

Oracle Linux 7

Release Notes for Oracle Linux 7



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Preface

Warning

Oracle Linux 7 is now in Extended Support. See [Oracle Linux Extended Support](#) and [Oracle Open Source Support Policies](#) for more information.

Migrate applications and data to Oracle Linux 8 or Oracle Linux 9 as soon as possible.

[Oracle Linux 7: Release Notes for Oracle Linux 7](#) provides a summary of the new features and known issues in the initial release of Oracle Linux 7.

Conventions

The following text conventions are used in this document:

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

Documentation Accessibility

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Oracle customers that have purchased support have access to electronic support through My Oracle Support. For information, visit <https://www.oracle.com/corporate/accessibility/learning-support.html#support-tab>.

Diversity and Inclusion

Oracle is fully committed to diversity and inclusion. Oracle respects and values having a diverse workforce that increases thought leadership and innovation. As part of our initiative to

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

1

New Features and Changes

Warning

Oracle Linux 7 is now in Extended Support. See [Oracle Linux Extended Support](#) and [Oracle Open Source Support Policies](#) for more information.

Migrate applications and data to Oracle Linux 8 or Oracle Linux 9 as soon as possible.

This section describes the new features that Oracle Linux 7 introduces and the major changes from the previous release of Oracle Linux.

System Requirements

You can install Oracle Linux 7 on x86-64 systems with up to 2048 logical CPUs and 64 TB of memory. The theoretical upper limit is 5120 logical CPUs and 64 TB of memory, but this configuration isn't supported. A minimum of 2 logical CPUs and 1 GB of memory per logical CPU is recommended. Although the minimum disk space required for installation is 1GB, a minimum of 5 GB is recommended.

File System, Storage, and Address Space Limitations

The following table lists the maximum file size and maximum file system size for the btrfs, ext4, and XFS file systems.

File System Type	Maximum File Size	Maximum File System Size
btrfs	50 TB	50 TB
ext4	50 TB	50 TB
XFS	16 TB	500 TB

The maximum supported size for a bootable LUN is 50 TB. GPT and UEFI support are required for LUNs larger than 2 TB.

The maximum size of the address space that is available to each process is 128 TB.

Shipped Kernels

Oracle Linux 7 is shipped with the following kernels:

- Red Hat Compatible Kernel (RHCK), based on mainline Linux version 3.10.
- Unbreakable Enterprise Kernel Release 3 (UEK R3), starting with 3.8.13, based on mainline Linux version 3.8. This is the default kernel.

Note

UEFI Secure Boot is not currently supported with UEK R3.

Installer Features

The Anaconda installer has been enhanced and includes the following notable features:

- An enhanced graphical interface.
- A new text interface that can be used in a write-only mode.
- Support for non-partitioned, directly-formatted devices.
- `tmpfs` configuration.
- LVM thin provisioning.
- Configuration of `btrfs` or `XFS` for the root file system. Note that the file system type for `/boot` cannot be `btrfs`.
- The default file system type is `XFS`, which replaces `ext4`.
- Encryption of swap and all file systems except for `/boot`. For a `btrfs` file system, the encryption applies to all subvolumes.
- Bonding and teaming of network interfaces.

Apache Web Server Features

Apache HTTP Server version 2.4 provides the following notable features:

- The event Multi-Processing Module (MPM) and integrated proxy module support for the FastCGI protocol allow the server to serve more concurrent requests.
- Improvements to asynchronous read and write handling.
- Embedded Lua scripting.

For more information see https://httpd.apache.org/docs/2.4/new_features_2_4.html.

Authentication Features

Oracle Linux 7 introduces the following notable authentication features:

- If POSIX attributes are defined, authentication can obtain a user or group ID from Active Directory instead of using an ID generated from a Security Identifier. Clients must be running Oracle Linux 5 Update 9 and later, Oracle Linux 6 Update 3 and later, or Oracle Linux 7.
- The `slapi-nis` package contains the following plug-ins:
 - `nisserver-plugin` enables a directory server to act as a NIS server.
 - `schemacompat-plugin` enables a directory server to modify how entries in the directory information tree (DIT) are presented to clients.

These plug-ins are designed to help transition a network from NIS to LDAP.

Boot Loader Features

The GRUB2 boot loader in Oracle Linux 7 provides the following notable enhancements over the previous version of GRUB:

- Support for the BIOS, EFI, and Open Firmware.
- Support for GPT.
- Support for additional file system types, including HFS+ and NTFS.

Note

The installer does not permit you to configure GRUB2 in partitions as some file systems do not allow enough space for the boot loader.

Linux Containers

The Linux Containers (LXC) feature allows you to safely and securely run multiple applications or instances of an operating system on a single host without risking them interfering with each other. Containers are lightweight and resource-friendly, which saves both rack space and power. For more information, see [Oracle Linux 7: Administrator's Guide](#).

LXC is supported for both UEK R3 and RHCK. You can configure both 32-bit and 64-bit guest containers. However, some applications might not be supported for use with these features.

Load Balancing and High Availability

Oracle Linux 7 includes the Keepalived and HAProxy technologies for balancing access to network services while maintaining continuous access to those services.

Keepalived uses the IP Virtual Server (IPVS) kernel module to provide transport layer (Layer 4) load balancing, redirecting requests for network-based services to individual members of a server cluster. IPVS monitors the status of each server and uses the Virtual Router Redundancy Protocol (VRRP) to implement high availability.

HAProxy is an application layer (Layer 7) load balancing and high availability solution that you can use to implement a reverse proxy for HTTP and TCP-based Internet services.

For more information, see [Oracle Linux 7: Administrator's Guide](#).

MySQL Community and MariaDB Packages

In the initial release of Oracle Linux 7, the MySQL Community 5.6 packages were provided on the Oracle Linux 7 full installation DVD image but were not installable using the Anaconda installer or kickstart. The ISO image for update 1 to Oracle Linux 7 provides support for installing either MySQL 5.6 or MariaDB by using either the Anaconda installer or kickstart. For more information, see [Oracle Linux 7: Release Notes for Oracle Linux 7.1](#).

Networking Features

Oracle Linux 7 provides the following notable enhancements to support networking:

- The `chronyd` service enables mobile systems and virtual machines to update their system clock after a period of suspension or disconnection from a network. You can use the `chronyc` command to manage the `chronyd` service. For more information, see the `chronyc(1)` manual page.
- Domain Name System Security Extensions (DNSSEC) allow a DNS client to verify the authenticity of a DNS server and to check that responses to DNS queries have not been modified.
- The `firewalld` service provides a dynamically managed firewall that allows applications and system services to add firewall rules. By default, the `firewalld` service is enabled and the `iptables` and `ip6tables` services are disabled. For more information, see <https://fedoraproject.org/wiki/FirewallD>.
- The `nmcli` utility notifies the NetworkManager about configuration changes. By default, NetworkManager now does not monitor configuration file for changes. However, it still responds to any changes made using the D-Bus API. For more information, see the `nmcli(1)` manual page.
- OpenLMI provides an infrastructure for configuring, managing, and monitoring hardware, operating system software, and services on Linux systems, including bare-metal servers and virtual machine guests, as well as storage systems and networks. OpenLMI abstracts the complexity of system management and presents a simpler administration interface. The Open LMI agents on a managed system are accessible via the OpenLMI controller, which also provides access to client applications using C/C++, Java, Python, or the CLI. For more information, see <http://www.openlmi.org>.

Red Hat Compatible Kernel Features

The Red Hat Compatible Kernel (RHCK) is based on mainline Linux version 3.10 and provides the following notable features:

- Compression of swap memory to reduce I/O overhead (*zram*).
- Crash dumps can be recorded on systems with up to 3 TB of memory.
- DynTick support for suspending the system tick when there is only a single runnable task.
- Hardware Error Reporting Mechanism (HERM), which replaces `mcelog` and EDAC.
- NUMA-aware scheduling and memory allocation for improving the performance of NUMA systems.

Security Features

Oracle Linux 7 introduces the following notable security features:

- The `SSH 2 AuthenticationMethods` option specifies one or more comma-separated lists of authentication methods. If only one list is specified, a user is granted access if he or she successfully completes all of the methods in the list. If several lists are specified, a user must complete at least one of the lists. Each listed authentication method must be enabled in `/etc/ssh/sshd_config`.

The available methods are `hostbased`, `keyboard-interactive`, `password`, and `publickey`. You can use the `keyboard-interactive` method to invoke authentication mechanisms such as Pluggable Authentication Modules (PAM). You can configure PAM modules that use authentication methods such as GSSAPI, Kerberos, hardware tokens, or biometric matching.

The following example configuration requires either public-key authentication followed by PAM-defined authentication or connection from a trusted host followed by public-key authentication:

```
AuthenticationMethods "publickey,keyboard-interactive:pam hostbased,publickey"
```

- To overcome the inherent vulnerability of processes sharing a system key table, applications can use the GSS Proxy system service to set up a unique Kerberos context.
- The `selinuxuser_use_ssh_chroot` variable must be set for confined SELinux users (for example, `guest_u`, `staff_u`, or `user_u`). To ensure high security when specifying the Open SSH `ChrootDirectory` option, configure chrooted users as the confined user `guest_u`.
- Version 3.15.2 and later of the `nss` packages support the following AES-GCM cipher suites with TLS 1.2:
 - `TLS_DHE_RSA_WITH_AES_128_GCM_SHA256`
 - `TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256`
 - `TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256`
 - `TLS_RSA_WITH_AES_128_GCM_SHA256`
- OCSP and CRLs no longer accept MD2, MD4, and MD5 signatures.

Storage and File System Features

Oracle Linux 7 introduces the following notable features for managing storage and file systems:

- Oracle Linux 7 with both UEK R3 and RHCK uses the Linux-IO (LIO) Target to provide the block-storage SCSI target for FCoE, iSCSI, and Mellanox InfiniBand (iSER and SRP). To manage LIO, you can use the `targetcli` shell, which accepts plug-ins that support additional fabric types and functionality. For more information, see the `targetcli(8)` manual page and <http://linux-iscsi.org/wiki/Targetcli>. Note that Mellanox InfiniBand is only supported with UEK.
- The System Storage Manager command-line utility (`ssm`) unifies the configuration and management of storage and file systems by subsuming the functionality of commands such as `btrfs`, `cryptsetup`, `dmsetup`, `fsck`, `lv*`, `mdadm`, `mkfs`, `mount`, `pv*`, `tune2fs`, `vg*`, and `xf*`. For more information, see the `ssm(8)` manual page and <http://storagemanager.sourceforge.net>.
- Oracle Linux 7 provides the temporary file system (`tmpfs`), which is configured in volatile memory and whose contents do not persist after a system reboot. To mount this file system on `/tmp`, use the `systemctl` command to enable the `tmp.mount` systemd mount point unit. The `tmpfs` file system is suitable for use by non-privileged processes that need to store small quantities of temporary data.
- The `snapper` command allows you to manage read-only snapshots of `btrfs` file systems and thinly-provisioned LVM logical volumes. For more information, see the `snapper(8)` manual page and <http://snapper.io/documentation.html>.

Technology Preview

The following features are still under development, but are made available for testing and evaluation purposes with UEK R3.

- **DRBD (Distributed Replicated Block Device)**

A shared-nothing, synchronously replicated block device (*RAID1 over network*), designed to serve as a building block for high availability (HA) clusters. It requires a cluster manager (for example, pacemaker) for automatic failover.

- **Transcendent memory**

Transcendent Memory (*tmem*) provides a new approach for improving the utilization of physical memory in a virtualized environment by claiming underutilized memory in a system and making it available where it is most needed. From the perspective of an operating system, tmem is fast pseudo-RAM of indeterminate and varying size that is useful primarily when real RAM is in short supply. To learn more about this technology and its use cases, see the Transcendent Memory project page at <https://oss.oracle.com/projects/tmem/>.

For the RHCK, the following features are currently under technology preview:

- Active Directory and LDAP sudo providers.
- Block and object storage layouts for parallel NFS (pNFS).
- Block device caching by LVM, which allows small, fast devices to act as caches for large, slow devices.
- btrfs file system. Oracle supports btrfs with UEK R3.
- Crash kernel can be configured to boot with more than a single CPU.
- DIF/DIX for data integrity checking on SCSI devices.
- LSI Syncro CS feature in the `megaraid_sas` driver to support High-Availability Direct-Attached storage (HA-DAS) adapters.
- LVM API.
- More than 32 PCI slots can be configured with PCI Bridge in QEMU.
- OpenLMI Software Provider.
- PCI Express Bus, AHCI Bus, and USB 3.0 host adapter emulation are provided for KVM guests.
- SCAP Workbench and the OSCAP Anaconda add-on.
- Single-Root I/O virtualization (SR-IOV) in the `qlcnict` driver.
- Storage array management, which includes a command-line interface and the `libStorageMgmt` API.
- The `dm-era` device-mapper target records changes made to blocks over a specified time period.
- Trusted Network Connect.
- `virtio-blk-data-plane` in Quick EMULATOR (QEMU) improves block I/O performance.

Note

The upstream Kpatch RPM has been removed from Oracle Linux. Customers who wish to patch their running kernel with zero downtime should evaluate Oracle's Ksplice technology, which is included at no additional cost with Oracle Linux Premier support.

Compatibility

Oracle Linux maintains user-space compatibility with Red Hat Enterprise Linux, which is independent of the kernel version that underlies the operating system. Existing applications in user space will continue to run unmodified on the Unbreakable Enterprise Kernel Release 3 (UEK R3) and no re-certifications are needed for RHEL certified applications.

To minimize impact on interoperability during releases, the Oracle Linux team works closely with third-party vendors whose hardware and software have dependencies on kernel modules. The kernel ABI for UEK R3 will remain unchanged in all subsequent updates to the initial release. UEK R3 contains changes to the kernel ABI relative to UEK R2 that require recompilation of third-party kernel modules on the system. Before installing UEK R3, verify its support status with your application vendor.

Unsupported Emulex Devices

The following Emulex LightPulse HBA devices are being desupported by Emulex and are not supported for use with Oracle Linux 7:

- LP10000 (VID:10DF, DID:FA00)
- LP10000S (VID:10DF, DID:FC00)
- LP101 (VID:10DF, DID:F0A1)
- LP1050 (VID:10DF, DID:F0A5)
- LP11000S (VID:10DF, DID:FC10)
- LP11000-S (VID:10DF, DID:FD11)
- LP111 (VID:10DF, DID:F0D1)
- LP6000 (VID:10DF, DID:1AE5)
- LP7000 (VID:10DF, DID:F700)
- LP8000 (VID:10DF, DID:F800)
- LP9002 (VID:10DF, DID:F900)
- LP952 (VID:10DF, DID:F095)
- LP9802 (VID:10DF, DID:F980)
- LP982 (VID:10DF, DID:F098)
- LPe1000 (VID:10DF, DID:F0F5)
- LPe1000-SP (VID:10DF, DID:F0F5)
- LPe1002-SP (VID:10DF, DID:F0F7)
- LPe11000S (VID:10DF, DID:FC20)
- LPx1000 (VID:10DF, DID:FB00)
- LPx1000 (VID:10DF, DID:FB00)

Notable Changes from Oracle Linux 6

The following sections describe the most notable changes in Oracle Linux 7 from Oracle Linux 6.

Exporting System Configuration Parameters

Parameters defined in `/etc/sysconfig` files are automatically exported in Oracle Linux 7. You no longer need to use the `export` command.

Host Name Configuration

The host name is now defined in `/etc/hostname` instead of `/etc/sysconfig/network`.

Predictable Network Interface Naming

Network interface names are now based on information derived from the system BIOS or alternatively from a device's firmware, system path, or MAC address. This feature ensures that interface names persist across system reboots, hardware reconfiguration, and updates to device drivers and the kernel.

If you enable the `biosdevname` boot option (`biosdevname=1`), the `biosdevname` plugin (provided in the `biosdevname` package) to the `udev` device manager assigns names to network interfaces as follows:

em *N*

Ethernet interface on the motherboard, where *N* is the number of the interface starting from 1.

pS pP

Network interface on a PCI card, where *S* is the slot number and *P* is the port number.

pS pP _V

Virtual interface, where *S* is the slot number, *P* is the port number, and *V* is the virtual interface number.

If `biosdevname` is set to 0 (the default), `systemd` naming assigns the prefixes, `en`, `wl`, and `ww` to Ethernet, wireless LAN, and wireless WAN interfaces respectively. The prefix is followed by a suffix based on the hardware configuration, system bus configuration, or MAC address of the device:

o *N*

Onboard device with index number *N*.

pBsS[*fF*][*dD*]

PCI device with bus number *B*, slot number *S*, function number *F*, and device ID *D*.

pBsS[*fF*][*uP*]...[*cC*][*iI*]

USB device with bus number *B*, slot number *S*, function number *F*, port number *P*, configuration number *C*, and interface number *I*.

sS[*fF*][*dD*]

Hot-plug device with slot number *S*, function number *F*, and device ID *D*.

x *M*

Device with MAC address *M*.

For example, an Ethernet port on the motherboard might be named `en01` or `em1`, depending on whether the value of `biosdevname` is 0 or 1.

The kernel assigns a legacy, unpredictable network interface name (`eth N` and `wlan N`) only if it cannot discover any information about the device that would allow it to disambiguate the

device from other such devices. You can use the `net.ifnames=0` boot parameter to reinstate the legacy naming scheme.

To define the name of an interface manually:

1. Use the `ip link` command to display the MAC address of the existing interface, for example:

```
sudo ip link show enp0s3 | grep link

link/ether 08:00:27:16:c3:33 brd ff:ff:ff:ff:ff:ff
```

2. Change the name of the existing configuration file for the interface (`/etc/sysconfig/network-scripts/ifcfg-ifname`) so that the *ifname* suffix has the same value as the desired interface name, for example:

```
cd /etc/sysconfig/network-scripts
mv ifcfg-enp0s3 ifcfg-net1
```

3. Edit the renamed configuration file:

- a. Verify that the value of the `HWADDR` parameter is the same as the interface's MAC address as shown by the `ip link` command, for example:

```
HWADDR=08:00:27:16:c3:33
```

- b. Set the value of the `DEVICE` parameter to the desired interface name, for example:

```
DEVICE=net1
```

Add this parameter if it is not already present in the file.

- c. Set the value of the `NAME` parameter to the desired interface name, for example:

```
NAME=net1
```

This parameter defines the name of the interface as displayed in the Network Connections editor.

4. Reboot the system:

```
sudo systemctl reboot
```

Caution

Changing a network interface name or the naming scheme can make existing firewall rules invalid. It can also affect other software that refers to network interface names.

NFS v2

NFS v2 is not supported for use with Oracle Linux 7. You should use NFS v3 or NFS v4 instead.

ifconfig Output

The output of the `ifconfig` command has changed format. You might need to amend any programs that parse the output of this command. For future compatibility, it is recommended that you modify such programs to use the `ip` command instead of `ifconfig`.

Initial Setup Supersedes Firstboot

Although legacy support for firstboot allows third-party modules to continue to function, it is recommended that you rewrite these modules to work with the installer and Initial Setup.

Layout of the root File System

As `initrd` is now able to mount the `/usr` file system at boot time, the files in `/bin`, `/lib`, `/lib64`, and `/sbin` have been moved to `/usr/bin`, `/usr/lib`, `/usr/lib64`, and `/usr/sbin`. Symbolic links in `/` provide backward compatibility for programs.

Localization Settings

System-wide default localization settings such as the default language, keyboard, and console font are now defined in `/etc/locale.conf` and `/etc/vconsole.conf` instead of `/etc/sysconfig/i18n`.

System Logging

The new logging daemon, `journald`, records system messages in non-persistent journal files in memory and in `/run/log/journal`. `journald` forwards messages to `rsyslog`, which processes and archives only `syslog` messages by default. If required, you can configure `rsyslog` to archive any other messages that `journald` forwards, including kernel, boot, `initrd`, `stdout`, and `stderr` messages.

systemd Replaces Upstart and init

The `systemd` daemon replaces Upstart for managing system run levels and services. Replacing `init`, `systemd` is the first process that starts after the system boots, and is the final process that is running when the system shuts down. `systemd` controls the final stages of booting and prepares the system for use. `systemd` also speeds up booting by loading services concurrently.

[Table 1-1](#) shows the nearest equivalent `systemctl` command for various system management commands used in Oracle Linux 6.

Table 1-1 `systemctl` Command Equivalents

Legacy Command	Nearest Equivalent <code>systemctl</code> Command	Description
<code>chkconfig --list name</code>	<code>systemctl is-enabled name[.service]</code>	Check whether a service is enabled to start at boot time. The <code>.service</code> tag is optional.
<code>chkconfig name off</code>	<code>systemctl disable name[.service]</code>	Disable a service from starting at boot time.
<code>chkconfig name on</code>	<code>systemctl enable name[.service]</code>	Enable a service to start at boot time.
<code>halt</code>	<code>systemctl halt</code>	Halt the system.
<code>pm-hibernate</code>	<code>systemctl hibernate</code>	Put the system into hibernation.

Table 1-1 (Cont.) systemctl Command Equivalents

Legacy Command	Nearest Equivalent systemctl Command	Description
<code>pm-suspend</code>	<code>systemctl suspend</code>	Suspend the system.
<code>pm-suspend-hybrid</code>	<code>systemctl hybrid-sleep</code>	Put the system into hibernation and suspend its operation.
<code>poweroff</code>	<code>systemctl poweroff</code>	Power off the system.
<code>reboot</code>	<code>systemctl reboot</code>	Reboot the system.
<code>runlevel</code>	<code>systemctl list-units --type target</code>	Display the currently active targets, which taken as a group constitute the nearest equivalent that <code>systemd</code> has to a run level.
<code>service name start</code>	<code>systemctl start name[.service]</code>	Start a service.
<code>service name status</code>	<code>systemctl status name[.service]</code>	Display the status of a service.
<code>service name stop</code>	<code>systemctl stop name[.service]</code>	Stop a service.
<code>telinit runlevel</code>	<code>systemctl isolate name.target</code>	Change the <code>systemd</code> target.

As well as services (*name .service*) and targets (*name .target*), other types of unit that you can manage in `systemd` include devices (*name .device*), file system mount points (*name .mount*), and sockets (*name .socket*). For example, the following command instructs the system to mount the temporary file system (`tmpfs`) on `/tmp` at boot time:

```
# systemctl enable tmp.mount
```

[Table 1-2](#) shows the nearest equivalent `systemd` targets to the run levels that are used in Oracle Linux 6.

Table 1-2 systemd Target Equivalents

Run Level in Oracle Linux 6	Nearest Equivalent systemd Targets in Oracle Linux 7	Description
0	<code>poweroff.target</code> <code>runlevel0.target</code>	Shut down and power off the system.
1	<code>rescue.target</code> <code>runlevel1.target</code>	Set up a rescue shell.
2	<code>multi-user.target</code> <code>runlevel2.target</code>	Set up a non-graphical, multi-user system.
3	<code>multi-user.target</code> <code>runlevel3.target</code>	Set up a non-graphical, multi-user system with networking.
4	<code>multi-user.target</code> <code>runlevel4.target</code>	User defined or not used.

Table 1-2 (Cont.) systemd Target Equivalents

Run Level in Oracle Linux 6	Nearest Equivalent systemd Targets in Oracle Linux 7	Description
5	graphical.target runlevel5.target	Set up a multi-user system with networking and display manager.
6	reboot.target runlevel6.target	Shut down and reboot the system.

The `runlevel*` targets are implemented as symbolic links.

The nearest equivalent `systemd` target to the Oracle Linux 6 run levels 2, 3, and 4 is `multi-user.target`.

You can use the following commands to display the current default `systemd` target and to configure a new default target:

```
sudo systemctl get-default
sudo systemctl set-default name.target
```

If required, you can create customized versions of the targets that are defined in `/usr/lib/systemd/system`.

For more information, see the `systemctl(1)` and `systemd.unit(5)` manual pages and <https://freedesktop.org/wiki/Software/systemd/>.

Compatibility Limitations of systemd

`systemd` has the following limitations that can affect the compatibility of legacy programs running under Oracle Linux 7:

- All service script actions time out after 5 minutes to prevent the system hanging indefinitely.
- By default, `systemd` assigns each system service to a dedicated `cpu` control group, which prevents services from accessing real-time scheduling. For details of workarounds, see <https://www.freedesktop.org/wiki/Software/systemd/MyServiceCantGetRealtime/>.
- If a `systemd` target does not have an equivalent Oracle Linux 6 run level, legacy commands such as `runlevel` return `N` to indicate an unknown run level.
- Services cannot inherit user context so some legacy service initialization scripts might not work correctly.
- `systemd` can interpret and use the headers in Linux Standard Base service scripts.
- `systemd` does not attempt to stop services that are not running.
- `systemd` supports the `disable`, `enable`, `restart`, `start`, `status`, and `stop` actions for services. To support other service functions, you must use a separate program such as a service script.
- The `chkconfig` command might display incorrect information about run levels and services.
- The legacy `service` command forwards service action requests to `systemd` but `/etc/init.d` service scripts do not.

2

Known Issues

Warning

Oracle Linux 7 is now in Extended Support. See [Oracle Linux Extended Support](#) and [Oracle Open Source Support Policies](#) for more information.

Migrate applications and data to Oracle Linux 8 or Oracle Linux 9 as soon as possible.

This chapter describes the known issues for the initial release for Oracle Linux 7.

Configuring Encryption and /boot During Installation

During installation, if you select **Encrypt my data** on the Installation Destination screen and then perform manual partitioning, the **Encrypt** check box is not shown as selected on the Manual Partitioning screen. This check box refers to encryption that you can configure on a file system type that supports encryption or on an LVM logical volume that contains the file system. If you click **Modify**, the **Encrypt** check box on the Configure Volume screen is shown as selected for the volume, meaning that the encryption will be applied at the level of the underlying block device.

For LVM, selecting **Encrypt my data** encrypts the LVM physical volume and all the logical volumes that it contains. If you do not select **Encrypt my data**, you can encrypt the logical volume by selecting the **Encrypt** check box on the Manual Partitioning screen or encrypt the physical volume by selecting the **Encrypt** check box on the Configure Volume screen.

For btrfs, encryption can only be applied to the block device that contains the file system, including its subvolumes. For example, enabling encryption for the `/home` subvolume of a btrfs root file system implicitly enables encryption for the root file system itself. You can only select the **Encrypt** check box on the Configure Volume screen. As btrfs does not support encryption at the file-system level, you cannot select the **Encrypt** check box on the Manual Partitioning screen for a btrfs file system.

Do not select the **Encrypt** check box or a **BTRFS**, **LVM**, or **LVM Thin Provisioning** device type for `/boot`. The `/boot` file system must be configured on a standard partition and should be of type `ext4` or `XFS`.

When entering a password in the Disk Encryption Passphrase dialog, press Tab to move between the entry fields. You cannot use the mouse to select the fields.

Network Installation

Attempting to perform a network installation without configuring a network interface to use DHCP to obtain its IP settings or with static IP settings results in the error `Error in Installation Source`.

For example, if you use a feature such as a remote console or Lights-out management to access a boot ISO, the network configuration of the embedded server manager might not be available when you select the installation location. The workaround is to use the graphical

installer to configure the network settings manually before configuring the installation location. (Bug ID 19047736)

Installation Fails for ext3 / and /boot

Rebooting following installation fails if you format / and /boot as ext3 file systems. The system displays messages similar to the following before starting the emergency shell:

```
systemd[1]: Timed out waiting for device ...
systemd[1]: Dependency failed for /boot.
systemd[1]: Dependency failed for Local file ...

systemd[1]: Dependency failed for Mark the need to relabel after reboot.
systemd[1]: Dependency failed for Relabel all filesystems, if necessary.
systemd[1]: Dependency failed for File System Check on ...

[DEPEND] Dependency failed for Local File Systems.
[DEPEND] Dependency failed for Mark the need to relabel after reboot
[DEPEND] Dependency failed for Relabel all filesystems, if necessary.
```

The workaround is to disable SELinux during installation by specifying `selinux=0` on the installation boot command line or by specifying `selinux --disabled` in the Kickstart file. (Bug ID 19171480)

grubby Sets Incorrect Saved Entry

If `grubby` is used to remove a kernel menu entry from the GRUB 2 configuration, the value of the default entry in `/etc/grub2/grub.cfg` is incorrect. The workaround is to set the value of `GRUB_DEFAULT` in `/etc/default/grub` to the correct entry and use `grub2-mkconfig` to recreate `/etc/grub2/grub.cfg`, or use `yum` or `rpm` to remove the kernel packages. (Bug ID 19192278)

Per-CPU Allocation Fails when Loading `kvm_intel` Module with UEK R3

Per-CPU allocation fails when the `kvm_intel` module is loaded with UEK R3. Messages such as the following are logged:

```
kvm_intel: Could not allocate 48 bytes percpu data
PERCPU: limit reached, disable warning
```

There is no current workaround for UEK R3. (Bug ID 18459498)

avahi-daemon Fails to Start with UEK R3

The `avahi-daemon` fails to start with UEK R3 and messages such as the following are logged:

```
WARNING: No NSS support for mDNS detected, consider installing nss-mdns!
Unit avahi-daemon.service entered failed state.
```

The workaround is to comment out the `disallow-other-stacks` entry in `/etc/avahi/avahi-daemon.conf` as shown here:

```
#disallow-other-stacks=yes
```

(Bug ID 18459758)

Crash Kernel auto Setting

If you enable the `crashkernel=auto` kernel parameter for UEK R3 to simplify Kdump configuration, both `dmesg` output and `/proc/cmdline` show `crashkernel=NNMM@0M`. This is the expected behavior for the implementation, where `@0M` implies the `auto` setting. For Xen, `crashkernel=auto` is supported only for Domain 0.

systemd Fails to Load the autofs4 and ipv6 Modules with UEK R3

At boot time, `systemd` fails to load the `autofs4` and `ipv6` modules and errors such as the following are logged:

```
systemd[1]: Failed to insert module 'autofs4'  
systemd[1]: Failed to insert module 'ipv6'
```

There is no current workaround for UEK R3. (Bug ID 18470449)

firewalld Does Not Currently Support IPv6 NAT Under UEK R3

The following error message indicates that IPv6 NAT is not currently supported by `firewalld` with UEK R3.

```
ERROR: ipv6 table 'nat' does not exist (or not enough permission to check)
```

(Bug ID 18504545)

Oracle ASM Fails to Initialize with SELinux in Enforcing Mode

The `oracleasm` script fails if SELinux is in `Enforcing` mode. The suggested workaround is to disable the SELinux policy module for Oracle ASM before running `oracleasm`:

```
# semodule -d oracleasm  
# semodule -l | grep oracleasm  
oracleasm      1.0.0   Disabled
```

(Bug ID 18513404)

systemctl Does Not Support Some Service Actions

The `systemctl` command supports the `disable`, `enable`, `restart`, `start`, `status`, and `stop` actions for services such as `o2cb` and `oracleasm`. To perform actions such as `configure`, invoke the `/etc/init.d` script for the service directly. (Bug IDs 18527520 and 18528039)

btrfs-convert Fails

The `btrfs-convert` command fails when invoked to convert an `ext2`, `ext3`, or `ext4` file system to `btrfs`. This error occurs whether the system has been booted with UEK R3 or RHCK. There is currently no known workaround or fix available. (Bug ID 18534417)

Upgrading from Oracle Linux 6 Update 5

The following issues may be encountered when upgrading:

- The `redhat-upgrade-tool-cli` utility requires that you install version 3.2.29-43.0.1 or later of the `yum` package on the Oracle Linux 6 Update 5 system that you want to upgrade. If you use an earlier version of the `yum` package, the upgrade tool fails with dependency errors. (Bug ID 18648783)
- The old RHCK is not removed during the upgrade. (Bug ID 18767222)
- If you do not run the preupgrade assistant utility `preupg`, an upgraded system hangs while rebooting with the message `starting wait for plymouth boot screen to quit`. (Bug ID 18815298)
- The `redhat-upgrade-tool-cli` utility does not exit if UEK R3 is not installed. (Bug ID 18900135)
- The postupgrade scripts fail if a proxy is required to access Oracle Linux yum server. (Bug ID 19169163)
- The `libcgroup` package in Oracle Linux 7 does not include the `cgconfig` and `cgred` control group services. To restore these services on an upgraded system, install the `libcgroup-tools` package. (Bug ID 19177606)

Oracle Linux 7 Guests on Oracle VM and Xen

Oracle Linux 7 guests are supported for both hardware virtualization (HVM) and hardware virtualization with paravirtual drivers (PVHVM) on Oracle VM 3. Oracle Linux 7 guests in a paravirtualized domain (PVM) on Oracle VM or other Xen-based hypervisors are not supported.

Oracle Linux 7 guests of any type are not supported on Oracle VM 2.

Hebrew LaTeX Fonts

Installing the `tex-fonts-hebrew` package fails unless you first install all `texlive*` packages. (Bug ID 19059949)

sosreport Reports Many SELinux Warnings

The `sosreport -o selinux -a` command reports many SELinux warnings for files that do not belong to RPMs. This is the expected behavior. You can safely ignore these warnings. (Bug ID 18913115)

Using NFS v4 with an lxc-oracle Container Fails

Attempting to create an `lxc-oracle` container on a remote file system mounted using NFS v4 fails. In addition, attempting to mount a remote file system using NFS v4 from within an `lxc-oracle` container also fails. The workaround is to use NFS v3 instead. (Bug ID 16316266)

Enabling and Disabling NFS

You cannot enable or disable the NFS service by using the `systemctl` command with `nfs.service`. Specify `nfs-server.service` instead, for example:

```
sudo systemctl enable nfs-server
```

(Bug ID 18437212)

Network Teaming

Network teaming is not currently supported for use with UEK R3. The workaround is to use bonding instead. (Bug ID 19151770)

Network Connection Icon Reports Incorrect State for Interfaces

The network connection icon might report an active network interface as being disconnected. This behavior is seen for the `root` user but not for other users. Command-line utilities such as `ip link` and `ifconfig` report the correct state. (Bug ID 19060089)

net_prio Control Group

The Network Priority cgroup subsystem (`net_prio`) is not currently supported for use with UEK R3. Attempting to use the module with UEK R3 results in error messages such as the following:

```
modprobe: FATAL: Module netprio_cgroup not found
mount: special device cgroup does not exist.
```

(Bug ID 18966564)

XFS File Attributes Cause a Panic or Reboot

Attempting to add many attributes to a file in an XFS file system under UEK R3 can result in a kernel panic or a system reboot. (Bug ID 18504299)

Automatic Bug Reporting Tool

The automated reporting daemons and features provided by the Red Hat Automatic Bug Reporting Tool (ABRT) are not supported with Oracle Linux

ABRT packages and associated files, such as `libreport`, are included in the distribution to satisfy package dependencies and can be used to generate local bug reports but the features to automatically upload these reports are not supported. For technical assistance, contact Oracle Support by using the My Oracle Support portal or by telephone.

InfiniBand Issues

The following issues might be encountered with InfiniBand devices:

- You might see the following warning messages if you use the `ibportstate disable` command to disable a switch port:

```
ibwarn: [2696] _do_madrpc: recv failed: Connection timed out
ibwarn: [2696] mad_rpc: _do_madrpc failed; dport (Lid 38)
ibportstate: iberror: failed: smp set portinfo failed
```

You can safely ignore these warnings. (Bug ID 16248314)

- To configure Internet Protocol over InfiniBand (IPoIB):
 1. Edit the `/etc/sysconfig/network-scripts/ifcfg-ibN` configuration file, where *N* is the number of the interface. The following example shows the configuration for the interface `ib0`:

```
DEVICE=ib0
TYPE=InfiniBand
ONBOOT=yes
DHCP_HOSTNAME="myhost.mydom.com"
BOOTPROTO=static
IPADDR=192.168.100.1
NETMASK=255.255.255.0
IPV4_FAILURE_FATAL=yes
IPV6INIT=no
CONNECTED_MODE=no
NAME=ib0
```

2. Stop the NetworkManager service:

```
sudo systemctl stop NetworkManager
```

3. Start the RDMA service:

```
sudo systemctl start rdma
```

4. Bring up the interface:

```
sudo ifup ibN
```

(Bug ID 19150870)

- The IPoIB driver supports the use of either connected mode or datagram mode with an interface, where datagram mode is the default mode. Changing the mode of an InfiniBand interface by echoing either `connected` or `datagram` to `/sys/class/net/ibN/mode` is not supported. It is also not possible to change the mode of an InfiniBand interface while it is enabled.

To change the IPoIB mode of an InfiniBand interface:

1. Edit the `/etc/sysconfig/network-scripts/ifcfg-ibN` configuration file, where *N* is the number of the interface:
 - To configure connected mode, specify `CONNECTED_MODE=yes` in the file.
 - To configure datagram mode, either specify `CONNECTED_MODE=no` in the file or do not specify this setting at all (datagram mode is enabled by default).

Note

Before saving your changes, make sure that you have not specified more than one setting for `CONNECTED_MODE` in the file.

2. To enable the specified mode on the interface, use the following commands to take down the interface and bring it back up:

```
sudo ifdown ibN
sudo ifup ibN
```

(Bug ID 17479833)

- When the `rds_ib_srq` parameter for the `rds_rdma` module is enabled and the module is in use (for example, when running the `rds-stress` tool), restarting the `rdma` service (which reloads the `rds_rdma` module) generates error messages visible in `dmesg` or `/var/log/messages`. (Bug ID 19010606)

Power Button Defaults to ACPI Suspend

By default, Oracle Linux 7 in graphical (GUI) console mode treats the hardware power button as equivalent to the ACPI "Sleep" button, which puts the system into low-power sleep mode. This behavior is specific to Gnome desktop environment.

In previous Oracle Linux versions, the hardware power button initiated a system shutdown. To make Oracle Linux 7 do the same, create a file named `/etc/dconf/db/local.d/01-shutdown-button` with the following content:

```
[org/gnome/settings-daemon/plugins/power]
button-power='shutdown'
```

Then run the following command:

```
sudo dconf update
```

You must log out of the desktop environment and log back in for the new setting to take effect. (Bug ID 25597898)

3

Installation and Availability

⚠ Warning

Oracle Linux 7 is now in Extended Support. See [Oracle Linux Extended Support](#) and [Oracle Open Source Support Policies](#) for more information.

Migrate applications and data to Oracle Linux 8 or Oracle Linux 9 as soon as possible.

You can download a full Oracle Linux 7 installation media image from the Oracle Software Delivery Cloud at <https://edelivery.oracle.com/linux>. You can also obtain Oracle Linux 7 packages from the Unbreakable Linux Network (ULN) and the Oracle Linux yum server.

The following table lists some of the channels and repositories that will be made available on ULN and Oracle Linux yum server for Oracle Linux 7.

ULN Channel	Oracle Linux yum server Repository	Description
ol7_x86_64_latest	ol7_latest	Latest packages for Oracle Linux 7.
ol7_x86_64_u0_base	ol7_u0_base	Base packages for the initial release (Update 0) of Oracle Linux 7.
ol7_x86_64_u0_patch		Patches for the initial-release packages of Oracle Linux 7.
ol7_x86_64_addons	ol7_addons	GPL-licensed packages for Oracle Linux 7 that have not been sourced from upstream.
ol7_x86_64_Dtrace_userspace		DTrace user-space packages for Oracle Linux 7.
ol7_x86_64_Ksplice		Ksplice packages for Oracle Linux 7.
ol7_x86_64_MySQL55	ol7_MySQL55	MySQL Community Edition 5.5 packages for Oracle Linux 7.
ol7_x86_64_MySQL56	ol7_MySQL56	MySQL Community Edition 5.6 packages for Oracle Linux 7.
ol7_x86_64_optional_latest	ol7_optional_latest	Latest optional packages (including most *-devel packages) for Oracle Linux 7 that have been sourced from upstream.
ol7_x86_64_oracle		Oracle software packages for Oracle Linux 7.
ol7_x86_64_UEKR3	ol7_UEKR3	Latest Unbreakable Enterprise Kernel Release 3 (UEK R3) packages for Oracle Linux 7.

ULN Channel	Oracle Linux yum server Repository	Description
o17_x86_64_UEKR3_OFED20		OpenFabrics Enterprise Distribution (OFED) 2.0 packages for UEK R3 on Oracle Linux 7. See Installing OFED Packages from the o17_x86_64_UEKR3_OFED20 Channel .
o17_x86_64_VirtualBox		Oracle VM VirtualBox packages for Oracle Linux 7.

Note

Some ULN channels will not be made available until after the initial release.

Oracle Linux yum server does not provide equivalent repositories for some channels that are available on ULN. These channels provide non-open source packages.

The kernel source code is available after the initial release via a public git source code repository at <https://oss.oracle.com/git/?p=linux-uek3-3.8.git>.

UEK R3 is the default boot kernel for fresh installations of Oracle Linux 7.

For systems that are running UEK R3 and are subscribed to the o17_x86_64_UEKR3 channel on ULN, or the o17_x86_64_UEKR3 repository on Oracle Linux yum server Server, you upgrade to the latest UEK release as follows:

1. Upgrade all packages on the system, including kernel packages.

```
sudo yum update
```

By default, the boot manager automatically enables the most recent kernel version so you do not need to change your GRUB configuration.

2. Reboot the system.

```
sudo systemctl reboot
```

Installing OFED Packages from the o17_x86_64_UEKR3_OFED20 Channel

If you subscribe a system to the o17_x86_64_UEKR3_OFED20 channel on ULN, remove any existing OFED packages before installing any new OFED packages from this channel. The OFED packages are not upgradable if you installed them from the Oracle Linux 7 full installation DVD image, the o17_x86_64_latest channel on ULN, or the o17_latest repository on Oracle Yum Server, or if they are present on an Oracle Linux 6 Update 5 system that you have upgraded to Oracle Linux 7.

Use the `rpm` command to remove the old OFED packages, for example:

```
sudo rpm -e infiniband-diags \
libibcm \
libibcm-devel \
```

```
libibmad \  
libibmad-devel \  
libibumad \  
libibumad-devel \  
libibverbs \  
libibverbs-devel \  
libmlx4 \  
librdmacm \  
librdmacm-devel \  
opensm-devel \  
opensm-libs \  
ibacm-devel \  
ibutils \  
ibutils-libs
```

You can then use `yum` to install the new packages, for example:

```
sudo yum install ibutils
```

If you see a package conflict, use `rpm` to remove the old package before trying to install the new package again.

4

Package Changes from the Upstream Release

Warning

Oracle Linux 7 is now in Extended Support. See [Oracle Linux Extended Support](#) and [Oracle Open Source Support Policies](#) for more information.

Migrate applications and data to Oracle Linux 8 or Oracle Linux 9 as soon as possible.

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

Removed Packages

The following packages from the upstream release have been removed:

- kpatch
- libehca
- libica
- libreport-plugin-rhtsupport
- libreport-rhel
- librtas
- libservicelog
- libvpd
- libzfcphbaapi
- lsvpd
- openssl-ibmca
- powerpc-utils
- powerpc-utils-python
- ppc64-diag
- ppc64-utils
- publican-redhat
- python-rhsm
- Red_Hat_Enterprise_Linux-Release_Notes-7-as-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-bn-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-de-DE
- Red_Hat_Enterprise_Linux-Release_Notes-7-en-US
- Red_Hat_Enterprise_Linux-Release_Notes-7-es-ES

- Red_Hat_Enterprise_Linux-Release_Notes-7-fr-FR
- Red_Hat_Enterprise_Linux-Release_Notes-7-gu-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-hi-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-it-IT
- Red_Hat_Enterprise_Linux-Release_Notes-7-ja-JP
- Red_Hat_Enterprise_Linux-Release_Notes-7-kn-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-ko-KR
- Red_Hat_Enterprise_Linux-Release_Notes-7-ml-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-mr-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-or-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-pa-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-pt-BR
- Red_Hat_Enterprise_Linux-Release_Notes-7-ru-RU
- Red_Hat_Enterprise_Linux-Release_Notes-7-ta-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-te-IN
- Red_Hat_Enterprise_Linux-Release_Notes-7-zh-CN
- Red_Hat_Enterprise_Linux-Release_Notes-7-zh-TW
- redhat-access-gui
- redhat-logos
- redhat-support-lib-python
- redhat-support-tool
- s390utils
- servicelog
- subscription-manager
- subscription-manager-migration-data
- virt-who
- yaboot

Modified Packages

The following packages from the upstream release have been modified:

- abrt
- abrt-java-connector
- anaconda
- autofs
- basesystem
- coreutils
- dbus

- dhcp
- firefox
- fuse
- gdm
- glusterfs
- grub2
- grubby
- gstreamer
- httpd
- ipa
- irqbalance
- iscsi-initiator-utils
- java-1.7.0-openjdk
- kabi-yum-plugins
- kde-settings
- libreoffice
- libreport
- libreport-rhel-anaconda-bugzilla
- libreswan
- libxml2
- libxslt
- lorax
- mkbootdisk
- nss
- os-prober
- PackageKit
- pcs
- plymouth
- policycoreutils
- python-blivet
- redhat-bookmarks
- redhat-indexhtml
- redhat-lsb
- redhat-release-server
- redhat-rpm-config
- redhat-upgrade-dracut
- redhat-upgrade-tool

- `rhn-client-tools` (updated to support ULN)
- `rhnsd`
- `rpmdevtools`
- `rsyslog`
- `selinux-policy`
- `setroubleshoot`
- `setroubleshoot-plugins`
- `sos`
- `system-config-date`
- `system-config-kickstart`
- `systemtap`
- `tog-pegasus`
- `wireshark`
- `xfspgms`
- `xsane`
- `xulrunner`
- `yum`
- `yum-rhn-plugin`
- `yum-utils`

New Packages

The following packages are new:

- `initial-setup`
- `shim-signed`

Modified Optional Packages

The following optional packages have been modified:

- `publican`
- `sanlock`
- `jetty-artifact-remote-resources`
- `jetty-parent`
- `jetty-toolchain`

Packages Added by Oracle

The following packages have been added:

- `btrfs-progs`

- dtrace-modules
- kernel-uek
- libdtrace-ctf
- lxc
- ocfs2-tools
- oracle-logos
- oracleasm-support
- oraclelinux-release
- reflink
- uname26

5

Removed Modules

 **Warning**

Oracle Linux 7 is now in Extended Support. See [Oracle Linux Extended Support](#) and [Oracle Open Source Support Policies](#) for more information.

Migrate applications and data to Oracle Linux 8 or Oracle Linux 9 as soon as possible.

The following modules have been removed from UEK R3 for Oracle Linux 7 compared with UEK R3 for Oracle Linux 6 Update 5:

- 3c574_cs
- 3c589_cs
- 3c59x
- 3w-xxxx
- 8390
- acenic
- aic7xxx
- aic94xx
- amd8111e
- at76c50x-usb
- atmel
- atmel_cs
- atmel_pci
- axnet_cs
- b43
- b43legacy
- can
- can-bcm
- can-dev
- can-raw
- cassini
- c_can
- c_can_platform
- cciss

- cdc-phonet
- cxgb
- dl2k
- e100
- ems_pci
- ems_usb
- esd_usb2
- fealnx
- fmvj18x_cs
- forcedeth
- ips
- ipw2100
- ipw2200
- ixgb
- kvaser_pci
- libertas
- libertas_cs
- libertas_sdio
- libertas_tf
- libertas_tf_usb
- libipw
- mac80211_hwsim
- megaraid_mbox
- mptfc
- mptlan
- myri10ge
- natsemi
- ne2k-pci
- niu
- nmclan_cs
- ns83820
- p54common
- p54pci
- p54usb
- pch_can
- pcnet32
- pcnet_cs

- plx_pci
- r6040
- rt2400pci
- rt2500pci
- rt2500usb
- rtl8180
- s2io
- sc92031
- sis190
- sis900
- sja1000
- sja1000_platform
- slcan
- smc91c92_cs
- softing
- softing_cs
- starfire
- sundance
- sungem
- sungem_phy
- sunhme
- sym53c8xx
- tehuti
- tlan
- typhoon
- usb8xxx
- vcan
- via-rhine
- via-velocity
- vxge
- xirc2ps_cs
- zd1211rw