Release Notes

SUSE Linux Enterprise Server 12 SP5

This document provides guidance and an overview to high-level general features and updates for SUSE Linux Enterprise Server 12 SP5. Besides architecture or product-specific information, it also describes the capabilities and limitations of SUSE Linux Enterprise Server 12 SP5.

These release notes are updated periodically. The latest version of these release notes is always available at https://www.suse.com/releasenotes ↗. General documentation can be found at https:/documentation.suse.com/sles/12-SP5.

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Contents

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/releasenotes ↗.

Entries can be listed twice, 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 documents 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 12 SP5 is a highly reliable, scalable, and secure server operating system, built to power mission-critical workloads in both physical and virtual environments. It is an affordable, interoperable, and manageable open source foundation. With it, enterprises can cost-effectively deliver core business services, enable secure networks, and simplify the management of their heterogeneous IT infrastructure, maximizing efficiency and value.

The only enterprise Linux recommended by Microsoft and SAP, SUSE Linux Enterprise Server is optimized to deliver high-performance mission-critical services, as well as edge of network, and web infrastructure workloads.

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 performing guest on leading hypervisors and supports an unlimited number of virtual machines per physical system with a single subscription. This makes it the perfect guest operating system for virtual computing.

2.2　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 2.6, "Support Statement for SUSE Linux Enterprise Server"*

- *Section 4.2, "Upgrade-Related Notes"*

- *Section 5, "General Features & Fixes"*

2.3　Security, Standards, and Certification

SUSE Linux Enterprise Server 12 SP5 has been submitted to the certification bodies for:

- Common Criteria Certification, see https://www.commoncriteriaportal.org/ ↗

- FIPS 140-2 validation, see http://csrc.nist.gov/groups/STM/cmvp/documents/140-1/140In-Process.pdf ↗

For more information about certification, see https://www.suse.com/security/certificates.html ↗ .

2.4　Documentation and Other Information

2.4.1　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 media for a chronological log of all changes made to the updated packages.

- Find more information in the `docu` directory of the media of SUSE Linux Enterprise Server 12 SP5. This directory includes PDF versions of the SUSE Linux Enterprise Server 12 SP5 Installation Quick Start Guide and Deployment Guides. Documentation (if installed) is available below the `/usr/share/doc/` directory of an installed system.

2.4.2 Externally Provided Documentation

- For the most up-to-date version of the documentation for SUSE Linux Enterprise Server 12 SP5, see https:/documentation.suse.com/sles/12-SP5.

- Find a collection of White Papers in the SUSE Linux Enterprise Server Resource Library at https://www.suse.com/products/server/resource-library ↗.

2.5 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 12 has a 13-year life cycle, with 10 years of General Support and 3 years of Extended Support. The current version (SP5) will be fully maintained and supported until 6 months after the end of the SUSE Linux Enterprise Server lifecycle. See https://www.suse.com/lifecycle ↗ for details.

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, providing a total of 3 to 5 years of support on any given service pack.

For more information, check our Support Policy page https://www.suse.com/support/policy.html ↗ or the Long Term Service Pack Support Page https://www.suse.com/support/programs/long-term-service-pack-support.html ↗.

2.6 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/programs/subscriptions/?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 available documentation.

L2

> Problem isolation, which means technical support designed to analyze data, reproduce customer problems, isolate problem area and provide aresolution 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 2.7, "Technology Previews"*

- Sound, graphics, fonts and artwork

- Packages that require an additional customer contract

- Some packages shipped as part of the module *Workstation Extension* are L2-supported only

- Packages provided as part of the Software Development Kit (SLE Software Development Kit)

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

2.6.1 General Support

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

- *Section 5.6, "Kernel"*

- *Section 5.10, "Virtualization"*

- *Section 5.5, "File Systems"*

- *Section 10, "Removed and Deprecated Features and Packages"*

2.7　Technology Previews

Technology previews are packages, stacks, or features delivered by SUSE which are not supported. They may be functionally incomplete, unstable or in other ways not suitable for production use. They are included for your convenience and give you a chance to test new technologies within an enterprise environment.

Whether a technology preview becomes a fully supported technology later depends on customer and market feedback. Technology previews can be dropped at any time and SUSE does not commit to providing a supported version of such technologies in the future.

Give your SUSE representative feedback about technology previews, including your experience and use case.

2.7.1　Technology Previews for AMD64/Intel 64 64-Bit (x86_64)

2.7.1.1　Crystal Ridge: [HMEM] Hot Plug Device DAX Back Into the Kernel

Hotplug support for NVDIMM as a normal memory is provided as a technology preview.

3　Modules, Extensions, and Related Products

This section comprises information about modules and extensions for SUSE Linux Enterprise Server 12 SP5. Modules and extensions add parts or functionality to the system.

3.1　Available Modules

Modules are fully supported parts of SUSE Linux Enterprise Server with a different life cycle and update timeline. They are a set of packages, have a clearly defined scope and are delivered via an online channel only. Release notes for modules are contained in this document.

The following modules are available for SUSE Linux Enterprise 12 SP5:

Name	Content	Life Cycle
Advanced Systems Management Module	CFEngine, Puppet, Salt and the Machinery tool	Frequent releases

Name	Content	Life Cycle
Containers Module	Docker, tools, prepackaged images	Frequent releases
HPC Module	Tools and libraries related to High Performance Computing (HPC)	Frequent releases
Legacy Module[1]	`ksh`	No updates, supported through March 2022
Public Cloud Modul	Public cloud initialization code and tools	Frequent releases
Toolchain Module	GNU Compiler Collection (GCC)	Yearly delivery
Web and Scripting Module	PHP, Python, Ruby on Rails	3 years, ~18 months overlap

[1] Module is not available for the AArch64 architecture.

For more information about the life cycle of packages contained in modules, see https://scc.suse.com/docs/lifecycle/sle/12/modules ↗.

3.2 Available Extensions

Extensions add extra functionality to the system and require their own registration key, usually at additional cost. Extensions are delivered via an online channel or physical media. In many cases, extensions have their own release notes documents that are available from https://www.suse.com/releasenotes ↗.

The following extensions are available for SUSE Linux Enterprise Server 12 SP5:

- 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 ↗

- Geo Clustering for SUSE Linux Enterprise High Availability Extension: https://www.suse.com/products/highavailability/geo-clustering ↗ Access to Geo Clustering is now included into the subscription for the High Availability Extension.

- SUSE Linux Enterprise Real Time: https://www.suse.com/products/realtime ↗

- SUSE Linux Enterprise Workstation Extension: https://www.suse.com/products/workstation-extension ↗

Additionally, there are the following extension which are not covered by SUSE support agreements, available at no additional cost and without an extra registration key:

- SUSE Package Hub: https://packagehub.suse.com/ ↗

- SUSE Linux Enterprise Software Development Kit

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/releasenotes ↗.

- SUSE Enterprise Storage: https://www.suse.com/products/suse-enterprise-storage ↗

- 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 Manager: https://www.suse.com/products/suse-manager ↗

- SUSE OpenStack Cloud: https://www.suse.com/products/suse-openstack-cloud ↗

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 12 SP5.

> **❗ 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:/documentation.suse.com/sles/12-SP5/singlehtml/book_sle_deployment/book_sle_deployment.html.

4.1.1 Setting CPU Mitigations

The Linux kernel gained a boot option that controls the mitigations for recently discovered CPU vulnerabilities.

The installer now allows setting the mitigations level directly during the installation of the system, independently of whether the system is being installed manually or via AutoYaST.

The mitigations level can be set to "off", "automatic" or "automatic with disabled Simultaneous Multithreading".

4.2 Upgrade-Related Notes

This section includes upgrade-related information for SUSE Linux Enterprise Server 12 SP5.

> **❗ 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 *Deployment Guide, Chapter Upgrading SUSE Linux Enterprise* at https:/documentation.suse.com/sles/12-SP5/html/SLES-all/part-update.html.

4.2.1 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 not fully patched may fail.

4.2.2 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 first need to upgrade to SP4 before upgrading to SP5.

4.3 JeOS (Just enough Operating System)

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

We are providing different virtual disk images for JeOS, using the `.qcow2`, `.vhdx`, and `.vmdk` file formats respectively for KVM, Xen, OpenStack, Hyper-V, and VMware environments. All JeOS images are setting up the same disk size (24 GB) for the JeOS system but due to the nature of the different file formats, the size of the JeOS images are different.

4.3.1 JeOS Images for Hyper-V and VMware Are Now Compressed

Starting with SUSE Linux Enterprise Server 12 SP5, the JeOS images for Hyper-V and VMware using the `.vhdx` and `.vmdk` file formats respectively, are now compressed with the LZMA2 compression algorithm by default. Therefore, we are now delivering these images in an `.xz` file format, so you need to decompress the image before using it in your Hyper-V or VMware environment by, for example, using the `unxz` command.

The other JeOS images will remain uncompressed because the `.qcow2` format already optimizes the size of the images.

4.3.2   firewalld not Available on the OpenStack JeOS Image

Having a firewall inside an instance is unnecessary and confusing in an OpenStack environment since OpenStack provides security and network capabilities on a different level. OpenStack, for instance, uses security groups which block any incoming connection (no ICMP, no UDP, no TCP) by default. The OpenStack Administrator needs to explicitely enable ICMP and TCP via the security groups configuration, to ping and ssh into an instance.

The official OpenStack recommendation for Linux-based images is to disable any firewalls inside the image (see https://docs.openstack.org/image-guide/openstack-images.html ⬈), so we decided to remove the package `firewalld` from our OpenStack JeOS images.

4.3.3   kiwi-templates-SLES12-JeOS Package is Added to the SDK 12 SP5

The package `kiwi-templates-SLES12-JeOS` contains the necessary files to create and customize your own JeOS image. In previous Service Pack this package was only provided in the download area of JeOS on https://download.suse.com/ ⬈ .

With SUSE Linux Enterprise Server 12 SP5, we are providing the `kiwi-templates-SLES12-JeOS` package directly with the Software Development Kit 12 Service Pack 5 Media and its online channel.

4.4   For More Information

For more information, see *Section 5, "General Features & Fixes"* and the sections relating to your respective hardware architecture.

5   General Features & Fixes

Information in this section applies to all architectures supported by SUSE Linux Enterprise Server 12 SP5.

5.1 Authentication

5.1.1 Notable Updates

- `freeradius-server`: Updated to version 3.0.19.

- `warnquota`: now supports LDAP as default

- OpenID is now supported. This feature is provided by `apache2-mod_auth_openidc`.

5.2 Base System

5.2.1 Better NVDIMM support

Updated the NVDIMM support and configuration utilities including `ndctl` and others.

5.2.2 Default Size for Core Files Has Changed to `unlimited`

With `systemd-coredump` as the default coredump handler, the coredumping logic on SUSE Linux Enterprise Server has been enabled for all services by default. `systemd-coredump` allows to store and manage the coredump in a more comprehensive and clean way.

Therefore the default size for core files has changed to `unlimited`. In previous versions of SUSE Linux Enterprise Server, the default size for core files was set to `0`. To restore the previous behaviour, set

`DefaultLimitCORE=0`

in `/etc/systemd/system.conf`.

5.2.3 General Changes

- Replaced init script of `ebtables` with systemd service file

- sar: Better logging information on system shutdown

- Improved NoCOW settings, specifically in `/var/log`. It affects only new installations, the upgrade process does not touch storage settings.

- systemd: enabled GDPR compliant stack backtraces

5.2.4　Notable Updates

- Augeas was updated to version 1.10.1

- autofs was updated to version 5.1.5

- Intel VROC support was updated to latest version

5.3　Development

5.3.1　Supported Java Versions

The following table lists Java implementations available in SUSE Linux Enterprise Server 12 SP5:

Name (Package Name)	Version	Part of SUSE Linux Enterprise Server	Support
OpenJDK (java-1_11_0-open-jdk)	1.11.0	SLES	SUSE, L3
OpenJDK (java-1_10_0-open-jdk)	1.10.0	SLES	SUSE, L3
OpenJDK (java-1_9_0-open-jdk)	1.9.0	SLES	SUSE, L3
IBM Java (java-1_8_0-ibm)	1.8.0	SLES	External only
IBM Java (java-1_7_0-ibm)	1.7.0	SLES	External only
IBM Java (java-1_6_0-ibm)	1.6.0	Legacy Module	External only

5.3.2　Python

5.3.2.1　Added basic support for python-3.6

With this feature we are enabling the latest python 3.6 development which also includes machine learning applications.

5.3.2.2 Added tkinter with python-3.4

Python module allowing to use tensorflow with python 3.4

5.4 Desktop

5.4.1 Reduce Information on Logged Users During Logout

When trying to restart or poweroff a system from GNOME or GDM, a list of other users currently logged in could be viewed by any non-privileged user.

This is no longer the case with SUSE Linux Enterprise 12 SP5.

5.4.2 Flatpak Available as Technology Preview

Flatpak (1.4.x) is now available on SUSE Linux Enterprise 12 SP5, as Technology Preview.

Only command-line tools to install and run flatpaks are available.

5.4.3 Proper Unmount Notification in Nautilus

When unmounting devices from the Nautilus file viewer, a notification confirming success was not properly displayed.

This issue is fixed in SUSE Linux Enterprise Server 12 SP5.

5.4.4 Mesa Update

Mesa was updated to version 18.3.2, providing many bug fixes and support for Comet Lake U and Amber Lake Y chipsets.

5.4.5 Intel Graphics Memory Management Libray

The Intel® Graphics Memory Management Library (gmmlib) provides device specific and buffer management for the Intel® Graphics Compute Runtime for OpenCL™ and the Intel® Media Driver for VAAPI.

gmmlib is available in SUSE Linux Enterprise Server 12 SP5 and the SDK.

5.4.6   intel-vaapi Driver Update

The Intel® VAAPI driver (providing video acceleration for VA-API) was updated to version 2.2.0, providing support on Gemini Lake, Coffee Lake, Cannon Lake for many codecs (encoding and decoding).

5.4.7   Intel Media Driver for VAAPI

The Intel® Media Driver for VAAPI is a new VA-API (Video Acceleration API) user mode driver supporting hardware accelerated decoding, encoding, and video post processing for GEN based graphics hardware.

The `intel-media-driver` is available in SUSE Linux Enterprise Server 12 SP5.

5.4.8   Intel Media SDK

The Intel® Media SDK provides a plain C API to access hardware-accelerated video decoding, encoding and filtering on Intel® Gen graphics hardware platforms. the implementation is written in C++ 11 with parts in C-for-Media (CM).

- Supported video encoders: HEVC, AVC, MPEG-2, JPEG, VP9

- Supported video decoders: HEVC, AVC, VP8, VP9, MPEG-2, VC1, JPEG

- Supported video pre-processing filters: Color Conversion, Deinterlace, Denoise, Resize, Rotate, Composition

The Intel Media SDK is available in SUSE Linux Enterprise Server 12 SP5 and SDK.

5.5   File Systems

5.5.1   Comparison of Supported File Systems

SUSE Linux Enterprise was the first enterprise Linux distribution to support journaling file systems and logical volume managers back in 2000. Later, we introduced XFS to Linux, which today is seen as the primary work horse for large-scale file systems, systems with heavy load and

multiple parallel reading and writing operations. With SUSE Linux Enterprise 12, we went the next step of innovation and started using the copy-on-write file system Btrfs as the default for the operating system, to support system snapshots and rollback.

y supported

n unsupported

Feature	Btrfs	XFS	Ext4	OCFS 2[1]	ReiserFS[2]
Supported in product	SLE	SLE	SLE	SLE HA	SLE
Data/metadata journaling	N/A[3]	n / y	y / y	n / y	n / y
Journal internal/external	N/A[3]	y / y	y / y	y / n	y / y
Journal checksumming	N/A[3]	y	y	y	n
Subvolumes	y	n	n	n	n
Offline extend/shrink	y / y	n / n	y / y	y / n[4]	y / n
Inode allocation map	B-tree	B+-tree	Table	B-tree	u. B*-tree
Sparse files	y	y	y	y	y
Tail packing	n	n	n	n	y
Small files stored inline	y (in meta-data)	n	y (in inode)	y (in inode)	y (in meta-data)
Defragmentation	y	y	y	n	n
Extended file attributes/ACLs	y / y	y / y	y / y	y / y	y / y
User/group quotas	n / n	y / y	y / y	y / y	y / y
Project quotas	n	y	y	n	n

Feature	Btrfs	XFS	Ext4	OCFS 2[1]	ReiserFS[2]
Subvolume quotas	y	N/A	N/A	N/A	N/A
Data dump/restore	n	y	n	n	n
Block size default	4 KiB[5]				
Maximum file system size	16 EiB	8 EiB	1 EiB	4 PiB	16 TiB
Maximum file size	16 EiB	8 EiB	1 EiB	4 PiB	1 EiB

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

[2] ReiserFS is supported for existing file systems. The creation of new ReiserFS file systems is discouraged.

[3] 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`).

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

[5] 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 12 SP5 but are not supported by SUSE. By default, the file system drivers in SUSE Linux Enterprise Server 12 SP5 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.

5.5.2 Supported Btrfs Features

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

y supported

n unsupported

Feature	SLES 11 SP4	SLES 12 SP3	SLES 12 SP4	SLES 12 SP5	SLES 15 GA	SLES 15 SP1
Copy on Write	y	y	y		y	y
Free Space Tree (Free Space Cache v2)	n	n	n		n	y
Snapshots/Subvolumes	y	y	y		y	y
Swap Files	n	n	n		n	y
Metadata Integrity	y	y	y		y	y
Data Integrity	y	y	y		y	y
Online Metadata Scrubbing	y	y	y		y	y

Feature	SLES 11 SP4	SLES 12 SP3	SLES 12 SP4	SLES 12 SP5	SLES 15 GA	SLES 15 SP1
Automatic Defrag- mentation	n	n	n		n	n
Manual Defrag- mentation	y	y	y		y	y
In-band Dedupli- cation	n	n	n		n	n
Out-of-band Dedu- plication	y	y	y		y	y
Quota Groups	y	y	y		y	y
Metadata Duplica- tion	y	y	y		y	y
Changing Metada- ta UUID	n	n	n		n	y
Multiple Devices	n	y	y		y	y
RAID 0	n	y	y		y	y
RAID 1	n	y	y		y	y
RAID 5	n	n	n		n	n
RAID 6	n	n	n		n	n
RAID 10	n	y	y		y	y
Hot Add/Remove	n	y	y		y	y
Device Replace	n	n	n		n	n
Seeding Devices	n	n	n		n	n

Feature	SLES 11 SP4	SLES 12 SP3	SLES 12 SP4	SLES 12 SP5	SLES 15 GA	SLES 15 SP1
Compression	n	y	y		y	y
Big Metadata Blocks	n	y	y		y	y
Skinny Metadata	n	y	y		y	y
Send Without File Data	n	y	y		y	y
Send/Receive	n	y	y		y	y
Inode Cache	n	n	n		n	n
Fallocate with Hole Punch	n	y	y		y	y

5.5.3   Notable Updates

- `multipath-tools`: Now includes a new prioritizer based on a latency algorithm
- `quota-tools`: Added support for HPE XFS.

5.6   Kernel

5.6.1   Support for Hygon Dhyana CPUs

SUSE Linux Enterprise Server 12 SP5 now supports the Hygon Dhyana CPUs. They are AMD-based CPUs produced in China by a joint venture between AMD and Hygon.

5.6.2   IOMMU Passthrough is now Default on all Architectures

Passthrough mode provides improved I/O performance, especially for high-speed devices, because DMA remapping is not needed for the host (bare-metal or hypervisor).

IOMMU passthrough is now enabled by default in SUSE Linux Enterprise products. Therefore, you no longer need to add `iommu=pt` (Intel 64/AMD64) or `iommu.passthrough=on` (AArch64) on the kernel command line. To disable passthrough mode, use `iommu=nopt` (Intel 64/AMD64) or `iommu.passthrough=off` (AArch64), respectively.

5.6.3 Enable NVDIMMs in Memory Mode

Due to missing auto detection by the hardware, enabling NVDIMMs in memory mode, requires the kernel boot parameter `page_alloc.shuffle=1`.

5.6.4 Kernel Limits

This table summarizes the various limits which exist in our recent kernels and utilities (if related) for SUSE Linux Enterprise Server 12 SP5.

SLES 12 SP5 (Linux 4.12)	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	480
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
Maximum amount of swap space	Up to 29 * 64 GB	Up to 30 * 64 GB		
Maximum number of processes	1048576			
Maximum number of threads per process	Upper limit depends on memory and other parameters (tested with more than 120,000)[2].			

SLES 12 SP5 (Linux 4.12)	AMD64/Intel 64 (x86_64)	IBM Z (s390x)	POWER (ppc64le)	ARMv8 (AArch64)
Maximum size per block device	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".

5.7 Networking

5.7.1 Samba

The version of Samba shipped with SUSE Linux Enterprise Server 12 SP5 delivers integration with Windows Active Directory domains. In addition, we provide the clustered version of Samba as part of SUSE Linux Enterprise High Availability Extension 12 SP5.

5.7.2 NFSv4

NFSv4 with IPv6 is only supported for the client side. An NFSv4 server with IPv6 is not supported.

5.7.2.1 gssproxy

`gssproxy` comes with added suppoprt for kerberos authentication on NFSv4.

5.7.3 FTP

5.7.3.1 vsftpd

Support for virtual Users has been added to `vsftp`.

5.7.4 Wicked

5.7.4.1 Packaging

The wicked library (package `libwicked`) is no longer shipped in a separate package, but part or the package `wicked`.

5.7.4.2 DHCPv6 Prefix-Length

In accordance with RFC5942 Wicked no longer assumes a `/64` default prefix-length for the DHCPv6 addresses.

To use DHCPv6 on networks missing IPv6 Router advertisements that provide the prefix-length of the local network, you need to configure this value. To do so, set the `DHCLIENT6_AD-DRESS_LENGTH` ifcfg-variable in `/etc/sysconfig/network/dhcp` to the prefix-length, for example:

```
DHCLIENT6_ADDRESS_LENGTH=64
```

Alternatively configure the radvd daemon on a (router) machine in the network to provide the router advertisements.

If you are installing SUSE Linux Enterprise Server 12 SP5 in a network missing IPv6 router advertisements, use the ifcfg boot parameter on the kernel command line to set the prefix-length, for example:

```
ifcfg=*=dhcp,DHCLIENT6_MODE=managed,DHCLIENT6_ADDRESS_LENGTH=64
```

5.7.5 Notable Network Package Updates

- freeradius-server-3.0.19

- rsync 3.1.3

- squid-4.8

- warnquota now supports ldap

5.8 Security

5.8.1 Added SELinux Policy Core Utilities

The Package `policycoreutils` contains utilities required for the basic operation of a SELinux system. These utilities include `load_policy` to load policies, `setfiles` to label filesystems, `newrole` to switch roles, and `run_init` to run `/etc/init.d` scripts in the proper context.

5.8.2 `ibmtss` Update Changes Path to Binaries

IBM's TPM 2.0 TSS implementation has been updated upstream. The update now allows to install binaries in `/usr/bin/` rather than having to copy them manually into a custom directory. As a consquence, the binaries had to be renamed in order to not conflict with other programs of the same name. All binaries shipped with the `ibmtss` package are now prefixed with `tss`. So `/usr/lib/ibmtss/hash` for example, is now available as `/usr/bin/tsshash`.

5.8.3 Kernel Parameter `fs.protected_hardlinks`

The kernel parameter `fs.protected_hardlinks` is active by default in SUSE products. Deactivating it introduces additional vectors for malicious local users to escalate their privileges. If you need to deactivate it please refer to this knowledge base article (https://www.suse.com/support/kb/doc/?id=7024245) ↗ for additional information.

5.8.4 Notable Updates

- `gssproxy`: Added suppoprt for Kerberos authentication on NFSv4.

- `sudo`: Updated to the version 1.8.27.

5.9   Systems Management

5.9.1   Snapper's Space-Aware Snapshot Cleanup Has Been Improved

Previously, the space-aware cleanup of snapshots integrated in Snapper only looked at the disk space used by all snapshots. In certain cases, this narrow focus meant that the file system ran out of space anyway.

Starting with SUSE Linux Enterprise Server 12 SP5, the space-aware cleanup of Snapper additionally looks at the free space of the file system and keeps the file system at least 20 percent free.

5.9.2   Samba Identity Mapping Backends

The Windows Domain Membership YaST module (`yast-samba-client`) has been updated to handle the new Samba `idmap` backend mappings. Previously, the YaST module would only configure Samba to use the `tdb` back-end, which does not map users consistently on every Linux client. The module also configured Samba `idmap` with a deprecated syntax.

Now the Windows Domain Membership module configures a host by default using the `rid` back-end, which will provide more consistent SID to `uid` mappings between clients. It also uses the newer Samba `idmap` syntax in the `smb.conf`.

In addition to defaulting to a better `idmap` back-end, SUSE Linux Enterprise Server 12 SP5 allows you to modify which configuration is chosen from the *Domain Join* dialog. Advanced options include the `idmap` back-ends `tdb`, `ad`, `rid`, and `autorid`. Each back-end has its advantages and drawbacks. For more information, see https://www.suse.com/support/kb/doc/?id=7007006 ⌝ and the man page of `idmap`.

5.10   Virtualization

For more information about acronyms used below, see the virtualization documentation provided at https:/documentation.suse.com/sles/12-SP5/.

5.10.1 KVM

5.10.1.1 KVM Limits

Maximum VMs per Host	Unlimited (total number of virtual CPUs in all guests being no greater than 8 times the number of CPU cores in the host).
Maximum Virtual CPUs per VM	288
Maximum Memory per VM	4 TiB

Virtual Host Server (VHS) limits are identical to those of SUSE Linux Enterprise Server.

5.10.2 XEN 4.12

5.10.2.1 Important Changes

- Includes improved security mitigation support

- Includes an update for the file `xen-dom0-modules.service map.` xenlinux modules that lack aliases are ignored to avoid error messages from modprobe about unknown modules (fixes bsc#1137251).

- Starting with this release autoballooning is disable by default in `xl.conf`.

5.10.2.2 Xen Limits

Since SUSE Linux Enterprise Server 11 SP2, we removed the 32-bit hypervisor as a virtualization host. 32-bit virtual guests are not affected and are fully supported with the provided 64-bit hypervisor.

Feature	Limit
Maximum Physical CPUs per Host	1024
Maximum Physical Memory per Host	16 TiB

Feature	Limit
Maximum Virtual CPUs per Host	Unlimited (total number of virtual CPUs in all guests being no greater than 8 times the number of CPU cores in the host).
Maximum Physical Memory for Dom0	500 GiB
Maximum Virtual CPUs per VM[1]	FV: 128, PV: 512
Maximum Memory per VM	16 GiB x86_32, 2 TiB x86_64
Maximum number of block devices	12,000 SCSI logical units

[1] **PV:** Paravirtualization, **FV:** Full virtualization

5.10.3   Containers

5.10.3.1   Windows Subsystem for Linux (WSL) Image

The Windows Subsystem for Linux (WSL) Image for SUSE Linux Enterprise Server 12 SP5 can be used with both WSL and WSL 2, there is no separate image for WSL 2. The Image will receive regular updates.

5.10.4   libvirt

5.10.4.1   Important Changes

- Includes a fix to set `max_grant_frames` for domUs via libvirt (fixes bsc#1126325)

- Xen PVH has been temporarily disabled until the feature is better usable (fixes bsc#1125889)

- virsh now supports setting the precopy bandwidth for migrations (fixes bsc#1145586)

- libvirt now supports the Cascadelake-Server CPU model

- qemu: fix default value of `security_default_confined` (disabled by default)

- qemu: Add support for overriding the maximum threads per process limit (fixes bsc#1133719)

- cpu_map: add cpu feature md-clear (fixes CVE-2018-12126)

5.10.5 Vagrant

Vagrant (https://www.vagrantup.com/)↗ is a tool that provides a unified workflow for the creation, deployment and management of virtual development environments. It abstracts away the details of various Virtualization providers (like VirtualBox, VMWare or libvirt) and provides a uniform and simple configuration file, that allows developers and operators to quickly spin up a VM of any Linux distribution.

A new VM can be launched with Vagrant via the following set of commands. The example uses the Vagrant Box for openSUSE Tumbleweed:

```
vagrant init opensuse/Tumbleweed.x86_64
vagrant up
# your box is now going to be downloaded and started
vagrant ssh
# and now you've got ssh access to the new VM
```

5.10.5.1 Vagrant Boxes for SUSE Linux Enterprise Server

Starting with SUSE Linux Enterprise Server 12 SP5, we are providing official Vagrant Boxes for SUSE Linux Enterprise Server for x86_64 and aarch64 (only for the libvirt provider). These boxes come with the bare minimum of packages to reduce their size and are not registered, thus users need to register the boxes prior to further provisioning.

These boxes are only available for direct download via SCC and must be manually registered with Vagrant as follows:

```
vagrant box add --name SLES-12-SP5 SLES12-SP5-Vagrant.x86_64-12.5-libvirt-
*.vagrant.libvirt.box
```

The box is then available under the name **SLES-12-SP5** and can be used as all other Vagrant boxes:

```
vagrant init SLES-12-SP5
```

```
vagrant up
vagrant ssh
```

5.10.5.2   aarch64 support

The Vagrant Box is also available for the aarch64 architecture using the libvirt provider. It has been pre-configured for the usage on SUSE Linux Enterprise Server on aarch64 and might not launch on other operating systems without additional settings. Running it on other architectures than aarch64 is not supported.

In case the box fails to start with a libvirt error message, add the following to your Vagrantfile and adjust the variables according to the guest operating system:

```
config.vm.provider :libvirt do |libvirt|
  libvirt.driver = "kvm"
  libvirt.host = 'localhost'
  libvirt.uri = 'qemu:///system'
  libvirt.host = "master"
  libvirt.features = ["apic"]
  # path to the UEFI loader for aarch64
  libvirt.loader = "/usr/share/qemu/aavmf-aarch64-code.bin"
  libvirt.video_type = "vga"
  libvirt.cpu_mode = "host-passthrough"
  libvirt.machine_type = "virt-3.1"
  # path to the qemu aarch64 emulator
  libvirt.emulator_path = "/usr/bin/qemu-system-aarch64"
end
```

5.10.6   Others

5.10.6.1   perl-Sys-Virt

- Add all new APIs and constants in libvirt 5.1.0

6   AMD64/Intel 64-Specific Features & Fixes (x86_64)

Information in this section applies to the version of SUSE Linux Enterprise Server 12 SP5 for the AMD64/Intel 64 architectures.

6.1 Notable Updates

6.1.1 Virtualization

- Subpage protechtion

- Support for new Tremont AiA instructions

- Model-specific Split Lock Disable support

- new CLDEMOT instructions (SnowRidge)

- PT v4 (Intel Processor Trace buffer) for SnowRidge,

- enable ICX NIs for XEN

6.1.2 Driver Updates

- e1000e

- fm10k

- i40e

- i40iw

- iavf (i40evf)

- ice

- icrdma

- igb

- igbvf

- igc

- ixgbe

- ixgbevf

6.1.3   Package Updates

- ipmctl

- ledmon

- mdadm

6.1.4   Hardware

- Extened Crystal Ridge support

- Extended Intel omni-path architecture support

- Extended Jacobsville support for

    - SPI-NOR

    - GPIO

    - new enumeration of #AC for split lock

- Whitley/Icelake-SP Platform patches adding enhancements like `rep mov` for memcpy_mcsafe

6.2   Intel Optane DC Persistent Memory Operating Modes

Intel Optane DC Persistent Memory has two operating modes, AppDirect mode and Memory Mode.

In Memory Mode, the Optane DIMMs serve as cost-effective DRAM replacement. To applications the Optane memory is presented as volatile memory (that is, not persistent), just like on DRAM-only systems. In reality this is a combination of Optane and DRAM, where DRAM acts as a cache for the most frequently-accessed data, while the Optane persistent memory provides large memory capacity. The setup is slower with random access workloads than on DRAM-only systems, but allows for higher capacity memory and is more cost-effective. In this mode, data is not persistent, which means it is lost when the system is powered off.

Intel Optane running in memory mode is supported with SUSE Linux Enterprise Server running on certified platforms. Users running applications that take advantage of this mode must understand that without specific enhancements performance may decrease.

Direct any hardware related questions at your hardware partner. SUSE works with all major hardware vendors to make the use of Intel Optane a perfect user experience on the operating system level and open-source infrastructure level.

6.3 Intel Omni-Path Architecture (OPA) Host Software

Intel Omni-Path Architecture (OPA) host software is fully supported in SUSE Linux Enterprise Server 12 SP5.

Intel OPA provides Host Fabric Interface (HFI) hardware with initialization and setup for high performance data transfers (high bandwidth, high message rate, low latency) between compute and I/O nodes in a clustered environment.

For instructions on installing Intel Omni-Path Architecture documentation, see https://cdrdv2.intel.com/v1/dl/getContent/617176 ↗ .

6.4 sysfs Support for Dirty Shutdown Count

ACPI 6.3 introduces an a unlatched shutdown count. This will be supported by adding a static attribute to nmemX/nfit/. On machines that do not have ACPI 6.3, a fallback (NVDIMM_FAMILY_INTEL) is provided.

6.5 Miscellaneous

- VMA based swap readahead

7 IBM Z-Specific Features & Fixes (s390x)

Information in this section pertains to the version of SUSE Linux Enterprise Server 12 SP5 for the IBM Z architecture. For more information, see https://www.ibm.com/developerworks/linux/linux390/documentation_novell_suse.html ↗ .

7.1 Hardware

7.1.1 Valgrind IBM z13 Support

Valgrind now includes instruction support for IBM z13 instructions. This enables debugging and validation of binaries built and optimized for IBM z13. In particular this covers the vector instruction set extensions introduced with IBM z13.

7.1.2 Support for IBM z15 in binutils and glibc

Binutils and glibc have been updated to support instructions introduced with IBM z15.

7.1.3 Compression Improvements for zlib

The zlib library has been updated to exploit the IBM z15 compression capabilities.

7.1.4 Compression Improvements for gzip

The gzip tool has been updated to exploit the IBM z15 compression capabilities.

7.1.5 Performance Counters for IBM z15 (CPU-MF)

For optimized performance tuning the CPU-measurement counter facility now supports counters, including the MT-diagnostic counter set, that were originally introduced with IBM z14.

7.1.6 Collecting NVMe-Related Debug Data

To debug NVMe devices, the debug data gets collected and added to the dbginfo.sh script.

7.1.7 PCI Error Reporting Tool

Defective PCIe devices are now reported via error notification events that include health information of the adapters.

7.2 Network

7.2.1 OSA-Express7S Adapters are now Supported

With the OSA 7 network cards a link speed of 25Gb/s is supported.

7.2.2 Full-blown TCP Segmentation Offload

TCP segmentation offload is now supported on both layer 2 and layer 3 and is extended to IPv6.

7.2.3 Handle Provisioned MAC Addresses

You can now use provisioned MAC addresses for devices supported with IBM z14 and later hardware.

7.3 Performance

7.3.1 Synthesize perf Events/Samples from CPU-MF auxtrace Data

Enhance perf tool to synthesize perf diagnostic events and samples saved in the auxtrace buffer. The auxtrace buffer contains basic- and diagnostic sampling data entries.

7.3.2 CPU-MF/perf: Export Sampling Data for Post-Processing

Enhance the hardware sampling in the perf PMU driver to export additional information for improved perf tool post processing. Display address and function name where sample was taken.

7.3.3 Network Performance Improvements

Enhanced performance for OSA and Hipersockets via code improvements and exploitation of further kernel infrastructure.

7.4 Security

7.4.1 SIMD Implementation of Chacha20 in OpenSSL

This enables support for TLS 1.3 via the Chacha20 cipher suite providing good performance using SIMD instructions.

7.4.2 SIMD Implementation of Poly1305 in OpenSSL

This enables support for TLS 1.3 via the Poly1305 cipher suite providing good performance using SIMD instructions.

7.4.3 Support of CPACF Hashes in ep11 Token in openCryptoki and libica

Provides improved performance for applications computing many digital signatures using EP11 like Blockchain.

7.4.4 In-kernel Crypto: Support for Protected Keys Generated by random in the paes Module

This feature can generate volatile protected keys. This allows, for example, the secure encryption of swap volumes without the need for a CryptoExpress adapter

7.4.5 New Tool `zcryptstats` to Extract Crypto Measurement Data

Added a new tool `zcryptstats` to the s390-tools package to to obtain and display measurement data from crypto adapters for capacity planning.

7.4.6 Support Multiple zcrypt Device Nodes

The cryptographic device driver can now provide and maintain multiple zcrypt device nodes. These nodes can be restricted in terms of cryptographic adapters, domains, and available IOCTLs.

7.4.7   openCryptoki ep11 Enhancements

Support new functions and new mechanisms introduced for ep11 with IBM z14.

7.4.8   Enhanced openCryptoki Support

Enhanced openCryptoki ep11 token to support m_*Single functions from ep11 lib.

7.4.9   libica: CPACF Enhancements

Enhanced libica to support NIST curves as provided by CPACF MSA-9.

7.4.10   openssl-ibmca: CPACF Enhancements

Enhanced openssl-ibmca to support NIST curves as provided by CPACF MSA-9.

7.4.11   zcrypt DD: APQN Tags Allow Deterministic Driver Binding

Provides deterministic hot-plugging semantics to enable the virtualization and unique determination of crypto adapters in KVM environments even if the associated hardware gets intermittently lost and reconnected.

7.5   Storage

7.5.1   zdsfs: Online VTOC Refresh

A Linux application can now access new data sets that were created after zdsfs was mounted without the need to remount zdsfs.

7.5.2   Persistent Device Configuration

The following SUSE-supplied commands are now deprecated:

- `ctc_configure`
- `dasd_configure`

- `qeth_configure`

- `zfcp_disk_configure`

- `zfcp_host_configure`

These commands will be removed in a future release.

With SUSE Linux Enterprise Server 12 SP5, as an intermediate step, these scripts have been modified to use the IBM-supplied commands `chzdev` and `lszdev`.

If you are using the SUSE-supplied scripts, discontinue their use and directly use the commands `chzdev` and `lszdev` provided by IBM in the package s390-tools.

7.5.3   Enable Raw Track Access Without Prefix CCW

The DASD driver makes use of the Prefix CCW when accessing a DASD in raw track access mode. On some systems (e.g. zPDT), support for the Prefix CCW is not available. As a result, the raw track access mode cannot be used on those systems.

By enabling raw track access mode on zPDT, customers can easily move their Linux system volumes between zPDT and LPAR, allowing for greater flexibility during deployment of new setups.

7.5.4   Configurable IFCC Handling (Interface Control Check) for DASDs

Provides a possibility to direct IFCC messages to the kernel log again in addition to the actual path handling. Enables to switch off the actual handling of repeated IFCCs (i.e. removing paths) so that only IFCC messages are written to the log when thresholds are exceeded.

7.5.5   Split DIF and DIX Boot Time Controls

Enables the user to separately configure DIF and DIF + DIX integrity protection mechanisms for zFCP-attached SCSI devices.

7.5.6   scsi: zfcp: Add Port Speed Capabilities

Provides the possibility to display port speed capabilities for SCSI devices.

7.6 Virtualization

The following new features are supported in SUSE Linux Enterprise Server 12 SP5 under KVM:

7.6.1 Avoid Boot Failures After Changing Disks

On SUSE Linux Enterprise Server 12 virtual machines wopuld no longer boot after changing disks. In most cases this could be solved by changing dracut's persistent_policy to `by-path` and then rebuild the initrds. There SUSE Linux Enterprise Server 12 SP5 `persistent_policy=by-path` is the new default for dracut.

7.6.2 Enhanced Hardware Diagnose Data for the Linux Kernel

Provide improved problem determination capabilities by passing Linux kernel information to hardware diagnose data.

7.6.3 zPCI Passthrough Support for KVM

Allow KVM to pass control over ROCE Express host devices to a KVM guest enabling workloads that require direct access to PCI functions.

7.6.4 Interactive Bootloader

Enable to interactively select boot entries to recover misconfigured KVM guests.

7.6.5 Huge Pages

Allow KVM guests to use huge page memory backing for improved memory performance for workloads running with large memory footprints.

7.6.6 Expose Detailed Guest Crash Information to the Hypervisor

Provides additional debug data for operating system failures that occur within a KVM guest.

7.6.7   New CPU Model IBM z14 ZR1

Provide the CPU model for the IBM z14 ZR1 to enable KVM guests to exploit new hardware features on the z14 ZR1.

7.6.8   New CPU Model IBM z15

Provide the CPU model for the IBM z15 to enable KVM guests to exploit new hardware features on the z15.

7.6.9   Secure Linux Boot Toleration

Linux operating system images using a secure boot on-disk format can now be run in KVM without modifications required, lowering the overall administrative overhead.

7.6.10   IPL Support for ECKD DASDs

KVM guests can now IPL from ECKD DASDs attached via CCW passthrough, which is provided as a technology preview in SUSE Linux Enterprise Server 12 SP5.

7.6.11   Dedicated CryptoExpress Adapter Domains for KVM Guests

Allows KVM to dedicate domains of CryptoExpress adapters as passthrough devices to a KVM guest such that the guest can direct crypto requests directly to the IBM Z firmware without the hypervisor being able to observe the communication of the guest with the device.

7.7   Miscellaneous

7.7.1   Kernel Parameter `resume` Removed

On SUSE Linux Enterprise the `resume=…` kernel parameter was enabled by default on all platforms. With SUSE Linux Enterprise Server 12 SP5 it is no longer enabled on s390x, because it is not used on the IBM Z platform.

8 ARM 64-Bit-Specific Features & Fixes (AArch64)

Information in this section applies to the version of SUSE Linux Enterprise Server 12 SP5 for the AArch64 architecture.

8.1 cpufreq driver for Raspberry Pi

The cpufreq allowing the system to change its frequency dynamically, has been added. This makes the system use less power consumption when idle. Also, writing a configuration file to change the frequency is no longer necessary.

8.2 HDMI Audio support for Raspberry Pi 3

HDMI Audio support has been added for the Raspberry Pi 3 platform.

9 Known Issues & Workarounds

This is a list of known issues for this release.

9.1 Installation on RAID10 Array Composed from SSD Drives Hangs on Discard Request

When setting up RAID 10 on four SSD drives during the installation, after choosing the target partition to create RAID, the progress bar will hang at `1% completed` for some time (depending on the RAID size) before proceeding. This is a known performance issue on RAID 10 because the system takes time to split the large storage into many small ones. This issue only occurs once when setting up the RAID 10 and has no effect afterwards.

Upstream currently has no solution for it.

9.2 Installation in Text Mode: Switching the Keyboard Layout fails

When doing an installation in text mode, switching the keyboard layout in the Language, Keyboard, and License Agreement dialog does not work. The requested change does not get applied.

To work around this issue, make sure to choose a language on the boot screen. A corresponding keyboard layout will automatically be applied. On x86 and aarch64 machines with a traditional BIOS, press `F2` on the boot screen to select a language. On x86 and aarch64 machines with EFI, append the language parameter to the kernel command line (e.g. `Language=de_DE`). For IBM Z you may set the language via the parmfile.

9.3 Installation in Text Mode: Russian, Korean, and Chinese EULA is not Displayed Correctly

When installing on the text console, the console as well as font is configured depending on the selected language. Because different languages use different sets of characters, it is not always possible to display the EULA in all languages.

If the EULA is not shown correctly in your preferred the language, either change the language in the Language selection screen of YaST (in order to load the proper font) or in the boot screen (in order to set-up the console properly). Translated EULAs are also available for download at https://www.suse.com/licensing/eula/ ↗ .

9.4 Installation in Graphic Mode on IBM Z: Installation Fails with 1 GB RAM

When attempting to do an installation in graphic mode on IBM Z, the installation stops without completing on machines equipped with only 1 GB RAM.

To work around this issue, either perform a text mode installation or add more RAM. The graphical installation requires at least 1.5 GB of RAM.

9.5 Media Does Not Contain Translated Manuals in /docu

Former releases of SUSE Linux Enterprise Server contained translated manuals in the folder `/docu` on DVD1. 12 SP5 only contains English manuals in `/docu` on DVD1.

For 12 SP5 documentation translations were unfortunately not ready in time for building the product media. Rather than shipping outdated translations, we decided to remove translations from the `/docu` folder on the media.

12 SP5 continues to ship translated documentation as rpm packages. Up-to-date packages will be available as an online-update when 12 SP5 ships for the first time.

10 Removed and Deprecated Features and Packages

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

10.1 Removed Features and Packages

The following packages have been removed in this release.

- `libibmad-devel`
- `libipmctl2`
- `libqpdf13`
- `libreoffice-base-drivers-mysql`
- `libsmbldap0`
- `libsmbldap0-32bit`
- `openscap-extra-probes`
- `opensm-libs3`
- `opensm-libs3-32bit`
- `postgresql96`
- `postgresql96-contrib`
- `postgresql96-devel`
- `postgresql96-docs`
- `postgresql96-server`
- `vaapi-intel-driver`
- `xmlsec1-libgcrypt-devel`

10.2 Deprecated Features and Packages

The following features and packages are deprecated and will be removed with a future service pack of SUSE Linux Enterprise Server.

10.2.1 Chelsio T3 Driver (`cxgbe3`) Is Deprecated

The driver for Chelsio T3 networking equipment (`cxgbe3`) is now deprecated and may become unsupported in a future Service Pack of SUSE Linux Enterprise Server 12.

11 Obtaining Source Code

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