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Proxmox Clustering: High Availability for Your Self-Hosted Infrastructure

Turn a single Proxmox node into a resilient cluster. Corosync, quorum, live migration, shared storage with Ceph, and fencing — everything you need for self-hosted HA without VMware pricing.

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Running a single Proxmox node works fine until it does not. A failed disk, a kernel panic, or a bad update can take down every virtual machine and container in one shot. For homelab setups that host anything important — a family photo server, a business application, a personal VPN — that kind of downtime is painful. Proxmox VE supports full multi-node clustering with built-in high availability, shared storage via Ceph, and live VM migration, bringing enterprise-grade resilience to self-hosted infrastructure at zero licensing cost.

Why Cluster Proxmox?

A single Proxmox host is a single point of failure. Clustering solves this by spreading workloads across multiple physical nodes so that when one node goes offline, its virtual machines can restart automatically on a surviving node.

Beyond redundancy, a Proxmox cluster gives you:

- **Live migration**: Move running VMs between nodes with zero downtime
- **Centralized management**: One web interface manages all nodes simultaneously
- **Shared storage**: Ceph or NFS allows any node to access any VM disk
- **HA groups and priorities**: Define exactly which VMs are critical and where they should land

The minimum viable cluster is three nodes. Two nodes create a split-brain problem. Three nodes s… this through quorum.

Understanding Corosync and Quorum

Corosync is the cluster communication layer underneath Proxmox. Every node sends heartbeat messages to every other node. When a node stops responding, the surviving nodes vote on whether to continue operating.

Quorum requires more than half the cluster nodes to agree before taking any action. In a three-node cluster, two nodes constitute a quorum.

```
pvecm status
```

The Corosync Ring

Corosync supports multiple network rings for redundancy. Ring 0 is the primary cluster communication path. Ring 1 is optional backup. The cluster network should be isolated from VM traffic and management traffic.

Step-by-Step Cluster Creation

Prerequisites:

- Same Proxmox VE version on all nodes
- All nodes reachable by hostname
- SSH root access between all nodes
- Dedicated network interface for cluster traffic
- NTP synchronized on all nodes

Step 1: Create the Cluster

```
pvecm create my-cluster --ring0_addr 10.10.0.1
pvecm status
```

Step 2: Add the Second Node

```
pvecm add 10.10.0.1 --ring0_addr 10.10.0.2
pvecm nodes
```

Step 3: Add the Third Node

```
pvecm add 10.10.0.1 --ring0_addr 10.10.0.3
pvecm status
```

Shared Storage with Ceph

Ceph is a distributed storage system that Proxmox supports natively. Unlike NFS or iSCSI, Ceph has no single point of failure — storage is distributed across all nodes.

Ceph Components

- **MON (Monitor)**: Tracks cluster state and quorum. One per Proxmox node.
- **OSD (Object Storage Daemon)**: Manages one storage disk each. Three or more required.
- **MGR (Manager)**: Dashboard and metrics. One per node.

Installing and Configuring Ceph

```
# Install on each node
pveceph install

# Initialize on first node
pveceph init --network 10.10.0.0/24

# Add monitors on each node
pveceph mon create

# Add OSDs (one per disk, per node)
pveceph osd create /dev/sdb

# Create storage pool
pveceph pool create vm-pool --add_storages true
```

Live Migration

With shared Ceph storage, migrate running VMs without downtime:

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```
migrate <vmid> <target-node> --online
```

Live migration is invaluable for maintenance. Before rebooting a node for a kernel update, migrate all VMs to other nodes, perform the update, and migrate them back.

HA Groups and Fencing

What is Fencing?

Fencing forcibly shuts down a failed node before restarting its VMs elsewhere. Without fencing, two nodes could write to the same VM disk simultaneously, causing data corruption.

Enable the watchdog:

```
modprobe softdog
```

Enabling HA for a VM

```
ha-manager add vm:<vmid> --state started --max_restart 3
```

Creating HA Groups

```
ha-manager groupadd primary-group --nodes node1:2,node2:1,node3:1
ha-manager set vm:<vmid> --group primary-group
```

Monitoring HA Status

```
ha-manager status
pvesh get /cluster/ha/resources
```

Networking Considerations

Three-Network Architecture

1. **Management network**: Web interface, SSH, API calls
2. **Cluster/Corosync network**: Heartbeats, cluster state. Must be low-latency and reliable.
3. **Storage/migration network**: Ceph replication, live migration. High-bandwidth, ideally 10GbE.

This separation ensures that a VM migration saturating the storage network does not cause Corosync heartbeat timeouts.

Corosync Tuning

```
# /etc/corosync/corosync.conf — totem section
token: 3000
token_retransmits_before_loss_const: 10
```

MTU and Jumbo Frames

Enable jumbo frames (MTU 9000) on storage and cluster networks for significantly improved Ceph throughput. Ensure switches support it on the relevant ports.

Monitoring the Cluster

```
pvecm status
pvecm nodes
ceph status
ha-manager status
```

Prometheus Integration

The `pve-exporter` project provides a dedicated Prometheus exporter for Proxmox that exposes VM-level metrics, storage usage, and node health in a Grafana-ready format.

Log Monitoring

```
journalctl -u corosync -f
```

Ceph logs at `/var/log/ceph/`. Forward all cluster node logs to Loki or Graylog for visibility that survives a full cluster outage.

Summary

A three-node Proxmox cluster with Ceph shared storage and HA groups transforms a homelab from a collection of individual machines into a resilient platform. Corosync maintains cluster consensus, Ceph ensures VM disks are accessible from any node, and the HA manager handles automatic failover. The operational benefits go beyond redundancy — live migration makes hardware maintenance non-

disruptive and Ceph scales horizontally. A single node failure becomes a minor event rather than an emergency.

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