

Release Notes

SUSE Linux Enterprise Server is a modern, modular operating system for both multimodal and traditional IT. This document provides a high-level overview of features, capabilities, and limitations of SUSE Linux Enterprise Server 15 SP5 (prerelease) and highlights important product updates.

This product will be released in June 2024. The latest version of these release notes is always available at <https://www.suse.com/releasenotes> . Drafts of the general documentation can be found at <https://susedoc.github.io/doc-sle/main> .

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1 About the release notes

These Release Notes are identical across all architectures, and the most recent version is always available online at <https://www.suse.com/releasesnotes> .

Entries are only listed once but they can be referenced in several places if they are important and belong to more than one section.

Release notes usually only list changes that happened between two subsequent releases. Certain important entries from the release notes of previous product versions are repeated. To make these entries easier to identify, they contain a note to that effect.

However, repeated entries are provided as a courtesy only. Therefore, if you are skipping one or more service packs, check the release notes of the skipped service packs as well. If you are only reading the release notes of the current release, you could miss important changes.

2 SUSE Linux Enterprise Server

SUSE Linux Enterprise Server 15 SP5 (prerelease) is a multimodal operating system that paves the way for IT transformation in the software-defined era. It is a modern and modular OS that helps simplify multimodal IT, makes traditional IT infrastructure efficient and provides an engaging platform for developers. As a result, you can easily deploy and transition business-critical workloads across on-premises and public cloud environments.

SUSE Linux Enterprise Server 15 SP5 (prerelease), with its multimodal design, helps organizations transform their IT landscape by bridging traditional and software-defined infrastructure.

2.1 Interoperability and hardware support

Designed for interoperability, SUSE Linux Enterprise Server integrates into classical Unix and Windows environments, supports open standard interfaces for systems management, and has been certified for IPv6 compatibility.

This modular, general-purpose operating system runs on four processor architectures and is available with optional extensions that provide advanced capabilities for tasks such as real-time computing and high-availability clustering.

SUSE Linux Enterprise Server is optimized to run as a high-performance guest on leading hypervisors. This makes SUSE Linux Enterprise Server the perfect guest operating system for virtual computing.

2.2 What is new?

2.2.1 General changes in SLE 15

SUSE Linux Enterprise Server 15 introduces many innovative changes compared to SUSE Linux Enterprise Server 12. The most important changes are listed below.

Migration from openSUSE Leap to SUSE Linux Enterprise Server

SLE 15 SP2 and later support migrating from openSUSE Leap 15 to SUSE Linux Enterprise Server 15. Even if you decide to start out with the free community distribution, you can later easily upgrade to a distribution with enterprise-class support. For more information, see the *Upgrade Guide* at <https://documentation.suse.com/sles/15-SP5/html/SLES-all/cha-upgrade-online.html#sec-upgrade-online-opensuse-to-sle>.

Extended package search

Use the new Zypper command `zypper search-packages` to search across all SUSE repositories available for your product, even if they are not yet enabled. For more information see [Section 5.6.3, "Searching packages across all SLE modules"](#).

Software Development Kit

In SLE 15, packages formerly shipped as part of the Software Development Kit are now integrated into the products. Development packages are packaged alongside other packages. In addition, the *Development Tools* module contains tools for development.

RMT replaces SMT

SMT (Subscription Management Tool) has been removed. Instead, RMT (Repository Mirroring Tool) now allows mirroring SUSE repositories and custom repositories. You can then register systems directly with RMT. In environments with tightened security, RMT can also proxy other RMT servers. If you are planning to migrate SLE 12 clients to version 15, RMT is the supported product to handle such migrations. If you still need to use SMT for these migrations, beware that the migrated clients will have *all* installation modules enabled. For more information see [Section 4.2.4, "SMT has been replaced by RMT"](#).

Media changes

The *Unified Installer* and *Packages* media known from SUSE Linux Enterprise Server 15 SP1 have been replaced by the following media:

- **Online Installation Medium:** Allows installing all SUSE Linux Enterprise 15 products. Packages are fetched from online repositories. This type of installation requires a registration key. Available SLE modules are listed in [Section 3.1, “Modules in the SLE 15 SP5 \(prerelease\) product line”](#).
- **Full Installation Medium:** Allows installing all SUSE Linux Enterprise Server 15 products without a network connection. This medium contains all packages from all SLE modules. SLE modules need to be enabled manually during installation. RMT (Repository Mirroring Tool) and SUSE Manager provide additional options for disconnected or managed installations.

MAJOR UPDATES TO THE SOFTWARE SELECTION:

Salt

SLE 15 SP5 (prerelease) can be managed via Salt, making it integrate better with modern management solutions such as SUSE Manager.

Python 3

As the first enterprise distribution, SLE 15 offers full support for Python 3 development in addition to Python 2.

Directory Server

389 Directory Server replaces OpenLDAP as the LDAP directory service.

2.2.2 Changes in 15 SP5 (prerelease)

SUSE Linux Enterprise Server 15 SP5 (prerelease) introduces changes compared to SUSE Linux Enterprise Server 15 SP4. The most important changes are listed below:

2.2.3 Package and module changes in 15 SP5 (prerelease)

The full list of changed packages compared to 15 SP4 can be seen at this URL:

- https://documentation.suse.com/package-lists/sle/15-SP5/package-changes_SLE-15-SP4-GA_SLE-15-SP5-GA.txt ↗

The full list of changed modules compared to 15 SP4 can be seen at this URL:

- https://documentation.suse.com/package-lists/sle/15-SP5/module-changes_SLE-15-SP4-GA_SLE-15-SP5-GA.txt ↗

2.3 Important sections of this document

If you are upgrading from a previous SUSE Linux Enterprise Server release, you should review at least the following sections:

- *Section 2.7, “Support statement for SUSE Linux Enterprise Server”*
- *Section 4.2, “Upgrade-related notes”*
- *Section 5, “Changes affecting all architectures”*

2.4 Security, standards, and certification

SUSE Linux Enterprise Server 15 SP5 (prerelease) has been submitted to the certification bodies for:

- Common Criteria Certification, see <https://www.commoncriteriaportal.org/> ↗
- FIPS 140-2 validation, see <https://doi.org/10.6028/NIST.FIPS.140-2> ↗

For more information about certification, see <https://www.suse.com/support/security/certifications/> ↗.

2.5 Documentation and other information

2.5.1 Available on the product media

- Read the READMEs on the media.
- Get the detailed change log information about a particular package from the RPM (where *FILENAME.rpm* is the name of the RPM):

```
rpm --changelog -qp FILENAME.rpm
```

- Check the ChangeLog file in the top level of the installation medium for a chronological log of all changes made to the updated packages.
- Find more information in the docu directory of the installation medium of SUSE Linux Enterprise Server 15 SP5 (prerelease). This directory includes PDF versions of the SUSE Linux Enterprise Server 15 SP5 (prerelease) Installation Quick Start Guide.

2.5.2 Online documentation

- For the most up-to-date version of the documentation for SUSE Linux Enterprise Server 15 SP5 (prerelease), see <https://susedoc.github.io/doc-sle/main> (draft version).

2.6 Support and life cycle

SUSE Linux Enterprise Server is backed by award-winning support from SUSE, an established technology leader with a proven history of delivering enterprise-quality support services.

SUSE Linux Enterprise Server 15 has a 13-year life cycle, with 10 years of General Support and three years of Extended Support. The current version (SP5) will be fully maintained and supported until six months after the release of SUSE Linux Enterprise Server 15 SP6.

If you need additional time to design, validate and test your upgrade plans, Long Term Service Pack Support can extend the support duration. You can buy an additional 12 to 36 months in twelve month increments. This means that you receive a total of three to five years of support per Service Pack.

For more information, see the pages [Support Policy \(https://www.suse.com/support/policy.html\)](https://www.suse.com/support/policy.html) and [Long Term Service Pack Support \(https://www.suse.com/support/programs/long-term-service-pack-support.html\)](https://www.suse.com/support/programs/long-term-service-pack-support.html).

2.7 Support statement for SUSE Linux Enterprise Server

To receive support, you need an appropriate subscription with SUSE. For more information, see https://www.suse.com/support/?id=SUSE_Linux_Enterprise_Server.

The following definitions apply:

L1

Problem determination, which means technical support designed to provide compatibility information, usage support, ongoing maintenance, information gathering, and basic troubleshooting using the documentation.

L2

Problem isolation, which means technical support designed to analyze data, reproduce customer problems, isolate the problem area, and provide a resolution for problems not resolved by Level 1 or prepare for Level 3.

L3

Problem resolution, which means technical support designed to resolve problems by engaging engineering to resolve product defects which have been identified by Level 2 Support.

For contracted customers and partners, SUSE Linux Enterprise Server is delivered with L3 support for all packages, except for the following:

- Technology Previews, see [Section 2.8, “Technology previews”](#)
- Sound, graphics, fonts and artwork
- Packages that require an additional customer contract, see [Section 2.7.2, “Software requiring specific contracts”](#)
- Some packages shipped as part of the module *Workstation Extension* are L2-supported only
- Packages with names ending in `-devel` (containing header files and similar developer resources) will only be supported together with their main packages.

SUSE will only support the usage of original packages. That is, packages that are unchanged and not recompiled.

2.7.1 General support

To learn about supported features and limitations, refer to the following sections in this document:

- *Section 5.2, “Kernel”*
- *Section 5.4, “Storage and file systems”*
- *Section 5.7, “Virtualization”*
- *Section 6, “Removed and deprecated features and packages”*

2.7.2 Software requiring specific contracts

Certain software delivered as part of SUSE Linux Enterprise Server may require an external contract. Check the support status of individual packages using the RPM metadata that can be viewed with `rpm`, `zypper`, or YaST.

Major packages and groups of packages affected by this are:

- PostgreSQL (all versions, including all subpackages)

2.7.3 Software under GNU AGPL

SUSE Linux Enterprise Server 15 SP5 (prerelease) (and the SUSE Linux Enterprise modules) includes the following software that is shipped *only* under a GNU AGPL software license:

- Ghostscript (including subpackages)

SUSE Linux Enterprise Server 15 SP5 (prerelease) (and the SUSE Linux Enterprise modules) includes the following software that is shipped under multiple licenses that include a GNU AGPL software license:

- MySpell dictionaries and LightProof
- ArgyllCMS

2.8 Technology previews

Technology previews are packages, stacks, or features delivered by SUSE to provide glimpses into upcoming innovations. Technology previews are included for your convenience to give you a chance to test new technologies within your environment. We would appreciate your feedback! If you test a technology preview, contact your SUSE representative and let them know about your experience and use cases. Your input is helpful for future development.

Technology previews come with the following limitations:

- Technology previews are still in development. Therefore, they may be functionally incomplete, unstable, or in other ways not suitable for production use.
- Technology previews are **not** supported.
- Technology previews may only be available for specific hardware architectures. Details and functionality of technology previews are subject to change. As a result, upgrading to subsequent releases of a technology preview may be impossible and require a fresh installation.
- Technology previews can be removed from a product at any time. This may be the case, for example, if SUSE discovers that a preview does not meet the customer or market needs, or does not comply with enterprise standards.

3 Modules, extensions, and related products

This section comprises information about modules and extensions for SUSE Linux Enterprise Server 15 SP5 (prerelease). Modules and extensions add functionality to the system.



Note: Package and module changes in 15 SP5 (prerelease)


For more information about all package and module changes since the last version, see [Section 2.2.3, “Package and module changes in 15 SP5 \(prerelease\)”](#).

3.1 Modules in the SLE 15 SP5 (prerelease) product line


The SLE 15 SP5 (prerelease) product line is made up of modules that contain software packages. Each module has a clearly defined scope. Modules differ in their life cycles and update timelines.

The modules available within the product line based on SUSE Linux Enterprise 15 SP5 (prerelease) at the release of SUSE Linux Enterprise Server 15 SP5 (prerelease) are listed in the *Modules and Extensions Quick Start* at <https://susedoc.github.io/doc-sle/main/html/SLES-modules/>  (draft version).




Not all SLE modules are available with a subscription for SUSE Linux Enterprise Server 15 SP5 (prerelease) itself (see the column *Available for*).

For information about the availability of individual packages within modules, see <https://sc-c.suse.com/packages> .

3.2 SLE extensions

SLE Extensions add extra functionality to the system and require their own registration key, usually at additional cost. Most extensions have their own release notes documents that are available from <https://www.suse.com/releasesnotes> .

The following extensions are available for SUSE Linux Enterprise Server 15 SP5 (prerelease):

- SUSE Linux Enterprise Live Patching: <https://www.suse.com/products/live-patching> 
- SUSE Linux Enterprise High Availability Extension: <https://www.suse.com/products/high-availability> 
- SUSE Linux Enterprise Workstation Extension: <https://www.suse.com/products/workstation-extension> 





The following extension is not covered by SUSE support agreements, available at no additional cost and without an extra registration key:

- SUSE Package Hub: <https://packagehub.suse.com/>  (see *Section 5.5, “SUSE Package Hub”*)

3.3 Derived and related products

This sections lists derived and related products. Usually, these products have their own release notes documents that are available from <https://www.suse.com/releasesnotes> .

- SUSE Linux Enterprise JeOS: <https://www.suse.com/products/server/jeos>  (see *Section 4.3, “Minimal-VM and Minimal-Image”*)
- SUSE Linux Enterprise Desktop: <https://www.suse.com/products/desktop> 

- SUSE Linux Enterprise Server for SAP Applications: <https://www.suse.com/products/sles-for-sap> 
- SUSE Linux Enterprise for High-Performance Computing: <https://www.suse.com/products/server/hpc> 
- SUSE Linux Enterprise Real Time: <https://www.suse.com/products/realtime> 
- SUSE Manager: <https://www.suse.com/products/suse-manager> 

4 Installation and upgrade

SUSE Linux Enterprise Server can be deployed in several ways:


- Physical machine
- Virtual host
- Virtual machine
- System containers
- Application containers

4.1 Installation

This section includes information related to the initial installation of SUSE Linux Enterprise Server 15 SP5 (prerelease).



Important: Installation documentation

The following release notes contain additional notes regarding the installation of SUSE Linux Enterprise Server. However, they do not document the installation procedure itself. For installation documentation, see the *Deployment Guide* at <https://susedoc.github.io/docsle/main/html/SLES-deployment/>  (draft version).

4.1.1 New media layout

The set of media has changed with 15 SP2. There still are two different installation media, but the way they can be used has changed:

- You can install with registration using either the online-installation medium (as with SUSE Linux Enterprise Server 15 SP1) or the full medium.
- You can install without registration using the full medium. The installer has been added to the full medium and the full medium can now be used universally for all types of installations.
- You can install without registration using the online-installation medium. Point the installer at the required SLE repositories, combining the `install=` and `instsys=` boot parameters:
 - With the `install=` parameter, select a path that contains either just the product repository or the full content of the media.
 - With the `inst-sys=` parameter, point at the installer itself, that is, `/boot/ARCHITECTURE/root` on the medium.

For more information about the parameters, see https://en.opensuse.org/SDB:Linuxrc#p_install.

4.1.2 Installation via SSH on s390x

Before starting the installation using `yast.ssh`, it is necessary to set the environmental variable `QT_XCB_GL_INTEGRATION` to `xcb_egl`:

```
export QT_XCB_GL_INTEGRATION=xcb_egl
```


4.2 Upgrade-related notes

This section includes upgrade-related information for SUSE Linux Enterprise Server 15 SP5 (pre-release).



Important: Upgrade documentation

The following release notes contain additional notes regarding the upgrade of SUSE Linux Enterprise Server. However, they do not document the upgrade procedure itself.

For upgrade documentation, see the *Upgrade Guide* at <https://susedoc.github.io/doc-sle/main/html/SLES-upgrade/>  (draft version).

4.2.1 Hibernation requires manual intervention

Previously, it was possible for data loss to occur due to the system not hibernating correctly.

In 15 SP5 (prerelease), a sanity check was introduced to prevent this. It works by removing the kernel `resume` parameter if it points to a non-existent device. However, that means a system would not use the hibernation data. To fix it, do the following:

1. Edit `/etc/default/grub` and correct the `resume` parameter to point to an existing device.
2. Regenerate `initrd`.
3. Reboot.

4.2.2 Make sure the current system is up-to-date before upgrading

Upgrading the system is only supported from the most recent patch level. Make sure the latest system updates are installed by either running `zypper patch` or by starting the YaST module *Online Update*. An upgrade on a system that is not fully patched may fail.

4.2.3 Skipping service packs requires LTSS

Skipping service packs during an upgrade is only supported if you have a Long Term Service Pack Support contract. Otherwise, you need to first upgrade to SLE 15 SP4 before upgrading to SLE 15 SP5 (prerelease).

4.2.4 SMT has been replaced by RMT

SLE 12 is the last codestream that SMT (Subscription Management Tool) is available for.

When upgrading your OS installation to SLE 15, we recommend also upgrading from SMT to its replacement RMT (Repository Mirroring Tool). RMT provides the following functionality:

- Mirroring of SUSE-originated repositories for the SLE 12-based and SLE 15-based products your organization has valid subscriptions for.
- Synchronization of subscriptions from SUSE Customer Center using your organization's mirroring credentials. (These credentials can be found in SCC under *Select Organization, Organization, Organization Credentials*)
- Selecting repositories to be mirrored locally via `rmt-cli` tool.
- Registering systems directly to RMT to get required updates.
- Adding custom repositories from external sources and distributing them via RMT to target systems.
- Improved security with proxying: If you have strict security requirements, an RMT instance with direct Internet access can proxy to another RMT instance without direct Internet access.
- Nginx as Web server: The default Web server of RMT is Nginx which has a smaller memory footprint and comparable performance than that used for SMT.

Note that unlike SMT, RMT does not support installations of SLE 11 and earlier.

For more feature comparison between RMT and SMT, see https://github.com/SUSE/rmt/blob/master/docs/smt_and_rmt.md.

For more information about RMT, also see the new RMT Guide at <https://documentation.suse.com/sles/15-SP3/html/SLES-all/book-rmt.html>.

4.3 Minimal-VM and Minimal-Image

SUSE Linux Enterprise Server Minimal-VM and Minimal-Image is a slimmed-down form factor of SUSE Linux Enterprise Server that is ready to run in virtualization environments and the cloud. With SUSE Linux Enterprise Server Minimal-VM and Minimal-Image, you can choose the right-sized SUSE Linux Enterprise Server option to fit your needs.

SUSE provides virtual disk images for Minimal-VM and Minimal-Image in the file formats `.qcow2`, `.vhd`, and `.vmdk`, compatible with KVM, Xen, OpenStack, Hyper-V, and VMware environments. All Minimal-VM and Minimal-Image images set up the same disk size (24 GB) for the system. Due to the properties of different file formats, the size of Minimal-VM and Minimal-Image image downloads differs between formats.

4.4 JeOS renamed Minimal-VM and Minimal-Image

We have received feedback from users confused by the name JeOS, as a matter of fact the acronym JeOS, which meant Just enough Operating System, was not well understood and could be confused with other images provided by SUSE or openSUSE.

We have decided to go with simplicity and rename JeOS by "Minimal-VM" for all our Virtual Machine Images and "Minimal-Image" for the Raspberry Pi Image. We have also removed a few other characters, in the full images name to make it more simple and clear:

- [`SLES15-SP4-Minimal-VM.x86_64-kvm-and-xen-GM.qcow2`](#)
- [`SLES15-SP4-Minimal-VM.x86_64-OpenStack-Cloud-GM.qcow2`](#)
- [`SLES15-SP4-Minimal-VM.x86_64-MS-HyperV-GM.vhdx.xz`](#)
- [`SLES15-SP4-Minimal-VM.x86_64-VMware-GM.vmdk.xz`](#)
- [`SLES15-SP4-Minimal-VM.aarch64-kvm-GM.qcow2`](#)
- [`SLES15-SP4-Minimal-Image.aarch64-RaspberryPi-GM.raw.xz`](#)

4.4.1 Alternative Python 3 development interpreter moved to a separate module

SLE 15 SP4 introduces a new *Python 3* Module, which includes the alternatively available development Python interpreter, formerly included in the *Basesystem* Module. This new module will allow for more flexibility for the lifecycle of the packages provided within it and a clean separation between the system and development interpreter.

As the `python39` package was part of the *Basesystem* Module on SLE 15 SP3, the introduction of this new module will require some changes when migrating to SLE 15 SP5 (prerelease). If you are using `python39` and migrate from SLE 15 SP3, you will have to add the *Python 3* module after migration via SUSEConnect to receive updates for this alternative interpreter. Otherwise the package will remain orphaned and without security updates.

Packages inside this module can have differing support level and support lifecycle. For more information, see documentation.

4.5 For more information

For more information, see [Section 5, “Changes affecting all architectures”](#) and the sections relating to your respective hardware architecture.

5 Changes affecting all architectures

Information in this section applies to all architectures supported by SUSE Linux Enterprise Server 15 SP5 (prerelease).

5.1 Development

5.1.1 Alternative Python 3 development interpreter moved to a separate module

SLE 15 SP4 introduces a new *Python 3* Module, which includes the alternatively available development Python interpreter, formerly included in the *Basesystem* Module. This new module will allow for more flexibility for the lifecycle of the packages provided within it and a clean separation between the system and development interpreter.

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Packages inside this module can have differing support level and support lifecycle. For more information, see documentation.

5.1.2 Supported Java versions

The following Java implementations are available in SUSE Linux Enterprise Server 15 SP5 (pre-release):

Name (Package Name)	Version	Module	Support
OpenJDK (java-11-openjdk)	11	Base System	SUSE, L3, until 2026-12-31
OpenJDK (java-17-openjdk)	17	Base System	SUSE, L3, until 2028-06-30
OpenJDK (java-1_8_0-openjdk)	1.8.0	Legacy	SUSE, L3, until 2026-12-31
IBM Java (java-1_8_0-ibm)	1.8.0	Legacy	External, until 2025-04-30

5.2 Kernel

5.2.1 Kernel limits

This table summarizes the various limits which exist in our recent kernels and utilities (if related) for SUSE Linux Enterprise Server 15 SP5 (prerelease).

SLES 15 SP5 (prerelease) (Linux 5.14.21)	AMD64/Intel 64 (x86_64)	IBM Z (s390x)	POWER (ppc64le)	ARMv8 (AArch64)
CPU bits	64	64	64	64
Maximum number of logical CPUs	8192	256	2048	768
Maximum amount of RAM (theoretical/certified)	> 1 PiB/ 64 TiB	10 TiB/ 256 GiB	1 PiB/64 TiB	256 TiB/n.a.
Maximum amount of user space/kernel space	128 TiB/ 128 TiB	n.a.	512 TiB ¹ / 2 EiB	256 TiB/ 256 TiB

SLES 15 SP5 (prerelease) (Linux 5.14.21)	AMD64/Intel 64 (x86_64)	IBM Z (s390x)	POWER (ppc64le)	ARMv8 (AArch64)
Maximum amount of swap space	Up to 29 * 64 GB	Up to 30 * 64 GB		
Maximum number of processes	1,048,576			
Maximum number of threads per process	Upper limit depends on memory and other parameters (tested with more than 120,000) ² .			
Maximum size per block de- vice	Up to 8 EiB on all 64-bit architectures			
FD_SETSIZE	1024			

¹ By default, the user space memory limit on the POWER architecture is 128 TiB. However, you can explicitly request mmaps up to 512 TiB.

² The total number of all processes and all threads on a system may not be higher than the "maximum number of processes".

5.2.2 Restoring default Btrfs file compression

Previously in kernel 5.14, it was possible to disable compression by passing an empty string instead of explicitly mentioning `none` or `no`.

In SLES 15 SP5 (prerelease), this behavior is changed to the more expected one. From kernel 5.14 onwards, empty string will reset the default setting instead of disabling compression.

5.3 Security

5.3.1 TLS 1.1 and 1.0 are no longer recommended for use

The TLS 1.0 and 1.1 standards have been superseded by TLS 1.2 and TLS 1.3. TLS 1.2 has been available for considerable time now.

SUSE Linux Enterprise Server packages using OpenSSL, GnuTLS, or Mozilla NSS already support TLS 1.3. We recommend no longer using TLS 1.0 and TLS 1.1, as SUSE plans to disable these protocols in a future service pack. However, not all packages, for example, Python, are TLS 1.3-enabled yet as this is an ongoing process.

5.3.2 Replacement of gpg as recommended tool for file encryption

A new `rage-encryption` package has been added. The package provides the `rage` executable. `rage` is an implementation of the `age` file encryption format using Rust.

This replaces `gpg` as the preferred tool over `gpg` for file encryption. The main reasons are that `gpg` has a history of security issues, and is well known for its complexity. In comparison, `rage` focuses on usability and security. It especially tries to make key handling as simple as handling SSH keys (essentially short lines of text), which it also supports.

For more information, see:

- <https://github.com/str4d/rage> ↗
- <https://age-encryption.org/v1> ↗

5.4 Storage and file systems

5.4.1 Comparison of supported file systems

SUSE Linux Enterprise was the first enterprise Linux distribution to support journaling file systems and logical volume managers in 2000. Later, we introduced XFS to Linux, which allows for reliable large-scale file systems, systems with heavy load, and multiple parallel reading and writing operations. With SUSE Linux Enterprise 12, we started using the copy-on-write file system Btrfs as the default for the operating system, to support system snapshots and rollback.

The following table lists the file systems supported by SUSE Linux Enterprise.

Support status: + supported / – unsupported

Feature	Btrfs	XFS	Ext4	OCFS 2 ¹
Supported in product	SLE	SLE	SLE	SLE HA

Feature	Btrfs	XFS	Ext4	OCFS 2 ¹
Data/metadata journaling	N/A ²	– / +	+ / +	– / +
Journal internal/external	N/A ²	+ / +	+ / +	+ / –
Journal checksumming	N/A ²	+	+	+
Subvolumes	+	–	–	–
Offline extend/shrink	+ / +	– / –	+ / +	+ / – ³
Inode allocation map	B-tree	B+ -tree	Table	B-tree
Sparse files	+	+	+	+
Tail packing	–	–	–	–
Small files stored inline	+ (in metadata)	–	+ (in inode)	+ (in inode)
Defragmentation	+	+	+	–
Extended file attributes/ACLs	+ / +	+ / +	+ / +	+ / +
User/group quotas	– / –	+ / +	+ / +	+ / +
Project quotas	–	+	+	–
Subvolume quotas	+	N/A	N/A	N/A
Data dump/restore	–	+	–	–
Block size default	4 KiB ⁴			
Maximum file system size	16 EiB	8 EiB	1 EiB	4 PiB
Maximum file size	16 EiB	8 EiB	1 EiB	4 PiB

¹ OCFS 2 is fully supported as part of the SUSE Linux Enterprise High Availability Extension.

² Btrfs is a copy-on-write file system. Instead of journaling changes before writing them in-place, it writes them to a new location and then links the new location in. Until the last write, the changes are not "committed". Because of the nature of the file system, quotas are implemented based on subvolumes (qgroups).

³ To extend an OCFS 2 file system, the cluster must be online but the file system itself must be unmounted.

⁴ The block size default varies with different host architectures. 64 KiB is used on POWER, 4 KiB on other systems. The actual size used can be checked with the command `getconf PAGE_SIZE`.

Additional notes

Maximum file size above can be larger than the file system's actual size because of the use of sparse blocks. All standard file systems on SUSE Linux Enterprise Server have LFS, which gives a maximum file size of 2^{63} bytes in theory.

The numbers in the table above assume that the file systems are using a 4 KiB block size which is the most common standard. When using different block sizes, the results are different.

In this document:

- 1024 Bytes = 1 KiB
- 1024 KiB = 1 MiB;
- 1024 MiB = 1 GiB
- 1024 GiB = 1 TiB
- 1024 TiB = 1 PiB
- 1024 PiB = 1 EiB.

See also <http://physics.nist.gov/cuu/Units/binary.html>.

Some file system features are available in SUSE Linux Enterprise Server 15 SP5 (prerelease) but are not supported by SUSE. By default, the file system drivers in SUSE Linux Enterprise Server 15 SP5 (prerelease) will refuse mounting file systems that use unsupported features (in particular, in read-write mode). To enable unsupported features, set the module parameter `allow_unsupported=1` in `/etc/modprobe.d` or write the value `1` to `/sys/module/MODULE_NAME/parameters/allow_unsupported`. However, note that setting this option will render your kernel and thus your system unsupported.

5.4.2 Supported Btrfs features

The following table lists supported and unsupported Btrfs features across multiple SLES versions.

Support status: + supported / – unsupported

Feature	SLES 11 SP4	SLES 12 SP5	SLES 15 GA	SLES 15 SP1	SLES 15 SP2	SLES 15 SP3
Copy on write	+	+	+	+	+	+
Free space tree (Free Space Cache v2)	–	–	–	+	+	+
Snapshots/subvol- umes	+	+	+	+	+	+
Swap files	–	–	–	+	+	+
Metadata integrity	+	+	+	+	+	+
Data integrity	+	+	+	+	+	+
Online metadata scrubbing	+	+	+	+	+	+
Automatic defrag- mentation	–	–	–	–	–	–
Manual defrag- mentation	+	+	+	+	+	+
In-band deduplica- tion	–	–	–	–	–	–
Out-of-band dedu- plication	+	+	+	+	+	+
Quota groups	+	+	+	+	+	+

Feature	SLES 11 SP4	SLES 12 SP5	SLES 15 GA	SLES 15 SP1	SLES 15 SP2	SLES 15 SP3
Metadata duplication	+	+	+	+	+	+
Changing metadata UUID	–	–	–	+	+	+
Multiple devices	–	+	+	+	+	+
RAID 0	–	+	+	+	+	+
RAID 1	–	+	+	+	+	+
RAID 5	–	–	–	–	–	–
RAID 6	–	–	–	–	–	–
RAID 10	–	+	+	+	+	+
Hot add/remove	–	+	+	+	+	+
Device replace	–	–	–	–	–	–
Seeding devices	–	–	–	–	–	–
Compression	–	+	+	+	+	+
Big metadata blocks	–	+	+	+	+	+
Skinny metadata	–	+	+	+	+	+
Send without file data	–	+	+	+	+	+
Send/receive	–	+	+	+	+	+
Inode cache	–	–	–	–	–	–

Feature	SLES 11 SP4	SLES 12 SP5	SLES 15 GA	SLES 15 SP1	SLES 15 SP2	SLES 15 SP3
Fallocate with hole punch	–	+	+	+	+	+

5.5 SUSE Package Hub

SUSE Package Hub brings open-source software packages from openSUSE to SUSE Linux Enterprise Server and SUSE Linux Enterprise Desktop.

Usage of software from SUSE Package Hub is not covered by SUSE support agreements. At the same time, usage of software from SUSE Package Hub does not affect the support status of your SUSE Linux Enterprise systems. SUSE Package Hub is available at no additional cost and without an extra registration key.

5.5.1 Important package additions to SUSE Package Hub

Among others, the following packages have been added to SUSE Package Hub:

5.6 System management

5.6.1 Silence KillMode=None messages

The log level of the deprecation warnings regarding `killmode=None` have been reduced. Instead of `warning`, they are now logged at the `debug` log level.

5.6.2 `yast2-iscsi-client` drops `open-iscsi` and `iscsiuio` as dependencies

The `yast2-iscsi-client` package no longer automatically installs `open-iscsi` and `iscsiuio`. The two packages need to be installed manually before using `yast2-iscsi-client`.

5.6.3 Searching packages across all SLE modules

In SLE 15 SP5 (prerelease) you can search for packages both within and outside of currently enabled SLE modules using the following command:

```
zypper search-packages -d SEARCH_TERM
```

This command contacts the SCC and searches all modules for matching packages. This functionality makes it easier for administrators and system architects to find the software packages needed.

5.7 Virtualization

For more information about acronyms used below, see <https://documentation.suse.com/sles/15-SP5/html/SLES-all/book-virtualization.html>.



Important: Virtualization limits and supported hosts/guests

These release notes only document changes in virtualization support compared to the immediate previous service pack of SUSE Linux Enterprise Server. Full information regarding virtualization limits for KVM and Xen as well as supported guest and host systems is now available as part of the SUSE Linux Enterprise Server documentation.

See the *Virtualization Guide* at <https://susedoc.github.io/doc-sle/main/html/SLES-virtualization/cha-virt-support.html> (draft version).

5.7.1 KVM

We increase the support from 288 up 768 VCPU per virtual Machine.

5.7.2 Xen

Xen has been updated to version 4.17:

- The x86 MCE command line option info is now updated.
- `__ro_after_init` support, for marking data as immutable after boot.

- The project has officially adopted 4 directives and 24 rules of MISRA-C, added MISRA-C checker build integration, and defined how to document deviations.
- IOMMU superpage support on x86, affecting PV guests as well as HVM/PVH ones when they don't share page tables with the CPU (HAP/EPT/NPT).
- Support for `VIRT_SSBD` and `MSR_SPEC_CTRL` for HVM guests on AMD.
- Improved TSC, CPU, and APIC clock frequency calibration on x86.
- Support for Xen using x86 Control Flow Enforcement technology for its own protection. Both Shadow Stacks (ROP protection) and Indirect Branch Tracking (COP/JOP protection).
- Add `mwait-idle` support for SPR and ADL on x86.
- Extend security support for hosts to 12 TiB of memory on x86.
- Add command line option to set cpuid parameters for dom0 at boot time on x86.
- It is possible to use PV drivers with dom0less guests, allowing statically booted dom0less guests with PV devices.
- Add Xue - console over USB 3 Debug Capability.
- dropped support for the (x86-only) `vesa-mtrr` and `vesa-remap` command line options
- `launch_security`: Use SEV-ES policy = 0x07 if host supports it

5.7.3 QEMU

QEMU has been updated to version 7.1:

- Raise the maximum number of vCPUs a VM can have to 1024 (only 768 is supported)
- Improve dependency handling (for example, what is recommended compared to what is required)
- Add the `qemu-headless` subpackage that brings in all the packages that are needed for creating VMs with tools like `virt-install` or `VirtManager`; it can be run either locally or from a remote host
- The old `qemu-binfmt` wrappers around the various `qemu-$ARCH` Linux user emulation binaries are not necessary any longer
- Enable `aio=io_uring` on all KVM architectures

For more information see the following:

- <https://wiki.qemu.org/ChangeLog/7.1> ↗
- <https://wiki.qemu.org/ChangeLog/7.0> ↗
- <https://qemu-project.gitlab.io/qemu/about/removed-features.html> ↗
- <https://qemu-project.gitlab.io/qemu/about/deprecated.html> ↗



Note: Deprecation notice

In previous versions, if no explicit image format was provided, some QEMU tools tried to guess the format of the image, and then process it accordingly. Because this feature is a potential source of security issues, it has been deprecated and removed. It is now necessary to explicitly specify the image format. For more information, see <https://qemu-project.gitlab.io/qemu/about/removed-features.html#qemu-img-backing-file-without-format-removed-in-6-1> ↗.

5.7.4 libvirt

libvirt has been updated to version 9.0.0:

- New virt-qemu-sev-validate utility for validating the measurement reported for a domain launched with AMD SEV
- New subpackage libvirt-client-qemu providing client utilities to interact with QEMU-specific features of libvirt
- Migration to /usr/etc: saving user changed configuration files in /etc and restoring them while an RPM update

For more information see the following:

- <https://libvirt.org/news.html#v9-0-0-2023-01-16> ↗
- <https://libvirt.org/news.html#v8-10-0-2022-12-01> ↗
- <https://libvirt.org/news.html#v8-9-0-2022-11-01> ↗
- <https://libvirt.org/news.html#v8-8-0-2022-10-03> ↗
- <https://libvirt.org/news.html#v8-7-0-2022-09-01> ↗

5.7.5 VMware

5.7.5.1 open-vm-tools

open-vm-tools has been updated to version 12.1.5:

- Migration of PAM settings to /usr/lib/pam.d
- Remove `libgrpc++`, `libgrpc`, and `libprotobuf` from `containerinfo` Requires section. The dependencies will be added automatically.
- Add containerInfo plugin
- Add dependencies on `grpc`, `protobuf`, and `containerd` for container introspection
- A number of Coverity reported issues have been addressed.
- The deployPkg plugin may prematurely reboot the guest VM before cloud-init has completed user data setup. If both the Perl based Linux customization script and cloud-init run when the guest VM boots, the `deployPkg` plugin may reboot the guest before cloud-init has finished. The deployPkg plugin has been updated to wait for a running cloud-init process to finish before the guest VM reboot is initiated.
- A SIGSEGV may be encountered when a non-quiescing snapshot times out
- Unwanted vmtoolsd service error message if not on a VMware hypervisor When open-vm-tools comes preinstalled in a base Linux release, the vmtoolsd services are started automatically at system start and desktop login. If running on physical hardware or in a non-VMware hypervisor, the services will emit an error message to the systemd's logging service before stopping.

5.7.6 Others

5.7.6.1 virt-manager

virt-manager has been updated to version 4.1.0:

- Specifying `--boot` no longer implies `no_install=yes`
- add UI and cli support for `qemu-vdagent` channel

- cli: More `--iothreads` suboptions
- cli: Add support for URL query with disks

5.7.6.2 `sanlock`

`sanlock` has been updated to version 3.8.5:

- Add support for Python 3
- Add support for 4k sector size
- Support `SANLOCK_RUN_DIR` and `SANLOCK_PRIVILEGED` environment variables

5.7.6.3 `Perl-Sys-Virt`

Update to 0.9.0: * Add all new APIs and constants in libvirt 9.0.0

5.7.6.4 `numactl`

`numactl` has been updated to version 2.0.15.0.g01a39cb:

- Update to support multiple nodes
- numademo: Add a new test for multiple-preferred-nodes policy
- numactl: Simplify preferred selection

5.7.6.5 `libguestfs`

`libguestfs` has been updated to version 1.48.4:

- Drop reiserfs
- Multiple fixes to the OCaml bindings
- Inspection of guests which use LUKS encryption on top of LVM logical volumes should now work `guestfs_remove_drive` has been deprecated and now returns an error.
- `guestfs_add_drive` no longer supports hotplugging

- In `guestfs_xfs_admin` the `lazycounter` parameter is deprecated because it is no longer supported in recent versions of XFS.
- The User-mode Linux ("uml") backend has been removed.
- This release has moved many virt tools like `virt-builder`, `virt-cat`, `virt-customize`, `virt-df`, etc. to the `guestfs-tools` project. This makes `libguestfs` a bit easier to build and manage.
- We now use the `qemu/libvirt` feature `-cpu max` to select the best CPU to run the appliance.
- The `qemu -enable-fips` option is no longer used. It was not needed and has been deprecated by `qemu`.
- Using the equivalent SeaBIOS feature instead of `qemu's Serial Graphics Adapter option ROM
- Renamed packages:
 - `guestfs-winsupport` → `libguestfs-winsupport`
 - `guestfsd` → `libguestfsd`
- New packages:
 - `libguestfs`, `libguestfs-type1lib-Guestfs`,
 - `libguestfs-gobject`, `libguestfs-gobject-devel`
 - `libguestfs-rescue`, `libguestfs-rsync`, `libguestfs-xfs`
- Dropped packages:
 - `libguestfs-test`

5.7.6.6 `virt-v2v`

Update to version 2.0.7: * `Virt-v2v` has been modularised allowing external programs to examine the state of the conversion and inject their own copying step. Further enhancements will be made to this new architecture in forthcoming releases. * The command line is almost identical apart from some debugging features that were removed (see below). The only significant difference is that the output format (`-of`) now has to be specified if it is different from the input format,

whereas previous versions of virt-v2v would use the same output format as input format automatically. * A lot of time was spent improving the performance of virt-v2v in common cases. * Many bug fixes and performance enhancements were made to oVirt imageio output (Nir Soffer). * There is a new virt-v2v-in-place(1) tool which replaces the existing virt-v2v --in-place option. * Virt-v2v can now convert guests which use LUKS encrypted logical volumes. * Option -oo rhv-direct has been replaced by -oo rhv-proxy, and direct mode (which is much faster) is now the default when writing to oVirt, with proxy mode available for restricted network configurations. * The following command line options were removed: -print-estimate, --debug-overlays, --no-copy. * Virt-v2v no longer installs the RHEV-APT tool in Windows guests. This tool was deprecated and then removed in oVirt 4.3. * Deprecated tool virt-v2v-copy-to-local has been removed.

6 Removed and deprecated features and packages

This section lists features and packages that were removed from SUSE Linux Enterprise Server or will be removed in upcoming versions.



Note: Package and module changes in 15 SP5 (prerelease)

For more information about all package and module changes since the last version, see [Section 2.2.3, “Package and module changes in 15 SP5 \(prerelease\)”](#).

6.1 Removed features and packages

The following features and packages have been removed in this release.

- The `samba-ad-dc-libs` package has been removed. It was previously available as technical preview.
- Setting up Kerberos with LDAP backend via YaST has been removed.
- The `thunderbolt-user-space` package has been removed.

6.2 Deprecated features and packages

The following features and packages are deprecated and will be removed in a future version of SUSE Linux Enterprise Server.

- `gnote` has been deprecated. Use `bijiben` instead.
- We have switched from `openmpi2` to `openmpi4` as the default `openmpi` implementation. This is because `openmpi2` and `openmpi3` have been EOL for some time now. They will be removed in SLES 15 SP6.

7 Obtaining source code

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A Changelog for 15 SP5 (prerelease)

A.1 2023-03-01

A.1.1 New



- *Section 5.3.2, "Replacement of gpg as recommended tool for file encryption"* (Jira (<https://jira.suse.com/browse/PED-1891>))
- *Section 5.7.5.1, "open-vm-tools"* (Jira (<https://jira.suse.com/browse/PED-1344>))

A.1.2 Updated

- *Section 5.7.2, "Xen"* (Jira (<https://jira.suse.com/browse/PED-1858>))
- *Section 5.7.3, "QEMU"* (Jira (<https://jira.suse.com/browse/PED-1716>))
- *Section 5.7.1, "KVM"* (Jira (<https://jira.suse.com/browse/PED-1855>))
- *Section 5.7.4, "libvirt"* (Jira (<https://jira.suse.com/browse/PED-447>), Jira (<https://jira.suse.com/browse/PED-225>))




A.2 2023-02-01

A.2.1 New

- *Section 4.1.2, "Installation via SSH on s390x"* (Bugzilla (https://bugzilla.suse.com/show_bug.cgi?id=1206585) )
- *Section 5.6.1, "Silence KillMode=None messages"* (Jira (<https://jira.suse.com/browse/PED-407>) )



A.3 2022-11-30

A.3.1 New

- Deprecation of gnote in *Section 6.2, "Deprecated features and packages"* (Jira (<https://jira.suse.com/browse/PED-1839>) )
- Removal of samba-ad-dc-libs in *Section 6.1, "Removed features and packages"* (Jira (<https://jira.suse.com/browse/PED-143>) )
- *Section 5.6.2, "yast2-iscsi-client drops open-iscsi and iscsiui as dependencies"* (Bugzilla (https://bugzilla.suse.com/show_bug.cgi?id=1204978) )

A.4 2022-11-02

A.4.1 New

- *Section 5.2.2, "Restoring default Btrfs file compression"* (Jira (<https://jira.suse.com/browse/PED-63>) )
- Added note about openmpi2 and openmpi3 in *Section 6.2, "Deprecated features and packages"* (Jira (<https://jira.suse.com/browse/PED-904>) )

A.5 2022-10-18

A.5.1 New

- Added note about removing Kerberos/LDAP from YaST in *Section 6, “Removed and deprecated features and packages”* (Bugzilla (https://bugzilla.suse.com/show_bug.cgi?id=1202257) ↗)
- Added note about removing `thunderbolt-user-space` in *Section 6, “Removed and deprecated features and packages”* (Jira (<https://jira.suse.com/browse/PED-1358>) ↗)

A.5.2 Updated

- Updated Java lifecycle in *Section 5.1.2, “Supported Java versions”* (Jira (<https://jira.suse.com/browse/PED-1590>) ↗):
 - OpenJDK 11 end of life is now end of 2026
 - OpenJDK 17 added
 - OpenJDK 18 end of life is now end of 2026

B Kernel parameter changes



Warning

This list of changes may not be exhaustive.

B.1 Changes from SP4 to SP5

These Linux kernel parameters have been changed since SLES 15 SP4.