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PROXMOX

Proxmox
Virtual Environment

The Software-Defined Network (SDN) feature in Proxmox VE

PROXMOX SILVER PARTNER

PROXMOX AUTHORIZED RESELLER

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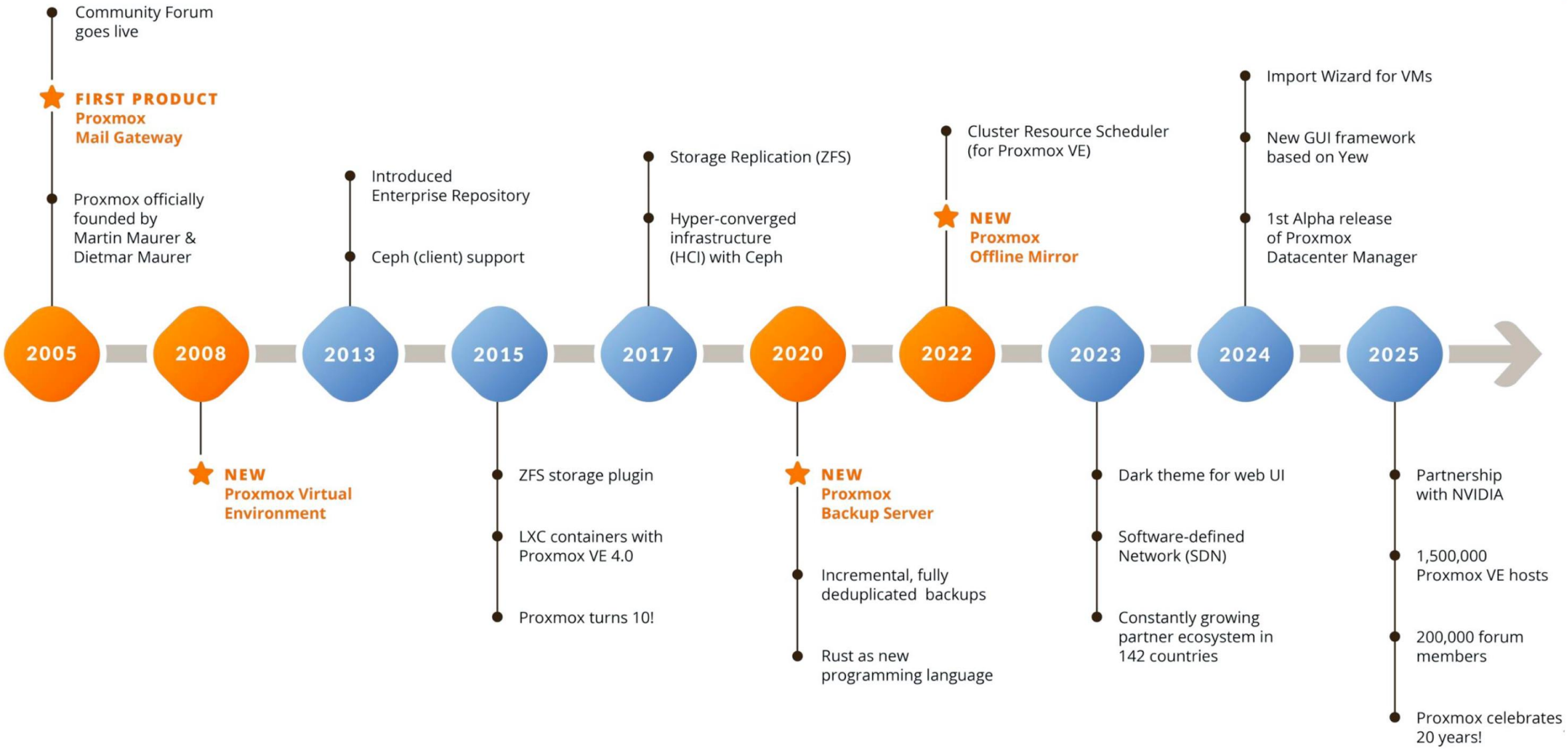
About Proxmox — History



ABOUT

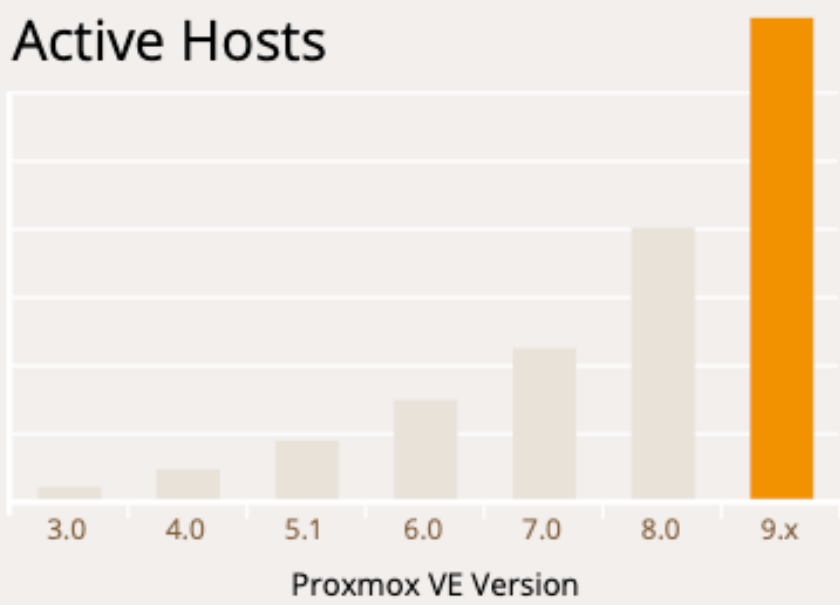
PROXMOX EXPONENTIAL GROWTH

142
Countries

225,000
Active Community Members

Enterprises of all sizes and industries

Over
2 Million
Active Hosts



PROXMOX Virtual Environment 9.2

Proxmox VE 9.2

More power. More control. More Proxmox.

What Proxmox Can Do

1

Virtual Machine & Container (LXC)

- Run full virtual machines with KVM.
- Run lightweight, isolated Linux containers with LXC.

2

Hyper-Converged Infrastructure (HCI) – Ceph Storage

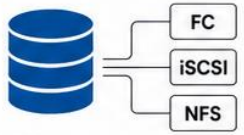
- Built-in Ceph for distributed block, file, and object storage.
- Scale-out storage with high performance and resilience.

3

High Available (HA) Cluster

- Built-in HA for VMs and containers.
- Automatic failover and service recovery for maximum uptime.

4



OOB Storage FC, iSCSI, NFS

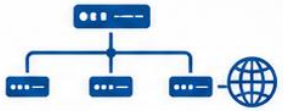
- Connect external storage via Fibre Channel, iSCSI, or NFS.
- Flexible storage options for enterprise environments.

5

Integration – Proxmox Backup Server

- Native integration with Proxmox Backup Server.
- Centralized backup, deduplication, compression, and encryption.

6



Software-Defined Network

- Complete SDN stack with firewall, VLAN, VXLAN, EVPN, and more.
- Micro-segmentation and advanced networking features built-in.

7

Storage Replication Stack (ZFS)

- ZFS-based replication for VM disks and containers.
- Efficient snapshots, send/receive, and disaster recovery.

8

GPU Workloads

- Official supported platform for NVIDIA vGPU.
- Accelerate AI, ML, VDI, and graphics-intensive workloads.

Built for Your Infrastructure.
Open Source. Enterprise Ready.

Open Source and transparent

Enterprise support available

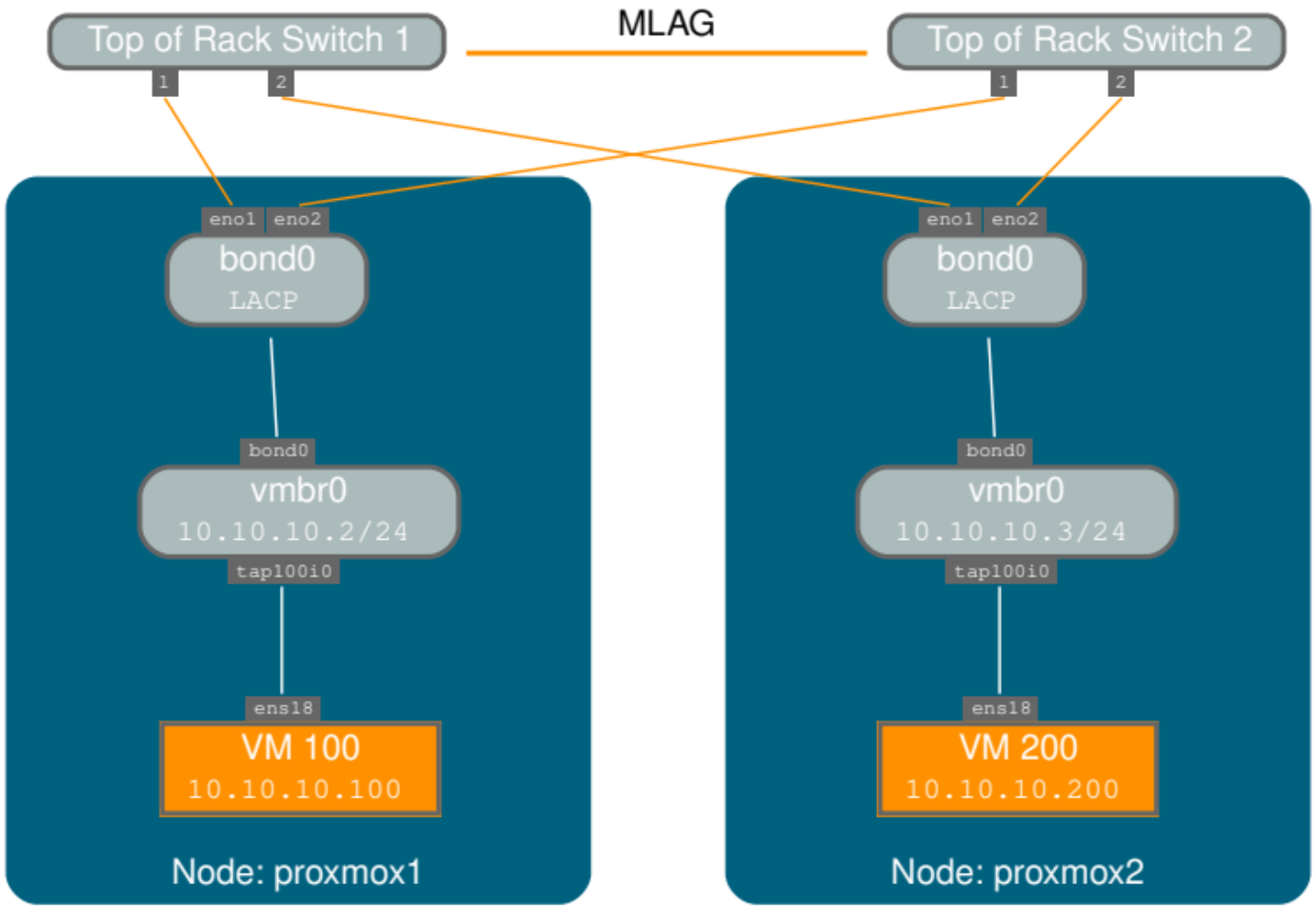
Trusted by thousands

Extensible and future-ready

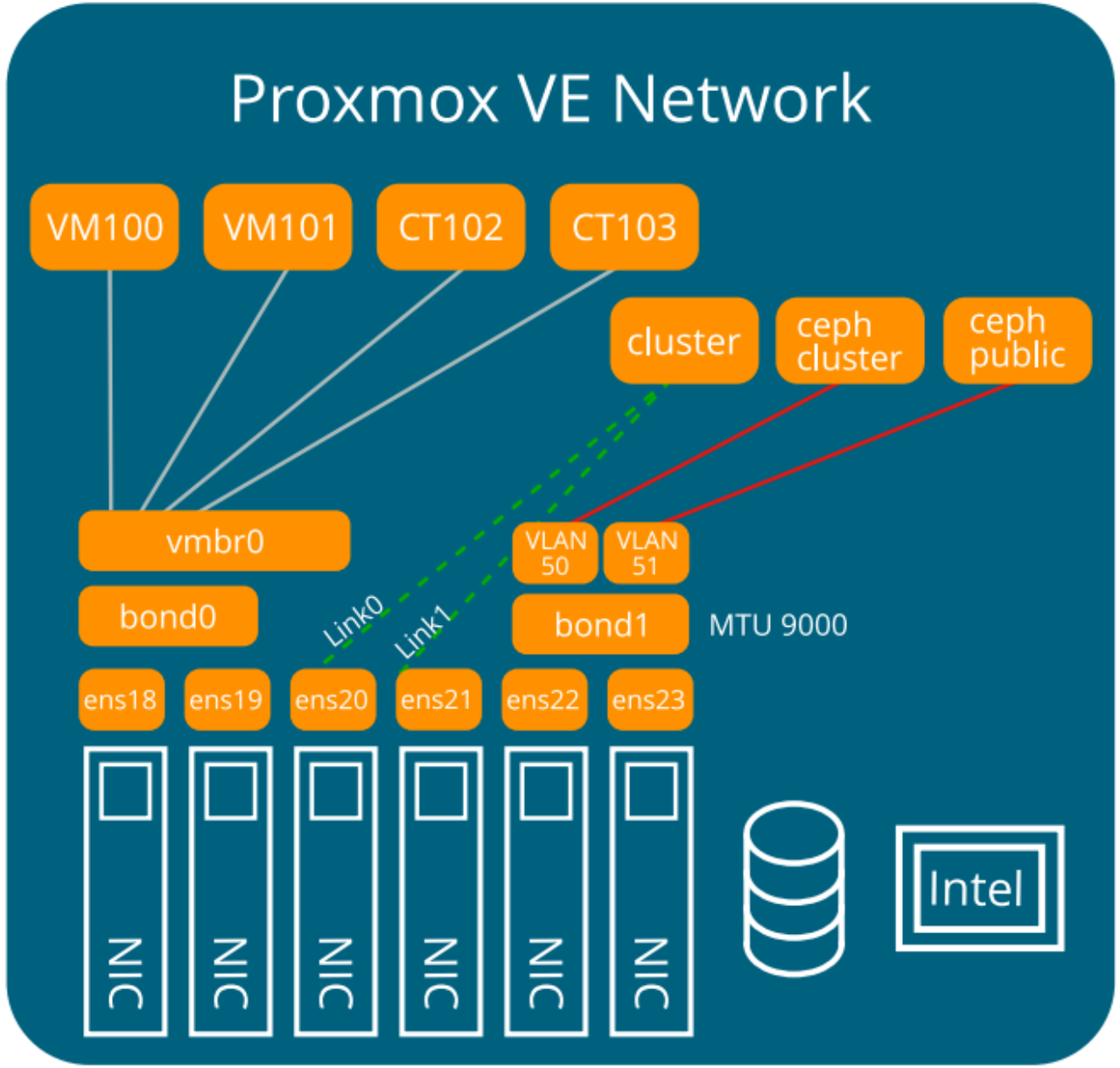
Get started with Proxmox VE 9.2 › pve.proxmox.com

PROXMOX Stronger together.

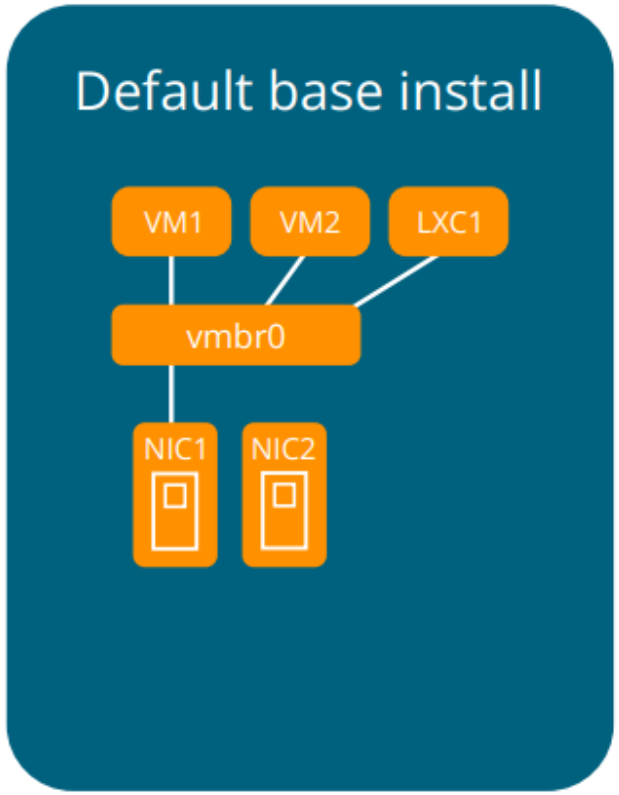
Use a bond as the bridge port

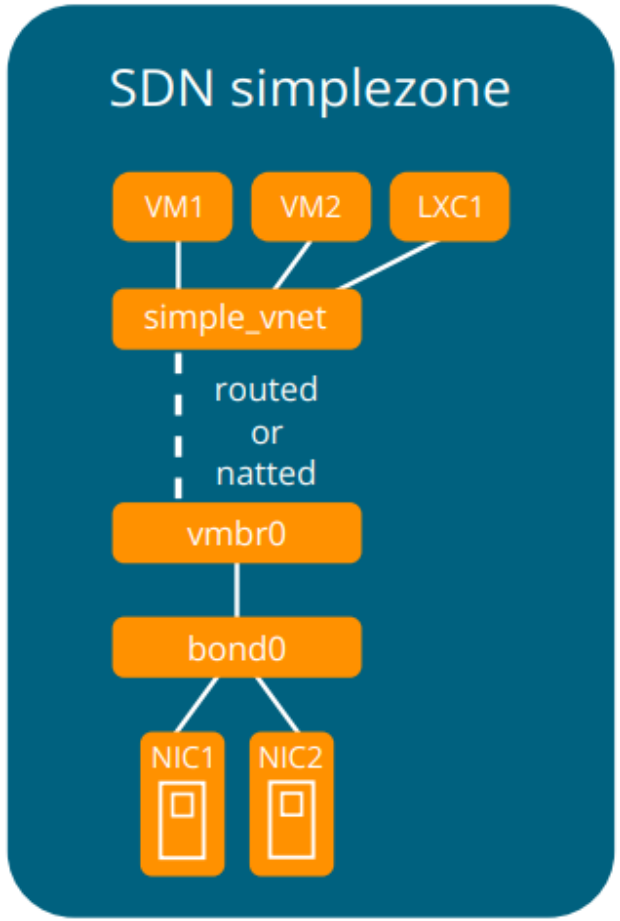


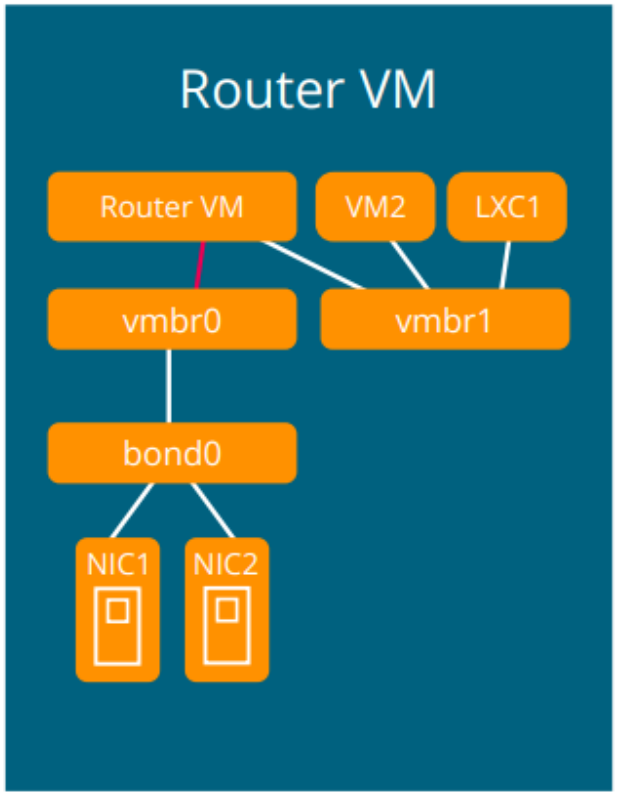

```
auto lo
iface lo inet loopback

iface eno1 inet manual

iface eno2 inet manual

auto bond0
iface bond0 inet manual
      bond-slaves eno1 eno2
      bond-miimon 100
      bond-mode 802.3ad
      bond-xmit-hash-policy layer2+3

auto vmbr0
iface vmbr0 inet static
        address  10.10.10.2/24
        gateway  10.10.10.1
        bridge-ports bond0
        bridge-stp off
        bridge-fd 0
```


Proxmox VE Network
VM100
VM101
CT102
CT103
cluster
ceph cluster
ceph public
vmbr0
bond0
Link0
Link1
VLAN 50
VLAN 51
bond1
MTU 9000
ens18
ens19
ens20
ens21
ens22
ens23
NIC
NIC
NIC
NIC
NIC
NIC
Intel

Guests in Virtual Network behind Router







PROXMOX

Proxmox VE SDN – Overview

Proxmox VE SDN is a fully integrated, software-defined networking solution. It allows you to create, manage, and operate virtual networks inside your Proxmox VE environment – without requiring additional SDN controllers.

Fully Integrated
Built into Proxmox VE

Flexible
Create any network topology you need

Scalable
From small setups to large data centers

Secure
Isolation, ACLs, and micro-segmentation

Open
Based on standard technologies

Introduction & Problem Statement

Why Software Defined Networking (SDN) matters in Proxmox VE

Modern private cloud needs automation, scalability, and simplicity.
Traditional networking is manual, repetitive, and error-prone.

TRADITIONAL NETWORKING

Configure VLAN on every host
Manual setup on each node and switch

Manual Linux bridge management
Create and configure bridges everywhere

High risk of human error
Configuration drift and inconsistency

Time-consuming and hard to scale
More nodes = more work

VS

SOFTWARE DEFINED NETWORKING (SDN)

Define once at cluster/datacenter level
Centralized network configuration

Automatically distributed to all nodes
Consistent and reliable

Reduced errors and configuration drift
Policy-driven and standardized

Scalable, automated, and efficient
Built for modern private cloud

Automation | Multi-tenant Isolation | Easy VM Mobility | Scalable Overlays

PROXMOX

Proxmox SDN brings these cloud capabilities into your infrastructure with open-source freedom.

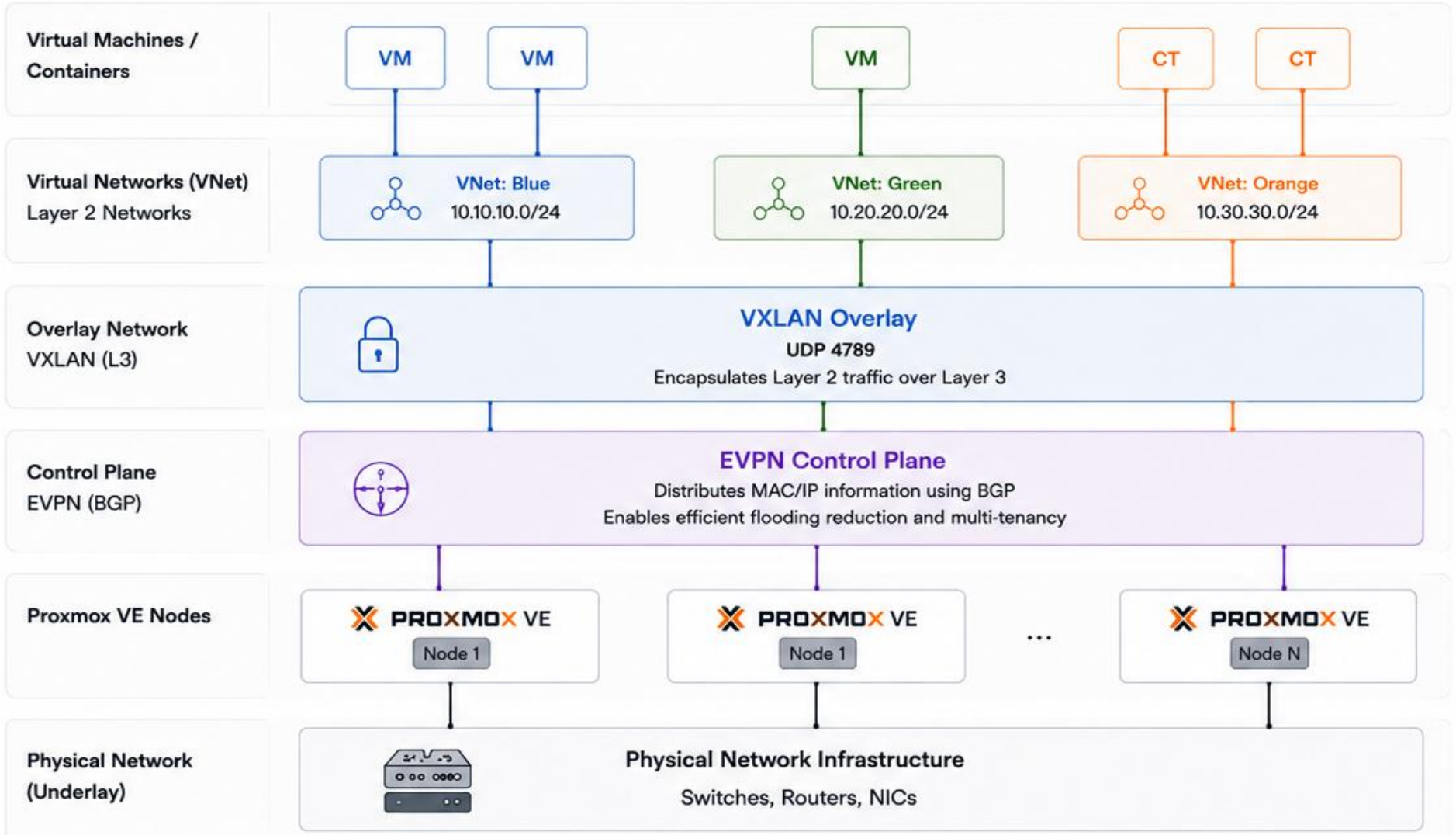
PROXMOX VIRTUAL ENVIRONMENT

Proxmox VE Software-Defined Network (SDN)

Overview Diagram

SDN

Proxmox VE SDN enables you to create, manage and operate virtual networks that are fully integrated and automatically provisioned across your cluster.



SDN Components

Zones
Define the scope of SDN by selecting nodes.

VNets
Virtual Layer 2 networks within a zone.

VXLAN Overlay
Encapsulates Layer 2 traffic over Layer 3 using VXLAN.

EVPN Control Plane
Uses BGP to exchange MAC/IP routes.

Isolation & Security
VNets are isolated from each other by default.

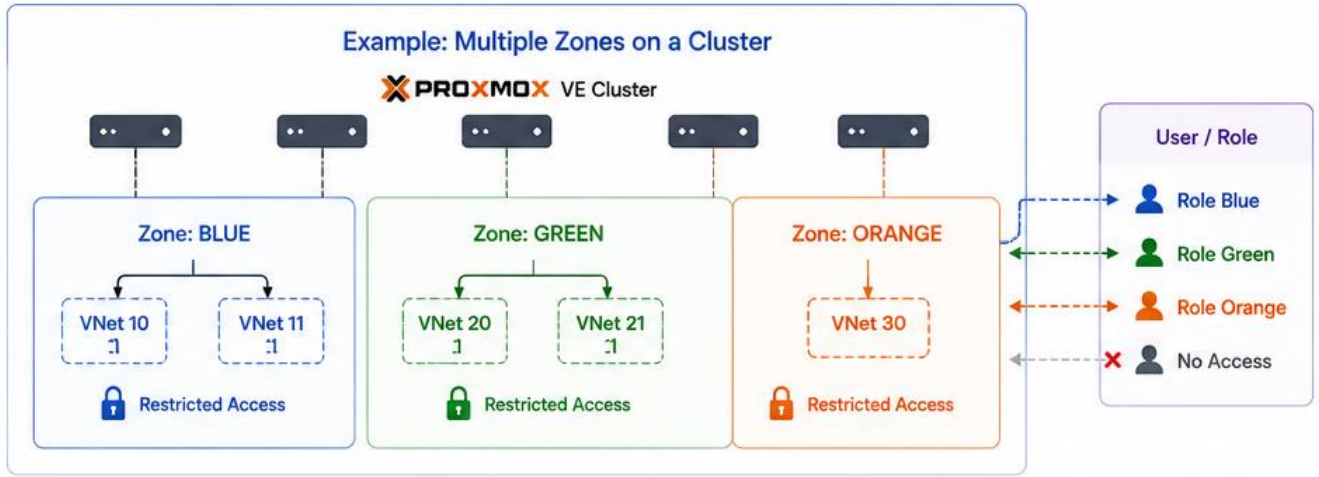
No External Controller
Fully integrated in Proxmox VE – no additional components required.

PROXMOX VIRTUAL ENVIRONMENT

Proxmox VE SDN – Zones

Zones

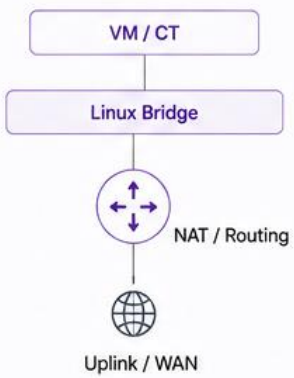
A zone defines a virtually separated network. Zones are restricted to specific nodes and assigned permissions, in order to restrict users to a certain zone and its contained VNets.



Different technologies can be used for separation:

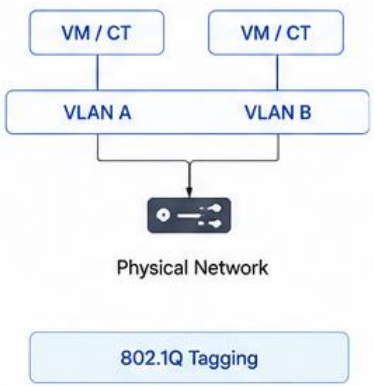
1. Simple
Isolated Bridge

A simple layer 3 routing bridge (NAT)



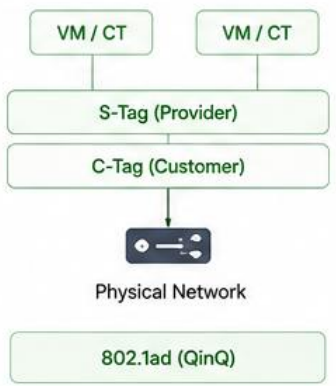
2. VLAN
Virtual LAN

Virtual LANs are the classic method of subdividing a LAN



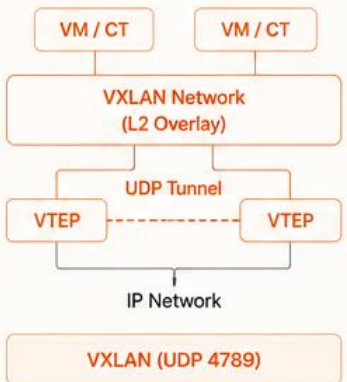
3. QinQ
Stacked VLAN

Stacked VLAN (formally known as IEEE 802.1ad)



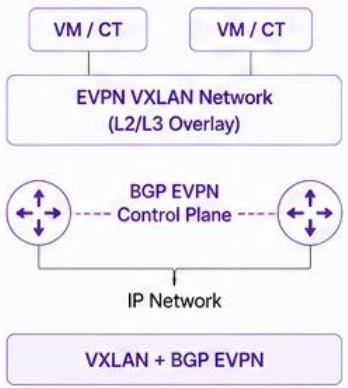
4. VXLAN
VXLAN Overlay

Layer 2 VXLAN network via a UDP tunnel



5. EVPN (BGP EVPN)
VXLAN with BGP

VXLAN with BGP to establish Layer 3 routing



Key Takeaway

Zones provide logical separation and access control, while different technologies offer flexibility from simple isolation to advanced, scalable Layer 3 networking across your environment.

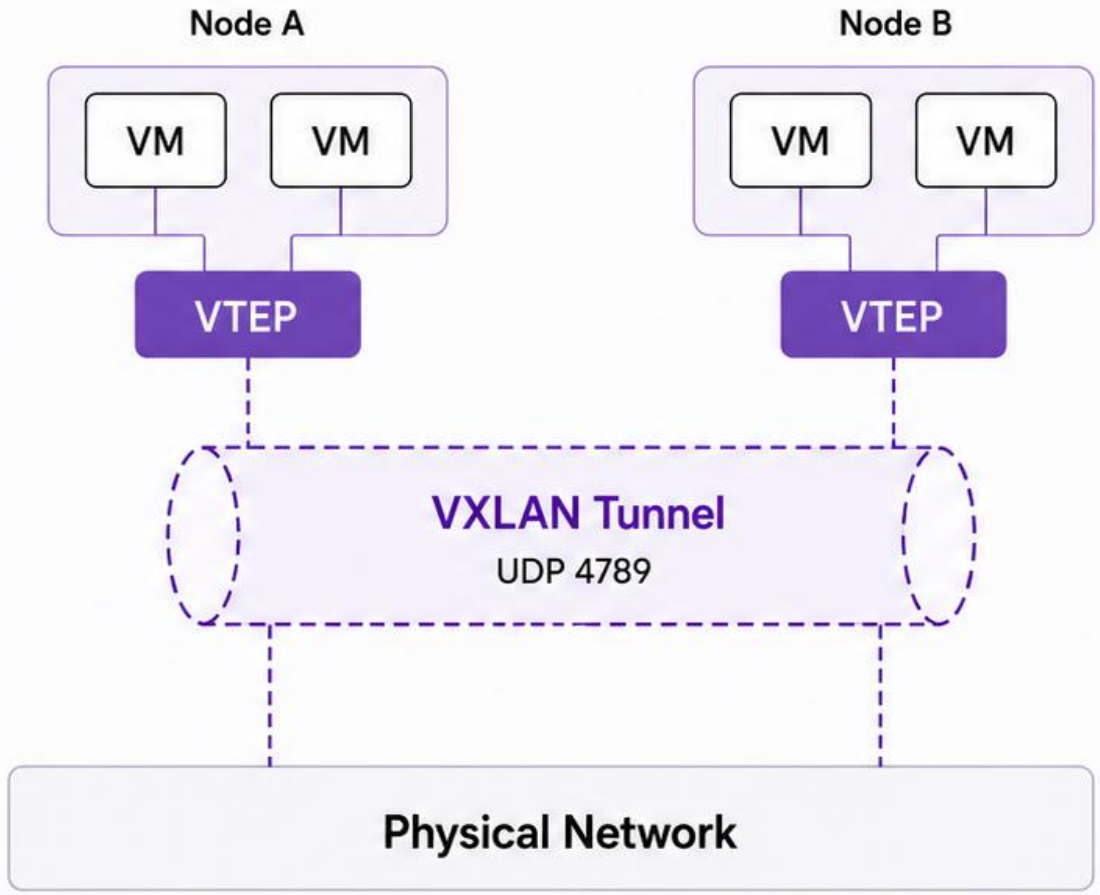
- Isolation & Security
- Access Control
- Flexible Technologies
- Scalable Networking

PROXMOX VIRTUAL ENVIRONMENT

VXLAN Overlay

VXLAN is used to extend Layer 2 networks over Layer 3.

- Encapsulates Ethernet frames in UDP.
- Default UDP port: 4789
- Provides scalability and multi-tenancy.
- Transparent to VMs and applications.

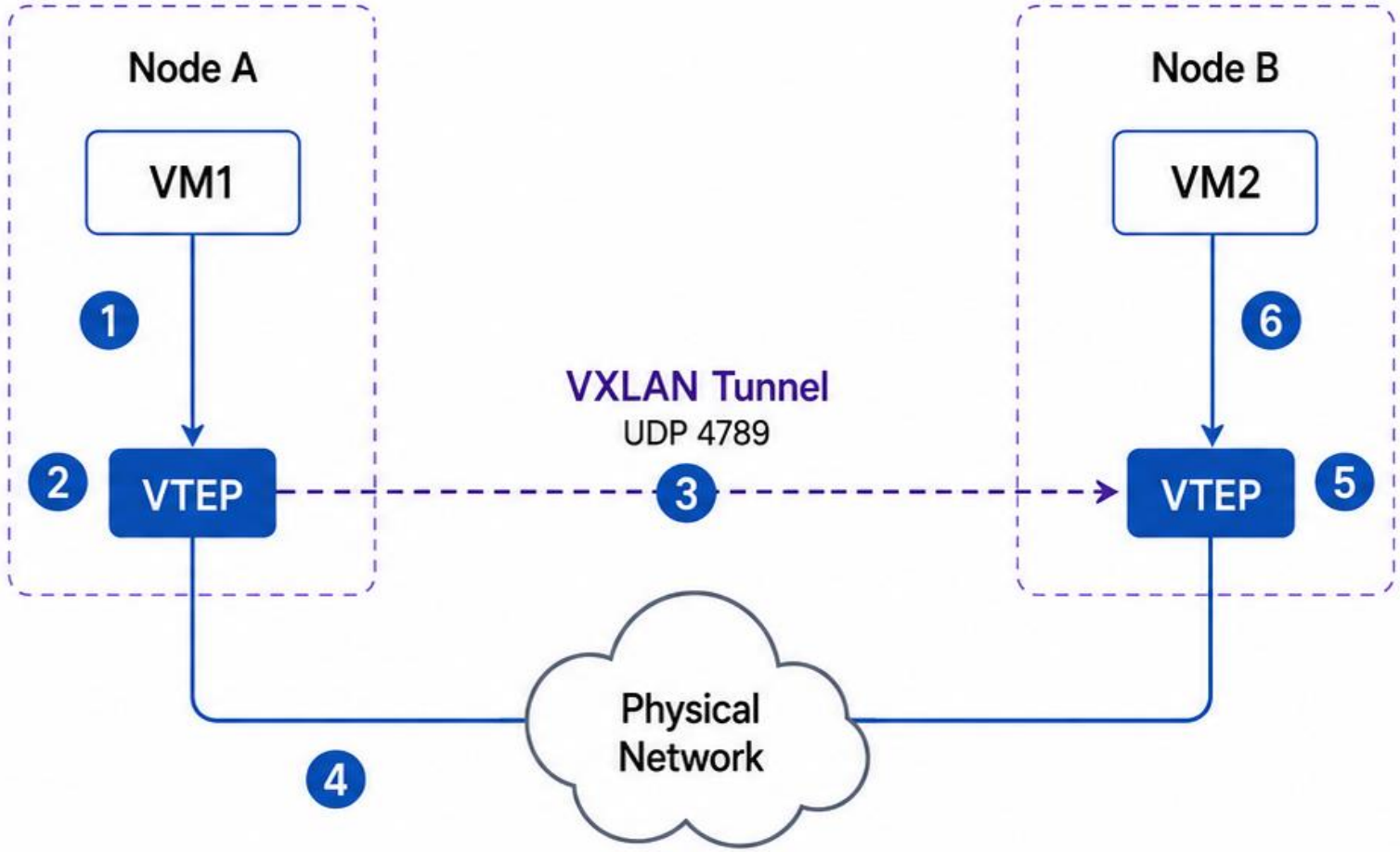


VTEP (VXLAN Tunnel End Point): The endpoint on each node that encapsulates and decapsulates VXLAN traffic.

PROXMOX VIRTUAL ENVIRONMENT

SDN Traffic Flow Example

1. VM1 wants to reach VM2.
2. Traffic sent to local VTEP.
3. Encapsulated with VXLAN (UDP 4789).
4. Sent over physical network.
5. Remote VTEP decapsulates the traffic.
6. Delivered to VM2.



MTU CONSIDERATIONS

VXLAN encapsulation adds overhead. Adjust MTU to avoid fragmentation.

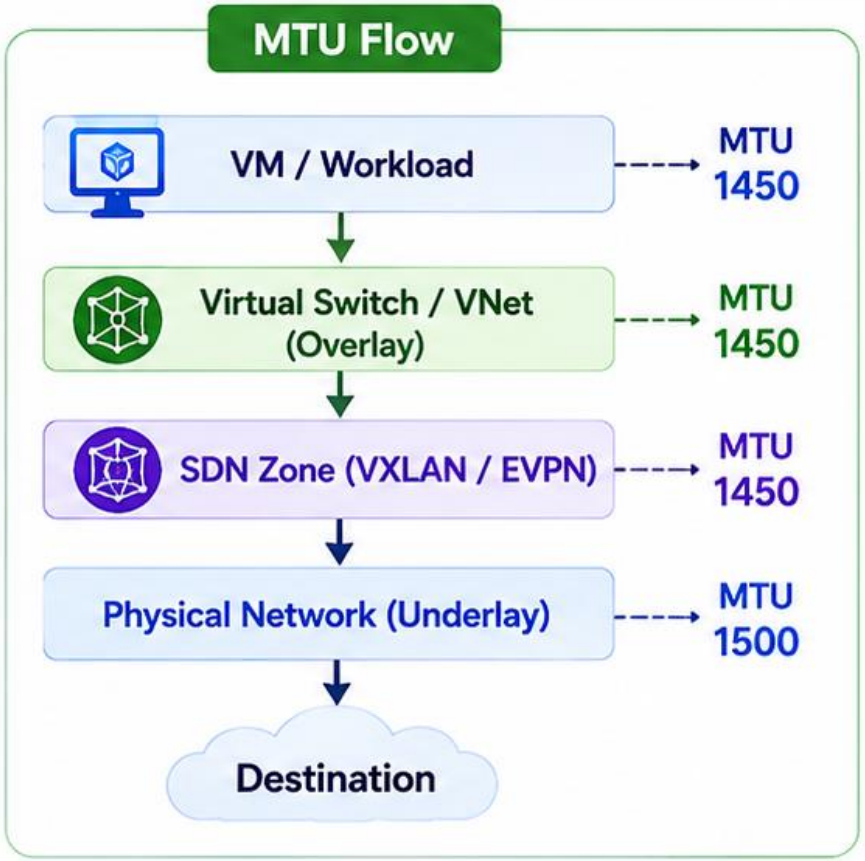
Ethernet 14 bytes + **VXLAN Encapsulation Overhead** ~50 bytes = **Effective Payload** 1450 bytes

Recommendations

- Set MTU 1450 on VMs and virtual switches
- Verify end-to-end MTU (underlay + overlay)
- Avoid fragmentation and performance issues

MTU Calculation

MTU Flow



Why It Matters

Incorrect MTU causes fragmentation, packet drops and poor performance.

Best Practice

Use MTU 1450 on overlay (VXLAN/EVPN) in most environments.

Result

Smooth traffic flow, no fragmentation, better performance.

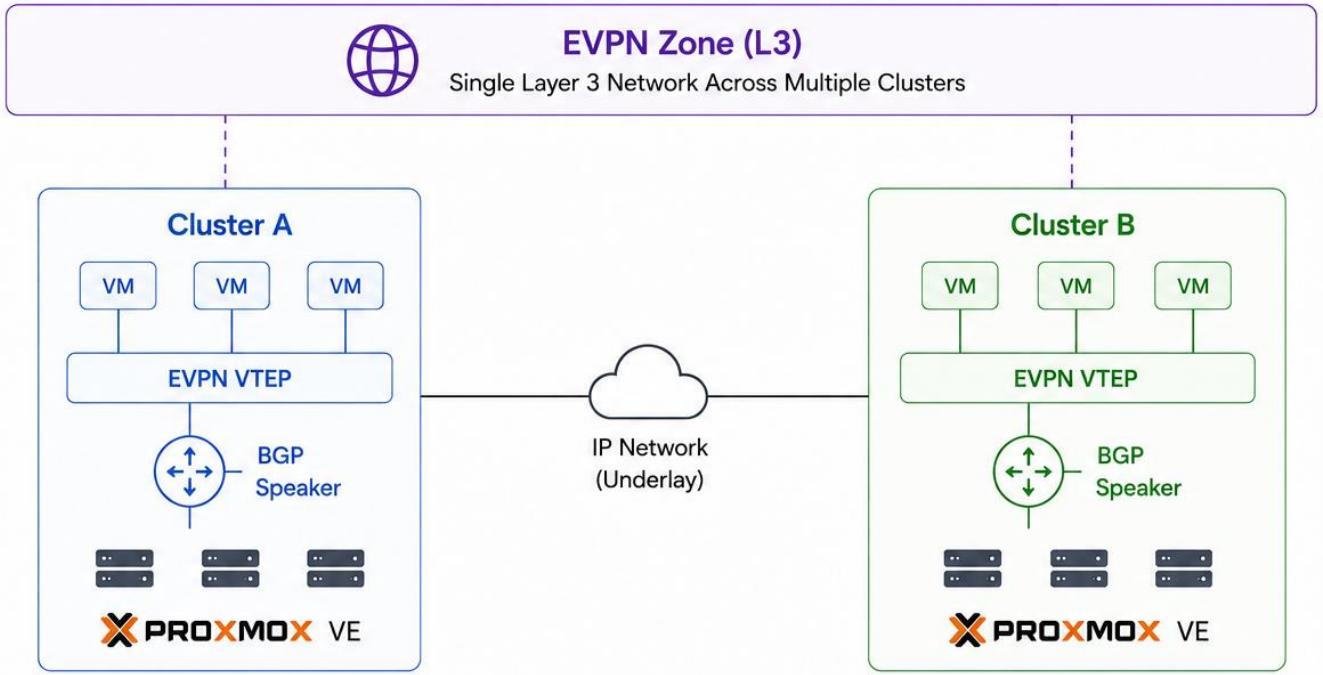
Tip

Always test MTU end-to-end from VM → Overlay → Underlay → Internet.

PROXMOX VIRTUAL ENVIRONMENT

EVPN Zones

The EVPN zone creates a routable Layer 3 network, capable of spanning across mutiple clusters.
This is achieved by establishing a VPN and utilizing BGP as the routing protocol.



Routable L3 Network
One IP network across all clusters

Multi-Cluster Connectivity
Seamless communication between clusters

High Availability
EVPN + BGP ensures resiliency and stability

Scalable
Easily add more clusters without re-architecting

PROXMOX VIRTUAL ENVIRONMENT

Firewall Integration

SDN integrates with the Proxmox VE firewall by automatically generating IPSets.
These IPSets can then be used in the source and destination fields of firewall rules.
This happens automatically for VNets and IPAM entries.

SDN Objects

VNets

- VNet: web-tier
  10.10.10.0/24
- VNet: db-tier
  10.10.20.0/24

IPAM Entries

- app-server
  10.10.10.15
- db-server
  10.10.20.15

Automatically Generated →

Auto-Generated IPSets

ipset: vnet_web-tier
10.10.10.0/24

ipset: vnet_db-tier
10.10.20.0/24

ipset: ipam_app-server
10.10.10.15/32

ipset: ipam_db-server
10.10.20.15/32

Used in Firewall Rules →

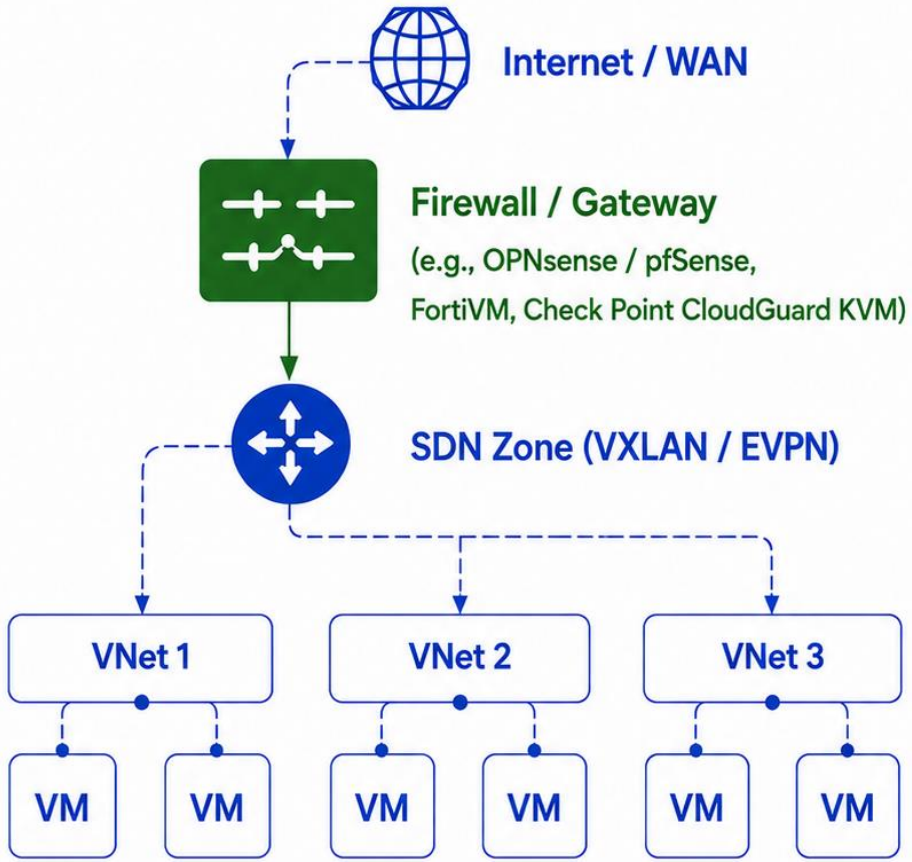
Proxmox VE Firewall

Firewall Rule Example

Action:	ACCEPT
Source:	ipset: vnet_web-tier
Destination:	ipset: ipam_app-server
Port:	80 (HTTP)
Comment:	Allow web tier to access app server

Integration & Services

Integrate SDN with routing, firewalls and load balancers.



SUPPORTED FIREWALL / SECURITY SOLUTIONS

- pfSense
- OPNsense
- FortiVM
- Checkpoint CloudGuard KVM

Use external firewalls/routers for north–south traffic and security.

PROXMOX

Walkthrough

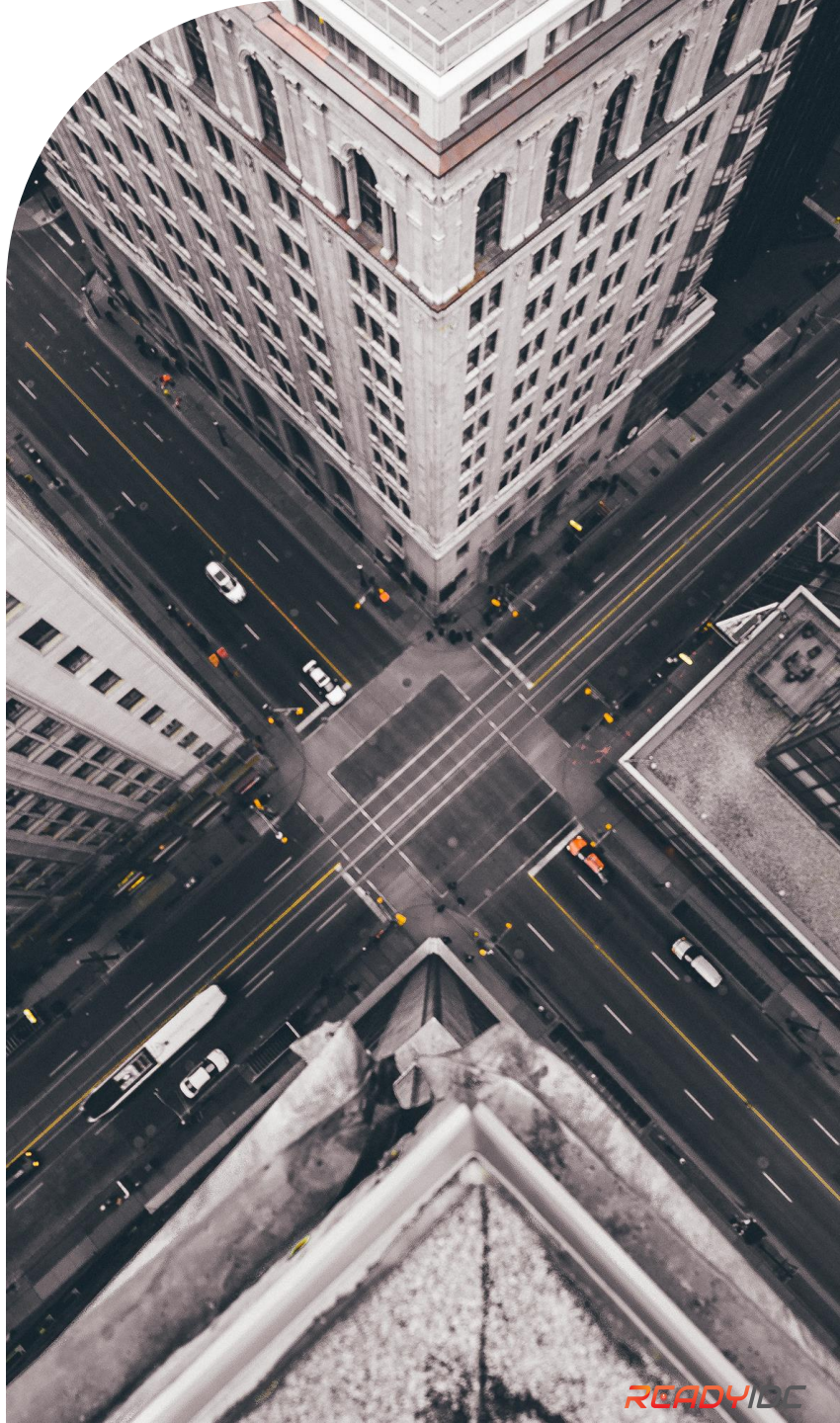
ReadyIDC Co., Ltd.

ReadyIDC is a cloud service provider dedicated to building resilient and high-performance hyper-converged infrastructures (HCI) based on Proxmox VE.

Pak Kret

ReadyIDC is a partner of Thailand Virtualization and Hyper converge Infrastructure with Ceph reduce you cost and high performance

- Design Infrastructure (Firewall, Network, Compute
- Migration as a service
- Advance Support



Thank You

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