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# PROXMOX VIRTUAL ENVIRONMENT

## OVERVIEW

Proxmox Virtual Environment is a complete, open-source solution for enterprise virtualization that integrates the KVM hypervisor and Linux containers (LXC), software-defined storage (SDS) and networking (SDN) on a single platform. From the central user interface, you can manage VMs and containers, storage resources, network configuration, and high availability for clusters. The interface also provides access to multiple out-of-the-box tools for tasks such as backup/restore, live-migration, storage replication, and firewall configuration. Proxmox VE is designed to scale to cluster-level and enables you to virtualize even the most demanding of Linux and Windows application workloads. By combining two virtualization technologies on a single platform, Proxmox VE provides maximum flexibility for your data center. It includes strong high-availability (HA) support and – thanks to the unique multi-master design – you don't need any additional management server, thus saving resources and allowing HA without a single point of failure (SPOF).

## ENTERPRISE-READY

Enterprises use the powerful Proxmox VE platform to easily install, manage, and monitor their hyper-converged (HCI) data centers. Multiple authentication sources, combined with role-based user and permission management enable flexible control of HA clusters. The REST API enables easy integration of third-party management tools, such as custom hosting environments. The future-proof and open-source development model of Proxmox VE guarantees full access to the product's source code as well as maximum flexibility and security.

## BENEFITS

### Streamlined IT Infrastructure
A single platform to manage VMs, containers, storage, and networks.

### Unified Operations
Seamlessly deploy and monitor VMs and containers with the intuitive REST API, GUI, and CLI for easy operation and integration.

### Software-Defined Storage
SDS made simple – Thanks to built-in support for Ceph, ZFS, and other storage backends.

### Scale without Limits
Build highly available clusters in minutes and easily scale clusters to support your growing workloads.

### 100% Open-Source
No hidden licensing fee and full access to source code for customization.

### Made for Production
Keep your business running smoothly with Enterprise-grade services & technical support from Proxmox.

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## Industry-leading Enterprise Virtualization

- Linux and Windows servers, 32- and 64-bit operating systems.
- Support for the latest Intel and AMD server chip sets – for great VM performance.
- Near bare-metal performance for real-world enterprise workloads.
- Management layer containing all the capabilities to manage and monitor an open-source, software-defined data center.
- Import wizard for VMware ESXi VMs.

## Free & Open-Source Software

- Licensed under the GNU AGPL, v3.
- Debian-based, using the Proxmox kernel with OpenZFS support.
- Designed for community cooperation.
- Public code repository (Git).
- Open development on transparent mailing list.
- Bug tracker for issue tracking.
- Community support forum.
- Documentation, project page, video tutorials, howto guides, and much more.

## Enterprise Support Agreement

- Avoid hidden costs with clear subscription model.
- Flexible support options that grow with your needs.
- Access to the stable and extensively tested Enterprise Repositories for Proxmox VE and Ceph.
- Updates and version upgrades via GUI.
- Proxmox Offline Mirror tool to keep air-gapped systems up-to-date.
- Premium technical support from the highly-skilled Proxmox support team.
- Supported by a global network of 3,000 official Proxmox integration partners for deployment, migration, and professional services.

## Self-Fencing

- The Proxmox VE HA Manager uses self fencing, provided by hardware watchdog or kernel softdog timers.
- No simultaneous data access or corruption.
- Works „out-of-the-box“.
- Includes Proxmox VE HA Simulator for testing.

## Highly Available (HA) Cluster

- No single point of failure (no SPOF).
- Multi-master cluster.
- Manage the HA settings for KVM and LXC via GUI.
- Cluster Resource Scheduling (CRS), including dynamic mode with real-time node and guest resource utilization. NEW
- pmxcfs – unique Proxmox VE Cluster File System: database-driven file system for storing configuration files, replicated in real-time across all nodes using Corosync.
- Based on proven Linux HA technologies, providing stable and reliable HA service.
- Resource agents for KVM and containers (LXC).
- Watchdog-based fencing.
- HA node and resource affinity rules.
- Dynamic Load Balancer for HA-managed guests to reduce node imbalance across the cluster. NEW
- Preserves HA resource state during planned maintenance workflows. NEW
- HA arm/disarm workloads. NEW

## Unified Virtual Guests Operation

- Create and maintain VMs and containers on a single platform.
- Set hard and soft limits for CPU and Memory.
- Pin virtual guests to a set of CPU cores.
- Migrate to any cluster node.

## Virtual Machines with QEMU/KVM

- Independent from OS: Run unmodified Windows, Linux, BSD, or others.
- QEMU/KVM for low overhead.
- Custom CPU models to tailor virtual CPU features for specific workloads and compatibility requirements. NEW
- Snapshot a full VM; optionally with memory (live).
- Hot-plug network devices, USB devices, disks, CPUs, and memory to a running VM.
- PCI(e) pass-through using the GUI.
- Import VMs from other hypervisors (via OVF/OVA files) directly via the GUI from file-based storages.
- Setup UEFI with secure boot and a Trusted Platform Module (TPM) to run modern guest OS.
- View guest display from anywhere with noVNC HTML5 web console or SPICE client (virt-viewer).

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## Containers with LXC

- Proxmox Container Toolkit (pct) provides easy and flexible management of Linux Container (LXC).
- Ready-to use images of most common Linux distributions, TurnKey Linux templates, and support for OCI images.
- Fine-grained memory and CPU resource control.
- Shares the host kernel: Almost zero overhead.
- Security features like AppArmor, seccomp, Cgroups, and kernel namespaces.
- Snapshot and rollback the full container state at any time.
- Quick maintenance with web console (xterm.js).

## Live/Online Migration

- Move QEMU VMs from one physical host to another with zero downtime.
- Local storage live-migration.
- Live migration with mediated devices.

## Flexible Storage Options

- Local storage such as ZFS, Btrfs, LVM, and LVMthin.
- Shared storage such as CIFS, iSCSI or NFS.
- Distributed storage such as Ceph RBD and CephFS.
- Encryption support for Ceph OSD and ZFS.
- Unlimited number of storage definitions (clusterwide).

## Storage Replication Stack (ZFS)

- Built-in, open-source storage replication framework.
- Redundancy for guests using local storage.
- Data availability without using shared storage.
- Asynchronous replication.
- Minimize data loss in the case of a failure.
- Improve reliability, fault-tolerance, and accessibility of your data.
- Enables fast, live migration (sync only delta since last replication).
- Flexible scheduling options with the calendar events format.

## Software-Defined Storage (SDS) with Ceph

- Integrated Ceph, a distributed object store and file system.
- Management via GUI or CLI.
- Easy-to-use installation wizard.
- Run Ceph RBD and CephFS directly on the Proxmox VE cluster nodes.
- Proxmox delivers its own Ceph packages.
- Ceph support is included in the support agreement.
- Add external Ceph clusters as storage via GUI.

## Software-Defined Network (SDN)

- Manage and control complex networking configurations and multi-tenant setups via GUI.
- Separate the different network areas into zones consisting of virtual networks (VNets), optionally including IP address management (IPAM).
- Applicable to all sizes of networks, from a simple routed NAT setup, traditional separation into 802.1q VLANs, to features like QinQ, VXLAN tunneling, and BGP-based EVPN infrastructures.
- Cluster-wide synchronization of the configuration.
- Live reload after a configuration is changed.
- Dynamic routing protocols including OpenFabric, OSPF and BGP. NEW

## Linux Network Stack

- Flexible options to manage local nodes.
- Well-known tools with configuration via the GUI.
- IPv4 and IPv6 support.
- Support for VLANs, bonds, and bridges.

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## Backup and Restore

- Full backups of VMs and containers.
- Live snapshot backups.
- Define flexible backup job schedules with the calendar event format.
- Configure multiple backup storages.
- GUI and CLI integration.
- Backup and restore via GUI.
- Set up backup retention policies via GUI.
- Run scheduled backup jobs manually in the GUI.
- Monitor backup jobs in the GUI via the tab “Tasks”.
- Automatically add notes to backups using a template.
- Backup fleecing using fast local storage as a buffer for I/O-heavy guests with slow backup targets.
- Support for 3rd party backup provider plugins.

## Integration of Proxmox Backup Server

- Full support for the open-source, enterprise backup solution from Proxmox.
- Incremental, fully deduplicated backups of VMs, containers, and physical hosts.
- QEMU dirty-bitmaps for extremely fast VM backup.
- Strong encryption on the client-side, with easy encryption key management.
- Single-file and directory restore.
- With live-restore, guests start as soon as the restore does.

## Disk Management

- View all disks and their partitions.
- Check S.M.A.R.T health status of disks.
- Wipe all data from a partition or disk via the GUI.
- Create ZFS (RAID-Z, dRAID, RAID 0/1/10), LVM(-thin) and file based (ext4, XFS) storages.

## Two-Factor Authentication

- Providing high security.
- Support for multiple 2nd factors for a single account.
- Ability to use a hardware token (Webauthn, TOTP, Yubikey-OTP).
- Generate single-use recovery codes.
- TFA/TOTP lockout to protect against brute-force attacks.

## Multiple Authentication Sources

- Proxmox VE supports multiple authentication realms.
- Linux PAM standard authentication (e.g., ‘root’ and other local users).
- Built-in Proxmox VE authentication server.
- Microsoft Active Directory (MS ADS).
- LDAP
- Single Sign-On (SSO) with OpenID Connect.
- Regular and automated user synchronization for LDAP/AD realms

## Flexible Access Control

- User and permission management for all objects (VMs, storage systems, nodes, hardware resources, networking zones, etc.) .
- Proxmox VE comes with a number of predefined roles (groups of privileges) which cover common use cases. The contained privileges can be seen in the GUI.
- Permissions to control access to objects (access control lists). Each permission specifies a subject (user or group) and a role (set of privileges) on a specific path.
- Create API Tokens and lock them further down for secure, and easily revocable access.
- Restricted by default: new users or API tokens do not have any permissions.

## VM Templates and Clones

- Deploying VMs from templates is blazing fast, very convenient, and if you use linked clones, highly storage efficient.
- Linked and full clones.

## VM Hardware passthrough

- Assign PCI(e) or USB devices to VMs and containers via the GUI.
- Hot-plug USB devices and ports into running VMs.
- Use virtual functions to share a single device with multiple guests.
- Pass through whole disks using the CLI.
- Resource mappings for VMs, with hardware pass-through/cluster-wide mapping of PCI/USB devices.

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## Proxmox VE Firewall

- Supporting IPv4 and IPv6.
- Linux-based netfilter technology. Stateful firewall for easy, dynamic filtering.
- Distributed: configurations in Proxmox VE cluster file system, with filtering rules applied on each node.
- Cluster-wide IP sets, aliases, and security groups.
- Tight integration with the SDN functionality (access of IPAM information as IP-sets).
- 3 levels of configuration (data center, host, VM/CT).
- Support for custom 'raw' tables; enable SYN flood attack protection.

## Web-based Management Interface

- Integrated - no need to install a separate management tool nor any additional management node.
- Fast and easy creation of VMs and containers.
- Seamless integration and easy management of an entire cluster. Group virtual guests by assigned tags.
- Fast, search-driven interface able to handle thousands of VMs and containers.
- Based on the Ext JS JavaScript framework.
- Secure HTML5 console, supporting SSL.
- Let's Encrypt TLS certificates via the ACME-based DNS or HTTP challenge mechanism.
- Subscription management via GUI.
- Simple management of APT package repositories, and upgrades via GUI.
- Modern web interface for cluster management on mobile devices.
- Integrated documentation.

## Command Line (CLI)

- Manage all components of your virtual environment.
- CLI with intelligent tab completion.
- Full UNIX man page documentation.

## REST API

- Easy integration for third-party management tools.
- Rest API (JSON as primary data format).
- Alternative human-readable API format with interactive browser, as built-in documentation.
- Full support for API tokens.
- Automatic JSON Schema powered parameter verification.
- Easy means of creating command line tools (use the same API).
- Resource Oriented Architecture (ROA).
- Declarative API definition using JSON Schema.

## Modern Linux Server Experience

- Flexible notification system: rule-based notifications sent as email via local Postfix MTA or authenticated SMTP, or sent via a Gotify instance.
- Webhooks for the notification system enable system events to trigger HTTP requests.
- Secure boot compatibility.
- Kernel pinning: select preferred kernel version.
- Automated and unattended installation for full automation of the setup of bare-metal nodes.
- Tailored installation ISO offering installation via GUI, terminal, or serial port.

## Android App

- Connect to Proxmox VE instances.
- Manage clusters, nodes, VMs, and containers.
- Access SPICE and HTML5 consoles.
- Based on the Flutter framework.

## GPU workloads

- GPU Passthrough.
- Officially supported plattform for NVIDIA vGPU.

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DATASHEET

# PROXMOX VIRTUAL ENVIRONMENT V9.2

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## LEARN MORE

Project page: **pve.proxmox.com**
Bugtracker: **bugzilla.proxmox.com**
Code repository: **git.proxmox.com**

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## SALES INQUIRIES?

Please contact our team:
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## ABOUT PROXMOX

Proxmox Server Solutions GmbH is a software provider dedicated to developing powerful and efficient open-source server solutions. The privately held company is based in Vienna (Europe).


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