Homelab Workshop

Session 1: Theory & Foundation

Build production-like infrastructure from the ground up

Agenda

Time	Topic
10 min	**What is a Homelab?** Why build one, use cases
10 min	**Hardware Selection** Mini PCs, specs, budget
15 min	**Network Design** VLANs, IP scheme, security
15 min	**Proxmox** Installation, clustering, LXC vs VMs
5 min	**Q&A**

Total: ~55 minutes

What is a Homelab?

~10 minutes

What is a Homelab?

A **personal computing environment** where you build, configure, and manage your own IT infrastructure at home.

- **Your own servers** - physical hardware you control
- **Your own network** - VLANs, firewalls, DNS
- **Your own services** - apps running 24/7
- **Your own data** - complete privacy and ownership

" Think of it as a miniature data center in your home ,,

Why Build a Homelab?

Learning & Career

- Hands-on practice with enterprise technologies
- Build a portfolio for interviews — DevOps skills are in demand

Self-Hosting & Privacy

- Run your own cloud storage, password manager, media server
- Your data stays under your roof — no subscriptions needed

It's Fun

- Tinker, break things, learn, repeat

What Can You Run?

Category	Services
DNS & Security	AdGuard Home, Pi-hole, WireGuard
Media	Plex, Jellyfin, Immich (photos)
Productivity	Nextcloud, Vaultwarden, Gitea
Smart Home	Home Assistant, Zigbee2MQTT
Monitoring	Grafana, Prometheus, Uptime Kuma
Development	CI/CD runners, staging environments
Networking	Reverse proxy, Cloudflare Tunnel, VPN

Hardware Selection

~10 minutes

Why Mini PCs?

	Enterprise Server	Mini PC	Raspberry Pi
Power	250-400W idle	**35-65W**	5-15W
Noise	60+ dB (loud)	**<30 dB (silent)**	Silent
Cost	$200-800 used	**$250-400 used**	$75-100 new
CPU	Xeon (old gen)	**i5/i7 8th gen**	ARM (limited)
RAM	64-128GB	**16-32GB**	4-8GB
VMs?	Yes	**Yes**	No (ARM)

Mini PCs hit the sweet spot - powerful enough for real workloads, efficient enough to run 24/7, quiet enough for your home.

Our Workshop Hardware

Master Node - Lenovo ThinkCentre M920q

- Intel Core **i7-8700T** (6 cores / 12 threads)
- **32GB** DDR4 RAM - 512GB NVMe SSD
- ~65W typical - **~$400 used**

Worker Nodes (x2) - Dell OptiPlex 3060 Micro

- Intel Core **i5-8500T** (4 cores / 8 threads)
- **16GB** DDR4 RAM - 256GB NVMe SSD
- ~35W typical - **~$250 each used**

Cluster Total

14 cores | 28 threads | 64GB RAM | 1TB SSD | ~135W | ~$900

Power & Cost

State	Power Draw	Monthly Cost*
Idle (all 3 nodes)	45W	~$5
Typical load	**135W**	**~$15**
Heavy load	220W	~$25
Max stress	280W	~$32

At $0.12/kWh

Comparison:

- Gaming PC running 24/7: **$35/month**
- Enterprise Dell R720: **$30/month**
- Our mini PC cluster: **$15/month**

Network & Infrastructure Design

~15 minutes

What are VLANs?

Virtual LANs = isolated network segments on the same physical hardware

Without VLANs (flat network):

```
All devices → same network → everything can talk to everything
                              (security nightmare)
```

With VLANs:

```
IoT devices     → VLAN 40 → internet only (isolated)
Guest WiFi      → VLAN 50 → internet only (isolated)
Your laptop     → VLAN 30 → can access servers
Proxmox nodes   → VLAN 10 → management only
```

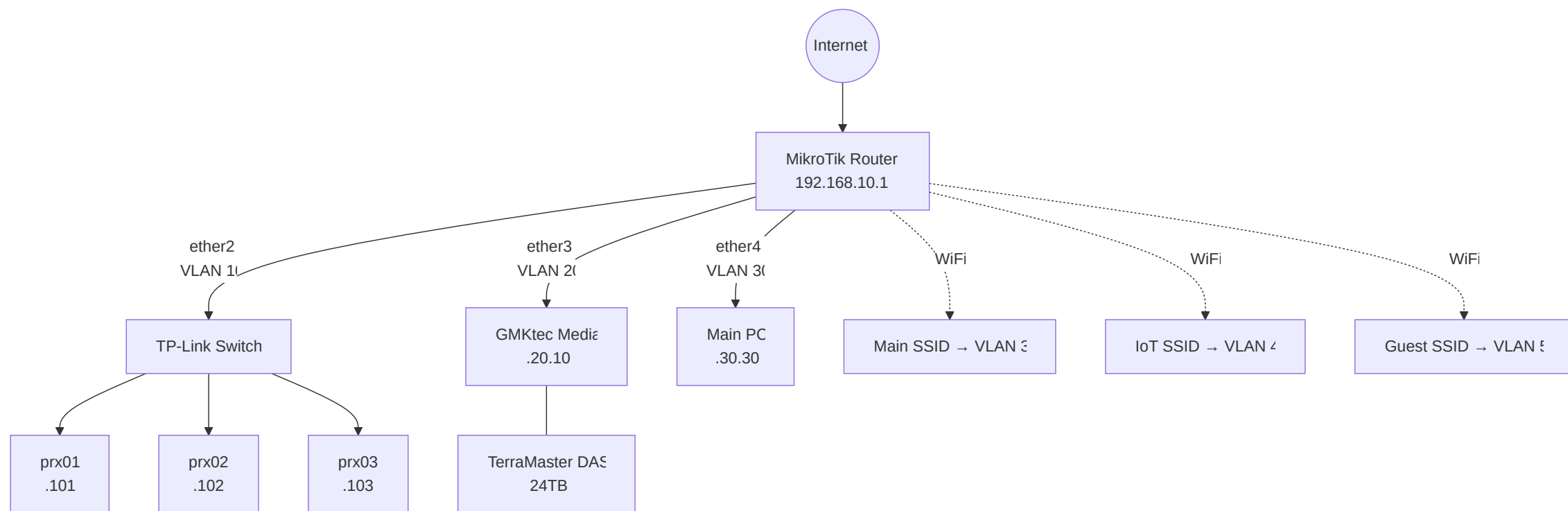**Why?** A hacked smart bulb can't reach your password manager.

Our 5-VLAN Design

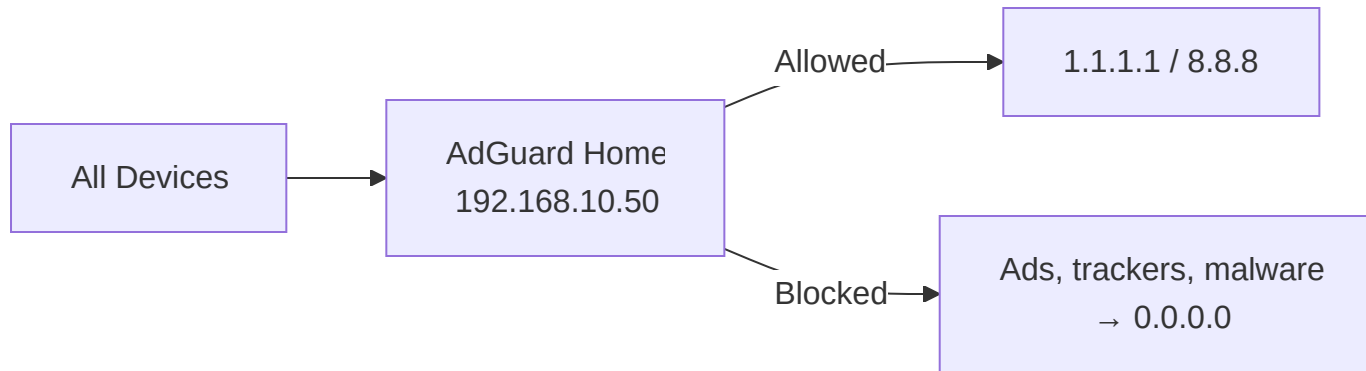| VLAN	Name	Network	Purpose	Access
10	Management	192.168.**10**.0/24	Proxmox, infra	Full access to all
20	Servers	192.168.**20**.0/24	Media, storage	From Mgmt + Trusted
30	Trusted	192.168.**30**.0/24	PC, phones	Internet + Servers
40	IoT	192.168.**40**.0/24	Smart home	Internet only
50	Guest	192.168.**50**.0/24	Visitors	Internet only

Router: MikroTik hAP ac3 (handles VLANs + firewall)
Switch: TP-Link LS108G (8-port gigabit, ~$25)

Network Topology

DNS & Ad Blocking

```
                                              ┌──────────────────────┐
                                    Allowed─── │   1.1.1.1 / 8.8.8    │
                                           ╱   └──────────────────────┘
┌──────────────┐       ┌──────────────────┐
│ All Devices  │────── │   AdGuard Home    │
└──────────────┘       │   192.168.10.50   │
                       └──────────────────┘╲   ┌──────────────────────┐
                                    Blocked──── │ Ads, trackers, malware│
                                               │     → 0.0.0.0         │
                                               └──────────────────────┘
```

- **AdGuard Home** runs on Docker host LXC container
- All VLANs use AdGuard as DNS server via DHCP
- Network-wide ad blocking — **every device, no app needed**
- ~30% of DNS queries get blocked (ads, telemetry, trackers)

Proxmox VE

~15 minutes

What is Proxmox VE?

Open-source virtualization platform (free, based on Debian Linux)

- Run **VMs** (full virtual machines) and **LXC containers** (lightweight)
- Web-based management UI at `https://node-ip:8006`
- Built-in clustering, snapshots, backups
- Massive community and documentation

Why Proxmox?

	Proxmox	VMware ESXi	Hyper-V
Cost	Free	$$$ (free tier limited)	Windows license
Linux support	Excellent	Good	OK
Community	Huge	Enterprise	Enterprise
Learning curve	Moderate	Steep	Moderate

LXC Containers vs VMs

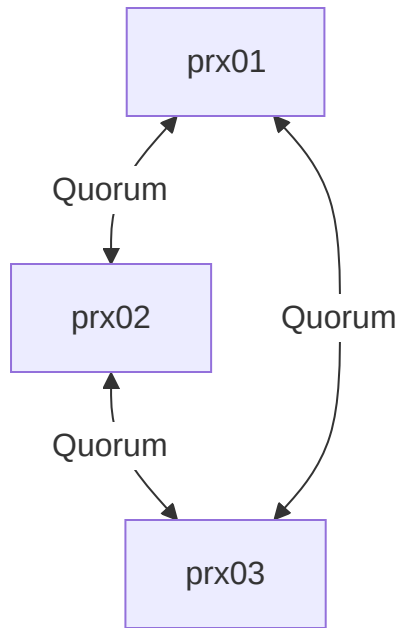|	LXC Container	Virtual Machine
Startup	**2-5 seconds**	30-60 seconds
RAM overhead	**~50MB**	512MB-1GB
Isolation	Shared kernel	Full isolation
Use case	**Services, Docker**	Windows, untrusted code
Performance	Near-native	~95% native

Rule of thumb:

- **Use LXC** for Linux services (Docker host, web servers, DNS)
- **Use VMs** for Windows, Kubernetes nodes, or untrusted workloads

We'll deploy a **Docker host as an LXC container** in Session 2.

Proxmox Cluster Setup

3-Node Cluster = High Availability

Setup steps:

1. Install Proxmox on each node (USB boot, ~15 min each)

Q&A

5 minutes

Questions?

What we covered today:

- **Homelabs** — personal infrastructure for learning & self-hosting

- **Hardware** — mini PCs: efficient, quiet, affordable (~$900 total)

- **Network** — 5 VLANs for security segmentation

- **Proxmox** — free virtualization with clustering

Coming up in Session 2 (Hands-on):

1. Deploy infrastructure with **Terraform**

2. Create LXC containers and VMs

3. Setup **Tailscale** VPN for remote access

4. Deploy services with **Docker Compose**