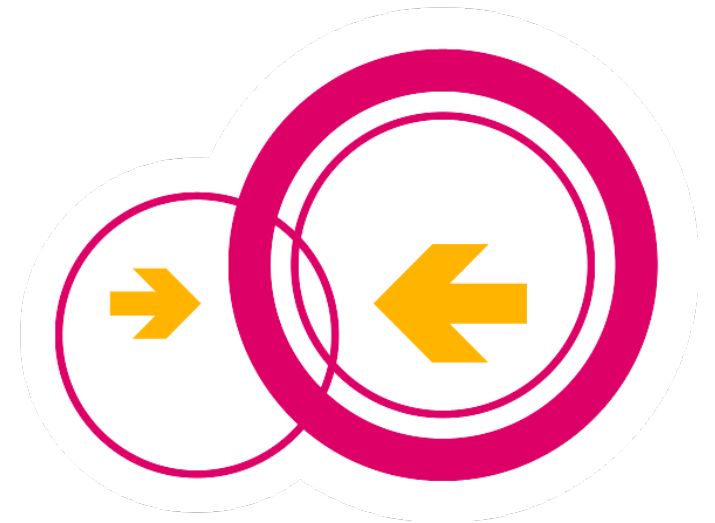
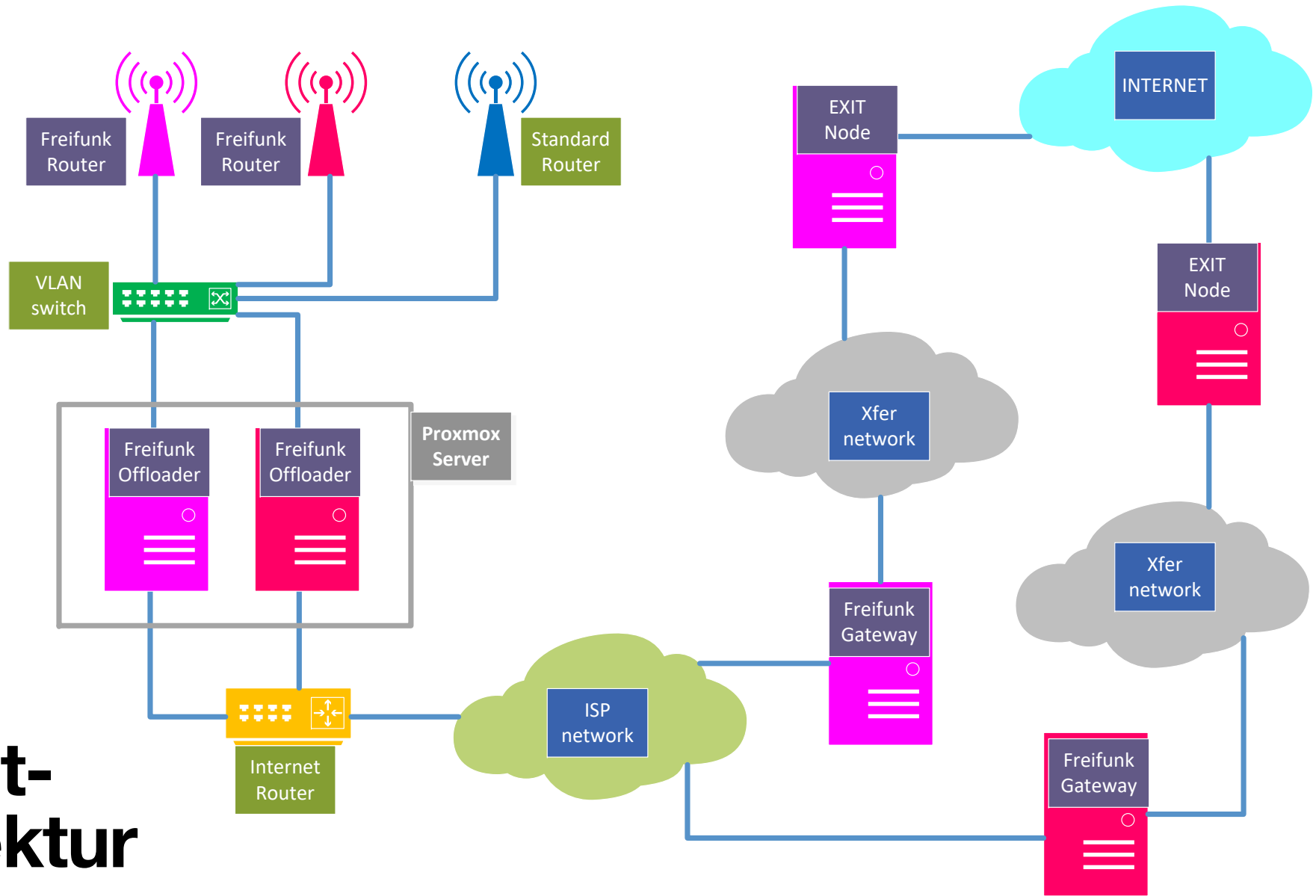


Freifunk-Offloader in Proxmox PVE-8.0

Kabel und Hardware sparen
mit VLAN-Switches (802.1q)



Gesamt- Architektur



Hardware für den Versuchsaufbau

- 1x Intel NUC5i3 (Proxmox PVE-8.0)
 - 8GB Memory
 - 500GB SSD (M.2 NVMe)
 - 1 NIC: 1 Gbit/s
- Internet-Router
 - Vorgabe des Providers
- 2x Web managed 802.1q Switches
 - 5-port TP-Link & 8-port Netgear
- 1x unmanaged Desktop Switch
 - 8-port D-Link
- 5x WLAN-Router / Access Points
 - TP-Link; Edimax; NoName (JCG)
 - OpenWRT-LEDE; Freifunk-Node

Was sind VLANs?

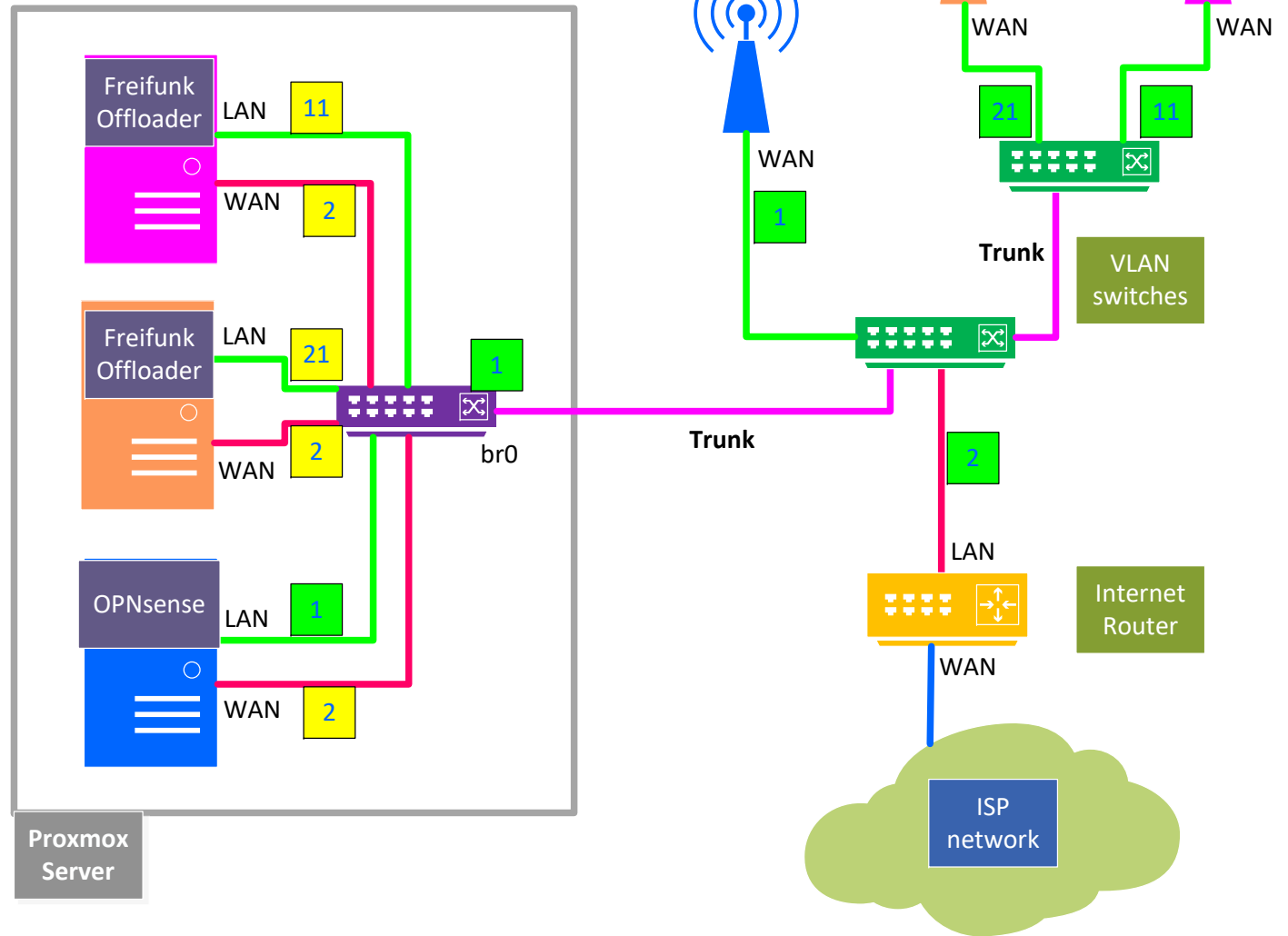
Und was kann man damit machen?

- Mit Hilfe von **VLANs** können Netzwerke *logisch* voneinander separiert werden, obwohl *physikalisch* die gleiche Infrastruktur (Rechner, Kabel, Switches) verwendet wird.
- Dazu werden Ethernet-Pakete um die **VID**-Bytes verlängert: die sog. **Tags**.
- Es gibt verschiedene VLAN-Versionen; aber nur Geräte die nach dem Standard **802.1q** arbeiten, sind miteinander interoperabel.
- **Beispiel:** der NUC-Rechner hat nur eine Netzwerkschnittstelle; für unsere Versuche werden aber mehrere, verschiedene LANs benötigt:
 - separate Netzwerke für LAN und WAN (bzw. DMZ)
 - Vermeidung von Störungen durch die verschiedenen Adressbereiche der einzelnen Freifunk-Netzwerke
 - pro LAN nur ein DHCP-Server

Versuchsaufbau

untagged VID

tagged VID



Planung der Netzwerk-Segmente

Verwendung	VID	IPv4 Adress-Bereiche	Geräte
Default Client-LAN	1	192.168.103.0/24	nuc3, opnsns-nuc3 , laptop, jcg- <u>ap</u>
DMZ Netzwerk	2	192.168.178.0/24	router-nfh-rahmenhof , opnsns-nuc3, opnwrn-nuc3, ffsw-nfh-rahmenhof , ffmuc-nfh-rahmenhof , ffws-duew-<u>ap</u>
FF-sw LAN	11	10.210.48.0/20	ffsw-nfh-rahmenhof , edimax- <u>ap</u>
FF-muc LAN	21	10.80.200.0/21	ffmuc-nfh-rahmenhof , tplink- <u>ap</u>
OpenWRT LAN	31	192.168.223.0/24	opnwrn-nuc3 , dlink-sw08, lede- <u>ap</u>
Trunk1 NUC3—SG105	1, 2, 31, 11, 21	--	nuc3-vmbr0, tl-sg105-p1
Trunk2 SG105—GS108	2, 31, 11, 21	--	tl-sg105-p3, ng-gs108-p8

Konfiguration TP-Link SG105E

via Web-Browser und interner Web-App

Ports	Untagged	Tagged	PVID	Device
1	1	2, 31, 11, 21	1	nuc3-vmbr0
2	1		1	laptop
3		1, 31, 11, 21	1	ng-gs108-p8
4	2		2	ffws-ap
5	2		2	rtr-nfh

The screenshot displays the TP-Link web interface for the TL-SG105E 5.0 switch. The 'VLAN' tab is active, showing the '802.1Q VLAN' configuration page. The 'Global Config' section has '802.1Q VLAN Status' set to 'Enable'. The '802.1Q VLAN Setting' section includes fields for 'VLAN (1-4094)', 'VLAN Name', 'Tagged Ports' (ports 1, 2, 3, 4, 5), and 'Untagged Ports' (ports 1, 2, 3, 4, 5). Below these settings is a table listing existing VLANs:

VLAN	VLAN Name	Member Ports	Tagged Ports	Untagged Ports	Delete VLAN
1	Default	1-3	3	1-2	
2	Egress	1, 4-5	1	4-5	Delete
11		1, 3	1, 3		Delete
21		1, 3	1, 3		Delete
31		1, 3	1, 3		Delete

Konfiguration Netgear ProSafe+ GS108E via Windows-Application

Ports	Untagged	Tagged	PVID	Device
1, 2	1		1	jcg-ap
3, 4	11		11	edimax-ap
5, 6	21		21	tplink-ap
7	31		31	dlink-sw08
8		1, 31, 11, 21	1	tl-sg105-p3

The screenshot shows the 'ProSAFE Plus-Konfigurationsprogramm-GS108Ev2-sw08-b' window. The 'VLAN' tab is active, and the configuration is for '802.1Q'. The interface includes a sidebar with navigation options like 'Einfach' and 'Erweitert'. The main area displays 'Erweiterte 802.1Q-VLAN-Konfiguration' with a status section for 'Erweiterter 802.1Q-VLAN' (set to 'Aktivieren') and a table for 'VLAN-Kennungseinstellung'.

VLAN-ID	Portmitglieder
<input type="checkbox"/> 01	01 02 08
<input type="checkbox"/> 11	03 04 08
<input type="checkbox"/> 21	05 06 08
<input type="checkbox"/> 31	07 08

At the bottom, there is a 'VLAN-ID' input field and buttons for 'LÖSCHEN' and 'HINZUFÜGEN'.

Konfiguration *NUC3*: Bridge *vmbr0* via Web-Browser und PVE-GUI

Ports	Untagged	Tagged	Device	VM	Ports	Untagged	Tagged	Device	VM
vmbr0	1		—	nuc3, opnsns	vmbr0.11		11	—	ffvp-nfh
vmbr0.2		2	—	opnsns, opnwr, ffvp, fmuc	vmbr0.21		21	—	ffmuc-nfh
enp0s25	1	2, 31, 11, 21	tl-sg105-p1	—	vmbr0.31		31	—	opnwr

Node 'nuc3'

Node 'nuc3'										
<input type="button" value="Create"/> <input type="button" value="Revert"/> <input type="button" value="Edit"/> <input type="button" value="Remove"/> <input type="button" value="Apply Configuration"/>										
Name ↑	Type	Active	Autostart	VLAN...	Ports/Slaves	Bond ...	CIDR	Gateway	Comment	
enp0s25	Network Device	Yes	No	No						
vmbr0	Linux Bridge	Yes	Yes	Yes	enp0s25		192.168.103.99/24	192.168.103.9	default LAN (vid 1)	
vmbr0.11	Linux VLAN	Yes	Yes	No						
vmbr0.2	Linux VLAN	Yes	Yes	No					WAN port (vid 2)	
vmbr0.21	Linux VLAN	Yes	Yes	No						
vmbr0.31	Linux VLAN	Yes	Yes	No			192.168.223.99/24		OpenWRT (vid 31)	
wlp2s0	Unknown	No	No	No						

Details der Netzwerk-Konfiguration

Proxmox basiert auf Debian: das PVE-GUI erstellt die Datei

`/etc/network/interfaces`

```
https://192.168.103.99:8006/?console=shell&xtermjs=1&vmid=0&vmname=&node=nuc3&cmd=
root@nuc3:~# cat /etc/network/interfaces
# network interface settings; autogenerated
# Please do NOT modify this file directly, unless you know what
# you're doing.
#
# If you want to manage parts of the network configuration manually,
# please utilize the 'source' or 'source-directory' directives to do
# so.
# PVE will preserve these directives, but will NOT read its network
# configuration from sourced files, so do not attempt to move any of
# the PVE managed interfaces into external files!

auto lo
iface lo inet loopback

iface enp0s25 inet manual

auto vbr0
iface vbr0 inet static
    address 192.168.103.99/24
    gateway 192.168.103.9
    bridge-ports enp0s25
    bridge-stp off
    bridge-fd 0
    bridge-vlan-aware yes
    bridge-vids 2-4094
#default LAN (vid 1)

iface wlp2s0 inet manual

auto vbr0.2
iface vbr0.2 inet manual
#WAN port (vid 2)

auto vbr0.31
iface vbr0.31 inet static
    address 192.168.223.99/24
#OpenWRT (vid 31)

auto vbr0.11
iface vbr0.11 inet manual

auto vbr0.21
iface vbr0.21 inet manual

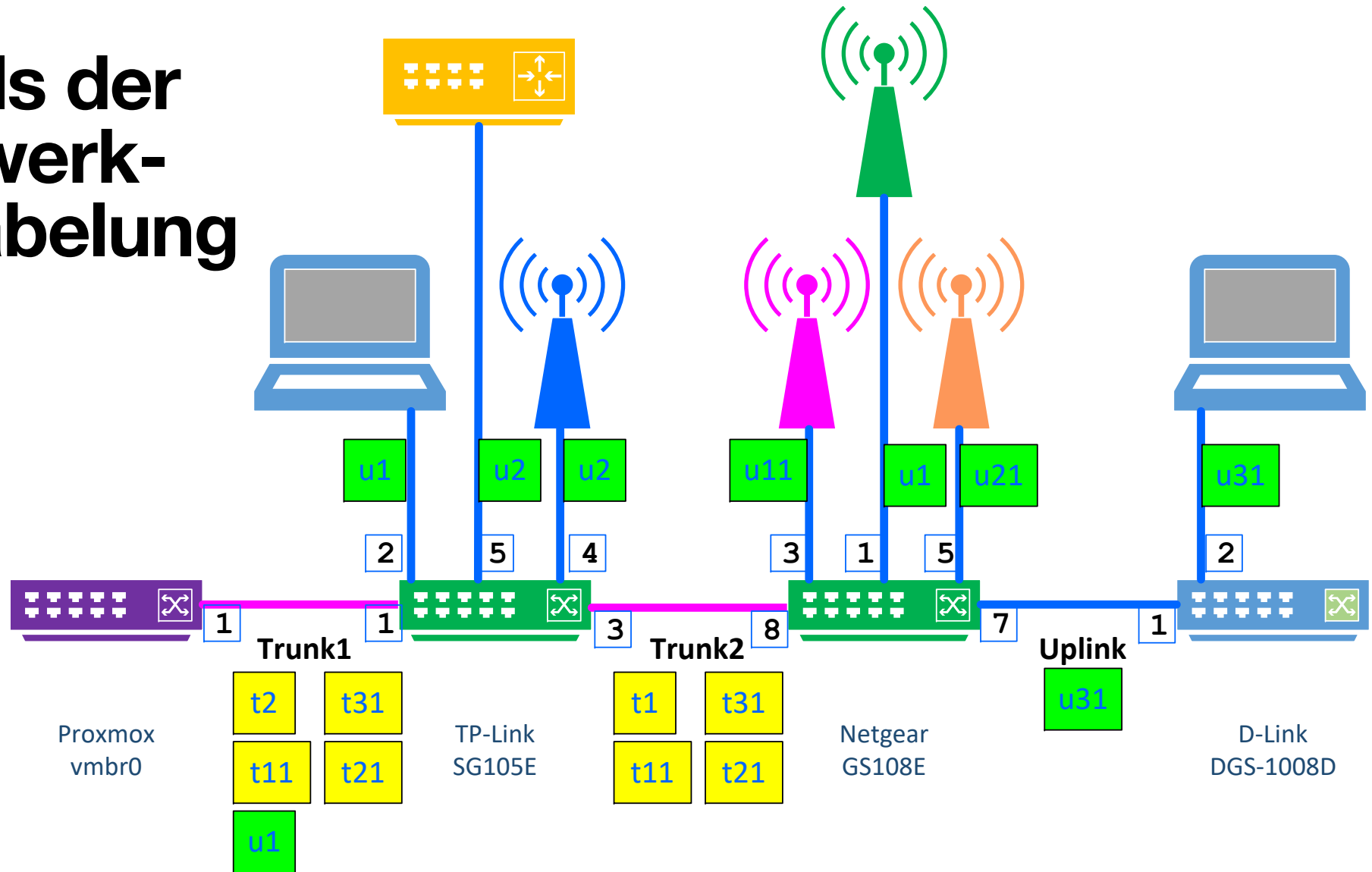
root@nuc3:~#
```

IP-Adressen und Hosts

Hostname	IPv4 Adresse
nuc3	192.168.103.99
opnsns-nuc3	192.168.103.9
tl-sg105-a	192.168.103.3
ng-gs108-b	192.168.103.4
jcg-ap	192.168.103.5
laptop	DHCP (192.168.103.x/24)
ffvp-nfh-rahmenhof	DHCP (10.210.48.x/20)
edimax-ap	DHCP (10.210.48.x/20)
lx1-client	DHCP (10.210.48.x/20)
opnwrn-nuc3	192.168.223.9
nuc3	192.168.223.99

Hostname	IPv4 Adresse
router-nfh-rahmenhof	192.168.178.1
opnsns-dmz	DHCP (192.168.178.x/24)
opnwrn-dmz	DHCP (192.168.178.x/24)
ffvp-nfh-dmz	DHCP (192.168.178.x/24)
ffmuc-nfh-dmz	DHCP (192.168.178.x/24)
ffws-duew-ap	DHCP (192.168.178.x/24)
ffmuc-nfh-rahmenhof	DHCP (10.80.200.x/21)
tplink-ap	DHCP (10.80.200.x/21)
lx2-client	DHCP (10.80.200.x/21)
lede-ap	DHCP (192.168.223.x/24)
lx3-client	DHCP (192.168.223.x/24)

Details der Netzwerk-Verkabelung



Vorbereitung des Workshops

Was wurde vorab gemacht?

- Installation **NUC5i3** mit PVE-8.0
 - <https://pve.proxmox.com/wiki/Installation>
- Konfiguration der VLAN-Switches
 - 5-port TP-Link SG105E
 - 8-port Netgear ProSafe+ GS108E
- Upgrade PVE auf neueste Patches
- Upload von **Freifunk**-Gluon- und OpenWRT-Images auf *NUC3*
- Installation VM OPNsense-23.1
 - <https://www.sunnyvalley.io/docs/network-security-tutorials/opnsense-installation>
 - <https://schulnetzkonzept.de/opnsense>
- Einrichtung DHCP und DNS auf LAN
Einrichtung IPv6 auf WAN und LAN
- Upgrade auf OPNsense-23.1.11

Installation von Proxmox PVE-7.3 auf NUC5i3

Summary

Please confirm the displayed information. Once you press the **Install** button, the installer will begin to partition your drive(s) and extract the required files.

Option	Value
Filesystem:	ext4
Disk(s):	/dev/nvme0n1
Country:	Germany
Timezone:	Europe/Berlin
Keymap:	de
Email:	[redacted]@gmail.com
Management Interface:	enp0s25
Hostname:	nuc3
IP CIDR:	192.168.103.99/24
Gateway:	192.168.103.9
DNS:	192.168.103.9

Management Interface: enp0s25 - b8:ae:ed:7d:23:c5 (e1000e) ▼

Hostname (FQDN): nuc3.agmc.de

IP Address (CIDR): 192.168.103.99 / 24

Gateway: 192.168.103.9

DNS Server: 192.168.103.9

Installation successful!

Proxmox VE is now installed and ready to use.

• Next steps

Reboot and point your web browser to the selected IP address on port 8006:

<https://192.168.103.99:8006>

Also visit www.proxmox.com for more information.

Durchführung des Workshops

Was ist bereits erledigt?

- Installation VM OpenWRT 22.03.3
 - OpenWRT Tutorials:
<https://hoerli.net/category/openwrt/>
<https://www.youtube.com/playlist>
- Konfiguration der 5 WLAN-Router als Access Points (APs)
- Installation Linux-Client VM

Was ist noch zu tun?

- Einrichtung der VLANs **11** & **21**
- **Freifunk**-Offloader VMs installieren:
 - Freifunk-Weinstrasse (ffsw-nfh)
 - Freifunk-München (ffmuc-nfh)
 - weitere Freifunk-Communities?
- Tests der **Freifunk**-Netzwerke mit Linux-, Windows-, MacOS-Clients

Proxmox im Überblick:

1 Linux Bridge

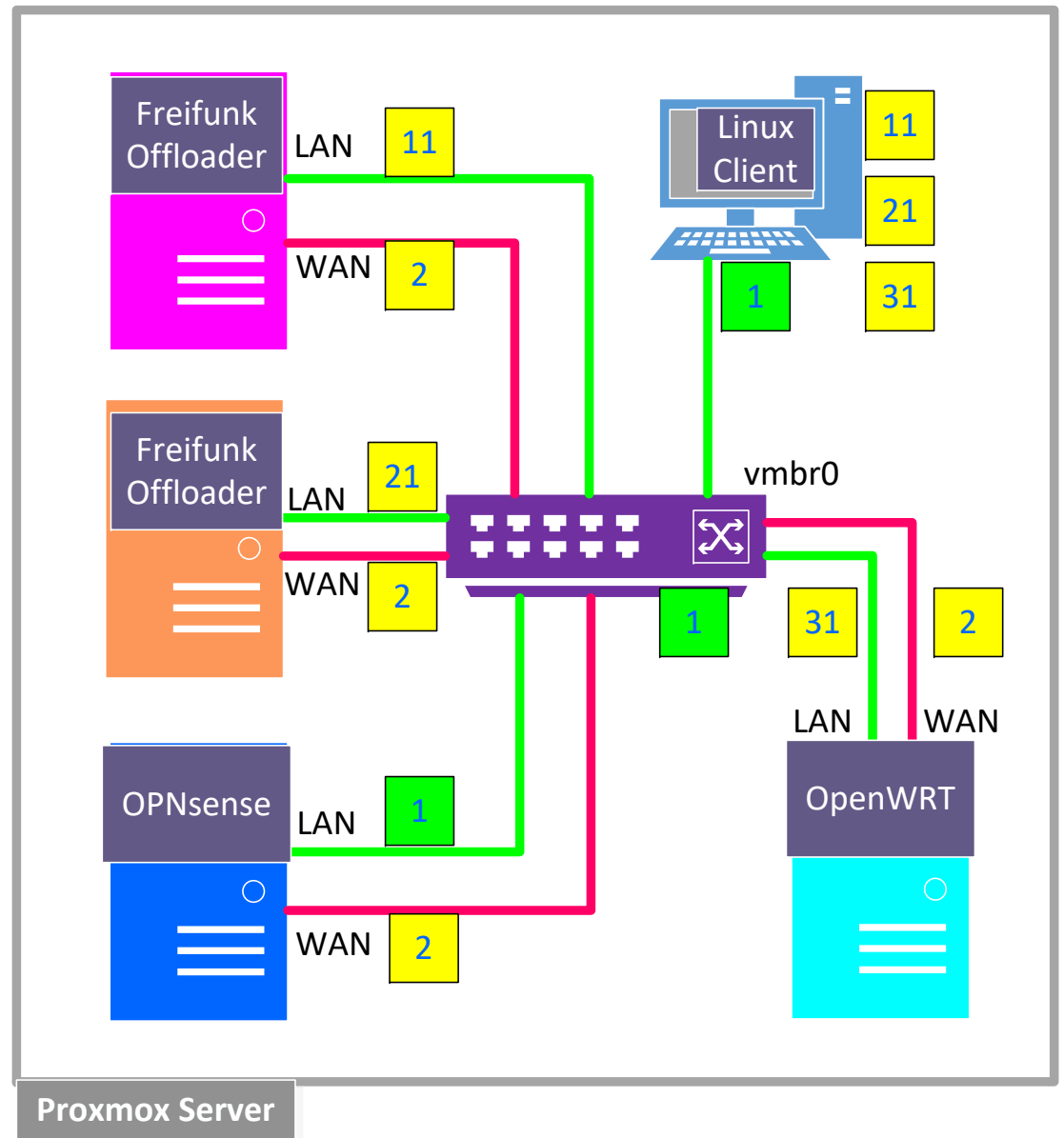
5 Linux VLANs

~ 6 VMs:

2x Firewall

2x Linux-Client

2x FF-Offloader



- Lobby
- Dashboard
- License
- Password
- Logout
- Reporting
- System
- Interfaces
- Firewall
- VPN
- Services
- Power
- Help

System Information

Name	OPNsns-nuc3.agmc.de
Versions	OPNsense 23.1.3-amd64 FreeBSD 13.1-RELEASE-p7 OpenSSL 1.1.1t 7 Feb 2023
Updates	Click to check for updates.
CPU type	Common KVM processor (1 cores, 1 threads)
CPU usage	
Load average	1.33, 0.89, 0.72
Uptime	02:03:46
Current date/time	Sun Mar 12 9:46:07 UTC 2023
Last config change	Sun Mar 12 9:42:16 UTC 2023
CPU usage	7 %
State table size	0 % (391/201000)
MBUF usage	0 % (254/125321)
Memory usage	14 % (291/2010 MB)
Disk usage	20% / [ufs] (1.8G/9.4G) 1% /boot/efi [msdosfs] (1.7M/256M)

Interfaces

Interface	Speed	Link	MAC	IP
LAN	10Gbase-T <full-duplex>	↑	192.168.103.9	track6
WAN	10Gbase-T <full-duplex>	↑	2001:9e8:8d3a:8800:a0a6:b8ff:fe54:4002	192.168.2.38

Services

Service	Description	Status
configd	System Configuration Daemon	▶ ⏪ ⏹
cron	Cron	▶ ⏪ ⏹
dhcpcd	DHCPv4 Server	▶ ⏪ ⏹
dhcpcd6	DHCPv6 Server	⏹ ▶
login	Users and Groups	▶ ⏪
ntpd	Network Time Daemon	▶ ⏪ ⏹
pf	Packet Filter	▶ ⏪
qemu-ga	QEMU Guest Agent	▶ ⏪ ⏹
radvd	Router Advertisement Daemon	▶ ⏪ ⏹
routing	System routing	▶ ⏪
sysctl	System tunables	▶ ⏪
syslog-ng	Syslog-ng Daemon	▶ ⏪ ⏹
unbound	Unbound DNS	▶ ⏪ ⏹
webgui	Web GUI	▶ ⏪

Gateways

Name	RTT	RTTd	Loss	Status
WAN_DHCP6 fe80::a96:d7ff:feea:f309	~	~	~	Online
WAN_DHCP 192.168.2.1	~	~	~	Online

Browser tabs: Login | OPNsense, nuc3 - Proxmox Virtual Env, Host System Administration, Qemu/KVM Virtual Machine, OpenWrt-nuc3 - Overview

Address bar: 192.168.223.9/cgi-bin/luci/admin/status/overview

Page Title: OpenWrt-nuc3

Navigation: Status, System, Network, Logout

REFRESHING

Status

System

Hostname	OpenWrt-nuc3
Model	QEMU Standard PC (i440FX + PIIX, 1996)
Architecture	Common KVM processor
Target Platform	x86/64
Firmware Version	OpenWrt 22.03.3 r20028-43d71ad93e / LuCI openwrt-22.03 branch git-22.361.69894-438c598
Kernel Version	5.10.161
Local Time	2023-03-15 07:49:54
Uptime	0h 2m 30s
Load Average	0.00, 0.00, 0.00

Memory

Total Available	44.39 MiB / 106.38 MiB (41%)
Used	44.57 MiB / 106.38 MiB (41%)
Buffered	1012.00 KiB / 106.38 MiB (0%)
Cached	10.23 MiB / 106.38 MiB (9%)

Browser window showing Proxmox Virtual Environment 7.3-6 interface. The URL is `https://192.168.103.99:8006/#v1:0=qemu%2F102:4:5:::8::`. The page title is "nuc3 - Proxmox Virtual Environm".

The interface displays the "Server View" for "Virtual Machine 102 (lxwelt) on node 'nuc3'". The left sidebar shows a tree view of the datacenter with nodes: 100 (opnsense), 101 (opnwr-223-a), 102 (lxwelt), local (nuc3), and local-lvm (nuc3). The main area shows the VM's configuration and a terminal window.

The terminal window shows the following output:

```
Terminal - guest@porteus:~
Datei Bearbeiten Ansicht Terminal Reiter Hilfe
guest@porteus
-----
Model: Standard PC (i440FX + PIIX, 1996) pc-i440fx-7.2
OS: Arch Linux x86_64
Kernel: 5.13.0-porteus
Uptime: up 1 minute
Shell: bash 5.1.8
Resolution: 1280x800
DE: MATE
WM: Metacity (Marco)
Theme: Clearlooks [GTK2/3]
Icons: NuoveXT2 [GTK2/3]
Terminal: Xfce4-terminal
CPU: Common KVM (2) @ 2.0GHz
GPU: Device 1234:1111
Memory: 962MB / 1994MB

guest@porteus:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: ens18: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 96:fe:71:25:9a:e3 brd ff:ff:ff:ff:ff:ff
    altname enp0s18
    inet 192.168.103.100/24 brd 192.168.103.255 scope global dynamic noprefixroute ens18
        valid_lft 7088sec preferred_lft 7088sec
    inet6 fe80::b32c:ac13:83b8:dc47/64 scope link noprefixroute
        valid_lft forever preferred_lft forever

guest@porteus:~$ ip r
default via 192.168.103.9 dev ens18 proto dhcp metric 100
192.168.103.0/24 dev ens18 proto kernel scope link src 192.168.103.100 metric 100
guest@porteus:~$
```

Browser window: nuc3 - Proxmox Virtual Environm x +
Address bar: Nicht sicher | https://192.168.103.99:8006/#v1:0=qemu%2F103:4:5:::8::

PROXMOX Virtual Environment 7.3-6 Search Documentation Create VM Create CT root@pam

Server View Virtual Machine 103 (knoppix) on node 'nuc3' No Tags Start Shutdown Console More Help

Summary Console Hardware Cloud-Init Options Task History Monitor Backup Replication Snapshots Firewall Permissions

```
knoppix@Microknoppix:~$ ip r
default via 192.168.223.9 dev eth0 proto dhcp metric 100
192.168.223.0/24 dev eth0 proto kernel scope link src 192.168.223.223 metric 100
knoppix@Microknoppix:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen
1000
   link/ether 3e:70:5f:b8:0d:a3 brd ff:ff:ff:ff:ff:ff
   inet 192.168.223.223/24 brd 192.168.223.255 scope global dynamic noprefixroute eth0
       valid_lft 43127sec preferred_lft 43127sec
   inet6 2001:9e8:a184:56fc::a9d/128 scope global dynamic noprefixroute
       valid_lft 6467sec preferred_lft 2867sec
   inet6 fd15:a10a:de6b::a9d/128 scope global dynamic noprefixroute
       valid_lft 43126sec preferred_lft 2867sec
   inet6 fd15:a10a:de6b:0:a8ff:1de2:3a0a:94d1/64 scope global noprefixroute
       valid_lft forever preferred_lft forever
   inet6 2001:9e8:a184:56fc:b3a3:8a5:b03a:852e/64 scope global dynamic noprefixroute
       valid_lft 6467sec preferred_lft 2867sec
   inet6 fe80::9790:8932:e7dc:ald9/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
knoppix@Microknoppix:~$
```

Taskbar: /bin/bash 12:34

Logs

Anleitungen von **Freifunk** München

zur Installation und Konfiguration eines **Freifunk**-Knotens

- Kurzanleitung
<https://ffmuc.net/router-konfigurieren/>
- Ausführliche Anleitung
<https://ffmuc.net/wiki/doku.php?id=knb:gui>
- Kommandozeile via SSH
<https://ffmuc.net/wiki/doku.php?id=knb:ssh>
- Diverse Artikel zu sicherem DNS
<https://ffmuc.net/wiki/doku.php?id=knb:dohdot>
<https://ffmuc.net/wiki/doku.php?id=knb:dnsencrypt>
<https://ffmuc.net/wiki/doku.php?id=knb:dns>

DANKE für Euer Interesse!