions and reduce compile-time memory use.
  - Memory allocation during linking is improved to reduce peak memory use.
  - Through the new `GCC_EXTRA_DIAGNOSTIC_OUTPUT` environment variable in IDEs, you can request machine-readable "fix-it-hints" without adjusting build flags.

- **Go Toolset 1.17.7**

  This version includes notable changes such as the following:

  - The `GO111MODULE` environment variable is set to `on` by default. To revert this setting, set the variable to `auto`.
  - The Go linker uses less resources and improves code robustness and maintainability in all supported CPU architectures and operating systems.
  - The new `embed` package enables you to access embedded files while compiling.
  - All functions of the `io/ioutil` package have been moved to the `io` and `os` packages, both of which provide better definitions.

- The Delve debugger 1.6.0 supports Go Toolset 1.16.6.

- **Go FIPS mode is supported with OpenSSL 3**

  With this support, you can use the OpenSSL library while on Go FIPS mode.

- **Rust Toolset updated to version 1.54.0**

  This version includes notable changes such as the following:

  - The Rust standard library is available for the `wasm32-unknown-unknown` target and enables you to generate WebAssembly binaries, including newly stabilized intrinsics.

  - You can use constant-value parameters to define generics. This change enables you to write functions completely generic over the values of any integer, boolean, or character type, and arrays generic over their element type as well as their length. Additionally, you can also iterate items from an array by value by using the new standard library's array type API `std::array::IntoIter`.

  - Rust includes the `IntoIterator` implementation for arrays. Use the `IntoIterator` trait to iterate over arrays by value and pass arrays to methods. However, `array.into_iter()` still iterates values by reference until the 2021 edition of Rust.

  - The syntax for `or` patterns allows nesting anywhere in the pattern, for example: `Pattern(1|2)` instead of `Pattern(1)|Pattern(2)`.

  - Unicode identifiers can contain all valid identifier characters as defined in the Unicode Standard Annex #31.

  - Methods and trait implementations have been stabilized.

- **LLVM Toolset updated to version 12.0.1**

  This version includes notable changes such as the following:

  - New compiler flag `-march=x86-64-v[234]` introduced.

  - Compiler flag `-fasynchronous-unwind-tables` of the `clang` compiler is the default on Oracle Linux aarch64 systems in this release.

  - The `clang` compiler supports the C++20 `[[likely]]` and `[[unlikely]]` attributes.

  - With the newly added function attribute `tune-cpu`, microarchitectural optimizations can be applied independently from the `target-cpu` attribute or TargetMachine CPU.

  - The `-fsanitize=unsigned-shift-base` sanitizer is added to the integer sanitizer `-fsanitizer=integer` to improve security.

  - The WebAssembly backend is now enabled in LLVM. when enables you to generate WebAssembly binaries with LLVM and Clang.

- **CMake updated to version 3.20.2**

  This version includes notable changes such as the following:

  - C++ compiler modes can be specified through the target properties `CXX_STANDARD`, `CUDA_STANDARD`, and `OBJCXX_STANDARD` or, alternatively, the `cxx_std_23` metafeature of the compile features section.

  - The NVIDIA CUDA compiler as a symbolic link is supported.

  - The Intel oneAPI NextGen LLVM compilers are supported with the `IntelLLVM` compiler ID.

  - CMake now facilitates cross compiling for Android by merging with the Android NDK's toolchain file.

- When generating a project build system, the `cmake` command rejects unknown arguments that start with a hyphen.

  To use CMake on projects that require this or an earlier version, use the command `cmake_minimum_required (version 3.20.2)`.

- **Java in Oracle Linux 9**

  In this release, Java includes the following packages:

  - `java-17-openjdk`

  - `java-11-openjdk`

  - `java-1.8.0-openjdk`

- **Java tools implementation**

  In this release, Java tools include the following:

  - `Maven 6.3.6`

  - `Ant 1.10.9`

  You can install these tools as non-modular RPM packages from AppStream.

- **SWIG 4.0 is available in CodeReady Builder repository**

  Version 4.0 of Simplified Wrapper and Interface Generator (SWIG), which includes support for PHP 8, can be installed as an RPM package from the CRB repository.

- **pcp 5.3.5**

  The Performance Co-Pilot (PCP) package (`pcp`) includes bug fixes, enhancements, and new features, including the following:

  - Large number of hosts can have performance metrics centrally logged (`pmlogger` farms) and automatically monitored with performance rules (`pmie` farms).

  - New `pcp-ss` tool for historical socket statistics is supported.

  - `php-htop` tool is improved.

  - Extensions have been added to the over-the-wire PCP protocol, which support higher resolution timestamps.

Database

Oracle Linux 9 is distributed with the MySQL 8.0 database software. For this software's documentation, see https://dev.mysql.com/doc/relnotes/mysql/8.0/en/.

Desktop

The following desktop features are included with Oracle Linux 9:

- **GNOME desktop environment updated to version 40**

  This version includes numerous new and improved features, including a redesigned Activities Overview that provides for better navigation of the system and the launching of applications. Note that workspaces are now arranged horizontally and the window overview, as well as the application grid, are accessed vertically.

- **Pipewire is the default audio service**

  Pipewire replaces both the PulseAudio and Jack audio services that was used in previous releases. All audio applications that use these earlier services are redirected to Pipewire. Jack applications work well with default Oracle Linux configurations and therefore do not require additional configurations.

- **Power profiles provided in GNOME**

  Power profiles enable you to optimize power usage of your system. The selected profile persists across system reboots. You can select from the following:

  – `Performance` sets the system for peak performance but reduces battery life. The profile is not available in all system configurations.

  – `Balanced` is the default profile which provides standard performance and power consumption.

  – `Power Saver` prioritizes battery life and can impact system performance. The system switches to this profile automatically if low battery level is detected.

- **Boot loader introduces changes**

  Configuration files are unified across CPU architectures. These files are stored in `/boot/grub2`, regardless of the platform. The `grub.cfg` file that GRUB previously used on UEFI systems is now a symbolic link to `/boot/grub2/grub.cfg`. This change provides benefits, such as improved user experience, simplified GRUB layout configuration, the ability to boot the same installation with either EFI or legacy BIOS, and so on.

- **Langpacks have replaced comps language groups**

  Previously, language support was provided by `comps` language groups, which required you to install the corresponding `code-support` package. In this release, you would install the `langpacks-code` package instead.

- **Single-application GNOME sessions supported**

  This support enables users to use a lightweight UI for single applications. Also described as the kiosk mode of a GNOME session, this feature displays a full-screen window only of the application that you have configured. In this mode, use of resources is less intensive than in a standard GNOME session.

Dynamic Programming Languages, Web, and Database Servers

Oracle Linux 9 includes several notable feature changes and improvements for dynamic programming languages, and web and database servers. This release also introduces new and improved module streams, which are described in the following list:

- **Python 3.9**

  Python 3.9 is the default version in Oracle Linux 9, and is also installed by default. Python 3.9 will be supported for the entire Oracle Linux 9 life cycle. However, additional versions of Python 3 are also distributed as RPM packages with a shorter life cycle through the AppStream repository. These versions can be installed in parallel.

  The `/usr/bin/python` command and other Python-related commands, such as `pip`, are made available in an unversioned form and point to the default Python 3.9 version.

> **✎ Note:**
>
> Python 2 is excluded in Oracle Linux 9.

- **Node.js 16**

  The following are notable changes:

  – The `V8` engine is updated to version 9.2.

  – The `npm` package manager is updated to version 7.20.3.

  – A new `Timers Promises` API that provides an alternative set of timer functions that return `Promise` objects is included.

  – A new experimental `Web Streams` API is included.

  – Node.js is compatible with OpenSSL version 3.0.

  Node.js 16 is the initial version of this Application Stream. However, additional Node.js versions will be provided as modules with a shorter life cycle in future minor releases of Oracle Linux 9.

- **Ruby 3.0.3**

  The following are notable changes:

  – Concurrency and parallelism features, such as Ractor and Fiber Scheduler.

  – Static analysis features, such as the RBS language and the `Typeprof` utility,

  – Pattern matching with the `case/in` expression is no longer experimental.

  – The experimental one-line pattern matching feature is redesigned.

  – The Find pattern is added as an experimental feature.

  Ruby 3.0 is the initial version of this Application Stream. Additional versions of Ruby will be provided as modules with a shorter life cycle in future minor releases of Oracle Linux 9.

- **Perl 5.32**

  This version includes numerous enhancements and bug fixes, some of which are the following:

  – Support for Unicode 13.0

  – Enhanced `qr` quote-like operator

  – Alpha assertions and script runs no longer experimental

  – Faster feature checks

  – Ability to dump compiled patterns prior to optimization

  Perl 5.32 is the initial version of this Application Stream. Additional versions of Perl will be provided as modules with a shorter life cycle in future minor releases of Oracle Linux 9.

- **PHP 8.0**

  This version includes numerous enhancements and bug fixes, some of which are the following:

- New self-documented and order-independent named arguments so you can specify only required parameters

- New attributes for using structured metadata with PHP's native syntax

- New union types for using native union types in place of PHPDoc annotations for a combination of types. These types are validated at runtime.

- Error exception is consistently generated when parameter validation fails.

- Improved `Just-In-Time` compilation performance

PHP 8.0 is the initial version of this Application Stream. Additional versions of PHP will be provided as modules with a shorter life cycle in future minor releases of Oracle Linux 9.

- **Git 2.31 and Git LFS 2.13**

  Git 2.31 includes numerous enhancements, some of which are the following:

  - Status of sparse checkout is included in the output of `git status`.

  - `git archive --add-file` includes untracked files in a snapshot from a tree-like identifier.

  - `clone.remotedefaultname` enables you to customize nickname for a source remote repository.

  - Maximum length of output file names is now configurable beyond the previous 64 byte limit.

  - PCRE1 library no longer supported.

  In addition, the Git Large File Storage (LFS) extension 2.13 includes numerous enhancements, some of which are the following:

  - SHA-256 repositories, as well as the `socks5h` protocol, are supported.

  - The `git lfs install|uninstall` commands include a new `--worktree` option.

  - The `git lfs migrate import` command includes a new `--above` option.

- **Subversion 1.14**

  Subversion 1.14 is the initial version of this Application Stream. Additional versions of Subversion will be provided as modules with a shorter life cycle in future minor releases of Oracle Linux 9.

- **Apache HTTP Server 2.4.51**

  The following are notable changes:

  - Changes to the Apache HTTP Server Control Interface (`apachectl`)

    * In the `apachectl status` output, `systemctl` pager is disabled.

    * Instead of the previous behavior of issuing warnings, the `apachectl` fails if you include additional arguments to the command.

    * The `graceful-stop` subcommand returns immediately.

    * The `configtest` subcommand runs `httpd -t` without changing the SELinux context.

  - The Apache eXtenSion tool (`apxs`) does not use or expose compiler optimization flags in the process of building the `httpd` package.

  - The `mod_lua` Apache module is provided in a separate package.

- In the `mod_access_compat` module's deprecated `Allow` directive, the use of the comment character (`#`) generates a syntax error.

- Kernel thread IDs are directly used in error log messages for accuracy and conciseness.

Apache HTTP Server 2.4 is the initial version of this Application Stream, which you can install easily as an RPM package.

- **nginx 1.20**

  The following are notable changes:

  - Support for client SSL certificate validation using the Online Certificate Status Protocol (OCSP).

  - Through the `min_free` parameter of the `proxy_cache_path` directive, the driver now supports cache clearing.

  - A new `ngx_stream_set_module` module is introduced.

  - New directives as well as directive variables are supported.

  - Support for HTTP/2 is improved.

- **Varnish Cache 6.6**

  Varnish Cache 6.5, which is a high-performance HTTP reverse proxy, provides a number of enhancements and bug fixes version 6.0 available.

  Varnish Cache 6 is the initial version of this Application Stream.

- **Squid 5.2**

  Squid 5.2 is a high-performance proxy caching server for web clients. Squid 5.2 includes support for FTP, Gopher, and HTTP data objects as well as the following additional features:

  - Uses a received IP address immediately when request forwarding requires it.

  - New directive have been introduced.

  - `dns_v4_first` directive no longer included in this version.

  - Uses the `CDN-Loop` header for loop detection in Content Delivery Networks (CDN).

  - Internet Content Adaptation Protocol (ICAP) trailers introduced as a new feature to enable ICAP agents to reliably send message metadata after the message body.

  - New configuration options are introduced to replace existing ones, such as `mark_client_packet` for `clientside_mark` and `shared_transient_entries_limit` for `collapsed_forwarding_shared_entries_limit`.

  Squid 5.2 is the initial version of this Application Stream.

- **MySQL 8.0**

  Oracle Linux 9 includes MySQL version 8.0. MySQL 8.0 is the initial version of this Application Stream.

- **Redis 6.2**

  Among enhancements and fixes in this version, the most notable is that the paths of Redis server configuration files are dedicated directories `/etc/redis/`

`redis.conf` and `/etc/redis/sentinel.conf`. In Oracle Linux 8, these files were located in `/etc/redis.conf` and `/etc/redis-sentinel.conf`.

Redis 6 is the initial version of this Application Stream. In future minor releases of Oracle Linux 9, additional Redis versions will be provided as modules with a shorter life cycle.

- **MariaDB**

  MariaDB is updated to version 10.5

- **PostgreSQL**

  PostgreSQL is updated to version 13.

File Systems

The following file system features are included in Oracle Linux 9:

- **XFS file system includes new features**

  The XFS file system supports two new options for the `mkfs.xfs` command: `bigtime` that supports timestamps beyond the year 2038 and `inobtcount` that reduces mount time on large file systems.

  > ⚠️ **Caution:**
  >
  > These options are enabled by default. Consequently, in Oracle Linux 9, the `mkfs.xfs` command creates an XFS file system that is unmountable by previous kernels where these options are not supported. To disable these options, type the `mkfs.xfs` command as follows:
  >
  > `mkfs.xfs -m bigtime=0,inobtcount=0`

  For more information about file systems in Oracle Linux, see Oracle Linux 9: Managing Local File Systems.

- **ext4 file systems support 2038 or later timestamps**

  The ext4 file system supports timestamps beyond the year 2038. This feature is enabled automatically and requires only that the file system size is not lower than the default 128 bytes size.

- **exFAT support**

  The newly supported Extensible File Allocation Table (exFAT) file system enables you to use this file system, which is typically used by default on flash memory.

High Availability and Clusters

The following high availability and clustering features are included in Oracle Linux 9:

- **resource-stickiness meta-attribute default is 1 instead of 0 for newly-created clusters**

  The change is in response to user preference that resources are not automatically moved in the process of a cluster balancing operation. Only newly-created clusters are affected by this change. The behavior does not change for existing clusters.

This new default value of `1` keeps the resources in place during balancing. However, a possible consequence might be that newly added nodes become resourceless and would require the administrator to manually intervene to allot resources to the nodes. Both resource stickiness (`1`) and non-stickiness (`0`) can produce unexpected behavior. However, user preference is to implement stickiness for resources.

If you prefer the old behavior for your cluster, delete the `resource-stickiness` entry from resource defaults.

- **New LVM volume group flag for controlling autoactivation**

  The `setautoactivation` flag controls whether logical volumes that are created from a volume group are automatically activated upon startup. When creating a volume group to be managed by Pacemaker in a cluster, you can set this flag to `n` by using the `vgcreate --setautoactivation n` command for the volume group. Running this command prevents possible data corruption. If you have an existing volume group that is used in a Pacemaker cluster, set the flag by using the `vgchange --setautoactivation n` command.

- **New command options for pcs resource status and pcs stonith status**

  The `pcs resource status` and the `pcs stonith status` commands include support for the following new options:

  - The `pcs resource status node=`*node_id* and `pcs stonith status node=`*node_id* options display the status of resources that are configured on a specific node.

  - The `pcs resource status` *resource_id* and `pcs stonith status` *resource_id* options display the status of a single resource.

  - The `pcs resource status` *tag_id* and `pcs stonith status` *tag_id* options display the status of all of the resources with a specified tag.

- **pcs resource safe-disable command includes a new reduced output display option**

  To print errors only in a report instead of including lengthy simulation results, you can use the `--brief` option in some `pcs resource` subcommands as follows:

  - `pcs resource safe-disable --brief`

  - `pcs resource disable --safe --brief`

  The error report now always contains resource IDs of affected resources.

- **New pcs command introduced for updating SCSI fencing device**

  The new `pcs stonith update-scsi-devices` command enables you to update SCSI devices without causing a restart of other cluster resources. The `pcs stonith update` command causes a restart of all of the resources that are running on the same node that the stonith resource was running.

- **fence_watchdog agent for configuring watchdog-only SBD setup**

  Use the new `fence_watchdog` agent to configure a watchdog-only SBD setup. This setup enables cluster configurations where only some nodes use watchdog-only SBD for fencing, while other nodes use other fencing types. Note that a cluster may only have a single such device, and it must be named `watchdog`. Previous watchdog-only SBD configurations had no such flexibility and required that all of the nodes in the cluster use SBD.

- **Local mode version of pcs cluster setup command supported**

  The `--corosync-conf` option switches the pcs cluster setup command to local mode. In this mode, the `pcs` command creates a `corosync.conf` file and saves on the local node only without communicating with any other node. You can thus create a `corosync.conf` file in a script and handle that file by using a script.

- **Automatic removal of location constraint following resource move**

  The `pcs resource move` command adds a constraint to the resource to prevent it from running on its original node. By default, the location constraint is automatically removed when the resource has been moved. The removal does not necessarily move the resource back to the original node. Where resources can run at that point depends on how your resources are initially configured. To move a resource and leave the resulting constraint in place, use the `pcs resource move-with-constraint` command.

- **pcs command accepts Promoted and Unpromoted roles**

  The `pcs` command accepts the `Promoted` and `Unpromoted` anywhere roles that are specified in Pacemaker configuration. Note that these role names are the functional equivalent of the `Master` and `Slave` Pacemaker roles that was used in previous releases. Also, these role names are visible in configuration displays and help pages.

Infrastructure Services

Oracle Linux 9 introduces several version updates to infrastructure and command-line tools, as well as other notable improvements, including the following:

- **chrony updated to version 4.1**

  This updated `chrony` package includes notable changes including the following:

  - Additional support for Network Time Security (NTS) authentication.

  - In Oracle Linux 9, Authenticated Network Time Protocol (NTP) sources are trusted over non-authenticated NTP sources. To restore the previous behavior, add the `autoselectmode ignore` argument to the `chrony.conf` file.

  - Removal of support for authentication with the following RIPEMD keys: `RMD128`, `RMD160`, `RMD256`, `RMD320`.

  - Removal of support for long non-standard MACs in NTPv4 packets. If you are using `chrony 2.x non-MD5/SHA1` keys, you will need to configure `chrony` by using the `version 3` option.

  The following differences exist between this release's version of `chrony` from the version in Oracle Linux 8:

  - The `seccomp` filter is enabled by default.

    The `-F Z` option is set in `/etc/sysconfig/chronyd`.

  - The `seccomp` filter conflicts with the `mailonchange` directive. If you set this directive in `/etc/chrony.conf`, then disable the filter by removing the `-F Z` setting.

Networking

Oracle Linux 9 introduces the following networking features, enhancements, and changes:

- **WireGuard is available on UEK**

WireGuard is a Virtual Private Network (VPN) implementation with advanced security features, but is also designed to be simple to use and can be a replacement for earlier tunneling protocols. WireGuard has been in production support in the UEK release since UEK R6U3 and continues to be a supported feature in Oracle Linux 9, with UEK R7. For more details, see Unbreakable Enterprise Kernel Release 7: Release Notes (5.15.0-0.30) . To configure WireGuard, see Oracle Linux: Configuring Virtual Private Networks.

Note, however, that in RHCK, WireGuard is available only as a Technology Preview. See Technology Preview.

- **diag modules available with kernel image**

  The kernel image includes the following `diag` modules:

  ```
  CONFIG_INET_DIAG
  CONFIG_INET_RAW_DIAG
  CONFIG_INET_TCP_DIAG
  CONFIG_INET_UDP_DIAG
  CONFIG_NETLINK_DIAG
  CONFIG_PACKET_DIAG
  CONFIG_UNIX_DIAG
  ```

  Being part of the kernel, these modules no longer need to be dynamically loaded with the `ss` command. The change facilitates debugging of networking issues regardless of customer policy in the kernel modules.

- **Core and IPv4-related networking kernel parameters added to sysctl**

  For a list of these parameters and their descriptions, install the `kernel-doc` package and refer to the following files:

  - `/usr/share/doc/kernel-doc-`*version*`/Documentation/admin-guide/sysctl/net.rst`

  - `/usr/share/doc/kernel-doc-`*version*`/Documentation/networking/ip-sysctl.rst`

- **Nmstate API uses more inclusive terminology**

  As part of an ongoing effort to make terms more inclusive, the term `slave` term has been replaced with the term `port` in the `nmstate` API.

- **NetworkManager support for queue_id in a bond port**

  `NetworkManager` ports that are in a bond include support for the setting the `queue_id` parameter.

  For example, if `eth1` is a port of a bond interface, you can enable the `queue_id` parameter for that bond port by using the following command:

  ```
  sudo nmcli connection modify eth1 bond-port.queue-id 1
  sudo nmcli connection up eth1
  ```

> **Note:**
>
> A network interface that needs to use this option should configure it with multiple calls until the appropriate priorities are set for all interfaces. For more information, see the `/usr/share/docs/kernel-doc-_version_/Documentation/networking/bonding.rst` file, which is provided in the `kernel-docs` package.

- **Oracle-provided RDMA packages**

  Oracle provides Remote Direct Memory Access (RDMA) packages for use with UEK R7 to enable direct memory access between two systems that are connected by a network. For more details, see Unbreakable Enterprise Kernel Release 7: Release Notes (5.15.0-0.30).

Security

Oracle Linux 9 introduces the following security features, enhancements, and changes:

- **System-wide crypto-policies are more secure**

  System wide cryptographic policies are more secure through the disabling of older cryptographic algorithms and increased minimum RSA key size. Using SHA-1 is restricted in the `DEFAULT` crypto policy. With the exception of HMAC and DNSSec usage, SHA-1 is not allowed in TLS, DTLS, SSH, IKEv2 and Kerberos protocols. As part of this change, some algorithms have been disabled.

  If you require that some of the disabled algorithms and ciphers be enabled, use policy modifiers or customize the policy.

- **OpenSSL version 3.0.1 is supported**

  This version contains enhancements and fixes such as new versioning schemes, support for new algorithms, new HTTP(S) client that supports GET and POST, and many others. The following are features related to OpenSSL:

  - **OpenSSL supports new concept of providers**

    The OpenSSL 3.0.1 toolkit introduces the concept of *providers*, which are collections of algorithms from which you can choose for different applications. The following providers are provided: `base`, `default`, `FIPS`, `legacy`, and `null`.

    By default, OpenSSL loads and activates the default provider, which is comprised of commonly used algorithms such as RSA, DSA, DH, CAMELLIA, SHA-1, and SHA-2. If the FIPS flag is set in the kernel, the FIPS provider is automatically loaded, and no manual switching to FIPS mode is required. To change the provider on the system level, edit the `openssl.cnf` configuration file.

    > **⚠ Caution:**
    >
    > Explicitly activating a provider overrides the default provider selection, which might make the system remotely inaccessible.

  - **OpenSSL random bit generator includes CPACF support**

The `openssl` packages provide support for the CP Assist for Cryptographic Functions (CPACF) in the OpenSSL NIST SP800-90A-compliant AES-based deterministic random bit generator (DRBG).

– **openssl-spkac can create SPKAC files signed with SHA-1 and SHA-256**

You can use the `openssl-spkac` utility to create Netscape signed public key and challenge (SPKAC) files that are signed with hashes different from MD5. Likewise, you can also create and verify SPKAC files that are signed with SHA-1 and SHA-256 hashes.

To use FIPS-approved only algorithms, you need only to set the FIPS flag in the kernel. OpenSSL then opens the FIPS provider that contains the approved algorithms. Thus, you no longer need to switch OpenSSL to FIPS mode.

• **openCryptoki 3.17.0 is supported**

Some differences exist between this version and what is provided upstream. Although `opencryptoki` supports the old data format that uses non-FIPs approved algorithms, the FIPS provider no longer allows those algorithms. Thus, you must migrate your existing tokens to the new format before enabling FIPS mode on your system. To migrate tokens using the old data format, use the `pkcstok_migrate` utility. See https://www.ibm.com/docs/en/linux-on-systems?topic=tools-pkcstok-migrate.

• **GnuTLS version 3.7.3 provided**

`gnutls` 3.7.3 packages include numerous improvements and bug fixes over previous versions, including the following: Fixed timing of the early date (zero round trip data, 0-RTT) exchange; the `cerutil` tool no longer inherits the CRL (Certificate Revocation List) distribution point from the certificate authority (CA) when signing a certificate signing request (CSR).

• **Network Security Service 3.71**

The Network Security Services (NSS) libraries 3.71 support only the SQLite format. Support for legacy DBM format has been removed.

• **System Roles support VPN management**

With the availability of VPN support, the Oracle Linux System Role can be used to more easily create VPN tunnels for host-to-host and mesh connections that involve large numbers of hosts. Consequently, you obtain a VPN configuration interface as well as tunneling configuration s that are more stable and constant within the System Roles project.

• **OpenSSH updated to version 8.7p1**

OpenSSH 8.7p1 includes notable features and enhancements such as `LogVerbose` configuration, client address-based rate-limiting through new directives, support for Universal 2nd Factor (U2F) hardware authenticators specified by the FIDO Alliance, and others. This version also includes the following fixes:

– A bug fix to address an exploitable integer overflow issue in the private key parsing code for the XMSS key type. This key type is still experimental and support for it is not compiled by default. No user-facing `autoconf` option exists in portable OpenSSH to enable it.

– A bug fix to clarify the semantics of the `ClientAliveCountMax=0` keyword has been implemented in Oracle Linux 9. Instead of the previous behavior of

instantly killing the connection after the first liveness test, regardless of its success, the mechanism entirely disables connection killing.

– Added protection is provided for private keys at rest in RAM against speculation and memory side-channel attacks like Spectre, Meltdown, and Rambleed. Oracle Linux 9 encrypts private keys when not in use with a symmetric key that is derived from a relatively large "prekey" that consists of random data (currently 16 KB).

- **Libreswan 4.6 is supported**

  This version of Libreswan contains enhancements and fixes. Notably, because IKEv2 is now generally deployed, IKEv1 packets are no longer supported by default. If your setup requires the use of IKEv1 packets, you can enable support for these packets by adding the `ikev1-policy=accept` line to the `/etc/ipsec.conf` file.

- **stunnel 5.62 is supported**

  This package version includes bug fixes and enhancements such as enabling or disabling the resumption of a session through the `sessionResume` option and the availability of a Bash-completion script.

- **nettle updated to version 3.7.3**

  This new version contains the following enhancements:

  – New algorithms and modes are supported, such as `Ed448`, `SHAKE256`, `AES-XTS`, and `SIV-CMAC`.

  – Support is provided for architecture-specific optimizations for existing algorithms.

- **pk11-kit updated to version 0.24**

  In this package version, the subdirectory for the location of distrusted Certificate Authorities is renamed `blocklist` for easier identification.

- **cyrus-sasl uses GDBM instead of Berkeley DB**

  The `cyrus-sasl` package no longer has the `libdb` dependency. Further, the `sasldb` plugin uses the GDBM (GNU `dbm`) database format instead of Berkeley DB.

  To migrate existing SASL databases that are stored in the old Berkeley DB format, use the following command:

  ```
  cyrusbdb2current sasldb-path new-path
  ```

- **SELinux policy is up to date with the current kernel**

  Performance of SELinux has improved through faster loading of SELinux policy to the kernel, reduction of memory overhead, and efficient disk space use. Additionally, the SELinux policy integrates well with the current kernel and can use the current's permissions, classes, and capabilities. which improves security. Better granularity in defining permissions enables systems to run with the MLS SELinuxpolicy, which can prevent systems with permissions undefined in the policy from starting.

  Additionally, you can only disable SELinux by using the `selinux=0` parameter in the kernel command line. Using the older method of disabling SELinux in the `/etc/selinux/config` does not disable SELinux; but rather, SELinux stays enabled, but no policy is loaded.

  By default, SELinux policy prohibits commands with text relocation libraries. SELinux can enter commands that use libraries requiring text relocation provided that the library files have the `textrel_shlib_t` label.

- **scap-security-guide 0.1.60 changes**

  In this version, rules for hardening PAM stack use `authselect` as the configuration tool.

- **fapolicyd version 1.1 is supported**

  The following are notable features in this version:

  – `/etc/fapolicyd/rules.d/` replaces `/etc/fapolicyd/fapolicyd.rules` to store files that allow or deny execution rules.

  – The new `/etc/fapolicyd/trust.d` directory supports separating a list of trusted files into more files. You can also add an entry for a file by using the `fapolicyd-cli -f` command syntax enables you to add an entry for a file with the `--trust-file` directive to these files.

  – White spaces in file names are supported through the `fapolicyd` trust database.

  – `fapolicyd` stores the correct path to an executable file when it adds the file to the trust database.

- **Rsyslog package includes rsyslog-mmfields subpackage**

  The subpackage provides the `mmfields` module as an alternative to the property replacer field extraction. The module extracts all the fields at once and stores them inside the structured data part. Thus, `mmfields` enables you to process field based log formats such as the Common Event Format (CEF). You can also use the module in cases where you need a large number of fields, or reuse specific fields.

- **logrotate provided in a separate rsyslog-logrotate package**

  In this release, the `logrotate` configuration has been removed from the main `rsyslog` package and is included in a new `rsyslog-logrotate` package. This change is useful in certain minimal environments for preventing the installation of unnecessary dependencies, for example, where log rotation is not required.

- **sudo program includes Python plugins**

  The `sudo 1.9` program provides capability for writing `sudo` plugins in Python. This capability makes it easier to enhance the `sudo` program to more precisely suit specific scenarios.

- **libseccomp 2.5.2 is supported**

  This version contains bug fixes and enhancements such as an updated syscall table for Linux v5.14-rc7, consolidated multiplexed syscall handling for all architectures into a single location, clarification of the maintainers' GPG keys, and so on.

- **Clevis includes support for SHA-256**

  The Clevis framework is in compliance with the recommendations of `RFC 7638` and supports the `SHA-256` algorithm as the default hash for JSON Web Key (JWK) thumbprints. The older thumbprints (`SHA-1`) continue to be supported so you can still decrypt previously encrypted data.

Virtualization

The following virtualization features, enhancements, and changes are introduced in Oracle Linux 9:

- **QEMU uses Clang**

  In Oracle Linux 9, the QEMU emulator is built by using the Clang compiler. This improvement enables the KVM hypervisor to use several advanced security and debugging features, which provides better opportunities for future feature development.

- **Capability for using SafeStack on VMs added**

  As of Oracle Linux 9, the QEMU machine emulator on x86_64 and AMD64 hardware can use the SafeStack feature. SafeStack is a enhanced compiler-based stack protection feature that reduces the ability of an attacker to exploit a stack- based buffer overflow to change return pointers in the stack and create Return-Oriented Programming (ROP) attacks. This change makes virtual machines (VMs) that are hosted on Oracle Linux 9 significantly more secure against ROP-based vulnerabilities.

Containers

The following containers features, enhancements, and changes are introduced in Oracle Linux 9:

- **Podman supports short names**

  The `registries.conf` file now accepts configuration of short-name aliases for images in the `[aliases]` table. The short-names modes are:

  - **Enforcing**: If no matching alias is found during the image pull, Podman prompts the user to choose one of the unqualified-search registries. If the selected image is pulled successfully, Podman automatically records a new short-name alias in the `$HOME/.cache/containers/short-name-aliases.conf` file (rootless user) and in the `/var/cache/containers/short-name-aliases.conf` (root user). If the user cannot be prompted (for example, `stdin` or `stdout` are not a TTY), Podman fails. Note that the `short-name-aliases.conf` file has precedence over `registries.conf` file if both specify the same alias.

  - **Permissive**: Similar to enforcing mode, but Podman does not fail if the user cannot be prompted. Instead, Podman searches in all unqualified-search registries in the given order. Note that no alias is recorded.

- **Changes implemented on container-tools module**

  The `container-tools` module contains the Podman, Buildah, Skopeo, and `runc` tools. The rolling stream, represented by the `container-tools:ol8` stream in Oracle Linux 8, is named `container-tools:latest` in Oracle Linux 9. Similarly to Oracle Linux 8, stable versions of container tools are going to be available in numbered streams (for example, 3.0).

- **containers-common package available in the containers-tools:latest module**

  The `containers-common` package has been added to the `container-tools:latest` module. The `containers-common` package contains common configuration files and documentation for the container tools' ecosystem, such as Podman, Buildah, and Skopeo.

- **podman-py package is available.**

  The `podman-py` package has been added to the `container-tools:3.0` stable module stream and the `container-tools:latest` module. The `podman-py` package is a library of bindings to use the RESTful API of Podman.

- **Improvements from control groups version 2**

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With the availability of `cgroupv2`, system administrators can limit resources for any application without causing performance problems that were encountered in the previous version.

For additional information about notable changes in `cgroupv2`, see Kernel.

- **container-tools meta-package is available**

  This RPM meta-package includes Podman, Buildah, Skopeo, CRIU, Udica, and all required libraries, and are in Oracle Linux 9. To install the container-tools meta-package, run the following command:

  ```
  sudo dnf install container-tools
  ```

- **Podman supports auto-building and auto-running pods using a YAML file**

  The `podman play kube` command automatically builds and runs multiple pods with multiple containers in the pods using a YAML file.

- **Oracle Linux 9 containers on Oracle Linux 7 host is unsupported**

  Running Oracle Linux 9 containers on an Oracle Linux 7 host is not supported. Such a setup might work, but cannot be guaranteed.

Oracle Linux in Cloud Environments

The following changes and features apply to Oracle Linux used in cloud environments.

- **WALinuxAgent updated to 2.3.0.2**

  The Windows Azure Linux Agent (WALinuxAgent) has been upgraded to upstream version 2.3.0.2, which introduces a number of bug fixes and enhancement, most notably the following:

  – Support has been added for RequiredFeatures and GoalStateAggregateStatus APIs.

  – Fallback locations for extension manifests have been added.

  – Missing calls to `str.format()` have been added when creating exceptions.

3

Technology Preview

The following items are available as technical previews in this release of Oracle Linux. Note that some items listed apply to Red Hat Compatible Kernel (RHCK) and might already be available in UEK.

KTLS

The Linux Kernel TLS (KTLS) handles TLS records for the AES-GCM cipher. KTLS also provides the interface for offloading TLS record encryption to NICs that support this functionality.

OpenSSL 3.0 is able to use KTLS if the `enable-ktls` configuration option is used during compiling.

The updated `gnutls` packages can use KTLS for accelerating data transfer on encrypted channels. To enable KTLS, add the `tls.ko` kernel module using the `modprobe` command, and create a new configuration file `/etc/crypto-policies/local.d/gnutls-ktls.txt` for the system-wide cryptographic policies with the following content:

```
[global]
ktls = true
```

Note that `gnutls` doesn't permit you to update traffic keys through TLS `KeyUpdate` messages, which impacts the security of AES-GCM ciphersuites.

SGX

Software Guard Extensions (SGX) from Intel® protects software code and data from disclosure and modification. RHCK currently enables SGX v1 and v1.5.

Note that SGX is supported in UEK.

DAX

Direct Access (DAX) is available for the `ext4` and XFS file systems. It enables an application to directly map persistent memory into its address space. DAX can be used on systems that have available persistent memory, typically NVDIMMs.

SEV and SEV-ES

The Secure Encrypted Virtualization (SEV) feature is provided for AMD EPYC host machines that use the KVM hypervisor. It encrypts a virtual machine's memory and protects the VM from access by the host.

SEV's enhanced Encrypted State version (SEV-ES) encrypts all CPU register contents when a VM stops running, thus preventing the host from modifying the VM's CPU registers or reading any information from them.

Note that SEV is supported in UEK.

WireGuard

WireGuard is a VPN solution that has improved security features and is easily configurable.

Note that WireGuard is fully supported in UEK. See Oracle Linux: Configuring Virtual Private Networks for more information on using WireGuard on Oracle Linux.

4

Deprecated Features

This chapter lists features and functionalities that are deprecated in Oracle Linux 9. While these features might be included and operative in the release, support isn't guaranteed in future major releases. Thus, these features must not be used in new Oracle Linux 9 deployments.

Installation

The following installation related features and functionalities are deprecated in Oracle Linux 9.

Kickstart Commands

- `timezone --ntpservers`
- `timezone --nontp`
- `logging --level`
- `%packages --excludeWeakdeps`
- `%packages --instLangs`
- `%anaconda`
- `pwpolicy`

Even though specific options are listed as deprecated, the base command and the other options remain available and operative. If you use a deprecated command in kickstart files, warnings are generated in the logs. To change deprecated command warnings to errors, set the `inst.ksstrict` boot option.

Dynamic Programming Languages, Web and Database Servers

The following features and functionalities that are related to dynamic programming, web, and database servers are deprecated in Oracle Linux 9.

Berkeley DB (`libdb`)

Deprecation of the Berkely DB (`libdb`) package includes the removal of cryptographic algorithms and dependencies. Users of `libdb` should migrate to a different key-value database.

Python Packages

`python3-pytz` and `mcpp` packages are removed from Oracle Linux 9.

Networking

The following network related features and functionalities are deprecated in Oracle Linux 9.

Network Teams

The `teamd` service, and the `libteam` library, and support for configuring network teams are deprecated in favor of network bonds. You should use network bonds instead, which have similar functions as teams, and which would receive enhancements and updates.

`/etc/sysconfig/network-scripts` File

Network configurations are previously stored in `/etc/sysconfig/network-scripts` in `ifcfg` format. In Oracle Linux 9, new network configurations are stored in `/etc/NetworkManager/system-connections` in key file format.

However, information in the `/etc/sysconfig/network-scripts` remain operative, and modifications to existing profiles continue to update the older files.

`iptables` Framework

With the deprecation of the `iptables` framework, the `iptables` backend and the `direct interface` are consequently also deprecated.

Accordingly, the following packages are also deprecated:

- `iptables-devel`
- `iptables-libs`
- `iptables-nft`
- `iptables-nft-services`
- `iptables-utils`

As an alternative to using `direct interface`, use the native features in `firewalld` to configure the required rules.

Security

The following security related features and functionalities are deprecated in Oracle Linux 9.

SHA-1 Algorithm

The SHA1 algorithm is deprecated in Oracle Linux 9. Digital signatures using SHA-1 hash algorithm are no longer considered secure and therefore not allowed on Oracle Linux 9 systems by default. Oracle Linux 9 has been updated to avoid using SHA-1 in security-related use cases.

However, the HMAC-SHA1 message authentication code and the Universal Unique Identifier (UUID) values can still be created by using SHA-1.

In cases where you need SHA-1 to verify existing or third party cryptographic signatures, you can enable SHA-1 as follows:

```
sudo update-crypto-policies --set DEFAULT:SHA1
```

As an alternative, you can switch the systemwide crypto policies to the `LEGACY` policy. However, this policy also enables other algorithms that are not secure, and therefore risks making the system vulnerable.

SCP Protocol

In the `scp` utility, secure copy protocol (SCP) is replaced by the SSH File Transfer Protocol (SFTP) by default. Likewise, SCP is deprecated in the `libssh` library.

Oracle Linux 9 does not use SCP in the OpenSSH suite.

OpenSSL Cryptographic Algorithms

- MD2
- MD4
- MDC2
- Whirlpool
- RIPEMD160
- Blowfish
- CAST
- DES
- IDEA
- RC2
- RC4
- RC5
- SEED
- PBKDF1

The implementations of these algorithms have been moved to the legacy provider in OpenSSL

For instructions on how to load the legacy provider and enable support for the deprecated algorithms, see the `/etc/pki/tls/openssl.cnf` configuration file.

`libcrypt.so.1`

The `libcrypt.so.1` cryptogarhic library is deprecated and might be removed in a future Oracle Linux version.

`/etc/system-fips` File

The `/etc/system-fips` file was used to indicate the FIPS mode in the system. This file is removed in Oracle Linux 9.

To install Oracle Linux 9 in FIPS mode, add the `fips=1` parameter to the kernel command line during the system installation. To check whether Oracle Linux 9 is operating in FIPS mode, use the `fips-mode-setup --check` command.

`fapolicyd.rules` File

The `/etc/fapolicyd/fapolicyd.rules` file is deprecated. You can store policy rules for `fapolicyd` in the `/etc/fapolicyd/rules.d/` directory. The `fagenrules` script merges all component rule files in this directory to the `/etc/fapolicyd/compiled.rules` file.

Rules in `/etc/fapolicyd/fapolicyd.trust` continue to be processed by `fapolicyd` for backward compatibility.

Kernel

The following kernel related features and functionalities are deprecated in Oracle Linux 9.

Asynchronous Transfer Mode

Asynchronous Transfer Mode (ATM) encapsulation enables Layer-2 (Point-to-Point Protocol, Ethernet) or Layer-3 (IP) connectivity for the ATM Adaptation Layer 5 (AAL-5). Currently, these protocols are used only in chipsets that ADSL technology, which are being phased out.

File Systems and Storage

The following features and functionalities related to file systems and storage are deprecated in Oracle Linux 9.

`lvm2-activation-generator`

The `lvm2-activation-generator` program is deprecated, together with its generated services as follows:

- `lvm2-activation`
- `lvm2-activation-early`
- `lvm2-activation-net`

The `lvm.conf event_activation` that used to activate these services no longer works. The only method that is used for automatic activation of volume groups is event based activation.

Desktop

The following desktop related features and functionalities are deprecated in Oracle Linux 9.

X.org Server

In Oracle Linux 9, the `X.org` display server is deprecated, and consequently, the `xorg-x11-server-Xorg` package.

The default desktop session is the Wayland session. However, the X11 protocol continues to be supported by using the `XWayland` backend. Therefore, applications that require X11 can run in Wayland sessions.

Motif Toolkit

The Motif widget tool is deprecated, including the following packages:

- `motif`
- `openmotif`
- `openmotif21`
- `openmotif22`

Likewise, the `motif-static` package has been removed. In place of Motif, use the GTK toolkit.

Virtualization

The following virtualization related features and functionalities are deprecated in Oracle Linux 9.

Signatures Using SHA-1

The use of SHA1-based signatures to perform SecureBoot image verification on UEFI (PE/COFF) executables is deprecated. Instead, use signatures that are based on SHA-2 or later.

Virtual Machine Snapshots

Support for creating snapshots of VMs is limited only to those that do not use UEFI firmware. However, the operation might cause the QEMU monitor to become blocked and affects hypervisor operations.

As an alternative, use external snapshots.

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`libvirtd` Daemon

As a replacement of the deprecated `libvirtd` daemon, use the modular daemons in the `libvirt` library. For example, the `virtqemud` handles QEMU drivers.

Virtual Floppy Driver

The `isa-fdc` driver controls virtual floppy disk devices. To ensure compatibility with migrated virtual machines (VMs), you should not use floppy disk devices in virtual machines that you subsequently host on Oracle Linux 9.

`qcow2-v2` Format

For virtual disk images, use the `qcow2-v3` format instead.

5

Known Issues

This chapter describes known issues that you may encounter when installing and using the Oracle Linux 9 software. Unless indicated otherwise, the issues apply to both x86_64 and aarch64 systems. Information that pertains only to a specific platform is also noted accordingly.

Installation Issues

The following are known installation issues for Oracle Linux 9.

iscsi-init service falls into a failed state by default

At the initial boot after installation, the `iscsi-init.service` service enters a failed state on a system where the operating system is installed to local disk. The failure is caused by the service attempting to write to a configuration file early in the boot process before the root file system becomes writable. Running the `systemctl is-system-running` command generates a report that indicates that the system is degraded. However, if a system is configured with a valid `InitiatorName` value in the `/etc/iscsi/initiatorname.iscsi` file, this issue is not encountered. In this case, the service runs normally.

To workaround this issue, wait until the system is fully booted. Then, run the following command:

```
sudo systemctl restart iscsi-init
```

The `iscsi-init.service` is a one-time service in the installation process and therefore, the issue is no longer encountered in subsequent reboots.

(Bug ID 33930979)

Network Installation With PXE Boot Server Fails

While using a PXE boot server to perform a network installation on a UEFI client where Secure Boot is enabled, the installation might fail because the `grubx64.efi` file can't load the `grub` configuration file. The `grub` bootloader switches to the command line mode and the installation process stops at the `grub` prompt.

To work around this issue, configure the `tftpd` service to run with the `-r blksize` option enabled.

If you are using `dnsmasq` for TFTP services, uncomment the `tftp-no-blocksize` line in the `/etc/dnsmasq.conf` file. Then restart the `dnsmasq` service.

(Bug ID 34233443)

Virtualization Issues

The following are known virtualization issues for Oracle Linux 9

KVM Virtual Machines Panic When Started on Oracle Linux 9 Hosts

The `glibc` version that's included with Oracle Linux 9 checks for compatibility between a system's CPU and new architectures that are supported. A system might pass the compatibility check. However, the CPU flags that are set on the system after passing the check might be unknown to the KVM virtual machines that are hosted on that system. Consequently, the VMs panic when they're booted.

To work around this issue, run the following command:

```
virsh edit vm-name
```

Then, add the following declaration in the virtual machine's XML file:

```
<cpu mode='host-model' check='partial'/>
```

The `check` parameter's `partial` setting sets `libvirt` to check the VM's CPU specification before starting a domain. However, the rest of the checking remains on the hypervisor, which can still provide a different virtual CPU.

(Bug ID 34224821)

Virtual Machines Fail to Start at Boot Because the `virbr0` Interface Isn't Available

After reboot, the `virbr0` network interface might be missing, which can prevent virtual machines from automatically starting up after boot.

The libvirt daemons on Oracle Linux 9 are modular to handle atomic features within the virtualization environment and are started and run as required, and stopped after two minutes of inactivity. The daemon responsible for setting up the networking interfaces for libvirt is `virtnetworkd`. This service isn't automatically started when a virtual machine is started.

To work around this issue, enable the `virtnetworkd` service so that the service starts at boot:

```
sudo systemctl enable --now virtnetworkd
```

(Bug ID 34237540)

Kernel Issues

The following are known kernel issues in Oracle Linux 9.

Kdump Might Fail on Some AMD Hardware

Kdump might fail on some AMD hardware that's running the current Oracle Linux release. Impacted hardware includes the AMD EPYC CPU servers.

To work around this issue, modify the `/etc/sysconfig/kdump` configuration file and remove the `iommu=off` command line option from the `KDUMP_COMMANDLINE_APPEND` variable. Restart the `kdump` service for the changes to take effect.

(Bug ID 31274238, 34211826, 34312626)

Sub-optimal Kdump settings on some platforms

The `crashkernel` memory reservations for certain platforms might not be optimal in all circumstances.

To check if Kdump settings are optimal, ensure the Kdump kernel is loaded:

```
sudo kdumpctl status
kdump: Kdump is operational
```

If `kdumpctl` reports otherwise, change the `crashkernel` settings to a higher value for your memory requirements:

1. Run `cat /proc/cmdline` to see the current kernel command line options.

2. Use the `grubby` command to remove the current `crashkernel` settings for all kernels, for example:

   ```
   sudo grubby --update-kernel=ALL --remove-args="crashkernel=2G-8G:256M,8G-:896M
   ```

3. Use the `grubby` command to add a new `crashkernel` setting for all kernels, for example:

   ```
   sudo grubby --update-kernel=ALL --args="crashkernel=2G-:448M"
   ```

4. Reboot the system for the changes to take effect. Confirm that the new changes have enabled the Kdump kernel to load correctly.

The `crashkernel=auto` option is no longer supported on Oracle Linux 9. Some platforms, such as the Raspberry Pi have maximum limits for crashkernel memory reservation.

(Bug ID 34240246)

`flatpak-system-helper` File Access Triggers SELinux Policy Violations

Booting Oracle Linux 9 with a GUI desktop environment that has SELinux enabled can produce SELinux security messages similar to the following:

```
SELinux is preventing /usr/libexec/flatpak-system-helper from read access on the file
passwd.
SELinux is preventing /usr/libexec/flatpak-system-helper from write access on the
directory flatpak.
SELinux is preventing /usr/libexec/flatpak-system-helper from watch access on the
directory /usr/libexec.
```

A popup message notifying you of a violation might appear immediately after the installation if the `Server with GUI` or `Workstation with GUI` installation profiles are selected and SELinux is enabled and Flatpak installed.

You can continue to use Flatpak with SELinux; however, continued use can result in large numbers of messages to the logs.

To work around this issue, create an SELinux policy module for the `flatpak-system-helper` service:

```
ausearch -c 'flatpak-system-' --raw |audit2allow -M my-flatpaksystem
semodule -i my-flatpaksystem.pp
```

(Bug ID 34321783)

(aarch64) Some GUI Elements Aren't Displayed During Installation and Boot Using VGA Output

During installations on the Arm platform, the Oracle Linux installer does not display some GUI elements, such as the progress update screen, on VGA output. Output is displayed on the serial console, instead.

Additionally, if you install Oracle Linux with GUI on an encrypted disk, for example, by choosing Server with GUI during the installation stage, and VGA is enabled, the password prompt doesn't appear on the VGA output at system boot, and consequently, the boot process can not be completed. The prompt appears only on a serial console, and therefore, you would need to switch to a serial console to provide the password there.

This issue is specific to systems on the Arm platform only and occurs regardless of whether you are using secure boot or non secure boot. Further, the issue applies to Oracle Linux 8 or Oracle Linux 9 systems that use UEKR6 and UEKR7. The issue occurs wherever Plymouth graphical elements are loaded in the GUI.

To resolve these GUI issues and to cause these elements to display on VGA output without using a serial console, add `plymouth.ignore-serial-consoles` to the kernel command line in the GRUB configuration. For instructions, see the *Managing Kernels and System Boot* chapter in Oracle Linux 9: Managing Core System Configuration.

(Bug ID 35034465 and 35270637)

Certain SEV Guest Configurations Might Cause Hypervisor CPU Soft-Lockup Warnings

On older generation AMD systems that are based on the AMD Rome processors, such as E2 and E3 systems, a guest with more than 350GB memory that's configured to use Secure Encrypted Virtualization (SEV) memory encryption can trigger a CPU soft-lockup warning on the hypervisor host during guest boot or shutdown operations.

The time that's needed to flush the pinned memory that's being encrypted is proportional to the amount of guest memory. However, with larger amounts of memory in excess of 350GB, the time on the CPU to flush the memory becomes excessive, which consequently triggers a warning. After the memory is flushed, the hypervisor resumes normal operations.

Newer systems that are based on the AMD Milan processor, such as E4 systems, have hardware support that can minimize the time required for flushing the memory. Therefore, the CPU soft-hang issue isn't encountered.

As a workaround, if a SEV enabled guest with more then 350GB of memory is required, create the guest on a system that's based on the AMD Milan processor. If you are using systems with the AMD Rome processor, limit the guest memory to less than 350GB if the guest is configured with SEV memory encryption.

(Bug ID 34050377)

Tuned Profile Packages for Oracle Cloud Infrastructure Are Moved

Packages intended for use only on Oracle Cloud Infrastructure instances, such as the `tuned-profile-oci-*` packages, are available in the `ol9_appstream` repository. Some of these packages were previously available in the dedicated `ol9_oci_included` repository but have been moved to avoid cross-channel dependencies.

The `tuned-profile` packages include profiles intended to run in specific corresponding environments and must be intentionally installed for the correct environment.

Sources for all profiles are included in the tuned source RPM package that is available in the `ol9_baseos` repository.

(Bug 34867566)

6

Package Changes from the Upstream Release

The following sections list the changes to binary and source packages from the upstream release.

Changes to Binary Packages

This section contains information about the removed, modified, and new **binary** packages in this release. For information about the **source** package changes, see Changes to Source Packages.

Added Binary Packages for BaseOS by Oracle

The following binary packages have been added to BaseOS by Oracle:

- `bcache-tools`
- `btrfs-progs`
- `dtrace`
- `iwl3945-firmware`
- `iwl4965-firmware`
- `iwl6000-firmware`
- `iwlax2xx-firmware`
- `kernel-uek`
- `kernel-uek-core`
- `kernel-uek-debug`
- `kernel-uek-debug-core`
- `kernel-uek-debug-devel`
- `kernel-uek-debug-modules`
- `kernel-uek-debug-modules-extra`
- `kernel-uek-devel`
- `kernel-uek-doc`
- `kernel-uek-modules`
- `kernel-uek-modules-extra`
- `libertas-sd8686-firmware`
- `libertas-usb8388-firmware`

- `libertas-usb8388-olpc-firmware`

- `linux-firmware-core`

- `liquidio-firmware`

- `NetworkManager-config-connectivity-oracle`

- `ocfs2-tools`

- `oracle-backgrounds`

- `oracle-indexhtml`

- `oraclelinux-release`

- `oraclelinux-release-el9`

- `oracle-logos`

- `oracle-logos-httpd`

- `oracle-logos-ipa`

Added Binary Packages for AppStream by Oracle:

The following binary packages have been added to AppStream by Oracle:

- `dnf-plugin-spacewalk`

- `dtrace-devel`

- `dtrace-testsuite`

- `libblockdev-btrfs`

- `python3-dnf-plugin-spacewalk`

- `python3-dnf-plugin-ulninfo`

- `python3-hwdata`

- `python3-pyOpenSSL`

- `python3-rhn-check`

- `python3-rhn-client-tools`

- `python3-rhnlib`

- `python3-rhn-setup`

- `python3-rhn-setup-gnome`

- `rhn-check`

- `rhn-client-tools`

- `rhnlib`

- `rhnsd`

- `rhn-setup`

- `rhn-setup-gnome`

Added Binary Packages for CodeReady Linux Builder by Oracle

The following binary packages have been added to CodeReady Linux Builder by Oracle:

- `oraclelinux-sb-certs`

Modified BaseOS Binary Packages

The following binary packages from the BaseOS upstream release have been modified:

- `alternatives`
- `autofs`
- `binutils`
- `binutils-gold`
- `chkconfig`
- `chrony`
- `cockpit`
- `cockpit-bridge`
- `cockpit-doc`
- `cockpit-system`
- `cockpit-ws`
- `coreutils`
- `coreutils-common`
- `coreutils-single`
- `dbus`
- `dbus-common`
- `dbus-libs`
- `dbus-tools`
- `dnf`
- `dnf-automatic`
- `dnf-data`
- `dnf-plugins-core`
- `dracut`
- `dracut-config-generic`
- `dracut-config-rescue`
- `dracut-network`
- `dracut-squash`
- `dracut-tools`

- `efibootmgr`

- `efi-filesystem`

- `firewalld`

- `firewalld-filesystem`

- `fwupd`

- `glibc`

- `glibc-all-langpacks`

- `glibc-common`

- `glibc-gconv-extra`

- `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-ckb`
- `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-mnw`
- `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-minimal-langpack`
- `grub2-common`
- `grub2-efi-aa64-modules`

- `grub2-efi-x64`
- `grub2-efi-x64-cdboot`
- `grub2-efi-x64-modules`
- `grub2-pc`
- `grub2-pc-modules`
- `grub2-tools`
- `grub2-tools-efi`
- `grub2-tools-extra`
- `grub2-tools-minimal`
- `grubby`
- `ima-evm-utils`
- `iproute`
- `iproute-tc`
- `iscsi-initiator-utils`
- `iscsi-initiator-utils-iscsiuio`
- `iwl1000-firmware`
- `iwl100-firmware`
- `iwl105-firmware`
- `iwl135-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`
- `iwlax2xx-firmware`
- `kexec-tools`
- `kmod`
- `kmod-kvdo`

- `kmod-libs`
- `krb5-libs`
- `krb5-pkinit`
- `krb5-server`
- `krb5-server-ldap`
- `krb5-workstation`
- `libatomic`
- `libdnf`
- `libertas-sd8686-firmware`
- `libertas-sd8787-firmware`
- `libertas-usb8388-firmware`
- `libertas-usb8388-olpc-firmware`
- `libgcc`
- `libgfortran`
- `libgomp`
- `libipa_hbac`
- `libkadm5`
- `libkcapi`
- `libkcapi-hmaccalc`
- `libnsl`
- `libquadmath`
- `libreport-filesystem`
- `libsss_autofs`
- `libsss_certmap`
- `libsss_idmap`
- `libsss_nss_idmap`
- `libsss_simpleifp`
- `libsss_sudo`
- `libstdc++`
- `libtirpc`
- `linux-firmware`
- `linux-firmware-core`
- `linux-firmware-whence`
- `liquidio-firmware`
- `mcelog`

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- microcode_ctl
- netronome-firmware
- NetworkManager
- NetworkManager-adsl
- NetworkManager-bluetooth
- NetworkManager-config-connectivity-oracle
- NetworkManager-config-server
- NetworkManager-initscripts-updown
- NetworkManager-libnm
- NetworkManager-team
- NetworkManager-tui
- NetworkManager-wifi
- NetworkManager-wwan
- nscd
- nvmetcli
- os-prober
- polkit
- polkit-libs
- python3-configshell
- python3-dnf
- python3-dnf-plugin-post-transaction-actions
- python3-dnf-plugins-core
- python3-dnf-plugin-versionlock
- python3-firewall
- python3-hawkey
- python3-libdnf
- python3-libipa_hbac
- python3-libsss_nss_idmap
- python3-rpm
- python3-sss
- python3-sssdconfig
- python3-sss-murmur
- redhat-release
- rpm
- rpm-build-libs

- `rpm-libs`

- `rpm-plugin-audit`

- `rpm-plugin-selinux`

- `rpm-sign`

- `rpm-sign-libs`

- `selinux-policy`

- `selinux-policy-doc`

- `selinux-policy-mls`

- `selinux-policy-sandbox`

- `selinux-policy-targeted`

- `shim-x64`

- `sos`

- `sos-audit`

- `sssd`

- `sssd-ad`

- `sssd-client`

- `sssd-common`

- `sssd-common-pac`

- `sssd-dbus`

- `sssd-ipa`

- `sssd-kcm`

- `sssd-krb5`

- `sssd-krb5-common`

- `sssd-ldap`

- `sssd-nfs-idmap`

- `sssd-polkit-rules`

- `sssd-proxy`

- `sssd-tools`

- `sssd-winbind-idmap`

- `systemd`

- `systemd-container`

- `systemd-libs`

- `systemd-oomd`

- `systemd-pam`

- `systemd-resolved`

- `systemd-rpm-macros`

- `systemd-udev`

- `tuned`

- `tuned-profiles-cpu-partitioning`

- `vim-filesystem`

- `vim-minimal`

- `yum`

- `yum-utils`

Modified Binary Packages for CodeReady Linux Builder by Oracle

The following binary packages to CodeReady Linux Builder by Oracle have been modified:

- `crash-devel`

- `cups-filters-devel`

- `dotnet-sdk-6.0-source-built-artifacts`

- `fwupd-devel`

- `gcc-plugin-devel`

- `glibc-benchtests`

- `glibc-nss-devel`

- `glibc-static`

- `ima-evm-utils-devel`

- `iproute-devel`

- `kmod-devel`

- `libdnf-devel`

- `libguestfs-devel`

- `libguestfs-gobject`

- `libguestfs-gobject-devel`

- `libguestfs-man-pages-ja`

- `libguestfs-man-pages-uk`

- `librados-devel`

- `libradospp-devel`

- `librbd-devel`

- `libreoffice-sdk`

- `libreoffice-sdk-doc`

- `libsss_nss_idmap-devel`

- `libstdc++-static`

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- `libtirpc-devel`

- `libvirt-devel`

- `libvirt-docs`

- `libvirt-lock-sanlock`

- `lua-guestfs`

- `mpich`

- `munge-devel`

- `NetworkManager-libnm-devel`

- `nginx-mod-devel`

- `nss_db`

- `nss_hesiod`

- `ocaml-libguestfs`

- `ocaml-libguestfs-devel`

- `OpenIPMI-devel`

- `openscap-engine-sce-devel`

- `PackageKit-glib-devel`

- `python3-ipatests`

- `python3-mpich`

- `ruby-libguestfs`

- `sanlock-devel`

- `sendmail-milter`

- `sendmail-milter-devel`

- `tog-pegasus-devel`

- `virt-v2v-man-pages-ja`

- `virt-v2v-man-pages-uk`

Modified AppStream Binary Packages

The following binary packages from the AppStream upstream release have been modified:

- `aardvark-dns`

- `anaconda`

- `anaconda-core`

- `anaconda-dracut`

- `anaconda-gui`

- `anaconda-install-env-deps`

- `anaconda-install-img-deps`

- `anaconda-tui`
- `anaconda-user-help`
- `anaconda-widgets`
- `aspnetcore-runtime-6.0`
- `aspnetcore-targeting-pack-6.0`
- `autocorr-af`
- `autocorr-bg`
- `autocorr-ca`
- `autocorr-cs`
- `autocorr-da`
- `autocorr-de`
- `autocorr-dsb`
- `autocorr-el`
- `autocorr-en`
- `autocorr-es`
- `autocorr-fa`
- `autocorr-fi`
- `autocorr-fr`
- `autocorr-ga`
- `autocorr-hr`
- `autocorr-hsb`
- `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-vro

- autocorr-zh

- binutils-devel

- blivet-data

- boom-boot

- boom-boot-conf

- boom-boot-grub2

- buildah

- buildah-tests

- clang

- clang-analyzer

- clang-devel

- clang-libs

- clang-resource-filesystem

- clang-tools-extra

- cloud-init

- cockpit-composer

- cockpit-packagekit

- cockpit-pcp

- cockpit-session-recording

- cockpit-storaged

- compat-libgfortran-48

- containers-common

- container-tools

- cpp

- crash

- cups-filters

- cups-filters-libs

- dbus-daemon

- dbus-devel

- dbus-x11
- ddiskit
- delve
- dotnet-apphost-pack-6.0
- dotnet-host
- dotnet-hostfxr-6.0
- dotnet-runtime-6.0
- dotnet-sdk-6.0
- dotnet-targeting-pack-6.0
- dotnet-templates-6.0
- dracut-caps
- dracut-live
- efi-srpm-macros
- eth-tools-basic
- eth-tools-fastfabric
- fapolicyd
- fapolicyd-dnf-plugin
- fapolicyd-selinux
- firefox
- firewall-applet
- firewall-config
- fwupd-plugin-flashrom
- galera
- gcc
- gcc-c++
- gcc-gfortran
- gcc-offload-nvptx
- gcc-plugin-annobin
- gdb
- gdb-doc
- gdb-gdbserver
- gdb-headless
- gdb-minimal
- git-clang-format
- glibc-devel

- glibc-doc
- glibc-headers
- glibc-locale-source
- glibc-utils
- gnome-shell-extension-background-logo
- httpd
- httpd-devel
- httpd-filesystem
- httpd-manual
- httpd-tools
- initial-setup
- initial-setup-gui
- ipa-client
- ipa-client-common
- ipa-client-epn
- ipa-client-samba
- ipa-common
- ipa-selinux
- ipa-server
- ipa-server-common
- ipa-server-dns
- ipa-server-trust-ad
- krb5-devel
- ksh
- libasan
- libblockdev
- libblockdev-btrfs
- libblockdev-crypto
- libblockdev-dm
- libblockdev-fs
- libblockdev-kbd
- libblockdev-loop
- libblockdev-lvm
- libblockdev-lvm-dbus
- libblockdev-mdraid

- `libblockdev-mpath`

- `libblockdev-nvdimm`

- `libblockdev-part`

- `libblockdev-plugins-all`

- `libblockdev-swap`

- `libblockdev-tools`

- `libblockdev-utils`

- `libgccjit`

- `libgccjit-devel`

- `libgomp-offload-nvptx`

- `libguestfs`

- `libguestfs-appliance`

- `libguestfs-bash-completion`

- `libguestfs-inspect-icons`

- `libguestfs-rescue`

- `libguestfs-rsync`

- `libguestfs-xfs`

- `libitm`

- `libitm-devel`

- `liblsan`

- `libquadmath-devel`

- `librados2`

- `librbd1`

- `libreoffice-base`

- `libreoffice-calc`

- `libreoffice-core`

- `libreoffice-data`

- `libreoffice-draw`

- `libreoffice-emailmerge`

- `libreoffice-filters`

- `libreoffice-gdb-debug-support`

- `libreoffice-graphicfilter`

- `libreoffice-gtk3`

- `libreoffice-help-ar`

- `libreoffice-help-bg`

- `libreoffice-help-bn`
- `libreoffice-help-ca`
- `libreoffice-help-cs`
- `libreoffice-help-da`
- `libreoffice-help-de`
- `libreoffice-help-dz`
- `libreoffice-help-el`
- `libreoffice-help-en`
- `libreoffice-help-eo`
- `libreoffice-help-es`
- `libreoffice-help-et`
- `libreoffice-help-eu`
- `libreoffice-help-fi`
- `libreoffice-help-fr`
- `libreoffice-help-gl`
- `libreoffice-help-gu`
- `libreoffice-help-he`
- `libreoffice-help-hi`
- `libreoffice-help-hr`
- `libreoffice-help-hu`
- `libreoffice-help-id`
- `libreoffice-help-it`
- `libreoffice-help-ja`
- `libreoffice-help-ko`
- `libreoffice-help-lt`
- `libreoffice-help-lv`
- `libreoffice-help-nb`
- `libreoffice-help-nl`
- `libreoffice-help-nn`
- `libreoffice-help-pl`
- `libreoffice-help-pt-BR`
- `libreoffice-help-pt-PT`
- `libreoffice-help-ro`
- `libreoffice-help-ru`
- `libreoffice-help-si`

- `libreoffice-help-sk`
- `libreoffice-help-sl`
- `libreoffice-help-sv`
- `libreoffice-help-ta`
- `libreoffice-help-tr`
- `libreoffice-help-uk`
- `libreoffice-help-zh-Hans`
- `libreoffice-help-zh-Hant`
- `libreoffice-impress`
- `libreofficekit`
- `libreoffice-langpack-af`
- `libreoffice-langpack-ar`
- `libreoffice-langpack-as`
- `libreoffice-langpack-bg`
- `libreoffice-langpack-bn`
- `libreoffice-langpack-br`
- `libreoffice-langpack-ca`
- `libreoffice-langpack-cs`
- `libreoffice-langpack-cy`
- `libreoffice-langpack-da`
- `libreoffice-langpack-de`
- `libreoffice-langpack-dz`
- `libreoffice-langpack-el`
- `libreoffice-langpack-en`
- `libreoffice-langpack-eo`
- `libreoffice-langpack-es`
- `libreoffice-langpack-et`
- `libreoffice-langpack-eu`
- `libreoffice-langpack-fa`
- `libreoffice-langpack-fi`
- `libreoffice-langpack-fr`
- `libreoffice-langpack-fy`
- `libreoffice-langpack-ga`
- `libreoffice-langpack-gl`
- `libreoffice-langpack-gu`

- `libreoffice-langpack-he`
- `libreoffice-langpack-hi`
- `libreoffice-langpack-hr`
- `libreoffice-langpack-hu`
- `libreoffice-langpack-id`
- `libreoffice-langpack-it`
- `libreoffice-langpack-ja`
- `libreoffice-langpack-kk`
- `libreoffice-langpack-kn`
- `libreoffice-langpack-ko`
- `libreoffice-langpack-lt`
- `libreoffice-langpack-lv`
- `libreoffice-langpack-mai`
- `libreoffice-langpack-ml`
- `libreoffice-langpack-mr`
- `libreoffice-langpack-nb`
- `libreoffice-langpack-nl`
- `libreoffice-langpack-nn`
- `libreoffice-langpack-nr`
- `libreoffice-langpack-nso`
- `libreoffice-langpack-or`
- `libreoffice-langpack-pa`
- `libreoffice-langpack-pl`
- `libreoffice-langpack-pt-BR`
- `libreoffice-langpack-pt-PT`
- `libreoffice-langpack-ro`
- `libreoffice-langpack-ru`
- `libreoffice-langpack-si`
- `libreoffice-langpack-sk`
- `libreoffice-langpack-sl`
- `libreoffice-langpack-sr`
- `libreoffice-langpack-ss`
- `libreoffice-langpack-st`
- `libreoffice-langpack-sv`
- `libreoffice-langpack-ta`

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- `libreoffice-langpack-te`
- `libreoffice-langpack-th`
- `libreoffice-langpack-tn`
- `libreoffice-langpack-tr`
- `libreoffice-langpack-ts`
- `libreoffice-langpack-uk`
- `libreoffice-langpack-ve`
- `libreoffice-langpack-xh`
- `libreoffice-langpack-zh-Hans`
- `libreoffice-langpack-zh-Hant`
- `libreoffice-langpack-zu`
- `libreoffice-math`
- `libreoffice-ogltrans`
- `libreoffice-opensymbol-fonts`
- `libreoffice-pdfimport`
- `libreoffice-pyuno`
- `libreoffice-ure`
- `libreoffice-ure-common`
- `libreoffice-wiki-publisher`
- `libreoffice-writer`
- `libreoffice-x11`
- `libreoffice-xsltfilter`
- `libreport`
- `libreport-anaconda`
- `libreport-cli`
- `libreport-gtk`
- `libreport-plugin-bugzilla`
- `libreport-plugin-reportuploader`
- `libreport-web`
- `libreswan`
- `libstdc++-devel`
- `libstdc++-docs`
- `libtsan`
- `libubsan`
- `libvirt`

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- `libvirt-client`
- `libvirt-daemon`
- `libvirt-daemon-config-network`
- `libvirt-daemon-config-nwfilter`
- `libvirt-daemon-driver-interface`
- `libvirt-daemon-driver-network`
- `libvirt-daemon-driver-nodedev`
- `libvirt-daemon-driver-nwfilter`
- `libvirt-daemon-driver-qemu`
- `libvirt-daemon-driver-secret`
- `libvirt-daemon-driver-storage`
- `libvirt-daemon-driver-storage-core`
- `libvirt-daemon-driver-storage-disk`
- `libvirt-daemon-driver-storage-iscsi`
- `libvirt-daemon-driver-storage-logical`
- `libvirt-daemon-driver-storage-mpath`
- `libvirt-daemon-driver-storage-rbd`
- `libvirt-daemon-driver-storage-scsi`
- `libvirt-daemon-kvm`
- `libvirt-libs`
- `libvirt-nss`
- `libxslt`
- `libxslt-devel`
- `lorax`
- `lorax-docs`
- `lorax-lmc-novirt`
- `lorax-lmc-virt`
- `lorax-templates-generic`
- `lorax-templates-rhel`
- `mecab-ipadic`
- `mecab-ipadic-EUCJP`
- `mod_ldap`
- `mod_lua`
- `mod_proxy_html`
- `mod_session`

- mod_ssl
- mpich
- mpich-autoload
- mpich-devel
- mpich-doc
- munge
- munge-libs
- netavark
- netstandard-targeting-pack-2.1
- NetworkManager-cloud-setup
- NetworkManager-dispatcher-routing-rules
- NetworkManager-ovs
- NetworkManager-ppp
- nginx
- nginx-all-modules
- nginx-filesystem
- nginx-mod-http-image-filter
- nginx-mod-http-perl
- nginx-mod-http-xslt-filter
- nginx-mod-mail
- nginx-mod-stream
- ntsysv
- opa-address-resolution
- opa-basic-tools
- opa-fastfabric
- opa-fm
- opa-libopamgt
- OpenIPMI
- OpenIPMI-lanserv
- OpenIPMI-libs
- openscap
- openscap-devel
- openscap-engine-sce
- openscap-python3
- openscap-scanner

- openscap-utils
- open-vm-tools
- open-vm-tools-desktop
- open-vm-tools-sdmp
- open-vm-tools-test
- osbuild-composer
- osbuild-composer-core
- osbuild-composer-dnf-json
- osbuild-composer-worker
- oscap-anaconda-addon
- osinfo-db
- PackageKit
- PackageKit-command-not-found
- PackageKit-glib
- PackageKit-gstreamer-plugin
- PackageKit-gtk3-module
- perl-Sys-Guestfs
- perl-XML-Parser
- pesign
- pki-acme
- pki-base
- pki-base-java
- pki-ca
- pki-kra
- pki-server
- pki-symkey
- pki-tools
- plymouth
- plymouth-core-libs
- plymouth-graphics-libs
- plymouth-plugin-fade-throbber
- plymouth-plugin-label
- plymouth-plugin-script
- plymouth-plugin-space-flares
- plymouth-plugin-two-step

- `plymouth-scripts`

- `plymouth-system-theme`

- `plymouth-theme-charge`

- `plymouth-theme-fade-in`

- `plymouth-theme-script`

- `plymouth-theme-solar`

- `plymouth-theme-spinfinity`

- `plymouth-theme-spinner`

- `podman`

- `podman-catatonit`

- `podman-docker`

- `podman-gvproxy`

- `podman-plugins`

- `podman-remote`

- `podman-tests`

- `polkit-devel`

- `polkit-docs`

- `pykickstart`

- `python3-blivet`

- `python3-blockdev`

- `python3-boom`

- `python3-clang`

- `python3-ipaclient`

- `python3-ipalib`

- `python3-ipaserver`

- `python3-iscsi-initiator-utils`

- `python3-kickstart`

- `python3-libguestfs`

- `python3-libreport`

- `python3-pki`

- `python3-rtslib`

- `python3-sanlock`

- `rear`

- `rhel-system-roles`

- `rpm-apidocs`

- rpm-build
- rpm-cron
- rpm-devel
- rpmdevtools
- rpm-plugin-fapolicyd
- rpm-plugin-ima
- rpm-plugin-syslog
- rpm-plugin-systemd-inhibit
- sanlock
- sanlock-lib
- scap-security-guide
- scap-security-guide-doc
- selinux-policy-devel
- sendmail
- sendmail-cf
- sendmail-doc
- setroubleshoot
- setroubleshoot-plugins
- setroubleshoot-server
- systemd-devel
- systemd-journal-remote
- systemtap
- systemtap-client
- systemtap-devel
- systemtap-exporter
- systemtap-initscript
- systemtap-runtime
- systemtap-runtime-java
- systemtap-runtime-python3
- systemtap-runtime-virtguest
- systemtap-runtime-virthost
- systemtap-sdt-devel
- systemtap-server
- target-restore
- thunderbird

- `tog-pegasus`

- `tog-pegasus-libs`

- `tuned-gtk`

- `tuned-profiles-atomic`

- `tuned-profiles-mssql`

- `tuned-profiles-oracle`

- `tuned-profiles-spectrumscale`

- `tuned-utils`

- `vim-common`

- `vim-enhanced`

- `vim-X11`

- `virt-install`

- `virt-manager`

- `virt-manager-common`

- `virt-p2v`

- `virt-v2v`

- `virt-v2v-bash-completion`

- `WALinuxAgent`

- `WALinuxAgent-udev`

- `xsane`

- `xsane-common`

Removed BaseOS Binary Packages

The following binary packages from the BaseOS upstream release have been removed:

- `kpatch`

- `kpatch-dnf`

- `libdnf-plugin-subscription-manager`

- `python3-cloud-what`

- `python3-subscription-manager-rhsm`

- `redhat-release-eula`

- `rhsm-icons`

- `subscription-manager`

- `subscription-manager-cockpit`

- `subscription-manager-plugin-ostree`

- `subscription-manager-rhsm-certificates`

Removed AppStream Binary Packages

The following binary packages from the AppStream upstream release have been removed:

- `ansible-collection-microsoft-sql`
- `ansible-collection-redhat-rhel_mgmt`
- `insights-client`
- `libreport-rhel-anaconda-bugzilla`
- `NetworkManager-config-connectivity-redhat`
- `nmap`
- `nmap-ncat`
- `realtime-tests`
- `redhat-backgrounds`
- `redhat-indexhtml`
- `redhat-logos`
- `redhat-logos-httpd`
- `redhat-logos-ipa`
- `rhc`
- `rhc-worker-playbook`
- `toolbox`
- `toolbox-tests`
- `virtio-win`
- `virt-who`

Removed CodeReady Linux Builder Binary Packages

The following binary packages from the CodeReady Linux Builder upstream release have been removed:

- `redhat-sb-certs`

Changes to Source Packages

This section contains information about the removed, modified, and new **source** packages in this release. For information about the **binary** package changes, see Changes to Binary Packages.

Added Source Packages for BaseOS by Oracle

The following source packages have been added to the BaseOS by Oracle:

- `bcache-tools`

- `btrfs-progs`

- `dtrace`

- `kernel-uek`

- `ocfs2-tools`

- `oracle-indexhtml`

- `oraclelinux-release`

- `oraclelinux-release-el9`

- `oracle-logos`

Added Source Packages for AppStream by Oracle

The following source packages have been added to AppStream by Oracle:

- `dnf-plugin-spacewalk`

- `dtrace`

- `pyOpenSSL`

- `python3-dnf-plugin-ulninfo`

- `python-hwdata`

- `rhn-client-tools`

- `rhnlib`

- `rhnsd`

Modified BaseOS Source Packages

The following source packages from the BaseOS upstream release have been modified:

- `autofs`

- `binutils`

- `chkconfig`

- `chrony`

- `cockpit`

- `coreutils`

- `dbus`

- `dnf`

- `dnf-plugins-core`

- `dracut`

- `efibootmgr`

- `efi-rpm-macros`

- `firewalld`

- fwupd
- gcc
- glibc
- grub2
- grubby
- ima-evm-utils
- iproute
- iscsi-initiator-utils
- kexec-tools
- kmod
- kmod-kvdo
- krb5
- libdnf
- libkcapi
- libreport
- libtirpc
- linux-firmware
- mcelog
- microcode_ctl
- NetworkManager
- nvmetcli
- os-prober
- polkit
- python-configshell
- redhat-release
- rpm
- selinux-policy
- shim
- sos
- sssd
- systemd
- tuned
- vim

Modified AppStream Source Packages

The following source packages from the AppStream upstream release have been modified:

- anaconda
- anaconda-user-help
- binutils
- boom-boot
- buildah
- ceph
- chkconfig
- clang
- cloud-init
- cockpit
- cockpit-composer
- cockpit-session-recording
- compat-libgfortran-48
- containers-common
- container-tools
- crash
- cups-filters
- dbus
- ddiskit
- delve
- dotnet6.0
- dracut
- efi-rpm-macros
- eth-tools
- fapolicyd
- firefox
- firewalld
- fwupd
- galera
- gcc
- gdb

- glibc
- gnome-shell-extension-background-logo
- httpd
- initial-setup
- ipa
- iscsi-initiator-utils
- krb5
- ksh
- libblockdev
- libguestfs
- libreoffice
- libreport
- libreswan
- libvirt
- libxslt
- lorax
- lorax-templates-rhel
- mecab-ipadic
- mpich
- munge
- NetworkManager
- nginx
- opa-ff
- opa-fm
- OpenIPMI
- openscap
- open-vm-tools
- osbuild-composer
- oscap-anaconda-addon
- osinfo-db
- PackageKit
- perl-XML-Parser
- pesign
- pki-core
- plymouth

- podman

- polkit

- pykickstart

- python-blivet

- python-rtslib

- rear

- rhel-system-roles

- rpm

- rpmdevtools

- sanlock

- scap-security-guide

- selinux-policy

- sendmail

- setroubleshoot

- setroubleshoot-plugins

- systemd

- systemtap

- thunderbird

- tog-pegasus

- tuned

- vim

- virt-manager

- virt-p2v

- virt-v2v

- WALinuxAgent

- xsane

Modified Source Packages for CodeReady Linux Builder by Oracle

The following binary packages to CodeReady Linux Builder by Oracle have been modified:

- anaconda

- ceph

- crash

- cups-filters

- dotnet6.0

- dovecot

- `fwupd`

- `gcc`

- `glibc`

- `ipa`

- `java-11-openjdk`

- `java-1.8.0-openjdk`

- `kmod`

- `libbpf`

- `libdnf`

- `libguestfs`

- `libreoffice`

- `libvirt`

- `mpich`

- `munge`

- `NetworkManager`

- `nginx`

- `ocaml`

- `OpenIPMI`

- `openscap`

- `PackageKit`

- `python-packaging`

- `python-psutil`

- `sanlock`

- `sendmail`

- `sssd`

- `tog-pegasus`

- `virt-v2v`

Removed BaseOS Source Packages

The following source packages from the BaseOS upstream release have been removed:

- `kpatch`
- `subscription-manager`

Removed AppStream Source Packages

The following source packages from the AppStream upstream release have been removed:

- `ansible-collection-microsoft-sql`

- `ansible-collection-redhat-rhel_mgmt`

- `insights-client`

- `libica`

- `nmap`

- `realtime-tests`

- `redhat-indexhtml`

- `redhat-logos`

- `rhc`

- `rhc-worker-playbook`

- `toolbox`

- `virtio-win`

- `virt-who`