

Layer2@Home

Enabling Remote Layer2 Networking for Digital Laboratory Education

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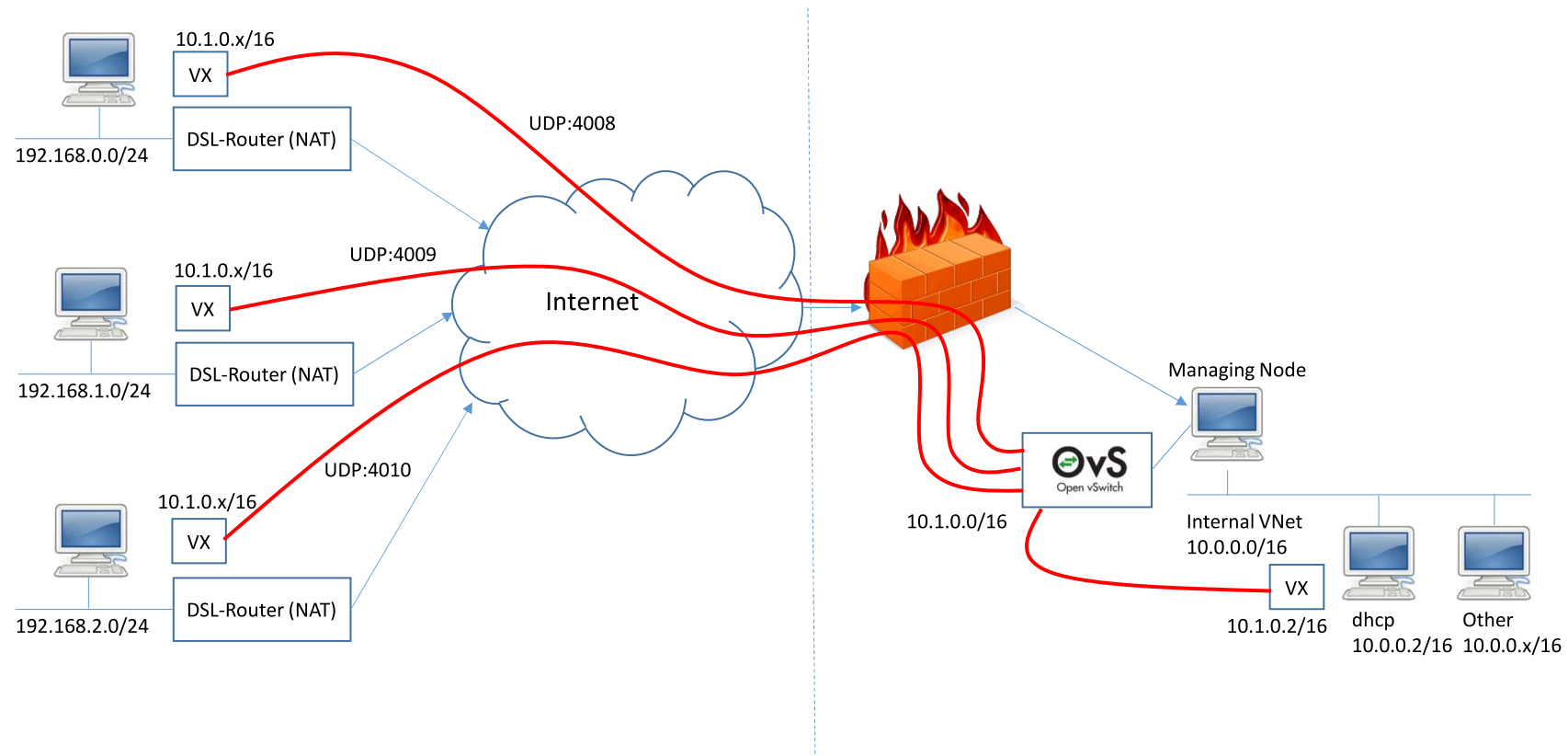
Institut für Informatik

4.5.2026

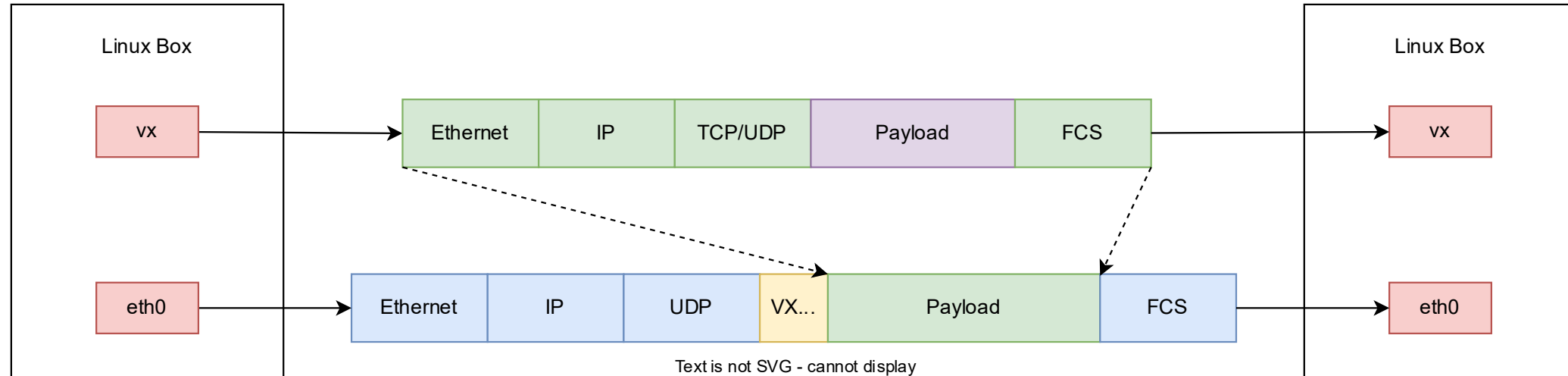
Requirements

- ↪ Virtual Computer Network Lab Environment
- ↪ Layer 2 Connectivity
- ↪ Work at Home via DSL (NAT Traversal)
- ↪ Multiple Networks
- ↪ Secure Connection
- ↪ Overlay Network
- ↪ Firewall friendly

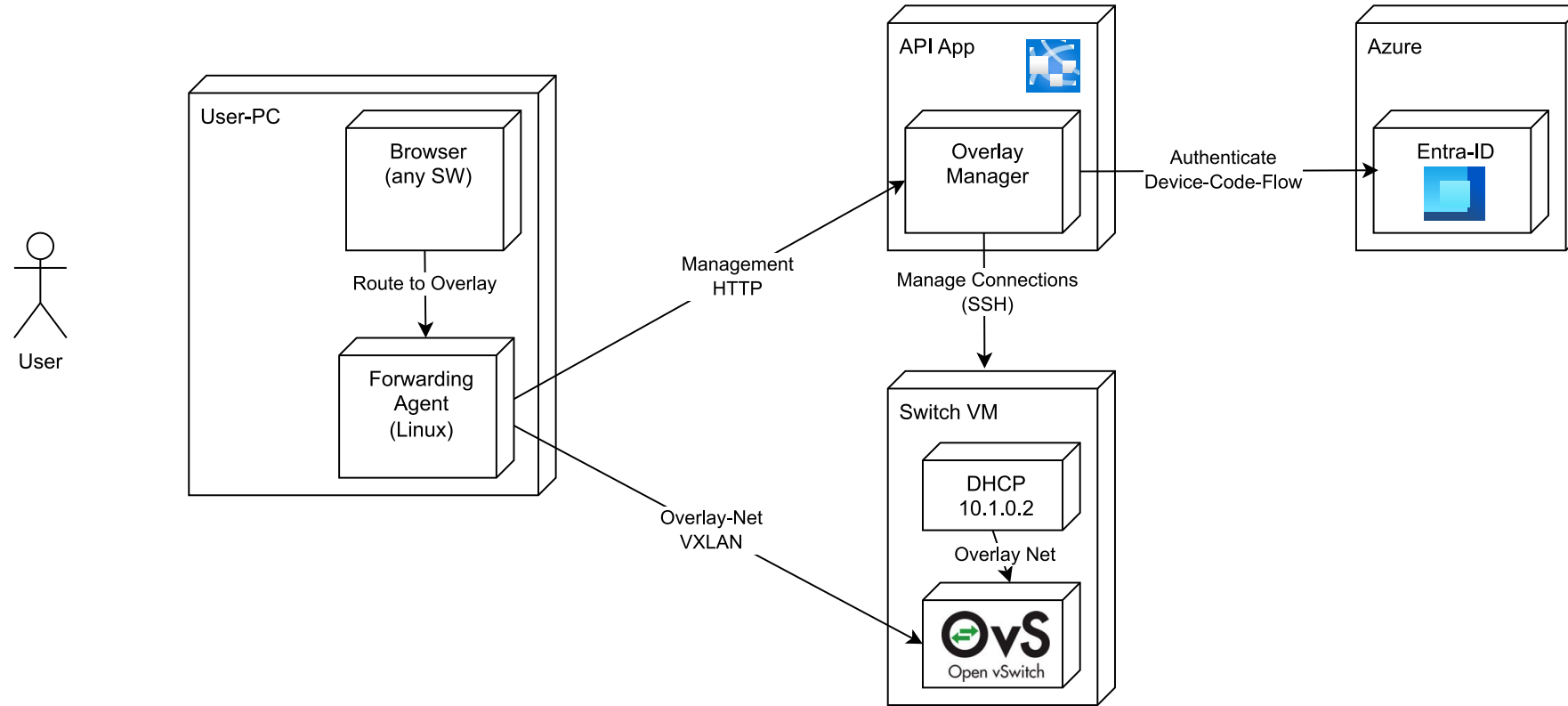
Principle of an Overlay Network



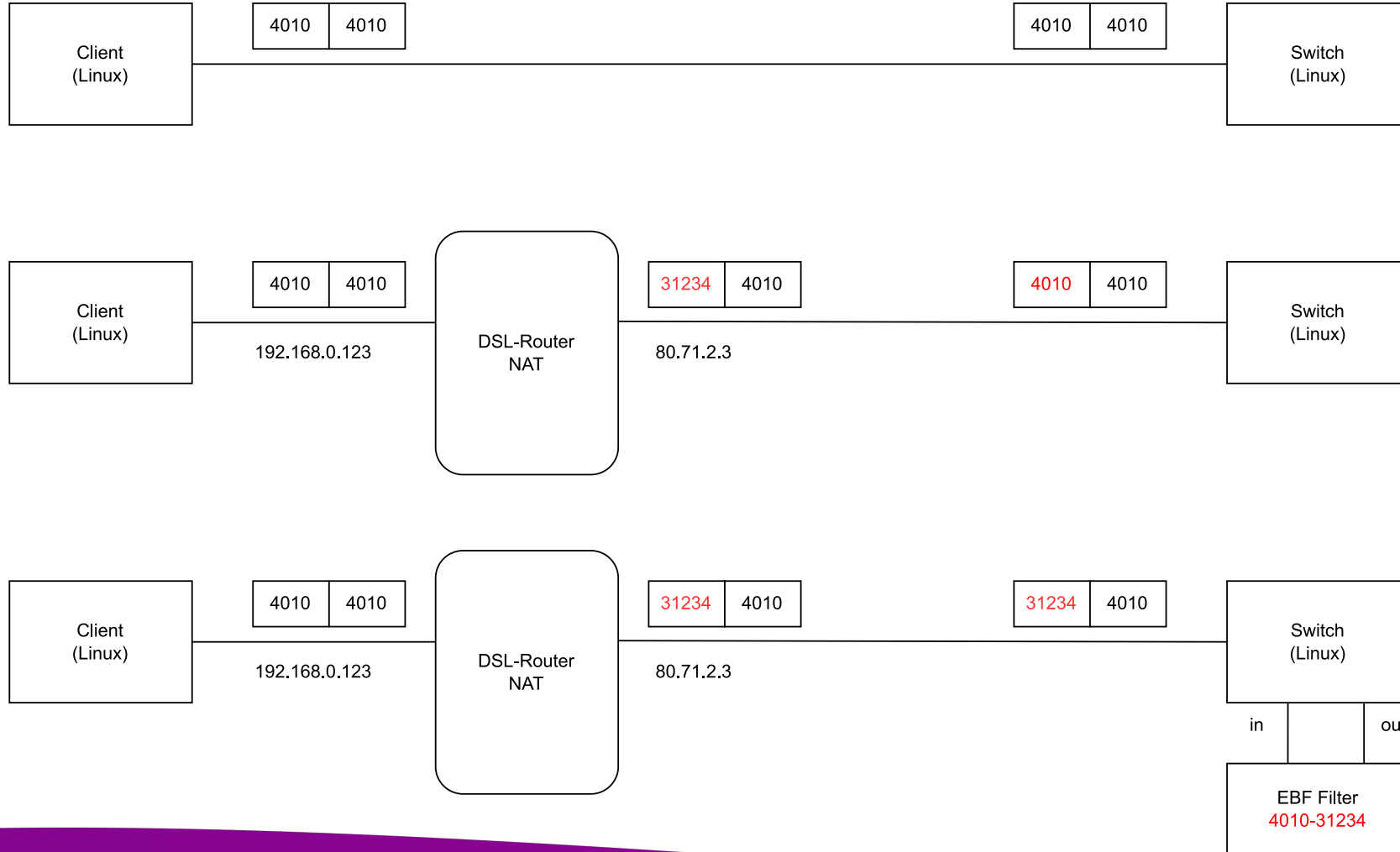
VXLAN Encapsulation



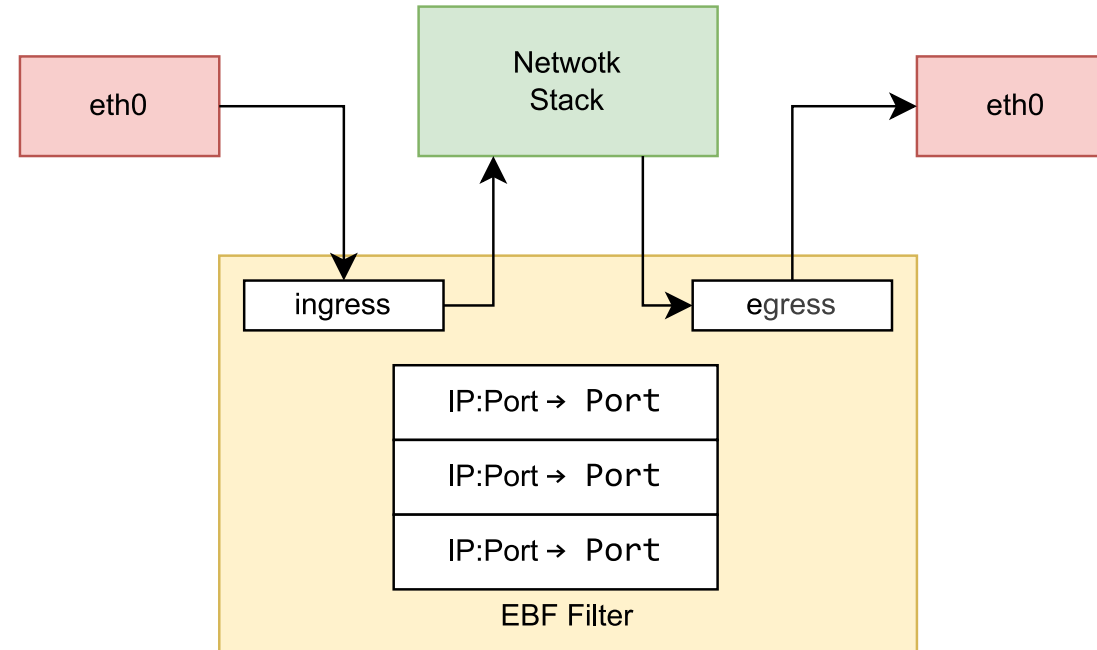
Architecture



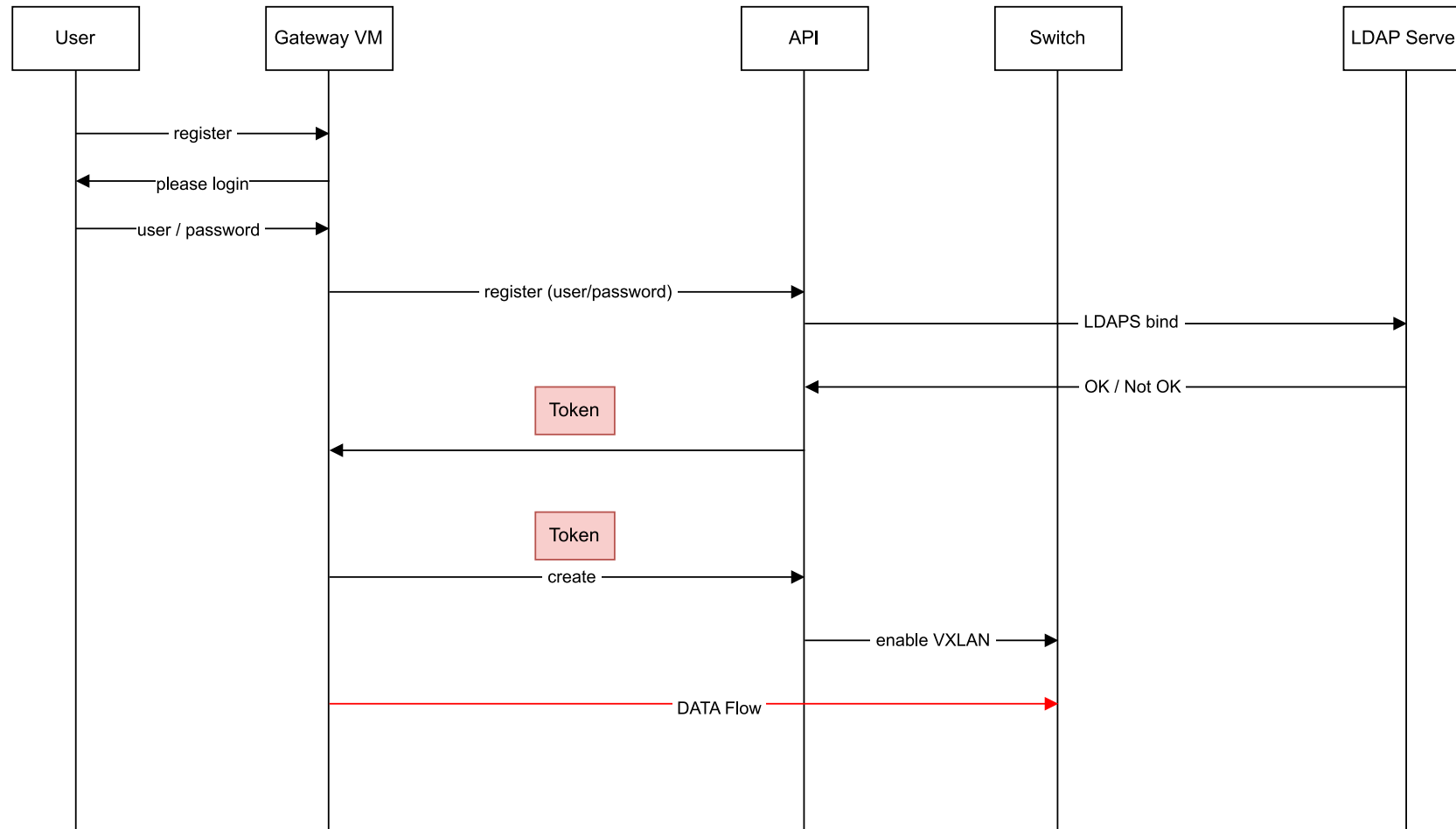
NAT Traversal



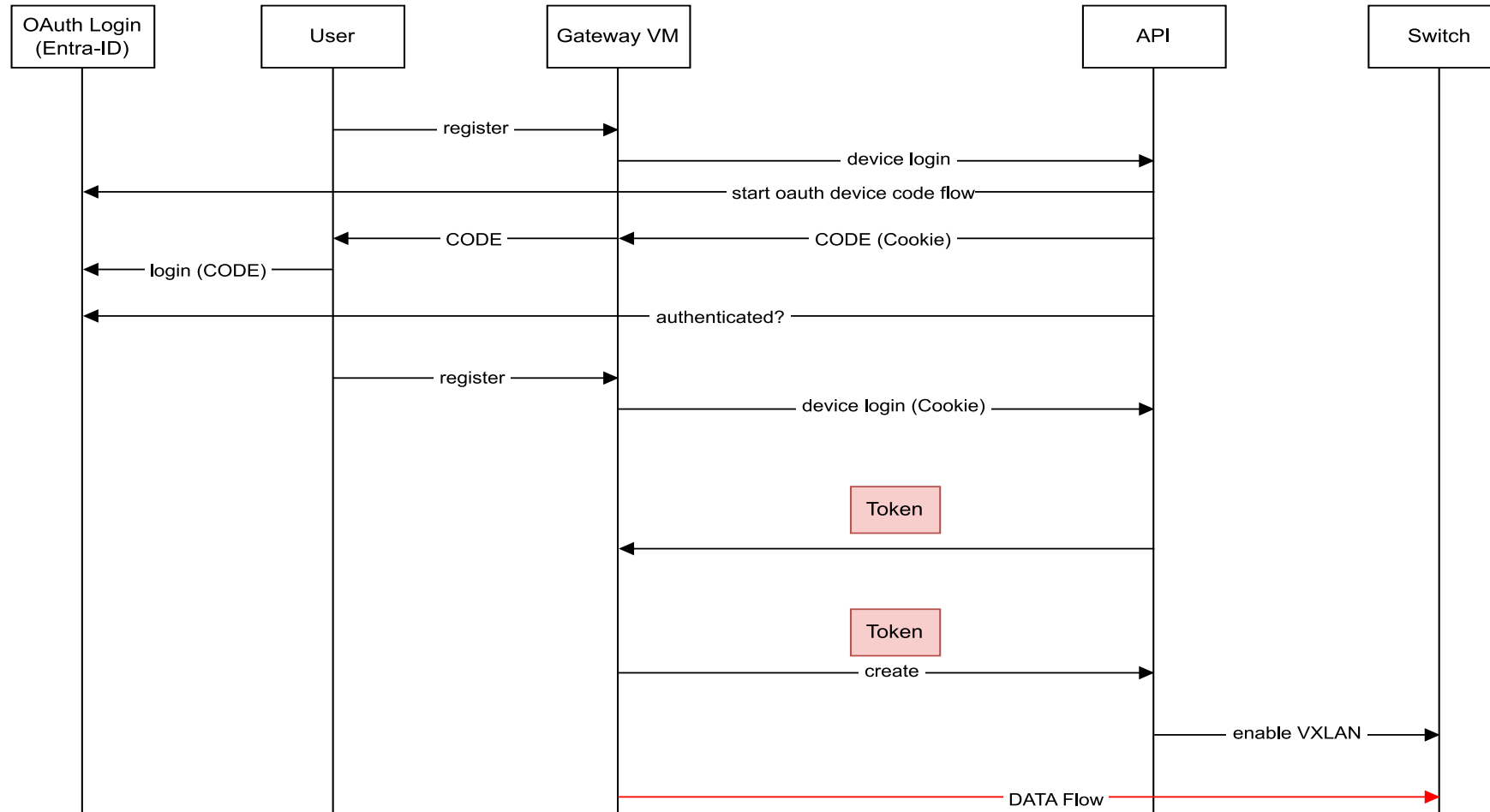
Linux eBPF Filter (extended Berkeley Packet Filter)



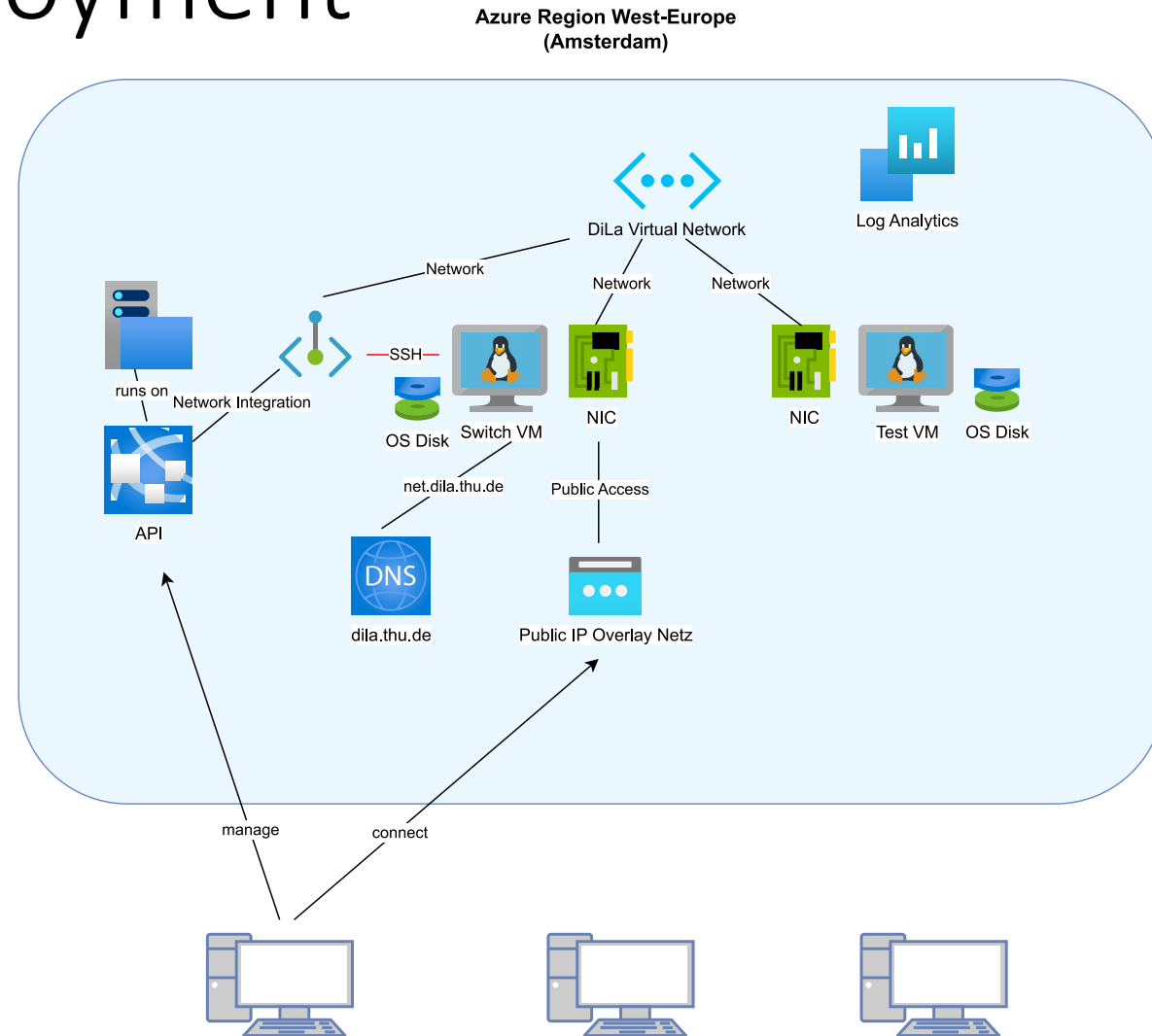
Authentication (HTTP Basic & LDAP)



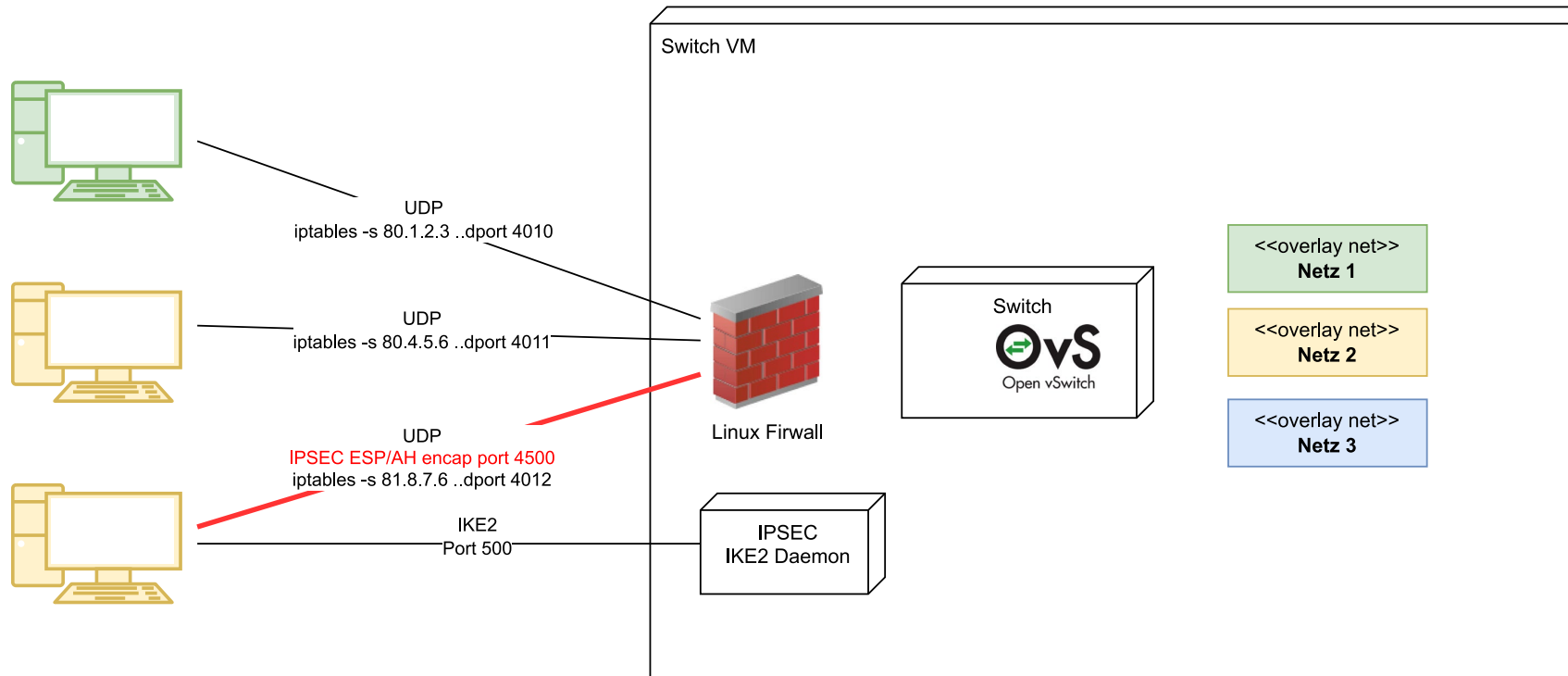
Authentication OAuth2 Device Code



Azure Deployment



Security



Security Risks

- Unauthorized Access
 - Authorize by JWT
 - Dynamic Firewall
- VXLAN unencrypted
 - HTTPS intern
 - IPSEC or other VPN
- Breakout
 - Firewall
- → Endpoint Management
- → separate VLAN

Howto Connect (1) Multipass or WSL

Video: <https://thude.sharepoint.com/sites/traust01/Freigegebene%20Dokumente/Videos/DiLa-Overlay-Connect.mp4?csf=1&web=1&e=NXnOLy>

```
$ alias vx='curl -s https://ovl.dila.thu.de/vx.sh | sudo bash -s -'
```

```
$ vx -o register
```

```
OVL net is at 50.85.226.73
```

```
=====
```

To sign in, use a web browser to open the page
<https://login.microsoft.com/device> and enter the code
GFGAH7FRL to authenticate.

GFGAH7FRL

Close the web page after logging in and try again
with the same command line options

```
=====
```

```
$ vx -o register
```

```
OVL net is at 50.85.226.73
```

```
device login successful
```

```
register machine 753a478d099cfa57ef02ff5d6305284b
```

```
machine 753a478d099cfa57ef02ff5d6305284b registered for overlay net
```

```
token stored in /root/.vx
```

Howto Connect (2) Multipass or WSL

Video: <https://thude.sharepoint.com/sites/traust01/Freigegebene%20Dokumente/Videos/DiLa-Overlay-Connect.mp4?csf=1&web=1&e=NXnOLy>

```
$ vx start
OVL net is at 50.85.226.73
start vx
Machine registered until "2026-05-04T00:00:00+00:00"
using port 4010
10.1.0.2
done
My IP is 10.1.0.11
Hostname set to ST-P4
$ ping -c 2 10.1.0.2
PING 10.1.0.2 (10.1.0.2) 56(84) bytes of data.
64 bytes from 10.1.0.2: icmp_seq=1 ttl=64 time=22.2 ms
64 bytes from 10.1.0.2: icmp_seq=2 ttl=64 time=22.5 ms

--- 10.1.0.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 22.222/22.350/22.479/0.128 ms
$
```



Outlook

- ↷ Improve Login from Browser
- ↷ Add more Gateway Types
- ↷ Allow Non-Admin to Connect (set Routes)
- ↷ Use IP Assignment per API
- ↷ Auto enable IPSec
- ↷ Use Keep-Alive for Active Monitoring
- ↷ Native Windows VXLAN Support